USDA Natural Resources Conservation Service

Ecological site R073XY101KS
Limy Slopes

Last updated: 9/30/2019
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.

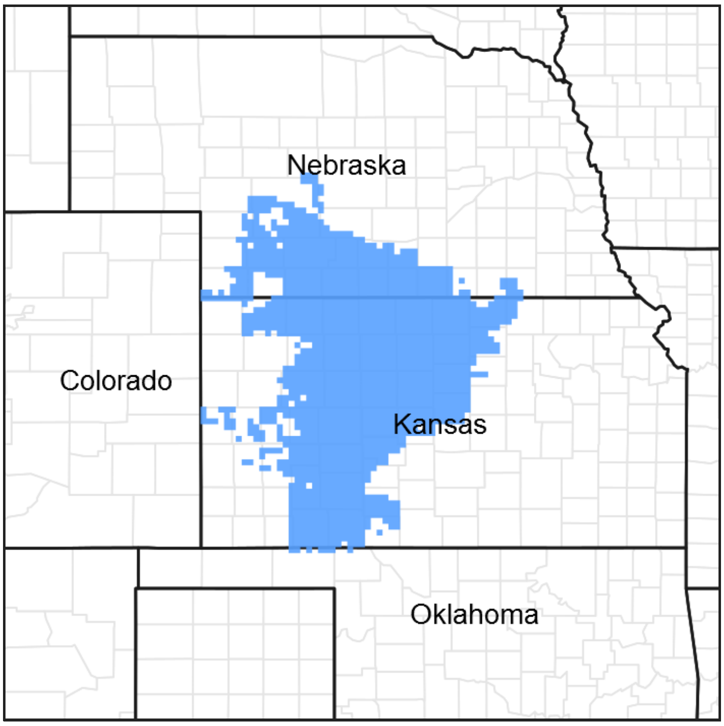


Figure 1. Mapped extent

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 Limy Slopes (073XY101) ecological site was formerly known as Limy Upland (073XY012). The Limy Slopes ecological site occurs on nearly level to steeply sloping hills, plains, or high terraces. Slopes are generally less than 30 percent. This site produces runoff to areas lower on the landscape. The calcium carbonate levels making up this site are weakly calcareous to strongly calcareous at the soil surface.

Associated sites

R073XY100KS	**Loamy Plains** The Loamy Plains ecological site is commonly located adjacent to or in coordination with the Limy Slopes 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, therefore produces runoff to areas lower on the landscape.
R073XY112KS	**Shallow Limy** The Shallow Limy site occurs on nearly level to rough broken and steeply sloping uplands and is located adjacent to the Limy Slopes site. The soils on this site range from 4 to 20 inches over caliche or fractured limestone.
R073XY114KS	**Loess Hills** This site can be found adjacent to and in conjunction with Limy Slopes. The Loess Hills ecological site occurs on narrow ridges and divides with steep slopes. The slopes of this site range from greater than 30% to near vertical. The steep side slopes are broken with series of short and shallow slope slips, referred to as "terracettes" or "catsteps." The spatial extent of this site is occupied in the northern part of MLRA 73. This is a new ecological site in MLRA 73. Formerly a place holder id# in ESIS of R073XY016NE. Now recognized as R073XY114KS. The range site was formally recognized as Loess Breaks in MLRA 72.

Similar sites

R073XY100KS	**Loamy Plains** The Loamy Plains (073XY100) ecological site was formerly known as Loamy Upland (073XY015). 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. This site is similar to Limy Slopes in species composition and production. Landform position and soil order are the major differences between these sites. Loamy Plains site generates runoff and Limy Slopes can generate and receive runoff water. Loamy Plains soils are Mollisols (well developed soil) and Limy Slopes soils are Entisols (less developed soil).

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Bouteloua gracilis*

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 Limy Slopes site is loess, most likely Peorian Loess of Wisconsin age.

The Limy Slopes ecological site occurs on nearly level to steeply sloping uplands or high terraces. This site consists of moderately deep to very deep upland soils with silty or loamy through clayey surface layers and subsoils.

On steep areas, this site is characterized by slopes broken with a series of short and shallow slope slips, commonly referred to as "catsteps."

On all slopes a primary identifying feature for this site is the presence of calcium carbonate at or near the soil surface. 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 overgrazing and fire events. Livestock trailing on this site often leads to the formation of gullies.

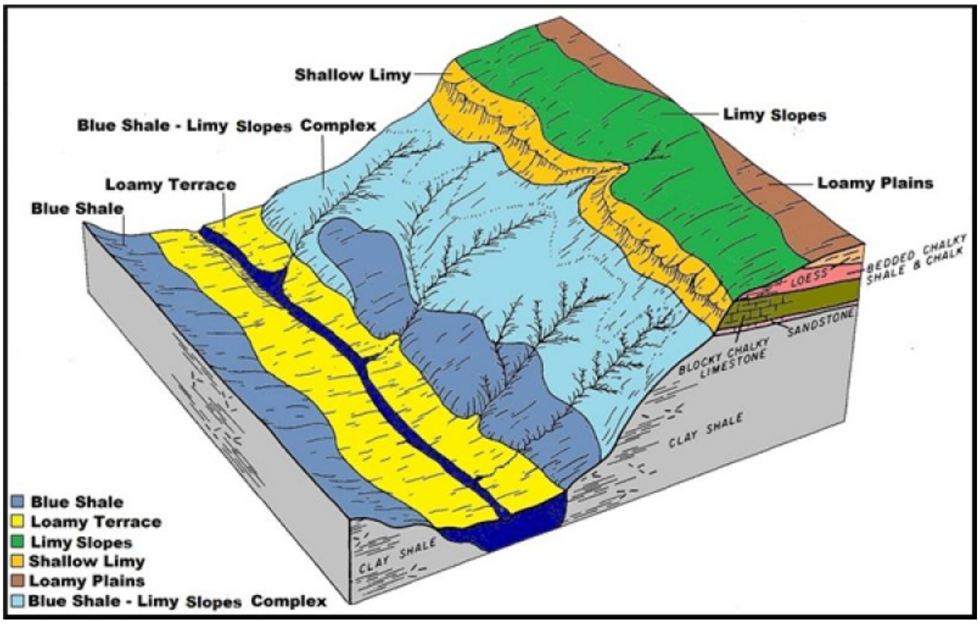


Figure 2. MLRA 73 ecological site block diagram.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Plain (3) Terrace
Flooding frequency	None
Ponding frequency	None
Elevation	2,000–3,000 ft
Slope	1–30%
Ponding depth	0 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)	148 days
Freeze-free period (average)	170 days
Precipitation total (average)	24 in

Climate stations used

- (1) DODGE CITY [USW00013985], Dodge City, KS
- (2) NESS CITY [USC00145692], Ness City, KS
- (3) CURTIS 3NNE [USC00252100], Curtis, NE
- (4) GLEN ELDER LAKE [USC00143100], Glen Elder, KS
- (5) HILL CITY 1E [USC00143665], Hill City, KS
- (6) OBERLIN [USC00145906], Oberlin, KS
- (7) BEAVER CITY [USC00250640], Beaver City, NE
- (8) MEDICINE CREEK DAM [USC00255388], Moorefield, NE
- (9) RUSSELL MUNI AP [USW00093997], Russell, KS

Influencing water features

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

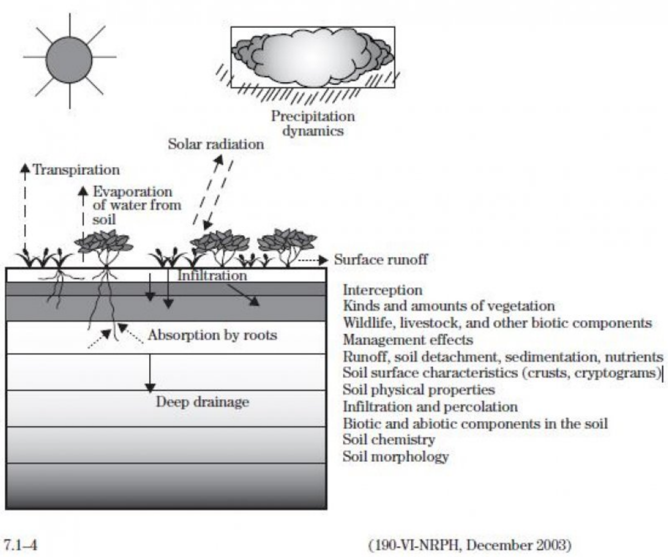


Figure 7–1 The hydrologic cycle with factors that affect hydrologic processes

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

Soil features

The soils on this site are moderately deep to very deep, well drained, and have thin to thick, calcareous surface layers. (Calcium carbonate is usually at the surface and throughout the entire soil depth, but may be leached in the upper 1 to 4 inches in non-cultivated areas.) These soils are formed from calcareous loess, calcareous sedimentary material derived from the Ogallala Formation, or calcareous limestone and shale. Slopes range from 1 to 60 percent. Soil texture for both surface and subsoil layers of these soils range from silty (or loamy) through clayey. Depth to caliche or fractured sedimentary bedrock ranges from 20 inches to more than 80 inches. Soils in this site generally have low to moderately low organic matter content.

The major soils which characterize the Limy Slopes ecological site are Armo, Campus, Coly, Penden, and Wakeen.

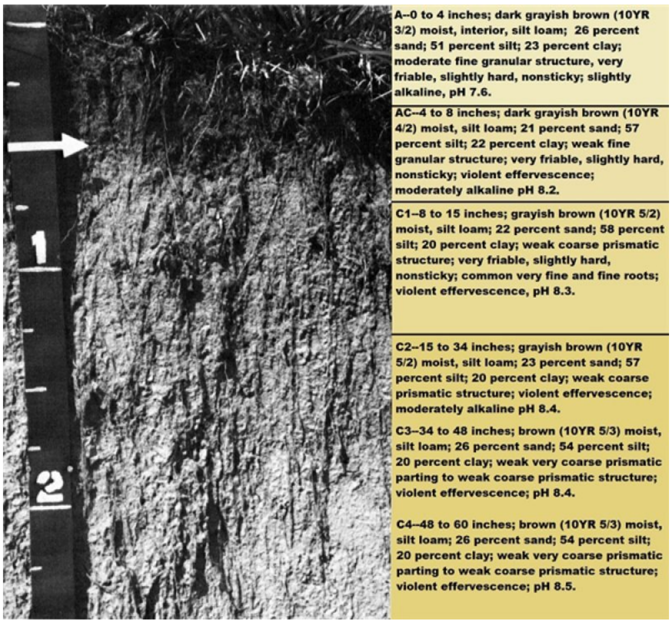


Figure 8. Coly soil series, Frontier County, Nebraska 1978.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to moderate
Soil depth	20–80 in
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–15%

Available water capacity (0-40in)	2.6–12.36 in
Calcium carbonate equivalent (0-40in)	5–55%
Electrical conductivity (0-40in)	0–1 mmhos/cm
Sodium adsorption ratio (0-40in)	0–1
Soil reaction (1:1 water) (0-40in)	7.6–8.5
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 Limy Slopes 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 Tillage 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 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. 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 upon 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 Limy Slopes 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 Limy Slopes ecological site generally occurs on nearly level to steeply sloping uplands or high terraces where extra moisture from drainage or overflow is received. The flatter slopes of this site are preferred by livestock, which can lead to grazing distribution problems. 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.

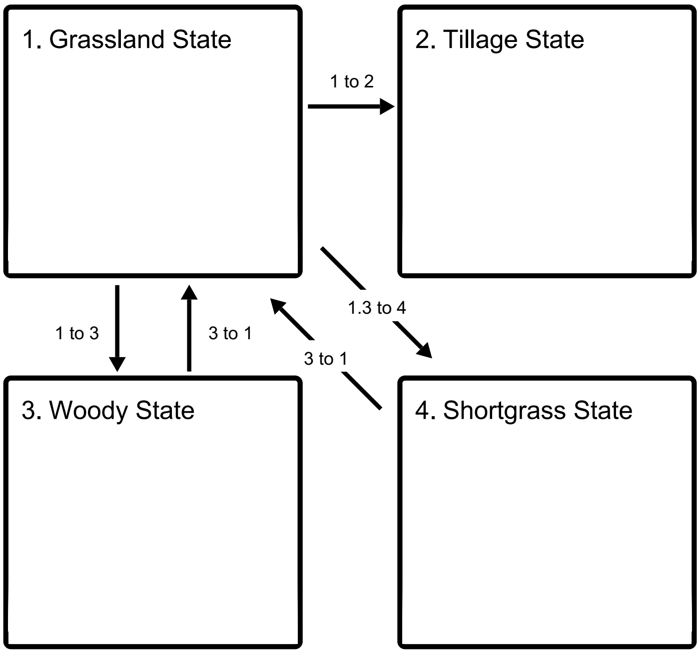
The general response of the Limy Slopes ecological site to long-term, heavy, continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tall- and mid-grass species and shift the plant community toward midgrass, shortgrass, and/or cool-season species.

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.

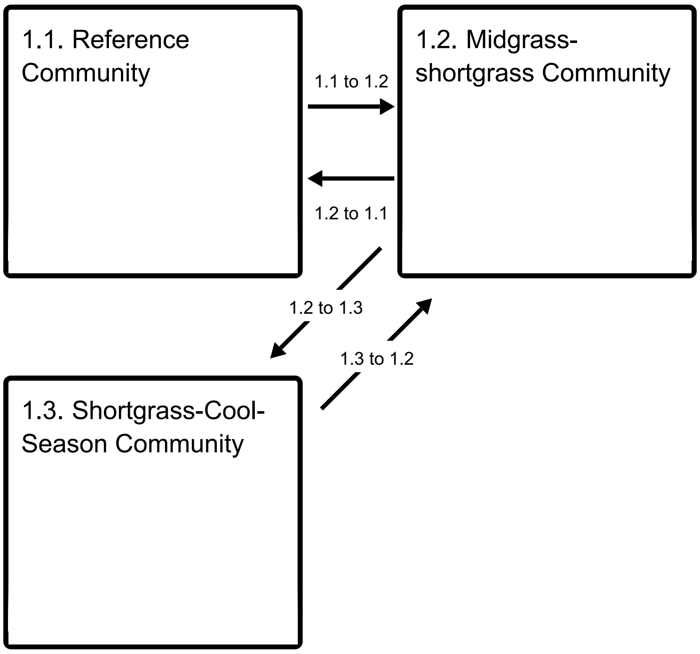
The following diagram illustrates pathways that the vegetation on this site may take, within the Grassland Reference State and beyond, as influencing ecological factors change. There may be other states or plant communities not shown in the diagram, as well as noticeable variations within those illustrated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

State and transition model

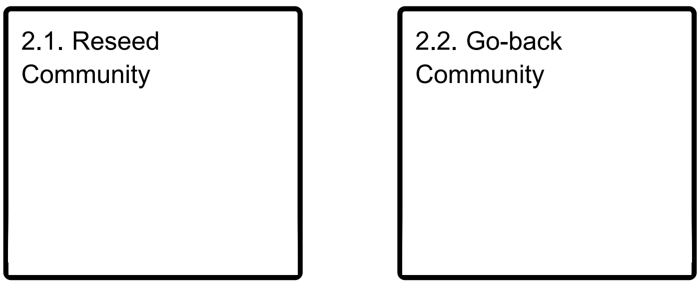
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities

3.1. Tree and/or Brush Community

State 4 submodel, plant communities

4.1. Shortgrass Community

State 1
Grassland State

The Grassland State defines the ecological potential and natural range of variability resulting from the natural disturbance regime of the Limy Slopes 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 is dominated by (65 percent) warm-season tall- and midgrass species. The midgrass-shortgrass community is made up primarily of warm-season midgrasses and decreasing amounts of forbs. The shortgrass and cool-season plant community is dominated by shortgrasses cool-season midgrasses with remnant warm-season midgrasses.

Community 1.1
Reference Community

Figure 9. Buffalo Park soil; 12-2016; T. Cochran

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 is dominated by (50%) tallgrasses, midgrasses are subdominant (29%), shortgrasses are minor (7%), and a host of cool-season grasses and grasslikes are trace (2%) amounts. A minor (10%) forb component, and trace (2%) shrub component make up the remainder of the Reference Plant Community composition by weight. Plant species in the dominant plant group include big bluestem, switchgrass, Indiangrass, composite dropseed, and sand dropseed. Plant species in the subdominant group are sideoats grama, little bluestem, and plains muhly. The cool-season grasses and grasslikes consist of western wheatgrass, sedge, threadleaf sedge, fall rosette grass, Canada wildrye, needle and thread, prairie Junegrass, and green needlegrass. This plant community has a diverse forb population, and the more prevalent forbs being Cuman ragweed, blacksamson echinacea, and dotted blazing star. The most prevalent shrubs include broom snakeweed, soapweed yucca, and plains pricklypear. 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 2,000 to 3,000 pounds of air-dried vegetation per acre per year and will average 2,600 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	1875	2340	2590
Forb	125	195	275
Shrub/Vine	0	65	135
Total	**2000**	**2600**	**3000**

Figure 11. 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-shortgrass Community

This plant community defines a shift in plant composition, function, and structure from that of the tall- and midgrass community to a mid- and shortgrass community. 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, sideoats grama, blue grama, with an increase in western ragweed and small soapweed. Western wheatgrass will continue to increase in composition with no implementation of prescribed fire and/or repetitive late growing season grazing use. 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 2,200 pounds per acre (air-dry weight).

Community 1.3
Shortgrass-Cool-Season Community

This plant community defines a shift in plant composition, function, and structure from that of a midgrass community to a shortgrass-cool-season 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 and/or needleandthread as cool-season midgrasses. The dominant plants in this community phase include blue grama, western wheatgrass, sideoats grama, and buffalograss. Increased grazing pressure will further reduce sideoats grama and western wheatgrass, 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 and western ragweed is the most prominent forb. The shrub species present will depend upon the location within the MLRA. Broom snakeweed, showberry, 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. Depending 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 1,500 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 is void of a forage and animal balance and does not provide adequate 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 to be adjusted to two consecutive years of prescribed fires.

State 2
Tillage State

The Tillage State consists of abandoned cropland that has been naturally revegetated (go-back) or planted/seeded to grassland. Many reseeded plant communities were planted with a local seeding mix under the Conservation Reserve Program (CRP) or were planted to a monoculture of sideoats grama. Go-back communities are difficult to define due to the variability of plant communities that can exist. Many of these communities are represented by the genus Aristida (threeawns). 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 2.1
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 upon 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 2.2
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, and 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.

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 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 3.1
Tree and/or Brush Community

This community is dominated by trees with a canopy cover that usually is 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 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 (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, 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 4
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 Sod-bound 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 2003).

Community 4.1

Shortgrass Community

Figure 12. Buffalo Park soil; 11-2016 Photo by T.Cochran

The potential vegetation is a short-grass prairie consisting of approximately 88 percent grasses and grass-like plants, 2 percent forbs, and 10 percent woody plants. Blue grama and buffalograss are the dominant grasses in this community. A slight increase in plains pricklypear and soapweed yucca can possibly be observed. Forb diversity has declined with Cuman ragweed, and white sagebrush being the most observed. This plant community is resistant to change due to grazing and drought tolerance of both buffalograss and blue grama. 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, “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. Buffalograss and blue grama have developed a dense sod. Sideoats grama and western wheatgrass occur in trace amounts making less than 2 percent of the total annual production. During years of drought, western wheatgrass makes little or no growth and the entire site may appear to be only buffalograss and blue grama. 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 800 pounds per acre (air-dry weight).

Transition 1 to 2

State 1 to 2

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.

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 affects 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 4
State 1 to 4

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 and buffalograss sod. Drought in combination with this type of management will quicken the rate at which this transition occurs. Ecological processes affected are the hydrologic and nutrient cycles. Increased evaporation rate, an increase in runoff, an increase in bulk density, a decrease in infiltration, plant composition change, 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 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).

Restoration pathway 3 to 1
State 4 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).

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 tallgrasses Dominant 50%**			800–1300	
	big bluestem	ANGE	*Andropogon gerardii*	630–860	–
	switchgrass	PAVI2	*Panicum virgatum*	50–130	–
	Indiangrass	SONU2	*Sorghastrum nutans*	50–130	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	50–130	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–50	–
2	**Midgrasses Subdominant 29%**			400–760	
	sideoats grama	BOCU	*Bouteloua curtipendula*	200–400	–
	little bluestem	SCSC	*Schizachyrium scoparium*	200–400	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–50	–
3	**Shortgrasses minor 7%**			75–175	
	blue grama	BOGR2	*Bouteloua gracilis*	100–200	–
	buffalograss	BODA2	*Bouteloua dactyloides*	15–80	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–50	–
4	**Cool-season grasses/grasslikes trace 2%**			20–60	
	western wheatgrass	PASM	*Pascopyrum smithii*	40–80	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–15	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–15	–
	green needlegrass	NAVI4	*Nassella viridula*	0–10	–
	sedge	CAREX	*Carex*	0–5	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–5	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–5	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–5	–
Forb					
5	**Forbs Minor component 10%**			80–260	
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	15–30	–
	dotted blazing star	LIPU	*Liatris punctata*	15–30	–

	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	10–20	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	10–20	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	10–20	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	10–20	–
	white heath aster	SYER	*Symphyotrichum ericoides*	10–20	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–15	–
	nineanther prairie clover	DAEN	*Dalea enneandra*	0–15	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–15	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–15	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–15	–
	velvety goldenrod	SOMO	*Solidago mollis*	0–15	–
	stiff goldenrod	OLRI	*Oligoneuron rigidum*	0–15	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–15	–
Shrub/Vine					
6	**Shrubs Trace component 2%**			0–50	
	sumac	RHUS	*Rhus*	0–10	–
	prairie rose	ROAR3	*Rosa arkansana*	0–10	–
	common snowberry	SYAL	*Symphoricarpos albus*	0–10	–
	soapweed yucca	YUGL	*Yucca glauca*	0–10	–
	leadplant	AMCA6	*Amorpha canescens*	0–10	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–10	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	–

Animal community

Wildlife Interpretations

This ecological site is on nearly level to steeply sloping uplands or high terraces. The steeper sites are typically not farmed so many areas remain in native vegetation. Historically, the predominance of a diverse assemblage of grasses and forbs on this site supported the large herds of grazers and mixed feeders such as bison, elk, mule deer, pronghorn and a diverse group of grassland obligate birds such as prairie chickens and small to mid-sized mammals. Greater prairie chickens occur generally in the northern part of MLRA 73 and lesser prairie chickens in the south. This site in particular often supports a great diversity of forbs.

Due to the heterogeneity inherent in all landscapes, some areas were not grazed uniformly by the 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.

Woody invasion from species such as eastern redcedar, hedge, and locust has been shown to be detrimental to prairie birds like the greater and lesser prairie chicken and numerous grassland songbirds. Prairie birds have shown an avoidance behavior toward the vertical structure of trees and tall man-made structures. Trees can also increase the potential for nest parasitism by brown-headed cowbirds when adjacent to grasslands. Deciduous and evergreen tree species such as those commonly established in shelterbelts and windbreaks provide habitat for mid-sized mammals such as raccoons, opossums and striped skunks, which can be detrimental to ground-nesting birds native to grassland habitats. Tree plantings can further decrease suitable habitat for many grassland species by fragmenting larger expanses of contiguous grassland habitat required by many grassland-nesting birds.

Periodic events such as prolonged drought, wildfire, disease, or high insect numbers will alter plant community diversity and structure and associated wildlife species. Wildlife native to the site depend on a plant community diverse in species and structure.

Big Bluestem, Little Bluestem, Sideoats Grama (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 birds. Grasshoppers, associated with grasses, are a critical food source for birds in later stages of development. Ornate box turtles, six-lined racerunners, and snakes such as the racer and the gopher snake are common reptiles on this site. The Reference Plant Community with its inherent clumpy native warm-season grasses and residual plant material offer suitable prairie chicken nesting habitat. These sites are particularly valuable for nesting when located within one mile of prairie chicken mating, or lek sites. Lek sites are typically located on or near ridgetops and other high points on the landscape where the vegetation is typically short and offers unobstructed visibility. Lek sites can also be located within this plant community on suitable locations on the landscape where utilization by cattle is high, such as areas near watering facilities, mineral licks or other areas of heavy animal concentration. Sites with a diversity of forbs and are relatively open at ground level provide prairie chickens and other ground-nesting birds suitable brood-rearing habitat. Prairie voles and deer mice are common and provide prey for raptors such as red-tailed hawks and great-horned owls throughout the year and prey for northern harriers, rough-legged hawks, and short-eared owls during the winter. Small mammals also provide prey for coyotes and other predators.

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 conditions.

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 was 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, 9/30/2019

Acknowledgments

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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 3-01-2017 David Kraft, John Henry, Doug Spencer and Dwayne Rice Original Authors 02-2005
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Date	09/26/2019
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:** Typically none. If present (steeper slopes following intense storms) short and not connected.

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.

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, 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).

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.

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.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Coly Series
   A--0 to 4 inches; very dark grayish brown (10YR 3/2) interior, silt loam; 26% sand; 51% silt; 23% clay; moderate fine granular structure; very friable, slightly hard, nonsticky; many fine roots; slightly alkaline, pH 7.6.
   AC--4 to 8 inches; dark grayish brown (10YR 4/2) interior, silt loam; 21% sand; 57% silt; 22% clay; weak fine granular structure; very friable, slightly hard, nonsticky; common fine roots, violent effervescence; moderately alkaline, pH 8.2.

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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.

---

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: 1. Warm-season tallgrasses dominant 50%. big bluestem 630-860, switchgrass 50-130, Indiangrass 50-130, composite dropseed 50-130, sand dropseed 0-50

Sub-dominant: 2. Warm-season midgrasses subdominant 29%. sideoats grama 200-400, little bluestem 200-400, plains muhly 0-50

Other: 3. Warm-season shortgrasses minor 7%. buffalograss 75-175, blue grama 100-200, hairy grama 0-50.

Additional: Group 4 Other grasses trace amount 2%
Group 5 Forbs minor component 10%
Group 6 Shrubs trace component 2%

---

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):** 2000-3000 lbs/acre. Representative value is 2600 lbs/forage/acre. Below normal precipitation during the growing season expect 2000 lbs/forage/acre and above normal precipitation during the growing season expect 3000 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.
