USDA Natural Resources Conservation Service

Ecological site R072XY112KS
Shallow Limy

Accessed: 05/10/2025

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.

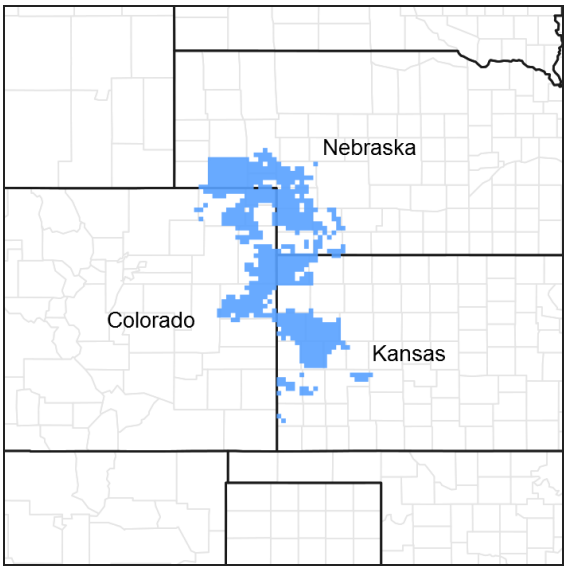


Figure 1. Mapped extent

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): 072X–Central High Tableland

Major Land Resource Area (MLRA) 72--Central High Tableland. This area is in Kansas (54 percent), Nebraska (25 percent), and Colorado (21 percent). A very small part of the area is in Wyoming. The area makes up about 34,550 square miles (89,535 square kilometers). It includes the towns of Garden City, Goodland, and Colby, Kansas; Imperial, North Platte, Ogallala, and Sidney, Nebraska; and Holyoke and Wray, Colorado. Interstate 70 bisects the area, and Interstates 76 and 80 follow the south side of the South and North Platte Rivers, respectively. The Cimarron National Grasslands occur in the southwest corner of the MLRA.

Classification relationships

Major land resource area (MLRA): 072-Central High Tableland

Ecological site concept

This site occurs on the breaks landscape and characterized by soils that are less than 20 inches to bedrock. The breaks landscape is the area between the tableland and river valleys highlighted by cliff faces. The Shallow Limy ecological site occurs on nearly level to steeply sloping uplands. Much of the site is steep and characterized by rock ledges forming vertical drops.

Associated sites

R072XY101KS	**Limy Slopes** The Limy Slopes ecological site is located on shoulders and backslopes on hillslopes on tableland landscapes. Soils that are correlated to Limy Slopes have free carbonates occurring within 4 inches (10cm) of the surface. This site is dominated by loess parent material.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua curtipendula*

Physiographic features

This site occurs on nearly level to very steep uplands (including vertical rock faces) that are comprised of limestone and sandstone. 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 by overgrazing and fire events. Vehicular traffic on this site is very limited to impossible.

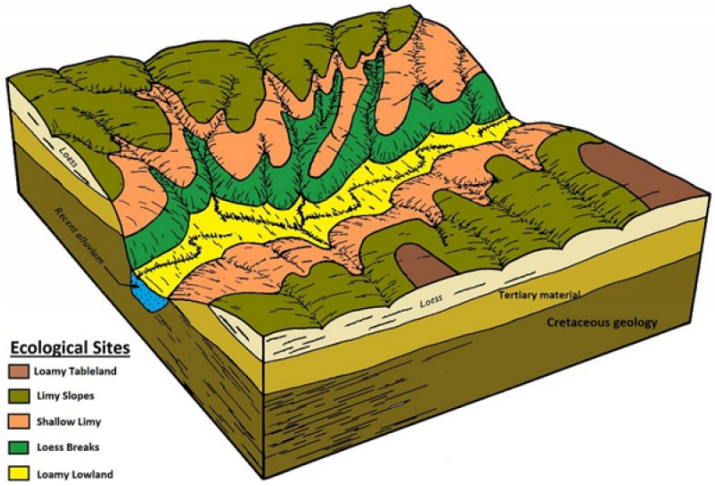


Figure 2. MLRA72 Breaks landscape ESD block diagram

Table 2. Representative physiographic features

Landforms	(1) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	3,000–5,000 ft
Slope	0–30%
Water table depth	80 in

Climatic features

The average annual precipitation in this area is 14 to 25 inches (355 to 635 millimeters). It fluctuates widely from year to year. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from late spring through early autumn. Precipitation in winter occurs as snow. The annual snowfall ranges from about 16 inches (40 centimeters) in the southern part of the area to 35 inches (90 centimeters) in the northern part. The average annual temperature is 46 to 57 degrees F (8 to 14 degrees C). The freeze-free period averages 161 days and ranges from 135 to 210 days, increasing in length from northwest to

southeast. Climate data comes 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)	137 days
Freeze-free period (average)	155 days
Precipitation total (average)	20 in

Influencing water features

There are no adjacent wetland/riparian water regimes that influence the vegetation and/or management of this site that makes it distinct from other ecological sites. The landform position of the Shallow Limy site can be in a water receiving or water shedding position.

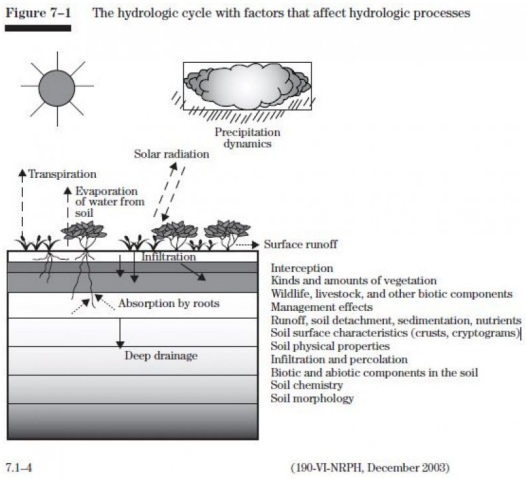


Figure 7. Fig.7-1 from National Range and Pasture Handbook.

Soil features

The soils on this site range from less than 10 to 20 inches deep over Tertiary material or Cretaceous bedrock (limestone, caliche, or sandstone). These soils have a loamy surface and subsurface layer. They are calcareous throughout and have very low to low available water capacity. Vertical rock faces are common. Soils in this site generally have moderately low organic matter.

Exposed Tertiary material (mostly limestone) and bare ground are inherent to this site. Where slopes are gentle, water flow paths should be broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers and exhibit slight to no evidence of rills, wind scoured areas or pedestaled plants.

As slopes become steep and bare areas increase, expect to find evidence of water flow patterns and pedestaled plants. Sub-surface soil layers, where not affected by bedrock, are non-restrictive to water movement and root penetration.

Major soil series correlated to this ecological site, and their percent spatial area, include: Canyon 46%, Tassel 35%, and Canlon 13%.

Other soils correlated to this site include Brownson, Epping, Escabosa, Penrose, and Travesilla. Each of these series make up one percent of the spatial extent of the site.

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

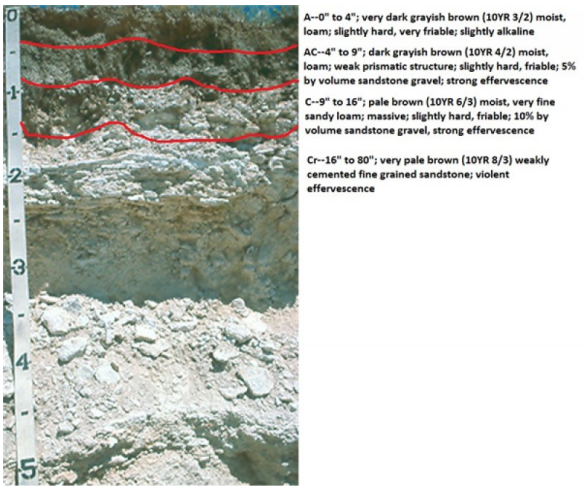


Figure 8. Canyon (OSD description) profile from Kimball, NE

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and sandstone
Surface texture	(1) Gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Moderately slow to moderately rapid
Soil depth	0–20 in
Surface fragment cover <=3"	5–15%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	0.6–6.4 in
Calcium carbonate equivalent (0-40in)	0–40%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–6
Soil reaction (1:1 water) (0-40in)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	14–27%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

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

This ecological site is made up of a grassland state. The grassland state is characterized by non-broken land (no tillage), both warm and cool season, rhizomatous, bunch, and sod-forming grasses, forbs and shrubs.

Vegetation changes are expected within this ecological site and will be dependent on the site's geographical location inside Major Land Resource Area 72 (MLRA). Variation in precipitation east and west is not as affected as is temperature north and south. The northern part of MLRA 72 is characterized by cooler temperatures and a shorter growing season in respect to the southern end. As a result, cool season bunchgrasses and sod formers proliferate. Growth of native cool season plants begins about April 15, and continues to about June 15. Native warm season plants begin growth about May 15, and continue to about August 15. Green up of cool season plants may occur in September and October if adequate moisture is available (weather data from National Climate Data Center 1980-2010).

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

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 climate largely dictates the plant communities for the site.

Drought cycles were part of the natural range of variability within the site and have historically had a major impact upon the vegetation. The species composition changes according to the duration and severity of the drought cycle (Albertson and Weaver 1942).

The vegetation on this site is impacted by topography. The percent (steepness) and aspect of the slope interact with the other ecological processes to further influence the vegetative dynamics of the site.

This site generally occurs on the more sloping parts of the landscape. The flatter slopes of this site and adjacent, more level sites are preferred by livestock, which can lead to grazing distribution problems. Water locations, salt placement, and other aids help distribute grazing. Other management techniques such as concentrated grazing and/or grazing systems help to distribute grazing more evenly.

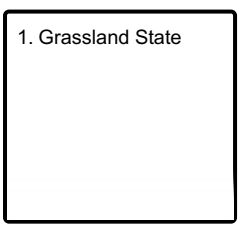
The general response of the Shallow Limy ecological site to long term continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tall and mid-grass species and shift the plant community toward short-grass species.

The tall and mid-grass species generally escape excessive grazing pressure on the steeper, less accessible areas. The tall and mid grasses maintained on the steep area help provide a source for these species to repopulate the site after long periods of drought and/or overgrazing. The use of grazing management that includes needed distribution tools, proper stocking, and adequate recovery periods during the growing season, helps restore this site to its productive potential.

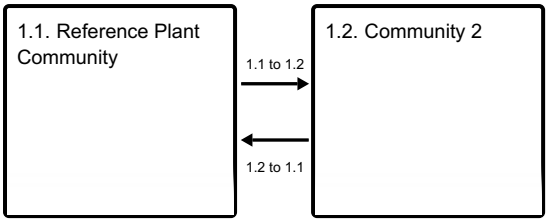
The following diagram illustrates pathways that the vegetation on this site may take from the Reference Plant Community as influencing ecological factors change. There may be other states or plant communities not shown in the diagram as well as noticeable variations within those illustrated and described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

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 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 sod and bunchgrasses, cool season sod forming grasses, forbs and shrubs. Plant community 2 is made up primarily of warm season shortgrass and few midgrasses with increasing amounts of threadleaf sedge and small soapweed.

Community 1.1
Reference Plant Community

The reference community is supported by empirical data, historical data, local expertise and photographs. The potential vegetation is a mixed grass prairie consisting of approximately 85 percent grasses and grass-like plants, 10 percent forbs, and 5 percent shrubs. Little bluestem, sideoats grama, blue grama, and big bluestem are the dominant grasses in this community. Secondary species include switchgrass, Indiangrass, and buffalograss. This community has a diverse forb population, most of which occur in small amounts. Shrubs include broom snakeweed, pricklypear, leadplant and soapweed yucca. Little bluestem and sideoats are the dominant, mid-grass species in this plant community. Combined, they make up approximately 50% of the total annual production, by weight, per acre, for the year. Big bluestem and blue grama make up approximately 15%. The cool season grasses play a minor component in this plant community, which includes western wheatgrass and needle and thread. Combined they make up 5% of the total annual production, by weight, per acre, for the year. Both are valuable forage plants in late spring and/or early summer. Needle and thread appears to be more prevalent in the northern part of MLRA 72 as well as along the western reaches. The Reference Plant Community is diverse and productive. Litter is uniformly distributed with very little movement off-site and natural plant mortality is very low. This community is resistant to many disturbances with the exception of heavy, long term continuous grazing, tillage and/or development into urban or other uses. Total annual production ranges from 600 to 1,600 pounds of air-dried vegetation per acre per year, and will average 1,200 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 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	510	1020	1360
Forb	60	120	160
Shrub/Vine	30	60	80
Total	**600**	**1200**	**1600**

Figure 10. Plant community growth curve (percent production by month). KS6372, Little Bluestem, Sideoats Grama, Blue Grama.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	35	25	10	5	0	0	0

Community 1.2
Community 2

This plant community developed with heavy, continuous grazing without adequate recovery periods during the growing season. The dominant grasses are blue grama, buffalograss, threadleaf sedge, threeawns and small soapweed. Little bluestem and sideoats grama, if present, are in remnant amounts. Big bluestem, switchgrass, and western wheatgrass have been significantly reduced and at risk of being removed from the plant community. Small soapweed, prickly pear, and broom snakeweed will start to increase. Total annual plant production and litter levels are lower compared to the Reference Plant Community. Soil erosion may be a concern at this point, especially on high travel or impact areas and those areas with steeper slopes. Some flow paths may be connected and rills may be present. The water and nutrient cycles are beginning to be affected by the reduction of dominant warm season species, forbs and shrubs. Total annual production ranges from 300 to 1,000 pounds of air-dried vegetation per acre per year and will average 700 pounds.

Pathway 1.1 to 1.2
Community 1.1 to 1.2

Long term management without a forage and animal balance and heavy continuous grazing without adequate recovery periods between grazing events will convert the Reference Plant Community to a community dominated by blue grama, buffalograss, threadleaf sedge, and small soapweed. Drought, in combination with this type of management will quicken the rate at which the Reference Community pathways to Community 2.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

Prescription grazing to include a forage and animal balance, and adequate rest and recovery during the growing season will move this plant community towards the reference plant community, given that remnant reference plants are still present.

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 Tall-Midgrasses Dominant 65%**			430–780	
	little bluestem	SCSC	*Schizachyrium scoparium*	190–325	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	190–300	–
	big bluestem	ANGE	*Andropogon gerardii*	50–100	–
	switchgrass	PAVI2	*Panicum virgatum*	0–60	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–20	–
2	**Short and cool season grasses Subdominant 15%**			105–180	
	blue grama	BOGR2	*Bouteloua gracilis*	80–100	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–40	–
	buffalograss	BODA2	*Bouteloua dactyloides*	25–40	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–25	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–25	–
3	**Other grasses and sedge Minor 5%**			0–60	
Forb					
4	**Forbs and Legumes Subdominant 10%**			60–120	
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	5–20	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	5–20	–

	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	10–20	–
	dotted blazing star	LIPU	*Liatris punctata*	10–20	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	5–15	–
	white heath aster	SYER	*Symphyotrichum ericoides*	5–15	–
	stemless four-nerve daisy	TEAC	*Tetraneuris acaulis*	5–10	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	5–10	–
	spiny phlox	PHHO	*Phlox hoodii*	5–10	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	5–10	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	5–10	–
	common yarrow	ACMI2	*Achillea millefolium*	5–10	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	5–10	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–5	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–5	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–5	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	0–5	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–5	–
	yellowspine thistle	CIOC2	*Cirsium ochrocentrum*	0–5	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	0–5	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–5	–
	stiff goldenrod	OLRI	*Oligoneuron rigidum*	0–5	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–5	–
	beardtongue	PENST	*Penstemon*	0–5	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–5	–
	prairie coneflower	RATIB	*Ratibida*	0–5	–
	desert princesplume	STPIP	*Stanleya pinnata var. pinnata*	0–5	–
Shrub/Vine					
5	**Shrubs minor component 5%**			20–60	
	leadplant	AMCA6	*Amorpha canescens*	0–20	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	5–20	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–20	–
	soapweed yucca	YUGL	*Yucca glauca*	5–20	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–12	–

Animal community

Wildlife Interpretations

This ecological site is on the sides and narrow tops of upland ridges that are dissected by deeply entrenched drainageways. Slopes can range from 2 percent to 60 percent and often contain rocky outcrops. The shallow soils and steep slopes make farming this site difficult, if not impossible, leaving the majority of these sites in native vegetation.

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

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

Low-growing shrubs offer escape and thermal cover for several species of wildlife. Limestone or sandstone outcroppings are common on this site and provide specialized habitat for many species not found elsewhere.

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

Little Bluestem, Sideoats Grama, Reference Plant Community

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

Community 2

With reduced cover of the taller native bunch grasses and a decrease in residual plant cover that is usually associated with the degradation of the Reference Plant Community, nesting habitat for ground nesting birds begins to decline. Species composition of small mammals can shift rapidly in response to changes in the plant community structure due to overgrazing or other disturbances such as wildfire. Many forbs beneficial to wildlife may not be reduced by grazing in this plant community and will continue to provide habitat for wildlife.

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 desirability preference of plant species and/or grazing system and site graze ability 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. This site is dominated by soils in hydrologic group B, with localized areas in hydrologic group A. Infiltration is moderate to high and runoff potential for this site is moderate depending on soil hydrologic group and ground cover. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff. (Refer to NRCS Section 4, National Engineering Handbook (NEH-4) for runoff quantities and hydrologic curves).

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 esthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

None noted.

Other information

Site Development and Testing Plan.

Future work (for approved ESD) includes field visits to verify ES site concepts with field staff. Field staff include, but not limited, to project office leader, area soil scientist, state soil scientist, ecological site specialist, state rangeland conservationist, area rangeland management specialist and local field personnel. Field visits are to be determined by spatial extent of the site as well as personal knowledge of the site. Activity during field visits will include, but not limited to, identifying the soil, landform, plant community and verifying existing site concepts.

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 Shallow Limy (South) ESD in 2001 include: Tim Watson, Amanda Shaw, Susan Francis, Jon Deege, and Robert Schiffner, from Kansas. Harvey Sprock, and Josh Saunders from Colorado.

NRCS individuals involved in developing the Shallow Limy (North) ESD in 2001 include: Harvey Sprock from Colorado. Carol Eakins, Chuck Markley, Jeff Nichols, and Mary Schrader from Nebraska. Joan Gienger, and Ted Houser from Kansas.

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

Range Site Description for Kansas, Shallow Limy, USDA-Soil Conservation Service, September, 1983

Range Site Description for Colorado, Loamy Slopes, USDA-Soil Conservation Service, December 1975

Range Site Description for Colorado, Limestone Breaks, USDA-Soil Conservation Service, January, 1975

Guide for determining range condition and suggestive initial stocking rates for Nebraska, Shallow Limy, Vegetative Zone 1 and II, USDA-Soil Conservation Service, April 1983

Range Site Description for Nebraska, Shallow Limy, USDA-Soil Conservation Service, August, 1981
Schacht, Walter H., Larsen, Dana. Section III

Range Sites, Shallow Limy Range Site, The Board of Regents of the University of Nebraska, publication

Ecological Site Description for Kansas, Shallow Limy (R072XA028KS) and South (R072XB0028KS), located in Ecological Site Information System (ESIS), 2007

Ecological Site Description for Colorado, Limestone Breaks(R072XY060CO), located in Ecological Site Information System (ESIS)

Other references

Eddleman, L.E. 1983. Some ecological attributes of western juniper. pp. 32-34. IN: Research in rangeland management, USDA, Agricultural Research Service, Special Report 682.

High Plains Regional Climate Center, University of Nebraska, Lincoln,(http://hpcc.unl.edu)

History of the Native Vegetation of Western Kansas During Seven Years of Continuous Drought, F.W. Albertson, J.E. Weaver, Ecological Monographs, Vol. 12, No. 1 Jan. 1942 pp. 23-51

N. C. Brady and R. R. Weill, The Nature and Properties of Soils, 14th Edition, 2008, pp. 504–517.

Thurow, T. L.; Hester, J. W. 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, NRCS. National Water and Climate Center, Portland, OR.(http://wcc.nrcs.usda.gov)

USDA, NRCS. National Range and Pasture Handbook, September 1997

USDA, NRCS. National Soil Information System, Information Technology Center, Fort Collins, CO. (http://nasis.nrcs.usda.gov)

USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA USA.

Contributors

Chris Tecklenburg

Acknowledgments

The ecological site development process is a collaborative effort, conceptual in nature, dynamic and is never considered complete. I thank all those who set the foundational work in the early 2000s in regards to this ESD. I thank all those who contributed to the development of this site. In advance, I thank those who would provide insight, comments and questions about this ESD in the future.

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 8-4-2016 David Kraft, John Henry, Doug Spencer and Dwayne Rice Original Authors 2-2005 Harvey Sprock and Dan Nosal 01/13/05 Shallow Limy (formerly Limestone Breaks)Colorado
Contact for lead author	Chris Tecklenburg (chris.tecklenburg@ks.usda.gov) David Kraft (david.kraft@ks.usda.gov)
Date	08/04/2016
Approved by	David Kraft
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to minor. Associated with steeper slopes.

---

2. **Presence of water flow patterns:** None to minimal on gentle slopes (< 15%). Flow paths should be broken, irregular in appearance. As slope and/or limestone outcrop increase, flow paths become more apparent and may be connected.

---

3. **Number and height of erosional pedestals or terracettes:** None to slight on gentle slopes. Expect some evidence of pedestalled plants when slopes exceed 15%.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 10% or less bare ground, with bare patches generally less than 3 inches. Extended drought may increase bare ground 5-10%. Exposed limestone is inherent to the site and would not be considered bare ground.

---

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

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to minor. Steep exposed areas may have small areas of wind souring.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is associated with water flow patterns and may move as much as 1-3 feet down slope during severe precipitation events, especially on steeper slopes.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating anticipated to be 3-4 in interspaces at soil surface.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM ranges from 1-3%. Soils are typically shallow and well drained. A-horizon ranges from 0-4 inches in depth with a very dark grayish brown color (10YR 3/2) moist. Surface texture is typically loam. Structure is weak medium granular. Caliche (limestone) fragments found on surface.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** A diverse grass, forb, and shrub functional and structural groups as well as diverse root structure and patterns reduces raindrop impact, slows overland flow, providing increased time for infiltration to occur. However, the composition of the plant community has less affect on infiltration and runoff on steeper slopes and limestone outcrop.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: 65% warm, mid and tallgrasses- little bluestem = sideoats grama >> big bluestem > switchgrass > Indiangrass.

    Sub-dominant: 15% shortgrass and cool season- blue grama > buffalograss = hairy grama > plains muhly = needle and thread

    Other: 10% Forbs and legumes 5% other grasses and 5% Shrubs

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None to slight. Expect slight mortality/decadence during and following extended drought.

---

14. **Average percent litter cover (%) and depth (in):** 35-50% litter cover at 0.25 inch depth on gentle slopes and 5-15% on steeper areas and exposed limestone.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 600 lbs./ac. low precip years, 1200 lbs./ac. average precip years, 1600 lbs./ac. high precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 300-500 lbs./ac.

---

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 plants should not occur in the Reference Plant Community. However, cheatgrass, Russian thistle, kochia, other non-native annuals will invade following extended drought assuming a seed source is available. Blue grama, red threeawn, sand dropseed, threadleaf sedge, locoweeds and milkvetches are the major native (non-invasive) increasers on this site.

---

17. **Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, and insects that may temporarily reduce reproductive capability.
