Ecological site R106XY076NE
Limy Upland

Last updated: 6/09/2025
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 106X–Nebraska and Kansas Loess-Drift Hills

Named the “Nebraska and Kansas Loess-Drift Hills,” Major Land Resource Area (MLRA) 106 is divided almost evenly between southeastern Nebraska (52%), and northeastern Kansas, (48%). The approximately seven-million-acre landscape covers all or parts of thirty counties between the two states. The northern border is located on the north end of Saunders County, Nebraska, and the MLRA extends into Douglas County, Kansas in the south. The Nebraska cities of Beatrice and Lincoln are the major population centers in the north, while Topeka and Lawrence in Kansas are the primary cities in the south. The Platte, Little Nemaha, and the North Fork of the Big Nemaha Rivers flow through the Nebraska side of the MLRA, while the Black Vermillion, the Soldier, and the Delaware Rivers are the major waterways on the Kansas side. The Big Blue River runs through both states, while the Salt Creek hydrologic system located near Lincoln, Nebraska provides habitat for the only known population of the Federally listed endangered Salt Creek Tiger Beetle. This dissected glacial drift plain primarily consists of broad, smooth ridgetops, and slopes ranging from nearly level to steep. The elevation in MLRA 106 decreases from west to east, and ranges from nearly 1,650 feet to less than 790 feet above sea level. Stream valleys in this landscape are narrow and bordered by steep hills, with 10 to 20 feet of local relief. The river valleys are broader and may drop up to over 160 feet below the adjacent hilltops. The uplands are primarily comprised of glacial drift underlying a mantle of loess, while alluvial deposits are found in the stream and river valleys. Limestone and shale quarries are also located in MLRA 106. The predominant soil orders in this MLRA are mesic, udic, Mollisols, Alfisols, and Entisols. Loams and clays are the primary soil textures in this landscape. Sixty-two percent of the land in this MLRA has been broken out of native prairie and farmed, while only 23 percent of the grasslands remain. Livestock grazing, primarily by cattle, is the main industry on these remnants. Corn, wheat, soybeans, and grain sorghum are the primary commodity crops, but a significant number of acres are also planted to alfalfa for harvest as hay. With annual precipitation averaging from 40 inches in the southeast, to 28 inches in the northwest, irrigation for crop production is not a critical factor in most years. The historical matrix vegetation type is Tallgrass Prairie, and big and little bluestem, switchgrass, Indiangrass, sideoats, and blue grama make up the bulk of the warm season species. Historically, western wheatgrass was the dominant cool-season grass but today the dominant cool-season grasses are introduced grasses, smooth brome in the north and tall fescue in the south. Large and small patch vegetative communities are found primarily along the riparian zones, and on both upland and lowland saline sites. Woodlands make up about six percent of MLRA 106, consisting primarily of green ash, oak, hackberry, boxelder, and maple trees. Wildlife flourishes in this combination of crop and grassland environments. In a landscape historically occupied by bison herds, white-tailed deer are now the most abundant wild ungulates. A variety of smaller species, including coyote, raccoon, opossum, porcupines, muskrat, beaver, squirrel, and mink thrive in the region. Native grassland bird populations are limited by the lack of contiguous native prairie and the fragmented habitat created by the farmland. The rivers, streams, and lakes harbor excellent fisheries, and migrating and local waterfowl use the wetland complexes. These complexes provide ideal habitat for wading and shore bird species as well. This landscape serves as a backdrop for a disturbance driven ecosystem, evolving under the influences of herbivory, fire, and variable climate. Historically, these processes created a heterogeneous mosaic of plant communities and structure heights across the region. Any given site in this landscape experienced fire every three to four years. Fires were caused by lightning strikes and also were set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. The Indigenous inhabitants understood the value of fire as a tool and that the highly palatable growth following a fire provided excellent forage for their horses and attracted grazing game animals such as bison and elk. Land use patterns by post European settlers have fragmented the native grasslands through conversion to cropland, transportation corridors, and other developments. This has significantly altered the natural fire regime allowing encroachment by native and introduced shrubs and trees into the native prairie remnants throughout the MLRA. Aggressive fire suppression policies have exacerbated this process to the point that shrub and tree encroachment is a major ecological threat in the majority of both native and reseeded grasslands. Introduction of eastern red cedar as a windbreak species further facilitates invasion by this species. While eastern red cedar is native to the landscape, the historic population in MLRA 106 was limited to isolated pockets in rugged river drainageways that were protected from fire. Widespread plantings of windbreaks with eastern red cedar as a primary component have provided a seed source for the aggressive woody plant. The ensuing encroachment into the native grasslands degrades the native wildlife habit and causes significant forage loss for domestic livestock. Since it is not a root sprouter, eastern red cedar is very susceptible to fire when under six feet tall. Management with prescribed fire is exceedingly effective if applied before this stage. Larger eastern red cedars can also be controlled with fire, but

successful application requires the use of specifically designed ignition and holding techniques.

Classification relationships

?USDA-NRCS (2022)? Land Resource Region – M, Central Feed Grains and Livestock Region Major Land Resource Area (MLRA) – 106 ?Fenneman (1916) Physiographic Regions ? Division – Interior Plains Province – Central Lowland Section – Dissected Till Plains ? USDA-USFS (2007) Ecoregions? Domain – Humid Temperate Division – Prairie Province – Prairie Parkland (Temperate) Section – Central Dissected Till Plains (251C) ?EPA Ecoregions (Omernik 1997)? I – Great Plains (9) II – Temperate Prairies (9.2) III – Western Corn Belt Plains (9.2.3) IV – Loess and Glacial Drift Hills (47i) ?Associated Counties? Nebraska: Butler, Cass, Gage, Jefferson, Johnson, Lancaster, Nemaha, Otoe, Pawnee, Richardson, Saline, Saunders, Seward Kansas: Atchison, Brown, Doniphan, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Marshall, Nemaha, Osage, Pottawatomie, Shawnee, Wabaunsee, Washington, Wyandotte

Ecological site concept

The Limy Upland ecological site is located on upland landscapes and does not receive additional moisture from runoff or overflow. The typical slope range is from 6 to 30 percent but may be as steep as 60 percent or higher. Soils are very deep (greater than 60 inches) with surface textures of silty clay loam, silty clay or silt loam that are typically 6 to 15 inches thick. These somewhat excessively drained soils are formed in calcareous till or fine silty loess. The diagnostic feature for the Limy Upland ecological site is the presence of calcium carbonate within ten inches (25 cm) with the amount of calcium carbonates increasing with depth. The vegetation in the Reference Community is mixed grass prairie. The primary grasses include big bluestem, little bluestem, and sideoats grama. Secondary grasses include switchgrass, Indiangrass, and blue grama. Forbs are common and diverse.

Associated sites

R106XY070NE	**Loamy Terrace** The Loamy Terrace ecological site is located below and often adjacent to the Limy Upland ecological site.
R106XY074NE	**Clayey Upland** The Clayey Upland ecological site is often located adjacent to the Limy Upland ecological site.
R106XY068NE	**Loamy Floodplain** The Loamy Floodplain ecological site is located below and often adjacent to the Limy Upland ecological site.
R106XY075NE	**Loamy Upland** Loamy Upland ecological site is often located adjacent to the Limy Upland site

Similar sites

R106XY074NE	**Clayey Upland** The Clayey Upland ecological is occurs on a similar landscape position but is not calcareous within 10 inches of the soil surface.
R106XY077NE	**Shallow Limy** The Shallow Limy ecological site is calcareous at or near the surface but limestone or shale bedrock is present within 20 inches of the surface while Limy Upland sites are very deep (greater than 60 inches).

R106XY075NE	**Loamy Upland** The Loamy Upland ecological site is located on a similar landscape position but is not calcareous within 10 inches of the soil surface.

Table 1. Dominant plant species

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

Physiographic features

The Limy Upland ecological site occurs on moderate to steeply sloping uplands with slopes typically ranging from 6 to 30 percent. The depth to the water table dictates that the vegetative community is completely reliant on precipitation as the water source.

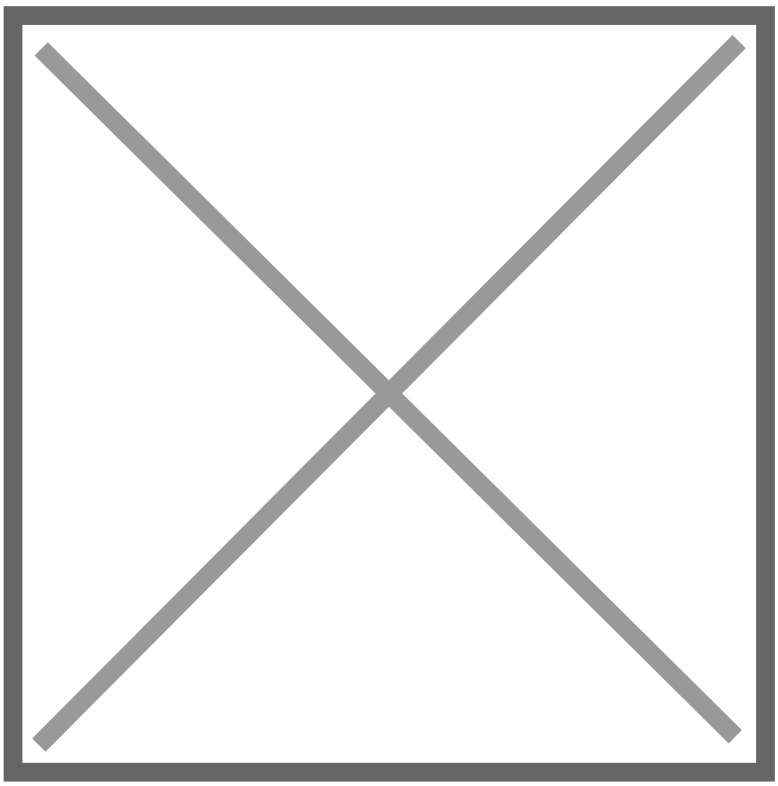

Figure 1.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hillslope
Runoff class	Medium to very high
Flooding frequency	None

Ponding frequency	None
Elevation	220 – 610 m
Slope	10 – 30 %
Water table depth	200 cm
Aspect	Aspect is not a significant factor

Climatic features

Like most Great Plains landscapes, the climate in this MLRA is under the sway of the continental effect. This creates a regime of extremes, with summer highs often in the triple digits and winter lows plunging well below zero. Blizzards can occur anytime between early fall and late spring, dropping the temperature more than 50 degrees in just a few hours. These events can pile up several feet of snow, often driven by winds in excess of 50 miles an hour. The resulting huge snow drifts can cause serious hardship for livestock, wildlife, and humans. Winters can be open, with bare ground for most of the season, or closed, with several feet of snow persisting until March. Most winters have a number of warm days interspersed with dropping temperatures, usually associated with approaching cold fronts. Spring brings violent thunderstorms, hail, and high winds. Tornadoes occur frequently.

About three-fourths of the precipitation falls as high intensity, convective thunderstorms from late spring through early autumn. The average annual precipitation gradient trends higher from northwest (28") to southeast (40"), and the average annual temperature gradient trends higher from north (50°F) to south (55°F). Daily winds range from an average of 14 miles per hour during the spring to 11 miles per hour during the late summer. Occasional strong storms may bring brief periods of high winds with gusts to more than 80 miles per hour.

Native cool season plants begin growth in early April and continue to about mid-June. Native warm season plants begin growth in early June and continue to early August. Green up of cool season plants may occur in September and October.

Table 3 Representative climatic features

Frost-free period (characteristic range)	140-150 days
Freeze-free period (characteristic range)	160-190 days
Precipitation total (characteristic range)	790-970 mm
Frost-free period (actual range)	130-150 days
Freeze-free period (actual range)	150-190 days
Precipitation total (actual range)	740-1,020 mm
Frost-free period (average)	140 days
Freeze-free period (average)	170 days

Precipitation total (average)	860 mm

- (1) MARYSVILLE [USC00145063], Marysville, KS
- (2) BEATRICE 1N [USC00250622], Beatrice, NE
- (3) CRETE [USC00252020], Crete, NE
- (4) MEAD 6S [USC00255362], Ithaca, NE
- (5) RAYMOND 2NE [USC00257055], Raymond, NE
- (6) TABLE ROCK 4 N [USC00258410], Table Rock, NE
- (7) BONNER SPRINGS [USC00140957], Bonner Springs, KS
- (8) CENTRALIA [USC00141408], Centralia, KS
- (9) HIAWATHA 9 ESE [USC00143634], Robinson, KS
- (10) HORTON [USC00143810], Horton, KS
- (11) PERRY LAKE [USC00146333], Perry, KS
- (12) SYRACUSE [USC00258395], Syracuse, NE
- (13) TECUMSEH 1S [USC00258465], Tecumseh, NE
- (14) WEEPING WATER [USC00259090], Weeping Water, NE
- (15) TOPEKA MUNI AP [USW00013996], Topeka, KS
- (16) CLINTON LAKE [USC00141612], Lawrence, KS
- (17) ASHLAND NO 2 [USC00250375], Ashland, NE
- (18) VIRGINIA [USC00258875], Virginia, NE
- (19) LINCOLN MUNI AP [USW00014939], Lincoln, NE
- (20) LINCOLN UNIV PWR PLT [USW00014971], Lincoln, NE
- (21) LAWRENCE [USC00144559], Lawrence, KS
- (22) OSKALOOSA 4 NE [USC00146100], Mc Louth, KS
- (23) AUBURN 5 ESE [USC00250435], Auburn, NE
- (24) PAWNEE CITY [USC00256570], Pawnee City, NE
- (25) WAHOO [USC00258905], Wahoo, NE
- (26) FALLS CITY BRENNER FLD [USW00094957], Falls City, NE

Influencing water features

This site is not affected by water features such as water tables or wetlands.

Soil features

The soils associated with the Limy Upland ecological site are located on hillslopes on upland. Slopes typically range from 6 to 30 percent but may be higher. Soils were formed in calcareous loess or calcareous glacial till of mixed mineralogy. Soils are very deep (more than 60 inches) with surface textures of clay loam, loam or silty loam that are 6 to 15 inches thick. Soils are well drained to somewhat excessively drained. The depth to secondary calcium carbonates ranges from 0 to 10 inches. The clay content ranges from 24 to 35 percent, and the sand content from 20 to 52 percent. The A horizon may have up to 10 percent of mixed rock fragments. The A through the C horizons is slightly to moderately alkaline. These soils have high saturated hydraulic conductivity.

Steinauer and Netawaka are the primary soil series associated with this site. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Figure 8. Steinauer Profile

Table 4. Representative soil features

Parent material	(1) Till (2) Loess

Surface texture	(1) Clay loam (2) Loam (3) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Moderately slow to moderate
Soil depth	200 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	16.76 – 21.34 cm
Calcium carbonate equivalent (0-101.6cm)	0 – 20 %
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	6.6 – 8.4
Subsurface fragment volume <=3" (0-101.6cm)	0 – 10 %

Subsurface fragment volume >3" (0-101.6cm)	Not specified

Ecological dynamics

The Limy Upland ecological site developed under Central Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man caused wildfires, and other biotic and abiotic factors which typically influence soil/site development. This continues to be a disturbance driven site, by herbivory, fire, and variable climate. Changes occur in the plant communities due to weather variations, impacts of native and/or exotic plant and animal species, and management actions.

One of the primary impacts to this site introduced by European settlers is season long continuous grazing by domestic livestock. This management practice causes the repeated removal of the growing point and excessive defoliation of the leaf area of individual tall warm-season grasses. The resulting reduction of the ability of the plants to harvest sunlight depletes the root reserves, subsequently decreasing the root mass. This negatively impacts the ability of the plants to compete for life sustaining nutrients, resulting in declining vigor and eventual mortality. The space created in the vegetative community is then occupied by a species that evades the negative grazing impacts by a growing season adaptation such as a cool season, shorter structure, or reduced palatability mechanism.

The State and Transition Model (STM) is depicted following this section and includes a Reference State (1), a Native/Invaded State (2), a Sod-busted State (3), and an Invaded Woody State (4). Each state represents the crossing of a major ecological threshold due to alteration of the functional dynamic properties of the ecosystem. The main properties observed to determine this change are the soil and vegetative communities and the hydrologic cycle. The STM illustrates the common plant communities that can occur on the site and the transition pathways between communities (Bestelmeyer, 2010). The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

Each state may have one or more vegetative communities which fluctuate in species composition and abundance within the normal parameters of the state. Within each state, communities may degrade or recover in response to natural and man caused disturbances such as variation in the degree and timing of herbivory, presence or absence of fire, and climatic and local fluctuations in the precipitation regime.

Interpretations are primarily based on the Reference State and have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long term rotational grazing regimes. Trends in plant community dynamics have been interpreted from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 12. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 13. Community 3.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 14. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

LIVESTOCK – GRAZING INTERPRETATIONS: Grazing by domestic livestock is one of the major income producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep) requirements. The following table lists suggested stocking rates for cattle under continuous season long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity. Production and Carrying Capacity*Community 1.1, Reference Community: 3,000 lbs/acre, 0.95 AUM/acre. *Based upon the following conditions: continuous season long grazing with cattle under average growing conditions, 25 percent harvest efficiency. Air dry forage requirements are based on 3 percent of animal body weight or 790 lbs per animal unit (AU) per month (M). An AU is generally one mature cow of approximately 1,000 pounds and a calf as old as 6 months or their equivalent. WILDLIFE INTERPRETATIONS: Major Land Resource Area (MLRA) 106 lies primarily within the tall grass prairie ecosystem. Prior to European settlement of North America, this area consisted of diverse grassland habitats interspersed with varying densities of depressional wetlands and limited woody riparian corridors. These habitats provided critical life cycle components for the grassland birds, prairie dogs, and herds of roaming bison, elk, and pronghorn that historically occupied this landscape. Diverse populations of small mammals and insects provided a bountiful prey base for raptors and omnivores such as coyotes, foxes, raccoons, and opossums. Native Americans, bobcats, wolves, and mountain lions occupied the apex predator niche. In addition, a wide variety of reptiles and amphibians thrived in this landscape. The tall grass prairie was a disturbance driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement, elimination of fire, widespread conversion to cropland, and other sources of habitat fragmentation significantly altered the appearance and functionality of the entire ecosystem. The reduced stability of the system is reflected by major changes in the composition and abundance of the native flora and fauna. Introduced and invading species further degrade the ecological integrity of the plant and animal communities. Bison and prairie dogs were historically keystone species, but free roaming bison herds and nearly all prairie dogs have been extirpated in this MLRA. The loss of bison and fire as ecological drivers greatly influenced the character of the remaining native grasslands and the habitats they provide. Historically, an ecological mosaic of the sites provided habitat for species requiring unfragmented grasslands. Important habitat features and components found commonly or exclusively on modern day remnants include upland nesting habitat for grassland birds and game birds; nesting and escape cover for waterfowl; forbs and insects for brood rearing habitat; and a forage source for small and large herbivores. Fragmentation has reduced habitat quality for numerous area sensitive species, as highlighted by the decline of the greater prairie chicken. Many grassland nesting bird populations, such as dickcissel and Henslow's sparrow, are also declining. In this fragmented landscape, native grassland bird populations face increasing competition from the opportunistic European starlings and house sparrows are subject to nest parasitism from brown headed cowbirds. Tree encroachment creates habitat that favors generalist species such as American robin and mourning dove, and provides perches for raptors, increasing the predation mortality. Introduced species such as smooth bromegrass, reed canarygrass, Kentucky bluegrass, nodding plumeless thistle, and Canada thistle further degrade the biological integrity of many of these remnant prairies. 1. REFERENCE STATE: The predominance of tall and mid grasses and forbs in this community make it ideal for grazers and mixed feeders. Pollinating insects play a significant role in maintaining the forb community and provide a food source for grassland birds and other grassland dependent species. The vegetative structural diversity provides habitat for reptiles, amphibians, and a wide array of native and introduced bird species. The abundant prey base supports populations of Swainson’s hawk, short eared and great horned owls, and other grassland raptors. The grasses, forbs, and shrubs provide high nutrition levels for small and large herbivores including moles, mice, ground squirrels, and white-tail deer. The structure of this plant community provides suitable thermal, protective, and escape cover for small herbivores and grassland birds. Many wide-ranging predators utilize this plant community, including coyote, badger, red fox, and least and long tailed weasels. As the plant community degrades to more mid grasses and fewer tall grasses, less winter and escape cover are provided. It also provides less cover for predators.

Hydrological functions

The soils series associated with the Limy Upland ecological site have medium to very high runoff. They have a T (tolerance to erosion) factor of 5, and are rated as hydrologic class C.

Recreational uses

The Limy Upland ecological site provides hunting for upland game species and white-tailed deer, along with hiking, photography, and bird watching. The wide varieties of plants which bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

Although several tree species invade this site, they usually do not reach sufficient size to produce wood products except for firewood.

Other products

None of significance

Other information

Site Development and Testing Plan: Future work is needed to validate the information in this Provisional Ecological Site Description. Additional data collection and evaluation may also be needed to develop this ESD to the Approved, then Correlated level. This could include field activities to collect low, medium, and high intensity sampling, soil correlations, and analysis of that data. Field reviews of the project plan should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Inventory data references

The inventory data consists of four 417s, and three NRI data points.

Other references

Harms, R. 2009. Recovery Outline for the Salt Creek tiger beetle (Cicindela nevadica lincolniana). Available online. http://www.fws.gov/mountain-prairie/species/invertebrates/saltcreektiger/FinalRecoveryOutlineFeb2009.pdf. Accessed 1/02/2018.

High Plains Regional Climate Center, University of Nebraska. Available online. http://hpcc.unl.edu. Accessed 12/05/16.

Johnsgaard, P.A. 2001. “The Nature of Nebraska.” University of Nebraska Press.

Muhs, Daniel R., E. Bettis III, J. Aleinikoff, J. McGeehin, J. Beann, G. Skipp, B. Marshall, H. Roberts, W. Johnson, and R. Benton. "Origin and paleoclimatic significance of late Quaternary loess in Nebraska: Evidence from stratigraphy, chronology, sedimentology, and geochemistry" (2008). USGS Staff -- Published Research, Paper 162. Available online. http://digitalcommons.unl.edu/usgsstaffpub/162. Accessed 12/05/16.

Personal communications with professional ecologists and wildlife experts.

Rolfsmeier, S.B. and G. Steinauer. 2010. "Terrestrial Ecological Systems and Natural Communities of Nebraska", (version IV). Nebraska Natural Heritage Program.

Spomer, S. and L. Higley. 2001. The Salt Creek Tiger Beetle. Bio-graphica International. Available online. http://drshigley.com/lgh/sctb/default.htm. Accessed 1/02/2018.

U.S. Dept. of Agriculture. NRCS National Ecological Site Handbook. Available online. https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/ref/?cid=nrcseprd1291232 Accessed January, 2014.

U.S. Dept. of Agriculture. NRCS National Engineering Handbook, Section 4. Available online. https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21422. Accessed August, 2011
USDA, NRCS. National Water and Climate Center, Portland, OR. Available online. http://wcc.nrcs.usda.gov. Accessed 12/05/16.

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

USDA, NRCS. National Soil Information System, Information Technology Center, Fort Collins, CO. Available online. http://nasis.nrcs.usda.gov. Accessed 12/05/16.

USDA, NRCS. 2002. The PLANTS Database, Version 3.5. Available online. http://plants.usda.gov. Accessed 12/05/16.

USDA, NRCS Soil Surveys from: Butler, Saunders, Lancaster, Cass, Otoe, Nemaha, Johnson, Gage, Pawnee, Saline, Seward, Saunders and Richardson Counties in Nebraska; and Atchison, Brown, Doniphan, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Marshall, Nemaha, Osage, Pottawatomie, Shawnee, Wabaunsee, Washington, Wyandotte Counties in Kansas.

Contributors

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Approval

Suzanne Mayne-Kinney, 6/09/2025

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.

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Date	11/30/2024
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** **None. Rills are not expected on this site.**

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2. **Presence of water flow patterns:** **Typically, none. Water flow patterns are not expected on this site except on slopes exceeding 15 percent. When present, water flow patterns will be rare, short (6 to 12 inches or 15 to 30 cm) and disrupted by perennial vegetation. On slopes exceeding 30 percent, they will be more common and of moderate length (12 to 24 inches).**

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3. **Number and height of erosional pedestals or terracettes:** **None. Pedestals and terracettes are not expected to occur on this site. Pedestals and terracettes may occasionally occur on slopes exceeding 15 percent, becoming more abundant as slopes increase but with no exposed roots.**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** **Bare ground is 5 percent or less. Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).**

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5. **Number of gullies and erosion associated with gullies:** **Gullies are not expected on this site except on slopes exceeding 30 percent. On these steeper slopes, gullies will be formed by naturally occurring concentrated water flow and vegetated with no active erosion.**

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6. **Extent of wind scoured, blowouts and/or depositional areas:** **None. Wind scoured and/or depositional areas are not expected on this site.**

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7. **Amount of litter movement (describe size and distance expected to travel):** **Typically, none. Litter movement is not expected on this site except on slopes exceeding 15 percent and due to high intensity storms. In this case, fine litter movement will be short distances of 6 to 12 inches (15 to 30 cm) and be associated with water flow patterns.**

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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):** **Soil stability ratings will be 5 to 6, typically 6. High root content and organic matter will be present in the soil surface.**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **The surface horizon (A) typically ranges from 9 to 15 inches thick but be as little as 4 or as much as 18 inches. Soil colors in the surface horizon are typically dark brown, brown, or dark grayish brown (hue: 10YR, value: 3 or 4, chroma: 2 or 3) when moist and brown or grayish brown (hue: 10YR, value: 5, chroma: 2 or 3) when dry. Soil structure in the upper horizon ranges from moderate medium granular, moderate medium granular parting to moderate fine granular, to weak medium granular. See Official Soils Descriptions (OSD) for additional details. The primary soils correlated to the Limy Upland ecological site include Steinauer and Netawaka.**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** **Plant community composition of 70 to 85 percent grasses and grass-likes, 5 to 15 percent forbs, and 0 to 5 percent shrubs will optimize infiltration on the site. The grass and grass-like component consist of native, perennial, warm-season, tall grasses; native, perennial, warm-season, mid grasses; native, perennial, warm-season, short grasses; and native, perennial cool-season grasses and grass-likes. Infiltration can be adversely impacted by the invasion of Kentucky bluegrass, smooth brome, tall fescue, and trees when present above10 percent (subdominant designation).**

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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):** **None. No compaction layers are expected for this site**

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

Dominant: Phase 1.1: 1. Native, perennial, warm-season, tall grass (3 species minimum): big bluestem, Indiangrass, eastern gamagrass, switchgrass. 2. Native, perennial, warm-season, mid grass (2 species minimum): little bluestem, composite dropseed, sideoats grama, purple lovegrass. Phase 1.2: 1. Native, perennial, warm-season, mid grass (3 species minimum): little bluestem, composite dropseed, sideoats grama, purple lovegrass. Phase 1.3: 1. Native, perennial, warm-season, mid grass (2 species minimum): little bluestem, composite dropseed, sideoats grama, purple lovegrass.

Sub-dominant: Phase 1.1: 1. Native forbs (6 species minimum): forbs present will vary from location to location. 2. Native, perennial, warm-season, short grass (1 species minimum): blue grama, buffalograss, hairy grama. Phase 1.2: 1. Native, perennial, warm-season, tall grass (2 species minimum): big bluestem, Indiangrass, eastern gamagrass, switchgrass. 2. Native, perennial, warm-season, short grass (1 species minimum): blue grama, hairy grama. Phase 1.3: 1. Native, perennial, warm-season, short grass (1 species minimum): blue grama, hairy grama. 2. Native, perennial, cool-season grass (2 species minimum): porcupinegrass, Canada wildrye, prairie junegrass, western wheatgrass, Scribner's rosette grass, fall rosette grass.

Other: Minor - Phase 1.1: 1. Native, perennial, cool-season grass: porcupinegrass, Canada wildrye, prairie junegrass, western wheatgrass, Scribner's rosette grass, fall rosette grass. 2. Grass-likes: sedges. 3. Shrubs: coralberry, leadplant, Jersey tea, smooth sumac, prairie rose, western snowberry. Minor - Phase 1.2: 1. Native, perennial, cool-season grass: porcupinegrass, Canada wildrye, prairie junegrass, western wheatgrass, Scribner's rosette grass, fall rosette grass. 2. Native forbs: forbs present vary from location to location. 3. Grass-likes: sedges. 4. Shrubs: shrub present vary from location to location. Minor - Phase 1.3: 1. Native, perennial, warm-season, tall grass: big bluestem, Indiangrass, eastern gamagrass, switchgrass. 2. Non-native, cool-season grass: Kentucky bluegrass, smooth brome, tall fescue. 3. Shrubs: shrubs present vary from location to location. 4. Native forbs: forbs present vary from location to location. 5. Grass-likes: sedges. Trace - Phase 1.2: 1. Non-native, cool-season grass.

Additional: The Reference Community (1.1) includes seven F/S groups. These groups in order of abundance are native, perennial, warm-season, tall grass; native, perennial, warm-season, mid grass; native forbs; native, perennial, warm-season, short grass; native, perennial, cool-season grass; grass-likes; shrubs. The Degraded Native Grass Community (1.2) includes eight F/S groups. These groups are native, perennial, warm-season, mid grass; native, perennial, warm-season, tall grass; native, perennial, warm-season, short grass; native, perennial, cool-season grass; native forbs; grass-likes; shrubs; non-native, cool-season grass. The At-Risk Native Grass Community (1.3) includes eight F/S groups. These groups in order of abundance are native, perennial, warm-season, mid grass; native, perennial, warm-season, short grass; native, perennial, cool-season grass; native, perennial, warm-season, tall grass; non-native, cool-season grass; shrubs; native forbs; grass-likes.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): There is a diverse mixture of age classes among the plants. A few (less than 3 percent) dead centers may occur in bunchgrasses. Shrubs and trees may show some dead branches (less than 5 percent) as plants age.**

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14. **Average percent litter cover (%) and depth (in): Plant litter is expected to be 70 to 80 percent cover, at a depth of approximately 0.5 inch (1.25 cm) and evenly distributed throughout the site. Kentucky bluegrass is known to produce excessive litter accumulations that negatively impact site functionality.**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production): Production is shown in air-dry values. Representative Value (RV) = 3,000 pounds per acre Low production years = 2,500 pounds per acre. High production years = 3,500 pounds per acre.**

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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:** No nonnative invasive species are present. Kentucky bluegrass, smooth brome, Caucasian bluestem, tall fescue, eastern red cedar, honey locust, roughleaf dogwood, Siberian elm, Osage orange, green briar, leafy spurge, and sericea lespedeza are known invasives that have the potential to be dominant or co-dominant on the site. Consult the state noxious weed and state watchlists for potential invasive species on each ecological site. NOTE: Invasive plants (for the purposes of the IIRH protocol) are plant species that are typically not found on the ecological site or should only be in trace or minor categories under the natural disturbance regime and have the potential to become a dominant or co-dominant species on the site if their establishment and growth are not actively controlled by natural disturbances or management interventions. Species listed characterize degraded states AND have the potential to become a dominant or co-dominant species.

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to climatic conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
