USDA Natural Resources Conservation Service

Ecological site R065XY041NE
Shallow To Gravel

Last updated: 2/04/2025
Accessed: 05/11/2025

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.

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): 065X–Nebraska Sand Hills

The Nebraska Sand Hills (MLRA 65) is located in Nebraska (98 percent) and South Dakota (2 percent) and encompasses approximately 13.2 million acres (534,201 hectares) or 20,625 square miles (53,420 square kilometers). The largest town in the MLRA is North Platte, Nebraska and numerous small towns and villages are located within the MLRA, including the county seats of Arthur, Bartlett, Bassett, Brewster, Greeley, Hyannis, Mullen,

Thedford, and Tryon, Nebraska. The Niobrara River is near the northern boundary while the North Platte River flows along the southwest boundary of the area. The North Loup, Middle Loup Rivers, Calamus, Snake, and Dismal Rivers and Long Pine creek occur in the central and eastern portion of the area.

Fort Niobrara, Crescent Lake, and Valentine National Wildlife Refuges and portions of the Nebraska National Forest, including the Bessey Ranger District and Samuel R. McKelvie National Forest, are located within this MLRA. The Bessey Ranger District includes the largest human-planted forest in the United States and is home to the Bessey Tree Nursery which is listed on the National Register of Historic Places.

This MLRA is defined by an 8,000 year-old landscape of sand hills dominated by rolling to steep sand dunes with narrow, elongated, nearly level to steeply sloping valleys between the dunes. Dune heights range from 10 to 400 feet (3 to 130 meters) and slopes may exceed twenty-five percent. Dune complexes often extend for several miles

in a northwest to southeast direction. These Quaternary sand dunes are derived from the underlying Tertiary Ogallala and Arikaree Groups, which formed when rivers deposited sediments from erosional detritus after the uplift of the Rocky Mountains to the west. The Nebraska Sand Hills are the largest sand dune area in the Western Hemisphere and one of the largest grass-stabilized dune regions in the world. The soils of the MLRA are principally derived from deep eolian sand.

The Ogallala aquifer underlies the MLRA and is the most extensive and heavily used aquifer of the high plains between the Rocky Mountains and Mississippi River. The aquifer is at its thickest in the Sand Hills which are a primary recharge are for the aquifer. Numerous small permanent and intermittent lakes and wetlands occur in the MLRA. While the dominant source of water for these lakes is precipitation, groundwater discharge is important to maintaining these lakes especially in drier years. A number of these lakes, especially in the western portion of the MLRA are alkaline.

Considered to be a western extension of the tallgrass prairie, the matrix vegetation is a unique mix of species that is sometimes identified as Sandhills Prairie. Sand bluestem, prairie sandreed, Indiangrass, switchgrass, sand lovegrass, little bluestem, and needle and thread are the primary grasses. Porcupinegrass is a significant cool-season grass in the eastern portion of the MLRA while blue grama and hairy grama are important warm-season grasses in the western portion due to differences in precipitation. Soils which have a high water table support a tallgrass prairie dominated by big bluestem, switchgrass, Indiangrass, prairie cordgrass, and a variety of grass-likes. The endangered plant blowout penstemon (Penstemon haydenii) is found in this MLRA.

More than ninety percent of the land in MLRA 65 is native grassland utilized by grazing livestock. Areas along streams and in subirrigated valleys are utilized for prairie hay. Wetlands, legume hay, and irrigated cropland make up the balance of the land area with corn being the principal irrigated crop.

Wildlife flourishes in this native grassland environment. Historically large bison herds occupied the landscape. White-tailed deer, mule deer, pronghorn, black tailed jackrabbit, and coyote are now the major mammalian species. Upland sandpiper, lark bunting, grasshopper sparrow, western meadowlark, long-billed curlew, sharp-tailed grouse, and greater prairie chicken are common avian species. The mosaic of grassland and wetlands provide excellent habitat for wading and shorebird species as well.

This landscape serves as a backdrop for a disturbance-driven ecosystem, which developed under the influences of herbivory, fire, and periodic long-term drought. Historically, these processes created a heterogeneous mosaic of plant communities and vegetative structure across the region. Any given site in this landscape experienced fire every six to ten 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. Indigenous peoples 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 animals such as bison, elk, and pronghorn.

The natural fire regime has been disrupted by aggressive fire suppression policies which have facilitated woody species encroachment by both native and introduced shrubs and trees into the native prairie. The most common encroacher is eastern redcedar. While eastern redcedar is native to the landscape, it was present only in trace amounts due to the periodic fires. Widespread plantings of windbreaks with eastern redcedar as a primary component have provided a seed source for this aggressive woody plant causing encroachment into native grasslands, especially in the eastern and central Sand Hills. This encroachment causes significant forage loss for domestic livestock and degrades the native wildlife habit. Since it is not a root-sprouter, eastern redcedar is very susceptible to fire when under six feet tall making management with prescribed fire very effective when applied before trees reach this stage.

Classification relationships

►USDA-NRCS (2022)◄
Land Resource Region – G, Central Feed Grains and Livestock Region
Major Land Resource Area (MLRA) –65, Nebraska Sand Hills

►Fenneman (1916) Physiographic Regions ◄
Division – Interior Plains
Province – Great Plains

Section – High Plains

►USDA-USFS (2007) Ecoregions◄
Domain – Dry
Division – Temperate Steppe
Province – Great Plains Steppe (332)
Section – Mixed Grass Steppe

►EPA Ecoregions (Omernik 1997)◄
I – Great Plains (9)
II – West-Central Semi-Arid Prairies (9.3)
III – Nebraska Sandhills (44)
IV – Sandhills (44a), Alkaline Lakes Area (44b), Wet Meadow and Marsh Plain (44c), Lakes Area (44d)

Ecological site concept

The Shallow to Gravel ecological site is a run-off site occurring on hills and stream terraces. Slopes range from 0 to 30 percent. The soils very deep. and formed primarily in loamy or sandy alluvium over sandy and gravelly alluvium and outwash. Soil surface layers typically range in thickness from 5 to 7 inches, but may be as thick as 14 inches. The most significant characteristic of the Shallow to Gravel ecological site is the presence of more than 15 percent gravel in the top 20 inches of the soil.

The historic native vegetation of the Shallow to Gravel ecological site is mixed grass prairie. Vegetation in the Reference Community (1.1) consists of a mixture of warm- and cool-season grasses. Dominant grasses include sand bluestem, prairie sandreed, needle and thread, and blue grama. Forb and shrub diversity is low as compared to other ecological sites found in the MLRA. Lesser spikemoss is a common cryptogram on this site.

Associated sites

R065XY011NE	**Sandy 14-17" PZ** The Shallow to Gravel ecological site is often found interspersed with Sandy 14-17" PZ ecological sites.
R065XY032NE	**Sandy 17-22" PZ** The Shallow to Gravel ecological site is often found interspersed with Sandy 17-22" PZ ecological sites.
R065XY054NE	**Sandy 22-25" PZ** The Shallow to Gravel ecological site is often found interspersed with Sandy 22-25" PZ ecological sites.

Similar sites

R065XY032NE	**Sandy 17-22" PZ** The soil surface textures of Sandy 17-22" PZ sites have less than 15 percent gravel in the top 20 inches of the soil.
R065XY054NE	**Sandy 22-25" PZ** The soil surface textures of Sandy 22-25" PZ sites have less than 15 percent gravel in the top 20 inches of the soil.
R065XY011NE	**Sandy 14-17" PZ** The soil surface textures of Sandy 14-17" PZ and Shallow to Gravel ecological sites are similar, but Sandy 14-17" PZ sites have less than 15 percent gravel in the top 20 inches of the soil.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

The Shallow to Gravel ecological site occurs on stream terraces and uplands where gravelly sediments have been deposited. Slopes range from 0 to 30 percent.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace (2) Hillslope
Runoff class	Negligible to low
Flooding frequency	None
Ponding frequency	None
Elevation	1,000–3,940 ft
Slope	0–30%
Aspect	Aspect is not a significant factor

Climatic features

The mean average annual precipitation varies from 14 to 25 inches but has varied from 12 to 34 inches in the driest to wettest seasons. Approximately 65 percent of the annual precipitation occurs during the growing season of mid-April to late September. The average annual snowfall varies from about 30 inches to about 55 inches. The wind velocity is high throughout the year, averaging 10 to 12 miles per hour. Maximum wind velocities generally occur in the spring.

The average length of the growing season is 138 days, but the growing season has varied from 114 to 168 days. The average date of first frost in the fall is September 25, and the last frost in the spring is about May 10. July is the hottest month and January is the coldest. It is not uncommon for the temperature to reach 100 ºF during the summer. The winters are characterized with frequent northerly winds, producing severe cold with temperatures dropping to as low as -30 ºF.

Growth of native cool-season plants begins mid to late March and continues to late June. Native warm-season plants begin growth in early May and continue to late August. Green up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	109-126 days
Freeze-free period (characteristic range)	131-143 days
Precipitation total (characteristic range)	19-26 in
Frost-free period (actual range)	103-129 days
Freeze-free period (actual range)	129-146 days
Precipitation total (actual range)	18-27 in
Frost-free period (average)	118 days
Freeze-free period (average)	137 days
Precipitation total (average)	22 in

Climate stations used

- (1) ALLIANCE MUNI AP [USW00024044], Alliance, NE
- (2) ARTHUR [USC00250365], Arthur, NE
- (3) ATKINSON 3SW [USC00250420], Atkinson, NE
- (4) BARTLETT 1S [USC00250525], Bartlett, NE
- (5) BREWSTER [USC00251130], Brewster, NE

- (6) CHAMBERS [USC00251590], Chambers, NE
- (7) CRESCENT LAKE NWR [USC00252000], Oshkosh, NE
- (8) ELLSWORTH 15 NNE [USC00252647], Ellsworth, NE
- (9) ELSMERE 9 ENE [USC00252680], Johnstown, NE
- (10) ERICSON 8 WNW [USC00252770], Burwell, NE
- (11) GREELEY [USC00253425], Greeley, NE
- (12) HYANNIS [USC00254100], Hyannis, NE
- (13) KILGORE 1NE [USC00254432], Kilgore, NE
- (14) KINGSLEY DAM [USC00254455], Keystone, NE
- (15) MERRIMAN [USC00255470], Merriman, NE
- (16) MULLEN [USC00255700], Mullen, NE
- (17) MULLEN 21 NW [USC00255702], Whitman, NE
- (18) NEWPORT [USC00255925], Newport, NE
- (19) NORTH PLATTE RGNL AP [USW00024023], Maxwell, NE
- (20) PURDUM [USC00256970], Purdum, NE
- (21) ROSE 10 WNW [USC00257318], Long Pine, NE
- (22) SWAN LAKE [USC00258360], Amelia, NE
- (23) VALENTINE NWR [USC00258755], Valentine, NE
- (24) WHITMAN 5 ENE [USW00094079], Whitman, NE

Influencing water features

None.

Soil features

Soils associated with the Shallow to Gravel ecological site are very deep and formed in loamy alluvium, sandy and gravelly alluvium, sandy alluvium over sandy outwash, or sandy and gravelly alluvium over sandy outwash. Soil surface textures are sandy loam, loamy sand or sand. Soil surface layers typically range from 5 to 7 inches thick but may be as thick as 14 inches. The defining characteristic of the soils of the Shallow to Gravel ecological site is the presence of more than 15 percent gravel in the top 20 inches of the soil.

Runoff as evidenced by patterns of rill, gully or other water flow is negligible to low, despite the steep slopes, due to the very high intake rate of these soils. Some pedestalling of plants occurs, but it is not very evident on casual observation and occurs on less than 5 percent of the plants. Cryptobiotic crusts are present, but their function is not well understood.

The major soil series correlated to this ecological site are Meadin and Simeon. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more details specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Table 4. Representative soil features

Surface texture	(1) Loamy sand (2) Sand (3) Sandy loam
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Rapid to very rapid
Soil depth	80 in
Surface fragment cover <=3"	0–12%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	1.8–4.2 in

Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	9–36%
Subsurface fragment volume >3" (Depth not specified)	0–12%

Ecological dynamics

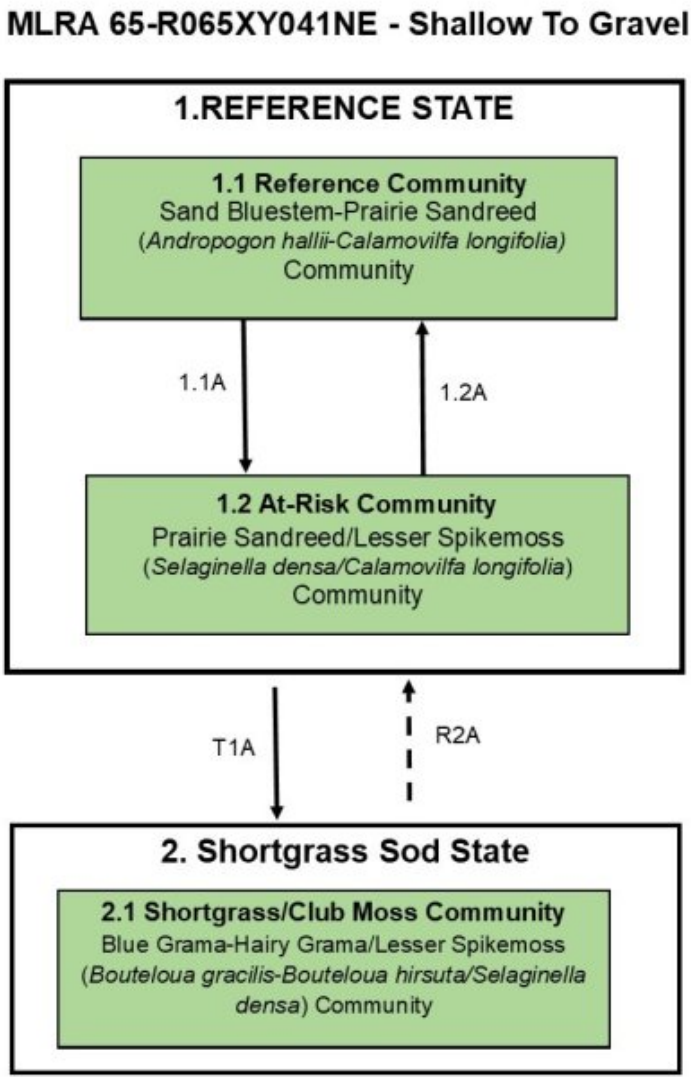
Shallow to Gravel ecological sites developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused fire, and other biotic and abiotic factors that typically influence soil and site development. This continues to be a disturbance-driven site with herbivory, fire, and variable climate being the primary disturbances. Changes in the plant communities occur due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions. This site is extremely responsive to above average precipitation when additional moisture is received during the growing season. The associated coarse textured soils have low moisture holding capability, which generally limits plant growth. With additional moisture, the interpretive plant community can significantly increase its production as compared to the production of a normal year.

The introduction of domestic livestock by European settlers along with season-long, continuous grazing impacted the vegetation of the Shallow to Gravel ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area of the more palatable warm-season tall- and midgrasses, reducing the ability of the plants to harvest sunlight thereby depleting root reserves and subsequently decreasing root mass. The ability of the plants to compete for nutrients is impaired, resulting in decreased vigor and eventual mortality. Species that evade negative grazing impacts through mechanisms such as a growing season adaptation (i.e., cool-season), growing points located near the soil surface, a shorter structure, or reduced palatability will increase. As this site deteriorates, sand bluestem, little bluestem, needle and thread, and sideoats grama decrease in frequency and production while blue and hairy grama increase. As this management continues, the site becomes dominated by warm-season shortgrasses and club moss.

The State and Transition Model (STM) is depicted below and includes a Reference State (1) and a Shortgrass Sod State (2). The Shortgrass Sod State represents the crossing of a major ecological threshold due to the alteration of the functional dynamic properties of the ecosystem. The primary properties observed to determine this change are soil stability, vegetative communities, and the hydrologic cycle. Each state may have one or more plant communities that 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 local climatic fluctuations especially in the precipitation regime. The processes that cause the movement between the states and communities are discussed in more detail in the state and community description following the diagram.

Interpretations are primarily based on the Reference Community (1.1), which has 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 ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have been used as well. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

State and transition model



Transitions and Restorations:
T1A – Heavy continuous season-long grazing or heavy rotational grazing with inadequate growing season recovery periods.
R2A— Long term (more than 15 years) prescribed grazing with adequate growing season recovery periods. This restoration may not be feasible.

Community Pathways:
1.1A – Moderate, continuous season-long grazing or rotational grazing with inadequate growing season recovery periods
1.2A – Prescribed grazing with adequate growing season recovery periods.

Figure 8. State and Transition Model Diagram, Shallow to Gravel Ecological Site, MLRA 65.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Shallow to Gravel ecological site where the range of natural variability under historic conditions and disturbance regimes is mostly intact. The Reference State developed under the combined influences of climatic conditions, periodic fire activity, grazing by large herbivores, and impacts from small mammals and insects. High perennial grass cover and production allows for increased soil moisture retention, vegetative production and overall soil quality. Natural fire played a significant role in the succession of this site by limiting the extent of shrubs. Wildfires have been actively controlled in recent times, reducing plant species diversity, especially forb diversity. The Reference State includes two community phases which are the Reference Community (1.1) and the At-Risk Community. The Reference Community serves as a description of the native plant community that occurs on the site when the natural disturbance regimes are intact or closely mimicked by management practices. The At-Risk Community results from management actions that are unfavorable for a healthy Reference Community.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Sand Bluestem-Prairie Sandreed (*Andropogon hallii-Calamovilfa longifolia*) Community (1.1). This plant community serves as a description of the native plant community that occurs on the site when the historic disturbance regimes are intact or are closely mimicked by management practices. This phase is dynamic, with fluid relative abundance and spatial boundaries between the dominant structural vegetative groups. These fluctuations are primarily driven by different responses of the species to changes in precipitation timing and abundance and to a lesser extent to fire and grazing events. This site developed with grazing by large herbivores and is well suited for grazing by domestic livestock. Sand bluestem, prairie sandreed, blue grama, and needle and thread are the dominant grasses. Grasses of secondary importance include sand dropseed, prairie Junegrass, little bluestem, and sideoats grama. The potential vegetative composition is 75 to 90 percent grasses, 2 to10 percent forbs, 5 to 15 percent shrubs, and 0 to 10 percent cryptogams by weight. Natural fire played a significant role in the succession of this site by limiting the extent of shrubs. Wildfires have been actively controlled in recent times, facilitating tree and shrub encroachment. This plant community can be found on areas that are managed with prescribed grazing, prescribed burning, and may be found on areas receiving occasional periods of short-term rest. This resilient community is well adapted to the Northern Great Plains climatic conditions. Plant diversity promotes strong tolerance to drought, site and soil stability, a functional hydrologic cycle, and a high degree of biotic integrity. These factors create a suitable environment for a healthy and sustainable plant community.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- blue grama (*Bouteloua gracilis*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	550	820	1185
Shrub/Vine	45	100	155
Moss	0	50	105
Forb	5	30	55
Total	**600**	**1000**	**1500**

Figure 10. Plant community growth curve (percent production by month). NE6534, NE/SD Sandhills, Native Grasslands. Warm-season dominant, cool-

season subdominant, mid- and tallgrasses.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	5	15	25	30	10	7	3		

Community 1.2
At-Risk Community

The At-Risk or Prairie Sandreed/Lesser Spikemoss (*Calamovilfa longifolia-Selaginella densa*) Community (1.2) develops with continuous season-long grazing, or rotational grazing with inadequate growing season recovery time. Species diversity is reduced compared to the Reference Community (1.1) due to continued defoliation of warm-season tall- and midgrasses during their critical growth periods. Prairie sandreed has been reduced but remains a dominant species. Blue grama has increased due to its ability to withstand heavy grazing. Lesser spikemoss has significantly increased in abundance. Sand bluestem, little bluestem, and needle and thread have decreased as has the production by other warm-season midgrasses and cool-season bunchgrasses. The herbaceous species present are adapted to heavy grazing. Dominant grasses include blue grama and prairie sandreed. Grasses or grass-like plants of secondary importance include little bluestem, prairie Junegrass, and sand dropseed. Missouri goldenrod and lacy tansyaster are common forbs. Significant shrubs include brittle pricklypear, broom snakeweed, and prairie sagewort. The potential vegetative composition is 65 to 85 percent grasses, 1 to 5 percent forbs, 5 to 15 percent shrubs, and 5 to 15 percent cryptogams by weight. This plant community is moderately resistant to change. If the herbaceous component is intact, the community tends to be resilient unless the disturbance is long-term. Heavy, continuous season-long grazing or heavy, rotational grazing with inadequate recovery periods will further reduce the warm-season tall- and midgrasses and cool-season bunchgrasses. Warm-season shortgrasses and lesser spikemoss will continue to increase causing the community to be at risk of crossing an ecological threshold and transitioning to the Shortgrass Sod State (2).

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- prairie sagewort (*Artemisia frigida*), other herbaceous
- lesser spikemoss (*Selaginella densa*), other herbaceous

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	515	695	770
Shrub/Vine	40	90	140
Moss	40	90	140
Forb	5	25	50
Total	**600**	**900**	**1100**

Figure 12. Plant community growth curve (percent production by month). NE6534, NE/SD Sandhills, Native Grasslands. Warm-season dominant, cool-season subdominant, mid- and tallgrasses.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	5	15	25	30	10	7	3		

Pathway 1.1A
Community 1.1 to 1.2

With moderate, continuous season-long grazing or rotational grazing with inadequate growing season recovery periods the Reference Community (1.1) will move to the At-Risk Community (1.2).

Pathway 1.2A

Community 1.2 to 1.1

Prescribed grazing with adequate growing season recovery periods will move the At-Risk Community (1.2) to the Reference Community (1.1).

State 2
Shortgrass Sod State

The Shortgrass Sod State (2) transitioned from the Reference State (1) and much of the native warm-season tall- and midgrass and cool-season bunchgrass components have been replaced by warm-season shortgrasses and clubmoss. This State is the result of heavy stocking rates combined with long-term (more than 10 years) grazing that did not provide adequate recovery time for warm-season tall- and midgrasses and mid-statured cool-season grasses. The management that results in the Shortgrass Sod State is typically heavy, continuous, season long grazing but heavy rotational grazing with inadequate growing season recovery periods can also cause this transition. The loss of plant diversity negatively impacts energy flow and nutrient cycling and alters hydrologic function. Runoff is higher and infiltration is lower than the Reference State. This state is very resistant to change. The Shortgrass Sod State includes the Shortgrass/Club Moss Community (2.1).

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- lesser spikemoss (*Selaginella densa*), other herbaceous

Community 2.1
Shortgrass/Club Moss Community

The Shortgrass/Cryptogam or Blue Grama-Hairy Grama/Lesser Spikemoss (*Bouteloua gracilis-Bouteloua hirsuta*/*Selaginella densa*) Community (2.1) This community is typically found near watering facilities on rangelands managed with continuous, summer long grazing with moderate grazing pressure. It may also be found at any location in heavily grazed pastures. Warm-season shortgrasses and cryptogams dominate the plant community with forbs and shrubs making up the balance of the community. Dominant grasses include blue grama and hairy grama. Grasses of secondary importance include prairie sandreed, little bluestem, sand dropseed, and prairie Junegrass. Common forbs include lacy tansyaster and goldenrod. Brittle pricklypear, prairie sagewort, and broom snakeweed are common shrubs. The potential vegetative composition is 55 to 65 percent grasses or grasslikes, 1to 10 percent forbs, 5 to 15 percent shrubs, and 15 to 30 percent cryptogams. As compared to the Reference Community (1.1) warm-season tall- and midgrasses and cool-season bunchgrasses have decreased while warm-season shortgrasses and cryptogams have increased.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- lesser spikemoss (*Selaginella densa*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	280	300	340
Moss	90	120	140
Shrub/Vine	20	50	75
Forb	10	30	45
Total	**400**	**500**	**600**

Figure 14. Plant community growth curve (percent production by month). NE6535, NE/SD Sandhills Blue Grama dominant. Warm-season dominant,

short grass.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	15	30	25	15	10	0	0	0

Transition T1A
State 1 to 2

Continuous season-long grazing or rotational grazing with inadequate growing season recovery periods combined with heavy stocking rates will move the Reference State (1) to the Shortgrass Sod State (2).

Restoration pathway R2A
State 2 to 1

Long term (more than 15 years) prescribed grazing with adequate growing season recovery periods may return the Shortgrass Sod State to the Reference State. This restoration may not be feasible and will only occur when adequate warm-season tall- and midgrasses and cool-season bunchgrasses remain in the plant community.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			200–400	
	sand bluestem	ANHA	*Andropogon hallii*	150–300	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	50–200	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
2	**Warm-Season Midgrass**			50–200	
	little bluestem	SCSC	*Schizachyrium scoparium*	50–100	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–100	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–50	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
3	**Warm-Season Shortgrass**			50–200	
	blue grama	BOGR2	*Bouteloua gracilis*	50–150	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–100	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
4	**Cool-Season Bunchgrass**			50–200	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	50–150	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–50	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
5	**Grass-likes**			0–50	
	sedge	CAREX	*Carex*	0–50	–
Forb					
6	**Forbs**			10–50	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–20	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–20	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–10	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–10	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–10	–
	Forb, annual	2FA	*Forb, annual*	0–10	–
	Forb, perennial	2FP	*Forb, perennial*	0–10	–
Shrub/Vine					
7	**Shrubs**			50–150	
	prairie sagewort	ARFR4	*Artemisia frigida*	10–50	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–50	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–50	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–50	–
Moss					
8	**Cryptogams**			0–100	
	lesser spikemoss	SEDE2	*Selaginella densa*	0–100	–

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			270–495	
	prairie sandreed	CALO	*Calamovilfa longifolia*	225–405	–
	sand bluestem	ANHA	*Andropogon hallii*	45–135	–
	Grass, perennial	2GP	*Grass, perennial*	0–27	–
2	**Warm-Season Midgrass**			9–180	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–90	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–45	–
	little bluestem	SCSC	*Schizachyrium scoparium*	9–45	–
	Grass, perennial	2GP	*Grass, perennial*	0–18	–
3	**Warm-Season Shortgrass**			135–270	
	blue grama	BOGR2	*Bouteloua gracilis*	90–225	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	45–135	–
	Grass, perennial	2GP	*Grass, perennial*	0–18	–
4	**Cool-Season Bunchgrass**			45–135	
	prairie Junegrass	KOMA	*Koeleria macrantha*	45–90	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–45	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–45	–
	Grass, perennial	2GP	*Grass, perennial*	0–18	–
5	**Grass-like**			0–90	
	sedge	CAREX	*Carex*	0–90	–
Forb					
6	**Forb**			9–45	
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–18	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–18	–
	Forb, perennial	2FP	*Forb, perennial*	0–18	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–9	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–9	–
Shrub/Vine					
7	**Shrub**			45–135	
	prairie sagewort	ARFR4	*Artemisia frigida*	9–45	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–45	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–45	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–45	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–45	–
Moss					
8	**Cryptogam**			45–135	
	lesser spikemoss	SEDE2	*Selaginella densa*	45–135	–

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			25–75	
	sand bluestem	ANHA	*Andropogon hallii*	25–75	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	25–50	–
	Grass, perennial	2GP	*Grass, perennial*	0–5	–
2	**Warm-Season Midgrass**			0–75	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–50	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–25	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–25	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
3	**Warm-Season Shortgrass**			175–250	
	blue grama	BOGR2	*Bouteloua gracilis*	150–250	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	25–150	–
	Grass, perennial	2GP	*Grass, perennial*	0–5	–
4	**Native Cool-Season Grass**			0–50	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–25	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–25	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
5	**Grass-like**			0–25	
	sedge	CAREX	*Carex*	0–25	–
Forb					
6	**Forb**			5–50	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–25	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–10	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–10	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–10	–
	Forb, annual	2FA	*Forb, annual*	0–10	–
	Forb, perennial	2FP	*Forb, perennial*	0–10	–
Shrub/Vine					
7	**Shrub**			25–75	
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–25	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–25	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–25	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–10	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–10	–
Moss					
8	**Cryptogam**			75–150	
	lesser spikemoss	SEDE2	*Selaginella densa*	75–150	–

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 year-long 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*
►Reference Community (1.1)
Average Production (lb./acre, air-dry): 1,000 Stocking Rate (AUM/acre): 0.27
►At-Risk Community (1.2)
Average Production (lb./acre, air-dry): 900 Stocking Rate (AUM/acre): 0.25
►Shortgrass Sod Community (2.1)
Average Production (lb./acre, air-dry): 500 Stocking Rate (AUM/acre): 0.14

*Based upon the following conditions: continuous season-long grazing by cattle under average growing conditions, 25 percent harvest efficiency. Air dry forage requirements based on 3 percent of animal body weight, or 912 lbs/AU/month.

WILDLIFE INTERPRETATIONS:
The Sandhills Prairie ecosystem consists of diverse grassland habitats interspersed with varying densities of Sandhills lakes and limited woody riparian corridors. The majority of this ecosystem is intact. These habitats historically provided critical life cycle components for the grassland birds, prairie dogs, and herds of roaming bison, elk, and pronghorn. Bobcats, wolves, and mountain lions occupied the apex predator niche. Diverse populations of small mammals and insects still provide a bountiful prey base for raptors and omnivores such as coyotes, foxes, raccoons, and opossums. In addition, a wide variety of reptiles and amphibians thrive in this landscape.

The Sandhills Prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement, elimination of fire and overgrazing altered the appearance and functionality of the ecosystem. Bison and prairie dogs were historically keystone species, but free-roaming bison herds have been extirpated in this region. The loss of bison and fire as ecological drivers influenced the character of the remaining native grasslands and the habitats that they provide. Fragmentation in MLRA 65 is limited and area sensitive grassland birds such as greater prairie chicken and sharp-tailed grouse continue to thrive here. The mosaic of sites continues to provide habitat for species requiring unfragmented grasslands, providing 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.

In the absence of fire and grazing, heavy litter buildup can occur on this site hindering the movement of young birds, especially quail and prairie chickens. Increased litter buildup results in decreased forb abundance and diversity and an accompanying decrease in insects, a critical food source for young birds. Introduced species such as cheatgrass, Kentucky bluegrass, and introduced forbs may be present but degradation of the biotic integrity from non-native species in this precipitation zone on ecological site is limited.

Disruption of the natural fire regime and accompanying woody encroachment is the greatest threat to ecosystem dynamics in this MLRA. Lack of fire facilitates tree and shrub encroachment degrades grassland habitats and creates habitats that favor generalist species such as American robin and mourning dove. Woody species provide perches for raptors, increasing the predation mortality on native bird populations. Woody encroachment is most severe in the eastern half of the MLRA but is a threat across the MLRA.

Hydrological functions

Water is the principal factor limiting forage production on the Shallow to Gravel ecological site. Meadin and Simeon soils on this site are in Hydrologic Soil Group A. Water transmission through Group A soils is normally greater than 0.30 inches per hour. Runoff is expected to occur only during the most intense storms (refer to Section 4, NRCS

National Engineering Handbook for runoff quantities and hydrologic curves).

The high infiltration rate of these soils results in few rills and gullies or water flow patterns even though steep slopes may be included. Pedestals are only slightly present in association with bunchgrasses such as needleandthread. Litter typically falls in place on flat slopes. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present but only cover 1 to 2 percent of the soil surface. This crusting is not significant for hydrologic considerations. Overall, this site has the appearance of being stable and productive.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which 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

Revision Notes: “This PROVISIONAL ecological site concept has been through the Quality Control and Quality Assurance processes to ensure that the site meets the NESH standards for a provisional ecological site that provides basic compiled information in one location. This site should not be considered an Approved ESD until further data entry and editing is completed.

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. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team. The project plan is ES-R065XY013NE - MLRA 65.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel was also used. Those involved in developing this site include Dave Cook, Rangeland Management Specialist, NRCS; Dwight Hale, Engineer, NRCS; Sheila Luoma, Resource Conservationist, NRCS; Marla Shelbourn, Rangeland Management Specialist, NRCS; Dave Steffen, Rangeland Management Specialist, NRCS.

There are three SCS-RANGE-417 records from Cherry County, Nebraska. The sample period is from 1980 to 1999.

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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)	Original Author: Stan Boltz. Version V participants: Dave Cook, Emily Helms, Jeff Nichols, Myra Richardson, Nadine Bishop
Contact for lead author	Jeff Nichols: jeffrey.nichols@usda.gov
Date	11/30/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Slight presence of rills on slopes exceeding 15 percent. When rills are present, they are discontinuous.

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2. **Presence of water flow patterns:** Slight presence of water flow patterns on slopes exceeding 15 percent. When present they are slightly visible, less than 0.5 inches (1.25 cm) deep, 6 inches (15.25 cm) wide, and 5 feet (1.5 meters) long.

3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants and terracettes are not expected on gentle slopes but may occur on slopes steeper than 10 percent. On these steeper slopes, bunch grasses may be slightly pedestalled (0.5 inch / 1.25 cm) with no exposed roots. Typically, less than 5 percent of the plants will be pedestalled. Drought or wildfire can contribute to increased incidences of pedestals and terracettes.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 5 percent or less. Multi-year drought and/or wildfire can increase bare ground to 10 percent for up to two years following the disturbance.

   Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** None. Gullies are not expected on this site.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter classes will generally move short distances usually less than 12 inches (30 cm). Medium size class litter will move very short distances usually less than 6 inches (15 cm). Coarse litter is not expected to move. Litter debris dams are occasionally present.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability will vary significantly with soil texture. Soils with sandy loam textures will have stability ratings of 4 to 5, while soils with sandy textures will have soil stability ratings of 2 or less. Biological crusts may be present (up to 10 percent of the surface) and may provide resistance to erosion.

   Surface erosion by water rarely occurs due to rapid infiltration, but surface may be susceptible to wind erosion when vegetative cover is reduced due to multi-year drought, wildfire, or multi-year heavy grazing. Biological crusts may be present and may serve to provide resistance to erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon is typically 4 to 16 inches (10-21 cm) thick. Soil colors are dark grayish brown, grayish brown, or dark gray (values of 3 to 6) when dry and dark brown, very dark brown, dark grayish brown to dark gray (values of 2 to 5) when moist. Structure is typically weak fine granular in the upper A-horizon. Soil texture ranges from sand to gravelly, coarse sand. The amount of gravel present ranges from 10 percent in the A-horizon and 20 percent in the AC-horizon.

   Meadin and Simeon are the major soil series correlated to this ecological site.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous

and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration.

The expected composition of the plant community is 75 to 90 percent perennial grasses and grass-likes, 1 to 10 percent forbs, 5 to 15 percent shrubs, and 0 to 10 percent cryptograms. The perennial grass and grass-like component is made up of warm-season tallgrass (20-40%); warm-season midgrass (5-20%); warm-season shortgrass (5-20%), cool-season bunchgrass (5-20%), and grass-like (0-5%).

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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. Compaction layers should not be present.

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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, tallgrass, 200-400 #/ac, 20-40%, 2 species minimum: sand bluestem, prairie sandreed.

Phase 1.2
1. Native, perennial, warm-season, tallgrass, 270-495 #/ac, 30-55%, 2 species minimum: sand bluestem, prairie sandreed.
2. Native, perennial, warm-season shortgrass, 135-270 #/ ac, 15-30%, 2 species minimum: blue grama, hairy grama.

Sub-dominant: Phase 1.1
1. Native, perennial, warm-season midgrass, 50-200 #/ac, 5-20%, 1 species minimum: little bluestem, sideoats grama, sand dropseed.
2. Native, perennial, warm-season shortgrass, 50-200 #/ ac, 5-20%, 1 species minimum: blue grama, hairy grama.
3. Native, perennial, cool-season grass, 50-200 #/ac, 5-20%, 1 species minimum: needle and thread, porcupinegrass, prairie Junegrass.
4. Shrubs, 50-150 #/ac, 5-15%, 1 species minimum: prairie sagewort, broom snakeweed, brittle pricklypear, plains prickly pear.

Phase 1.2
1. Native, perennial, warm-season midgrass, 9-180 #/ac, 1-20%, 1 species minimum: little bluestem, sideoats grama, sand dropseed.
2. Native, perennial, cool-season bunchgrass, 45-135 #/ac, 5-15%, 1 species minimum: needle and thread, porcupinegrass, prairie Junegrass.
3. Shrubs, 45-135 #/ac, 5-15%, 1 species minimum: prairie sagewort, broom snakeweed, brittle pricklypear, plains prickly pear.
4. Cryptograms, 45-135 #/ac, 5-15%, 1 species minimum: lesser spikemoss.

Other: Minor - Phase 1.1
1. Cryptograms, 0-100 #/ac, 0-10%: lesser spikemoss.
2. Native, perennial and annual forbs, 10-50, 1-5%: species vary from location to location.
3. Grass-likes, 0-50 #/ac, 0-5%: sedges.

Minor - Phase 1.2
1. Grass-likes, 0-90 #/ac, 0-10%: sedges.
2. Native, perennial and annual forbs, 9-45, 1-5%: species vary from location to location.

Additional: The Reference Community (1.1) includes eight functional/structural groups which are in order of relative

abundance native, perennial, warm-season tallgrass; native, perennial, warm-season midgrass=native, perennial, warm-season shortgrass=native, perennial, cool-season bunchgrass; shrubs; cryptogram; native forb; grass-like.

The At-Risk Community (1.2) includes eight functional/structural groups which are in order of relative abundance native, perennial, warm-season tallgrass; native, perennial, warm-season shortgrass; native, perennial, warm-season midgrass; native, perennial, cool-season bunchgrass=shrub=cryptogram; grass-like; forb.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs have few dead stems. The exception is the potential of up to 15 percent mortality of warm-season bunch grasses during multi- year drought cycles.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 40 to 60 percent and at a depth of 0.25 inch (0.65 cm). Litter cover during and following drought can range from 30 to 40 percent and 5 to 15 percent following wildfire.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 1,000 pounds per acer on an air dry weight basis. Low and high production years should yield 600 and 1,500 pounds per acre respectively.

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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:** Annual bromes (cheatgrass and Japanese/field), Kentucky bluegrass, and common mullein are known invasives that have the potential to be dominant or co-dominant on the site. Consult the state noxious weed and state watch lists 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 codominant 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 recent weather 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.
