USDA Natural Resources
Conservation Service

Ecological site R064XY039NE
Shallow Clay

Last updated: 12/16/2024
Accessed: 05/10/2025

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.

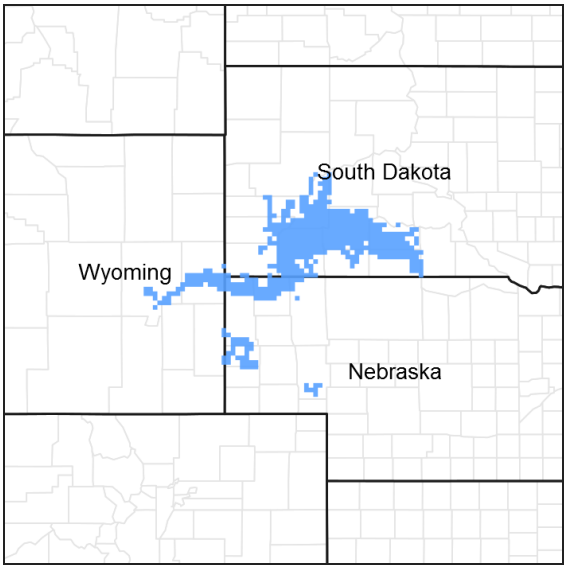

Figure 1. Mapped extent

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): 064X–Mixed Sandy and Silty Tableland and Badlands

The Mixed Sandy and Silty Tableland and Badlands (MLRA 64) is shared almost equally between South Dakota (42 percent) and Nebraska (41 percent). A small portion is in Wyoming (17 percent). The MLRA consists of 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron and Alliance, Nebraska; and Lusk, Wyoming, are all within the boundaries of this MLRA.

The following areas of special interest are in this MLRA: Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation; parts of the Oglala and Buffalo Gap National Grasslands, which are in the Nebraska National Forest; and nearly all of Badlands National Park. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

The northern section of the MLRA consists of old plateaus and terraces that have been deeply eroded by wind, water, and time. The southern section consists of nearly level to broad intervalley remnants of smooth fluvial plains. These two sections are separated by the Pine Ridge escarpment. Elevations gradually increase from 2,950 to 5,073 feet from east to west. The main drainageway through Badlands National Park is the White River. The headwaters of both the White and Niobrara Rivers are in MLRA 64. The Pine Ridge escarpment is at the northernmost extent of the Ogallala Aquifer.

Tertiary continental sediments consisting of sandstone, siltstone, and claystone underlie most of the area. Many of the bedrock units in the southern third of the MLRA are covered by loess. Soils range from shallow to very deep and from generally well drained to excessively drained. They are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Average annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer. This area supports a mixture of short-, mid-, and tall-statured warm- and cool-season grasses. On the Pine Ridge Escarpment, these plants grow in association with ponderosa pine, Rocky Mountain juniper, western snowberry, skunkbush sumac, common chokecherry, and rose. Wyoming big sagebrush grows in minor amounts in the drier, far western portion of the MLRA; however, small remnant stands can be found in the eastern portion of the Oglala National Grassland in Nebraska.

Sixty percent of the MLRA is grassland, 11 percent of which is under Federal management. Twenty-two percent of the area is used as cropland, and 4 percent is forested. Major resource concerns include wind erosion, water erosion, and surface water quality (USDA-NRCS, 2006, Ag Handbook 296).

For development of ecological sites, MLRA 64 is divided into two precipitation zones (PZ): 14 to 17 inches per year and 17 to 20 inches per year. The wetter zone extends from the western end of the Pine Ridge Escarpment near Lusk, Wyoming, eastward along the escarpment through Nebraska and into the Big Badlands area of South Dakota. The drier zone extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

A unique geologic area known as the Hartville Uplift is in the far southwest corner of the 14 to 17 inch precipitation zone. The Hartville Uplift is an elongated, north-northwest-oriented, broad domal arch of Laramide age (70-50 million years ago). It extends approximately 45 miles between Guernsey and Lusk, Wyoming, and is 15 miles wide at its widest point. Erosion has exposed a core of granite and Precambrian metasedimentary and metavolcanic rocks (Steele et al., 2018). In addition to the ecological sites in the 14 to 17 inch precipitation zone of MLRA 64, three unique ecological site descriptions were developed to describe the soils and plant community dynamics in the Hartville Uplift.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 64—Mixed Sandy and Silty Tableland and Badlands

U.S. Environmental Protection Agency (EPA)
Level IV Ecoregions of the Conterminous United States:
High Plains—25:
Pine Ridge Escarpment—25a.
Flat to Rolling Plains—25d.
Pine Bluffs and Hills—25f.
Sandy and Silty Tablelands—25g.
Northwestern Great Plains—43:
White River Badlands—43h.
Keya Paha Tablelands—43i.

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Great Plains and Palouse Dry Steppe Province—331:
Western Great Plains Section—331F:
Subsections:
Shale Scablands—331Fb.
White River Badlands—331Fh.
Pine Ridge Escarpment—331Fj.
High Plains—331Fk.
Hartville Uplift—331Fm.
Western Nebraska Sandy and Silty Tablelands—331Fn.
Keye Paha Tablelands—331Ft.

Powder River Basin Section—331G:
Subsection: Powder River Basin—331Ge.

Ecological site concept

The Shallow Clay ecological site occurs throughout MLRA 64. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. Typical slopes range from 1 to 45 percent. Soils are shallow, between 10 and 20 inches deep, with clay, silty clay, or silty clay loam surface textures 3 to 8 inches thick. Soils are typically calcareous above the bedrock. Fine to very fine, soft weathered shale fragments are common (up to 50 percent by volume) below 4 inches. The shale bedrock can be fractured in the upper part, and some fine roots can be found extending up to 30 inches below the surface.

The vegetation in the Reference State consists of a mix of cool- and warm-season grasses. Rhizomatous wheatgrass and green needlegrass are dominant; however, warm-season grasses, including little bluestem, sideoats grama, blue grama, and buffalograss, can make up a significant portion of the composition. If the bedrock is significantly fractured, big bluestem and prairie sandreed are likely to occur on this site. Forbs are common and diverse. Shrubs include leadplant and rose. Yucca can be common, especially on ridges. Wyoming big sagebrush and bluebunch wheatgrass will be common in the western portion of the MLRA.

Associated sites

R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can be found on less sloping landscapes adjacent to or downslope of the Shallow Clay site.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can be found on less sloping landscapes adjacent to or downslope of the Shallow Clay site.

Similar sites

R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site will occur on similar landscape positions, but soils are greater than 20 inches deep. The plant community will have less sideoats grama and little bluestem and higher forage production than the Shallow Clay ecological site.
R064XY040NE	**Shallow** The Shallow ecological site will occur on similar landscape positions as the Shallow Clay ecological site. The plant community will have more needlegrass than the Shallow Clay ecological site.
R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site will occur on similar landscape positions, but soils are greater than 20 inches deep. The plant community will have less sideoats grama and little bluestem and higher forage production than the Shallow Clay ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

The Shallow Clay ecological site occurs on gently to steeply sloping hills, plains, and ridges.

Table 2. Representative physiographic features

Landforms	(1) Upland > Plain (2) Upland > Hill (3) Upland > Ridge (4) Upland > Knoll
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–5,000 ft
Slope	1–45%
Aspect	Aspect is not a significant factor

Climatic features

MLRA 64 has a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature are common in some years. The climate results from MLRA 64 being near the geographic center of North America. There are few natural barriers on the Northern Great Plains. Air masses move freely across the plains and account for rapid changes in temperature.

Average annual precipitation ranges from 14 to 20 inches per year. The normal average annual temperature is about 47 °F. January is the coldest month with average temperatures ranging from about 21 °F (Wood, SD) to about 25 °F (Hemingford, NE). July is the warmest month with average temperatures ranging from about 70 °F (Keeline 3 W, WY: 1953–1986) to about 76 °F (Wood, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 55 °F. This large annual range attests to the continental nature of the climate of this area. Wind speeds average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime winds. Occasionally, strong storms bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	92-120 days
Freeze-free period (characteristic range)	119-139 days
Precipitation total (characteristic range)	16-19 in
Frost-free period (actual range)	87-122 days
Freeze-free period (actual range)	110-149 days
Precipitation total (actual range)	15-20 in
Frost-free period (average)	107 days
Freeze-free period (average)	130 days
Precipitation total (average)	17 in

Climate stations used

- (1) HARRISON 20 SSE [USW00094077], Harrison, NE
- (2) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (3) HARRISON [USC00253615], Harrison, NE
- (4) HEMINGFORD [USC00253755], Hemingford, NE
- (5) INTERIOR 3 NE [USC00394184], Interior, SD

- (6) MARTIN [USC00395281], Martin, SD
- (7) WOOD [USC00399442], Wood, SD
- (8) LUSK 2 SW [USC00485830], Lusk, WY
- (9) TORRINGTON 29N [USC00488997], Jay Em, WY
- (10) CHADRON 3NE [USC00251578], Chadron, NE

Influencing water features

No riparian or wetland features are directly associated with the Shallow Clay ecological site.

Wetland description

Not Applicable.

Soil features

The soils in this site are well-drained and formed in alluvium or residuum weathered from claystone or shale. Slopes range between 1 and 45 percent. The surface layer is 3 to 8 inches thick with clay to silty clay loam textures. The soils will be slight to moderately alkaline. Some series will have an impervious shale layer at 10 to 20 inches; however, other soil series will have a fractured shale layer with up to 50 percent by volume of fine to very fine, soft weathered shale fragment and roots extending to a depth of 30 inches. The soils have a slow to very slow infiltration rate. This site should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers.

Major soils correlated to the Shallow Clayey ecological site: Conata, Orella, and Samsil.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 5 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition or production. Low available water capacity and very slow permeability strongly influences the soil-water-plant relationship.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center for details specific to your area of interest, or go online to access USDA’s Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Alluvium–clayey shale (2) Residuum–shale
Surface texture	(1) Clay (2) Silty clay loam (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	10–20 in
Surface fragment cover <=3"	0–25%
Available water capacity (0-40in)	2–3 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–20

Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	5–15%

Ecological dynamics

The Shallow Clay ecological site developed under Northern Great Plains climatic conditions; light to severe grazing by bison and other large herbivores; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, severe disturbances, such as periods of well below average precipitation and the introduction of non-native cool-season grasses, can cause significant shifts in plant communities and species composition.

Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the Western Wheatgrass/Sideoats Grama/Green Needlegrass Plant Community. Species such as blue grama will increase. Cool season grasses such as green needlegrass, little bluestem, bluebunch wheatgrass, and rhizomatous wheatgrasses will decrease in frequency and production.

Interpretations are primarily based on the Western Wheatgrass/Sideoats Grama/Green Needlegrass Plant Community. It 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 also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Shallow Clay – R064XY039NE 7/18/18

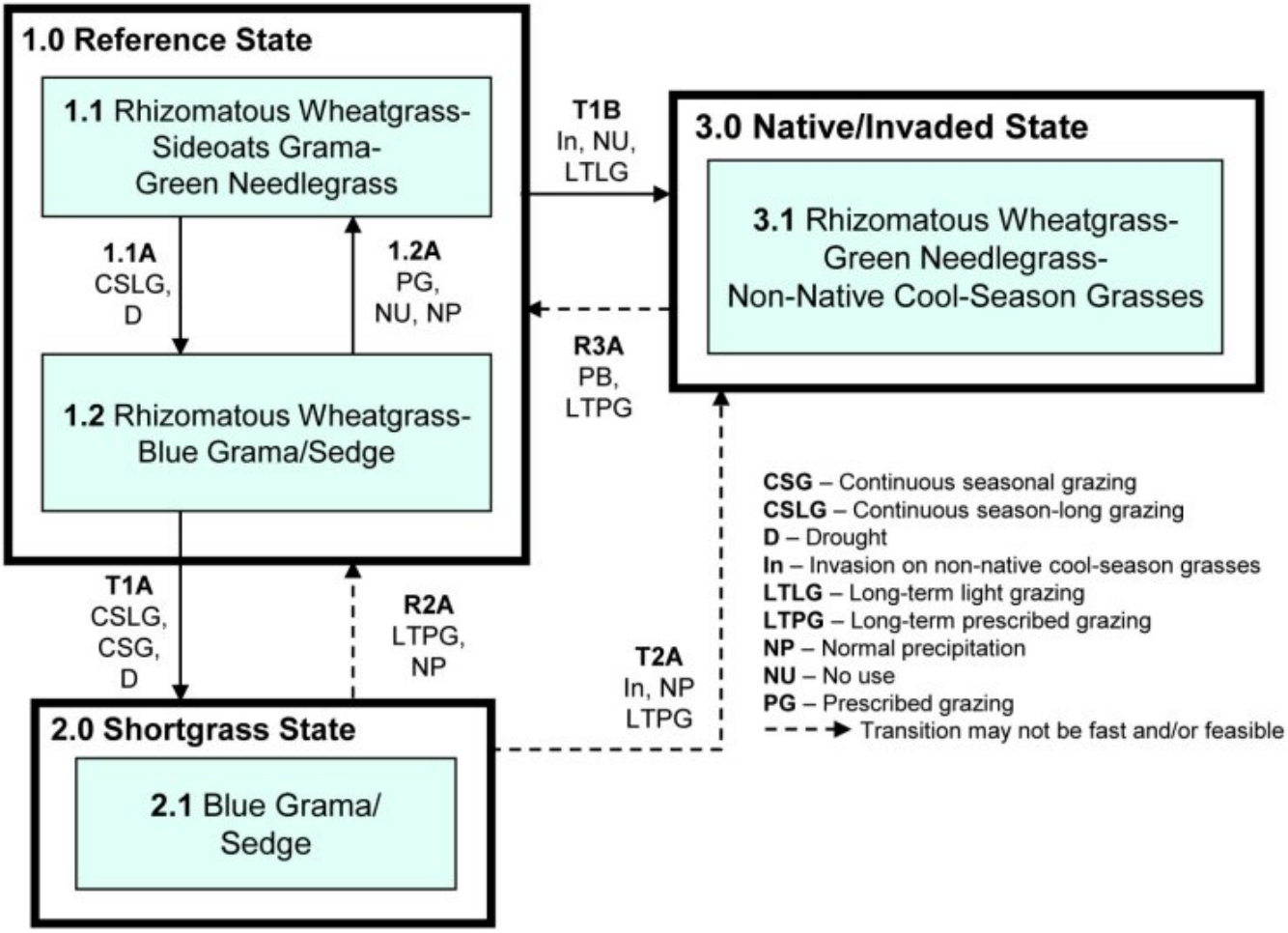

Diagram Legend - Shallow Clay - R064XY039NE

T1A	1.0 to 2.0	Continuous season-long grazing, or continuous seasonal grazing, without adequate recovery, or heavy grazing in combination with drought.
T1B	1.0 to 3.0	Invasion of non-native cool-season grasses, no use, or long-term light grazing.
T2A	1.0 to 3.0	Invasion of non-native cool-season grasses, long-term prescribed grazing, including proper stocking rates, change in season of use, adequate time for recovery, and a return to normal precipitation patterns following drought. Transition may not be rapid or meet management objectives.
R2A	2.0 to 1.0	Long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery, and a return to normal precipitation patterns. Extended periods of deferment and/or non-use my be beneficial. Restoration may not be rapid or achievable.
R3A	3.0 to 1.0	Prescribed burning, followed by long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for recovery. Restoration may not be rapid or achievable.
CP 1.1A	1.1 to 1.2	Continuous season-long grazing or heavy grazing in combination with drought.
CP 1.2A	1.2 to 1.1	Prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery, and a return to normal precipitation following drought. Periods of growing season deferment and/or non-use may be beneficial.

State 1
Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics in the Shallow Clay ecological site prior to European settlement. This site, in the Reference State, is dominated by

cool-season grasses and subdominant warm-season grass. Forbs will be common and diverse. Shrubs species will vary depending upon precipitation and slope aspect. Rocky Mountain juniper can occur on this site but in minor amounts. Grazing or the lack of grazing, fire, and drought are the major drivers between plant communities.

Community 1.1
Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass

Interpretations are primarily based on the Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass Plant Community. This is also considered to be the Reference Plant Community (1.1) Potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. The major grasses include western wheatgrass, green needlegrass, and sideoats grama. Other grasses and grass-likes that occur on this plant community include little bluestem, blue grama, sedge, and big bluestem. Forbs commonly occurring include purple coneflower, goldenpea, prairie coneflower, and scurfpea. Shrubs that commonly occur include leadplant, fringed sagewort, and rose. This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species can vary greatly in production depending upon growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient and water cycles, and energy flow are functioning properly. Plant litter is properly distributed with very little movement offsite and natural plant mortality is very low. The diversity in plant species allows for high tolerance to drought. Runoff from adjacent sites and moderate or high available water capacity provides a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1095	1376	1650
Forb	75	120	165
Shrub/Vine	30	96	165
Tree	0	8	20
Total	**1200**	**1600**	**2000**

Figure 9. Plant community growth curve (percent production by month). NE6402, Pine Ridge/Badlands, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm season, sub-dominant.

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

Community 1.2
Rhizomatous Wheatgrass-Grama/Sedge

This plant community develops under continuous season-long grazing by large herbivores. The potential vegetation is about 80 percent grasses and grass-likes, 10 percent forbs, and 10 percent shrubs. The major grasses and grass-likes include western wheatgrass, blue grama, and sedge. Other grasses occurring on this plant community include sideoats grama, little bluestem, threeawns, and needle and thread. Forbs that commonly occur include yarrow, cudweed sagewort, goldenpea, prairie coneflower, and scurfpea. Shrubs commonly found include rose, fringed sagewort, and broom snakeweed. In the western portion of the MLRA, Wyoming big sagebrush may occur in minor amounts. When compared to the Western Wheatgrass-Sideoats Grama-Green Needlegrass Plant Community (1.1), blue grama and sedges have increased. Green needlegrass, little bluestem, and sideoats grama have decreased. Production of cool-season grasses has also been reduced. Non-native species such as cheatgrass, thistle, and sweetclover will likely invade this plant community. This plant community is stable and protected from excessive erosion. The dominant herbaceous species are very adapted to grazing; however, the midgrass species and the more palatable forbs will decrease in the community through continuous seasonal grazing. This plant community tends to be resilient if disturbance is not long-term.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	725	1002	1275
Forb	55	120	185
Shrub/Vine	20	72	125
Tree	0	6	15
Total	**800**	**1200**	**1600**

Figure 11. Plant community growth curve (percent production by month). NE6402, Pine Ridge/Badlands, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm season, sub-dominant.

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

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal-long grazing or heavy grazing in combination with drought will convert this plant community to the Rhizomatous Wheatgrass-Grama/Sedge Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Non-use or long-term light grazing and the invasion of non-native cool-season grasses will convert the Reference State (1.0) to the Native/Invaded State (3.0).

Conservation practices

Prescribed Grazing

State 2
Shortgrass State

The Shortgrass State is dominated by shortgrass species and upland sedges. This State is the result of grazing management that did not provide adequate recovery time for tall- and mid-statured cool- and warm-season grasses. The hydrologic function of this state may be altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 2.1
Blue Grama/Sedge

This plant community develops under continuous season-long grazing or with continuous seasonal grazing with concentrated use in the early part of the growing season (as in calving/lambing pastures). It is made up of approximately 90 percent grasses (primarily short, warm-season grasses), 5 percent forbs, and 5 percent shrubs. The dominant grasses or grass-likes include blue grama, buffalograss, and sedge. Other grasses may include western wheatgrass, prairie Junegrass, threeawn, and annual brome. The dominant forbs include slimflower scurfpea, pussytoes, curlycup gumweed, and scarlet globemallow. The dominant shrubs are fringed sagewort and plains pricklypear. Compared to the Western Wheatgrass/Sideoats Grama/Green Needlegrass Plant Community, shortgrasses have increased and the cool-season midgrasses have diminished greatly. Some forbs and cactus have either increased or invaded the site. Plant diversity is low. This plant community is very stable. Generally, this plant community will require significant management inputs and time to move it away from this plant community. Onsite soil erosion is low. Infiltration is low and runoff is high. The runoff typically is very clean, but offsite areas can be significantly impacted due to the increased runoff.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	520	693	865
Forb	40	113	185
Shrub/Vine	40	90	140
Tree	0	4	10
Total	**600**	**900**	**1200**

Figure 13. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	15	24	23	15	5	5		

State 3
Native Invaded State

The Native/Invaded State is dominated by rhizomatous wheatgrass, green needlegrass, and non-native cool-season annual and perennial grasses. The Native/Invaded State can resemble the Reference State (1.0) except that it is invaded by non-native cool-season grasses. This plant community can be very productive if managed properly and it does not degrade.

Community 3.1
Rhizomatous Wheatgrass-Green Needlegrass-Non-Native-Cool-Season Grasses

This plant community develops after an extended period of non-use or long-term light grazing and the invasion of non-native cool-season grasses. This plant community can sometimes be found in small patches dispersed throughout the pasture, encircling spot-grazed areas, and areas distant from water sources. This is a typical pattern found in properly stocked pastures that are grazed season-long. Plant litter may accumulate as this plant community first develops. Due to a lack of tiller stimulation and sunlight, native bunchgrasses typically develop dead centers and native rhizomatous grasses are limited to colonies. Standing decadent plants and moderate litter covers shorter understory species (i.e., shortgrasses and sedges), restricting their ability to capture adequate sunlight for photosynthesis. Vigor and diversity of native plants are reduced. Annual and biennial forbs, annual grasses, and cryptogams commonly fill interspaces once occupied by desirable species. Kentucky bluegrass, smooth brome, cheatgrass, and sweetclover tend to invade and can sometimes dominate this plant community. Other grasses present include western wheatgrass, needle and thread, green needlegrass, prairie Junegrass, Sandberg bluegrass, and sedges with lesser amounts of plains muhly, little bluestem, blue grama, and sideoats grama. The common forbs include dotted gayfeather, Missouri goldenrod, prairie coneflower, silverleaf scurfpea, western yarrow, and white heath aster. Shrubs that occur on this plant community include rose, fringed sagewort, sagebrush, and broom snakeweed. The combination of both grazing and fire is most effective in moving this plant community towards the Reference State (1.0). Soil erosion is low. Compared to the Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass Plant Community (1.1), infiltration is reduced to the lower root zone. This plant community tends to favor early cool-season plant species.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	910	1169	1425
Forb	65	140	215
Shrub/Vine	25	84	145
Tree	0	7	15
Total	**1000**	**1400**	**1800**

Figure 15. Plant community growth curve (percent production by month). NE6401, Pine Ridge/Badlands, cool-season dominant. Cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	15	28	30	10	2	5	5		

Transition T1B
State 1 to 2

Non-use or long-term light grazing and the invasion of non-native cool-season grasses will convert the Reference State (1.0) to the Native/Invaded State (3.0).

Transition T1A
State 1 to 3

Continuous season-long grazing, or continuous seasonal grazing without change in season of use, or heavy grazing in combination with drought will convert the plant community to Shortgrass State (2.0). This transition is most likely to occur from the Rhizomatous Wheatgrass-Grama/Sedge Plant Community (1.2).

Restoration pathway R3A
State 2 to 1

Restoration work should include prescribed burning, followed by long-term prescribed grazing including proper stocking rates, change in season of use, and adequate time for plant recovery. This restoration may not be rapid or meet management goals.

Conservation practices

Prescribed Burning
Prescribed Grazing

Restoration pathway R2A
State 3 to 1

Long-term prescribed grazing including proper stocking rates, change in season of use, and adequate time for plant recovery after grazing may convert this plant community to the Reference State (1.0). A return to normal precipitation patterns following drought will help with recovery. This transition may not be rapid or meet management objectives.

Conservation practices

Prescribed Grazing

Transition T2A
State 3 to 2

Invasion and expansion of non-native cool-season grasses on the site. Long-term prescribed grazing including proper stocking rates, change in season of use, and adequate time for plant recovery after grazing may convert this plant community to the Native/Invaded State (3.0). A return to normal precipitation patterns following drought will help with the transition. This transition may not be rapid or meet management objectives.

Conservation practices

Prescribed Grazing

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			320–640	
	western wheatgrass	PASM	*Pascopyrum smithii*	320–640	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	16–160	–
2	**Cool-Season Bunchgrasses**			160–400	
	green needlegrass	NAVI4	*Nassella viridula*	160–400	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–160	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–48	–
3	**Mid- Warm-Season Grasses**			160–400	
	sideoats grama	BOCU	*Bouteloua curtipendula*	160–400	–
	little bluestem	SCSC	*Schizachyrium scoparium*	32–160	–
4	**Short- Warm-Season Grasses**			80–240	
	blue grama	BOGR2	*Bouteloua gracilis*	80–160	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–80	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–80	–
5	**Other Native Grasses & Grass-Likes**			80–240	
	big bluestem	ANGE	*Andropogon gerardii*	32–128	–
	sedge	CAREX	*Carex*	16–80	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	16–48	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–48	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–48	–
	Grass, perennial	2GP	*Grass, perennial*	0–48	–
	squirreltail	ELEL5	*Elymus elymoides*	0–32	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–32	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	–	–
6	**Non-Native Cool-Season Grasses**			0	
	cheatgrass	BRTE	*Bromus tectorum*	–	–
	field brome	BRAR5	*Bromus arvensis*	–	–
	Kentucky bluegrass	POPR	*Poa pratensis*	–	–
	smooth brome	BRIN2	*Bromus inermis*	–	–
Forb					
7	**Forbs**			80–160	
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–48	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–48	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–48	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–48	–
	milkvetch	ASTRA	*Astragalus*	0–48	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–48	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–48	–

	purple prairie clover	DAPU5	*Dalea purpurea*	0–48	–
	pussytoes	ANTEN	*Antennaria*	0–48	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–48	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–48	–
	scurfpea	PSORA2	*Psoralidium*	0–48	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–48	–
	yarrow	ACHIL	*Achillea*	0–48	–
	Forb, perennial	2FP	*Forb, perennial*	0–48	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–48	–
	desertparsley	LOMAT	*Lomatium*	0–48	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–48	–
	false boneset	BREU	*Brickellia eupatorioides*	0–48	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–32	–
	spiny phlox	PHHO	*Phlox hoodii*	0–32	–
	onion	ALLIU	*Allium*	0–32	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–16	–
	Forb, annual	2FA	*Forb, annual*	–	–
	thistle	CIRSI	*Cirsium*	–	–
	sweetclover	MELIL	*Melilotus*	–	–
Shrub/Vine					
8	**Shrubs**			32–160	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–48	–
	leadplant	AMCA6	*Amorpha canescens*	16–48	–
	rose	ROSA5	*Rosa*	16–48	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–48	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–48	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–48	–
	soapweed yucca	YUGL	*Yucca glauca*	0–48	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–48	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–48	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–48	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–16	–
Tree					
9	**Trees**			0–16	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–16	–
	eastern redcedar	JUVI	*Juniperus virginiana*	–	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			60–240	
	western wheatgrass	PASM	*Pascopyrum smithii*	60–240	–

	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–60	–
2	**Cool-Season Bunchgrasses**			0–120	
	green needlegrass	NAVI4	*Nassella viridula*	0–120	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–60	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–60	–
3	**Mid- Warm-Season Grasses**			60–180	
	little bluestem	SCSC	*Schizachyrium scoparium*	60–180	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	12–120	–
4	**Short- Warm-Season Grasses**			120–480	
	blue grama	BOGR2	*Bouteloua gracilis*	120–360	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–120	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–120	–
5	**Other Native Grasses & Grass-Likes**			60–240	
	sedge	CAREX	*Carex*	60–120	–
	squirreltail	ELEL5	*Elymus elymoides*	0–60	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–60	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	12–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–60	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–36	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–36	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–36	–
	big bluestem	ANGE	*Andropogon gerardii*	–	–
6	**Non-Native Cool-Season Grasses**			0–60	
	cheatgrass	BRTE	*Bromus tectorum*	0–36	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–24	–
	smooth brome	BRIN2	*Bromus inermis*	0–24	–
	field brome	BRAR5	*Bromus arvensis*	0–12	–
Forb					
7	**Forbs**			60–180	
	white sagebrush	ARLU	*Artemisia ludoviciana*	12–60	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–60	–
	white heath aster	SYER	*Symphyotrichum ericoides*	12–60	–
	Forb, perennial	2FP	*Forb, perennial*	0–60	–
	yarrow	ACHIL	*Achillea*	0–60	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–36	–
	Forb, annual	2FA	*Forb, annual*	0–36	–
	onion	ALLIU	*Allium*	0–36	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–36	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–36	–
	scurfpea	PSORA2	*Psoralidium*	12–36	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–36	–
	milkvetch	ASTRA	*Astragalus*	0–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	12–36	–

	sunflower				
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–36	–
	purple prairie clover	DAPU5	*Dalea purpurea*	12–36	–
	pussytoes	ANTEN	*Antennaria*	12–36	–
	desertparsley	LOMAT	*Lomatium*	0–36	–
	false boneset	BREU	*Brickellia eupatorioides*	0–24	–
	spiny phlox	PHHO	*Phlox hoodii*	0–24	–
	sweetclover	MELIL	*Melilotus*	0–24	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–24	–
	thistle	CIRSI	*Cirsium*	0–24	–
	woolly plantain	PLPA2	*Plantago patagonica*	12–24	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–12	–
	Indian breadroot	PEDIO2	*Pediomelum*	–	–
Shrub/Vine					
8	**Shrubs**			24–120	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	12–60	–
	prairie sagewort	ARFR4	*Artemisia frigida*	12–60	–
	soapweed yucca	YUGL	*Yucca glauca*	0–48	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–36	–
	rose	ROSA5	*Rosa*	12–36	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–36	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–24	–
	leadplant	AMCA6	*Amorpha canescens*	0–12	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–12	–
Tree					
9	**Trees**			0–12	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–12	–
	eastern redcedar	JUVI	*Juniperus virginiana*	0–12	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			9–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	9–90	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–9	–
2	**Cool-Season Bunchgrasses**			0–27	
	green needlegrass	NAVI4	*Nassella viridula*	0–27	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–27	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	–	–
3	**Mid- Warm-Season Grasses**			0–45	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–45	–

	little bluestem	SCSC	*Schizachyrium scoparium*	0–45	–
4	**Short- Warm-Season Grasses**			225–495	
	blue grama	BOGR2	*Bouteloua gracilis*	225–405	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–135	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–90	–
5	**Other Native Grasses & Grass-Likes**			45–225	
	sedge	CAREX	*Carex*	45–180	–
	squirreltail	ELEL5	*Elymus elymoides*	0–45	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–45	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	9–45	–
	Grass, perennial	2GP	*Grass, perennial*	9–45	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–27	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	–	–
	big bluestem	ANGE	*Andropogon gerardii*	–	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	–	–
6	**Non-Native Cool-Season Grasses**			9–45	
	cheatgrass	BRTE	*Bromus tectorum*	9–45	–
	smooth brome	BRIN2	*Bromus inermis*	0–27	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–18	–
	field brome	BRAR5	*Bromus arvensis*	0–9	–
Forb					
7	**Forbs**			45–180	
	white sagebrush	ARLU	*Artemisia ludoviciana*	9–90	–
	Forb, annual	2FA	*Forb, annual*	0–90	–
	yarrow	ACHIL	*Achillea*	0–72	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–72	–
	white heath aster	SYER	*Symphyotrichum ericoides*	18–72	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	18–45	–
	woolly plantain	PLPA2	*Plantago patagonica*	9–45	–
	Forb, perennial	2FP	*Forb, perennial*	0–45	–
	scurfpea	PSORA2	*Psoralidium*	18–45	–
	pussytoes	ANTEN	*Antennaria*	9–36	–
	milkvetch	ASTRA	*Astragalus*	0–27	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–27	–
	purple prairie clover	DAPU5	*Dalea purpurea*	9–27	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–27	–
	onion	ALLIU	*Allium*	0–27	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–18	–
	spiny phlox	PHHO	*Phlox hoodii*	0–18	–
	sweetclover	MELIL	*Melilotus*	0–18	–
	thistle	CIRSI	*Cirsium*	0–18	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–9	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–9	–

	scarlet beeblossom	GACO5	*Gaura coccinea*	–	–
	Indian breadroot	PEDIO2	*Pediomelum*	–	–
	false boneset	BREU	*Brickellia eupatorioides*	–	–
	desertparsley	LOMAT	*Lomatium*	–	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	–	–
Shrub/Vine					
8	**Shrubs**			45–135	
	prairie sagewort	ARFR4	*Artemisia frigida*	18–90	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	9–45	–
	soapweed yucca	YUGL	*Yucca glauca*	0–45	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–27	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–27	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	9–27	–
	rose	ROSA5	*Rosa*	9–27	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–27	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–27	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	–	–
	leadplant	AMCA6	*Amorpha canescens*	–	–
Tree					
9	**Trees**			0–9	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–9	–
	eastern redcedar	JUVI	*Juniperus virginiana*	0–9	–

Table 12. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			210–490	
	western wheatgrass	PASM	*Pascopyrum smithii*	210–490	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–140	–
2	**Cool-Season Bunchgrasses**			70–280	
	green needlegrass	NAVI4	*Nassella viridula*	70–280	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–70	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–42	–
3	**Mid- Warm-Season Grasses**			0–210	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–210	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–140	–
4	**Short- Warm-Season Grasses**			28–140	
	blue grama	BOGR2	*Bouteloua gracilis*	28–112	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–70	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–70	–
5	**Other Native Grasses & Grass-Likes**			70–210	
	sedge	CAREX	*Carex*	70–140	–

	big bluestem	ANGE	*Andropogon gerardii*	0–70	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	14–70	–
	squirreltail	ELEL5	*Elymus elymoides*	0–70	–
	Grass, perennial	2GP	*Grass, perennial*	0–42	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–28	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–14	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	–	–
6	**Non-Native Cool-Season Grasses**			70–350	
	smooth brome	BRIN2	*Bromus inermis*	28–210	–
	Kentucky bluegrass	POPR	*Poa pratensis*	14–140	–
	cheatgrass	BRTE	*Bromus tectorum*	14–70	–
	field brome	BRAR5	*Bromus arvensis*	0–14	–
Forb					
7	**Forbs**			70–210	
	white sagebrush	ARLU	*Artemisia ludoviciana*	14–70	–
	sweetclover	MELIL	*Melilotus*	0–70	–
	Forb, annual	2FA	*Forb, annual*	0–70	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–70	–
	scurfpea	PSORA2	*Psoralidium*	0–56	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–42	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–42	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–42	–
	Forb, perennial	2FP	*Forb, perennial*	0–42	–
	yarrow	ACHIL	*Achillea*	0–42	–
	milkvetch	ASTRA	*Astragalus*	0–42	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–42	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–42	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–28	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–28	–
	thistle	CIRSI	*Cirsium*	0–28	–
	onion	ALLIU	*Allium*	0–28	–
	desertparsley	LOMAT	*Lomatium*	0–28	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–28	–
	spiny phlox	PHHO	*Phlox hoodii*	0–28	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–28	–
	pussytoes	ANTEN	*Antennaria*	0–14	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–14	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–14	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–14	–
	false boneset	BREU	*Brickellia eupatorioides*	–	–
Shrub/Vine					
8	**Shrubs**			28–140	

	soapweed yucca	YUGL	*Yucca glauca*	14–70	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–42	–
	rose	ROSA5	*Rosa*	14–42	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–42	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–42	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–28	–
	leadplant	AMCA6	*Amorpha canescens*	0–28	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	14	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–14	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–14	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–14	–
Tree					
9	**Trees**			0–14	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–14	–
	eastern redcedar	JUVI	*Juniperus virginiana*	0–14	–

Animal community

Wildlife Interpretations:
MLRA 64 is in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this MLRA consisted of diverse grassland and shrubland habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, and amphibians and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant and remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox are associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem in which fire, herbivory, and climate functioned as the primary disturbance factors, either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further affected plant and animal communities. The bison was a historical keystone species but has been extirpated in this area as a free-ranging herbivore. The loss of the bison and the reduction of prairie dog populations and fire as ecological drivers greatly influenced the character of the remaining native plant communities and altered wildlife habitats. Human development reduced habitat quality for area-sensitive species.

Within MLRA 64, the Shallow Clay ecological site provides upland grassland cover with an associated forb, shrub, and tree component. It was typically part of a an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Overflow, Subirrigated, and Terrace ecological sites. This site provided habitat for species requiring unfragmented grassland. Important habitat features and components found commonly or exclusively on this site may include sharp-tailed grouse leks; upland nesting habitat for grassland birds, forbs and insects for brood habitat; and a forage source for small and large herbivores. Many grassland- and shrub steppe-nesting bird populations are declining. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Shallow Clay ecological site remains intact and provides increasingly important habitat for grassland- and shrub steppe-nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as annual brome grasses and cheatgrass have impacted the biological integrity of the site for some grassland birds. Changes in historic fire regime and domestic grazing have impacted the forb/shrub/grass

percentages.

Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass (1.1): The predominance of grasses plus high diversity of forbs and shrubs in this community favors grazers and mixed-feeders, such as deer and pronghorn. Insects, such as pollinators, play a large role in maintaining the forb community and provide a forage base for grassland birds and other species. The complex plant structural diversity provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, lark bunting, western meadowlark, and sharp-tailed grouse are common and benefit from the structure and composition this plant community provides. This site provides important breeding habitat for the loggerhead shrike. This site provides excellent nesting and brood-rearing habitat for sharp-tailed grouse. Diverse prey populations are available for grassland raptors such as ferruginous hawk, Swainson's hawk, golden eagle, and prairie falcon.

The diversity of grasses, forbs, and shrubs provide high nutrition levels for small and large herbivores including voles, mice, spotted ground squirrel, desert cottontail, white- and black-tailed jackrabbit, and deer. The moderate stature of this plant community provides suitable thermal, protective, and escape cover for small herbivores and grassland birds. Predators utilizing this plant community include coyote, American badger, red fox, and long-tailed weasel. This plant community provides limited habitat for amphibians, mostly toads (i.e., Great Plains, Woodhouse's, and plains spade-foot). Prey abundance and shade opportunities may attract multiple reptile species such as gopher snake, milk snake, prairie rattlesnake, and western ornate box turtle to this site.

Rhizomatous Wheatgrass-Blue Grama/Sedge (1.2): Resulting from continuous season-long grazing, grama species (e.g., blue and sideoats), and sedges will become dominant. The forb and shrub diversity decreased. Density of species such as grasshopper sparrow, sharp-tailed grouse, and desert cottontail should remain unchanged. This plant community may provide areas suitable for lek site development. Species such as the horned lark, long-billed curlew, upland sandpiper, and white- and black-tailed jackrabbit will increase.

The shorter stature of this plant community limits thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel. The shift to shorter plant structure will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox.

Blue Grama/Sedge (2.1): Resulting from continuous heavy grazing, grama species (e.g., blue) and sedges will dominate. Forb and shrub abundance increases and provides valuable wildlife cover in the absence of adequate grass cover. However, the decrease in diversity of grasses will result in less seed production or lower quality nutrition for small herbivores including voles, mice, and spotted ground squirrel. Species such as desert cottontail may frequently use this site.

The short stature of this plant community limits suitable thermal, protective, and escape cover. Prey populations are reduced and are more vulnerable to raptor and mammalian predation. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Extreme impairment of the ecological processes impacts off-site aquatic habitats through excessive runoff, nutrient, and sediment loads. Elevated surface temperatures resulting from reduced cover and litter will greatly reduce habitat for most amphibian species, grassland birds, and mammals.

Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (3.1): Resulting from non-use or long-term light grazing and the invasion of non-native cool-season grasses, this plant community develops excessive litter and exhibits a reduction in plant density. The shift to a lower plant density but excessive liter does not favor shortgrass-nesting bird species. Species such as the horned lark, long-billed curlew, and upland sandpiper may not use this site. Density of species such as grasshopper sparrow, sharp-tailed grouse, and desert cottontail should remain unchanged. This plant community continues to provide areas suitable for lek site development.

The shorter stature of this plant community limits thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel. The shift to shorter plant structure will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox.

Grazing Interpretations:

The following list suggests annual, initial stocking rates for average growing conditions. These estimates are conservative and should be used only as guidelines in the initial stages of conservation planning. Commonly, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate estimates of carrying capacity should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. In consultation with the land manager, a more intensive grazing management program that results in improved harvest efficiencies and increased carrying capacity may be developed.

The following suggested initial stocking rates are based on 912 lb/acre (air-dry weight) per animal-unit-month (AUM) with a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA-NRCS, National Range and Pasture Handbook). An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow, with or without calf, for one month.

Plant Community: Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass (1.1)
Average Production (lb/acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

Plant Community: Rhizomatous Wheatgrass-Blue Grama/Sedge (1.2)
Average Production (lb/acre, air-dry): 1,200
Stocking Rate (AUM/acre): 0.33

Plant Community: Blue Grama/Sedge (2.1)
Average Production (lb/acre, air-dry): 900
Stocking Rate (AUM/acre): 0.25

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (3.1)
Average Production (lb/acre, air-dry): 1,400
*Stocking Rate (AUM/acre): 0.38

Plant Community: All other plant communities identified in this document have variable annual production values and require onsite sampling to determine initial stocking rates.

* Total annual production and stocking rates are highly variable and require onsite sampling.

** Total onsite annual production may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for livestock. During the dormant period, the forage for livestock likely have insufficient protein to meet livestock requirements. Added protein allows ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group D. Infiltration varies from moderately slow to moderate and runoff varies from low to high depending on slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where shortgrasses form a dense sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff. Refer to the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Harvesting the seeds of native plants can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site concept has passed Quality Control (QC) and Quality Assurance (QA) to ensure that the site meets the 2014 NESH standards for a Provisional ecological site description. This is an updated “Previously Approved” ESD that represents a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 (rev.1, 2003) National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All Revision Notes: “Previously Approved” Provisional
This Provisional ecological site description (ESD) has passed Quality Control (QC) and Quality Assurance (QA) to ensure the it meets the 2014 NESH standards for a Provisional ecological site description.

This ESD is an updated “Previously Approved” ESD that represented a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of five years and is a proven functional document for conservation planning. The “Previously Approved” ESD may not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that it will continue refinement toward an “Approved” status.

Site Development and Testing Plan
Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are required to produce the final document.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, range management specialist (RMS), NRCS; Jill Epley, RMS, NRCS; Rick Peterson, RMS, NRCS; David Steffen, RMS, NRCS; Jeff Vander Wilt; RMS, NRCS; Phil Young, soil scientist, NRCS, and Wade Anderson, range professional and rancher.

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Approval

Suzanne Mayne-Kinney, 12/16/2024

Acknowledgments

This ecological site was reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS on 1/15/2019.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Stan Boltz, Mitch Faulkner, Emily Helms, John Hartung, Ryan Murray, George Gamblin, Rick Peterson, Nadine Bishop, Jeff Nichols
Contact for lead author	jeffrey.nichols@usda.gov
Date	12/12/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Typically, none. Rills may occur on slopes greater than 15 percent. When they do occur, they are discontinuous.

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2. **Presence of water flow patterns:** Typically, none. If water flow patterns are present, they will be barely visible and discontinuous with numerous debris dams present.

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3. **Number and height of erosional pedestals or terracettes:** A few pedestalled plants may occur, typically on slopes greater than 15 percent, 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 typically less than 5 percent on north and east facing slopes and typically 10 percent or less on south and west facing slopes. Bare ground patches are typically less than 2 to 3 inches (5.1 to 7.6 cm) in diameter.

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5. **Number of gullies and erosion associated with gullies:** Typically, none. Limited head cutting may form after heavy precipitation events. Existing gullies should be stabilized with good vegetative cover.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind scoured areas and depositional areas should not be present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter size classes generally move short distances (less than 6 inches or 15.25 cm), some medium size class litter will move very short (less than 3 inches or 8.5 cm) distances. Litter debris dams are occasionally present.

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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 should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 3 to 8 inches (7.6 to 20.3 cm) thick. Colors range from brown, reddish gray, to light brownish gray (values of 5 to 6) when dry and dark grown, dark grayish brown, to dark reddish brown (values of 4) when moist. Structure should typically be fine granular at least in the upper A-horizon. Soils will be slightly to moderately alkaline. Some series will have an impervious shale layer at 10 to 20 inches (25.4 to 50.8 cm).

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid and tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration. Invasion of introduced cool-season grasses such as annual bromes may have an adverse impact infiltration and runoff.

    Relative composition is approximately 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs or trees. The grass component is composed of C3, rhizomatous grasses (20-40%), C3, bunchgrasses (10-25%), C4, mid-grasses (10-25%), C4, short grasses (5-15%), C4, tallgrasses (3-10%), and grass-likes (1-5%).

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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. When dry, the B-horizons can be hard and appear to be compacted, but no platy structure will 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, C3, rhizomatous grass, 320-640 #/ac, 20-40% (1 species minimum): thickspike Wheatgrass, western wheatgrass.
2. Native, perennial, C3, bunchgrass, 160-400 #/ac, 10-25%, (1 species minimum): bluebunch wheatgrass, green needlegrass, needle and thread, prairie Junegrass, Sandberg bluegrass, squirreltail.
3. Native, perennial, C4, midgrass, 160-400 #/ac, 10-25%, (2 species minimum): little bluestem, sideoats grama, plains muhly.

Phase 1.2
1. Native, perennial, C4, shortgrass, 120-360 #/ac, 10-30%, (1 species minimum): blue grama, buffalograss, hairy grama, Fendler threeawn.

Sub-dominant: Phase 1.1
1. Native, perennial, C4, shortgrass, 80-240 #/ac, 5-15%, (1 species minimum): blue grama, buffalograss, hairy grama, Fendler threeawn.

Phase 1.2
1. Native, perennial, C3, rhizomatous grass, 60d-240 #/ac, 5-20% (1 species minimum): thickspike Wheatgrass, western wheatgrass.
2. Native, perennial, C3, bunchgrass, 60-240 #/ac, 5-20%, (1 species minimum): bluebunch wheatgrass, green needlegrass, needle and thread, prairie Junegrass, Sandberg bluegrass, squirreltail.
3. Native, perennial, C4, tall- and midgrass, 60-180 #/ac, 5-15%, (2 species minimum): little bluestem, sideoats grama, plains muhly, big bluestem, prairie sandreed.
4. Native forbs, 60-180 #/ac, 5-15% (8 species minimum): white sagebrush, white heath aster, hairy false goldenaster, purple prairie clover, pussytoes, upright prairie coneflower, scurfpea, scarlet beeblossom, and other forbs that vary from location to location.

Other: Minor - Phase 1.1
1. Native, perennial, C4, tallgrass, 48-160 #ac, 3-10%: big bluestem, prairie sandreed.
2. Native forbs, 80-160#/ac, 5-10%: forbs present will vary from location to location.
3. Shrubs, 32-160 #/ac, 2-10%: shrubs present will vary from location to location.
4. Native, grass-likes, 16-80 #/ac, 1-5%: sedges.

Minor - Phase 1.2
1. Native grass-likes, 60-120 #/ac, 5-10%: sedges;
2. Shrubs, 24-120 #/ac, 2-10%: shrubs present vary from location to location.
3. Non-native, C3 grass, 0-60 #/ac, 0-5%: cheatgrass, Kentucky bluegrass, smooth brome, field brome.

Trace - Phase 1.1
1. Native, coniferous trees, 0-16 #/ac, 0-1%: Rocky Mountain Juniper, eastern redcedar

Trace - Phase 1.2
1. Native, coniferous trees, 0-12 #/ac (0-1%): Rocky Mountain Juniper, eastern redcedar

Additional: The Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass Community or Reference Community (1.1) consists of nine F/S groups. These groups, in order of relative abundance are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass = native, perennial, C4, midgrass; native, perennial, C4, shortgrass; native forbs; native, perennial, C4, tallgrass; shrubs; native grass-likes; and native, coniferous trees.

The Rhizomatous Wheatgrass-Blue Grama/Sedge Community (1.2) consists of nine F/S groups. These groups, in order of relative abundance, are native, perennial, C4, shortgrass; native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass = native, perennial, C4, tall- and midgrass = native forbs; native grass-likes; shrubs; non-native, C3 grass; and native, coniferous trees.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.

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).

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production is 1,600 pounds per acre in a year with normal precipitation and temperatures. Low and High production years should yield 1,200 and 2,000 pounds per acre respectively.

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 non-native invasive species are present. Annual bromes and eastern red cedar are known invasives that have the potential to become dominant or co-dominant on this site. Consult the state noxious weed and state watch lists for potential invasive species. Note: species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.

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.