USDA Natural Resources
Conservation Service

Ecological site R064XY045NE
Dense Clay

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General information

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

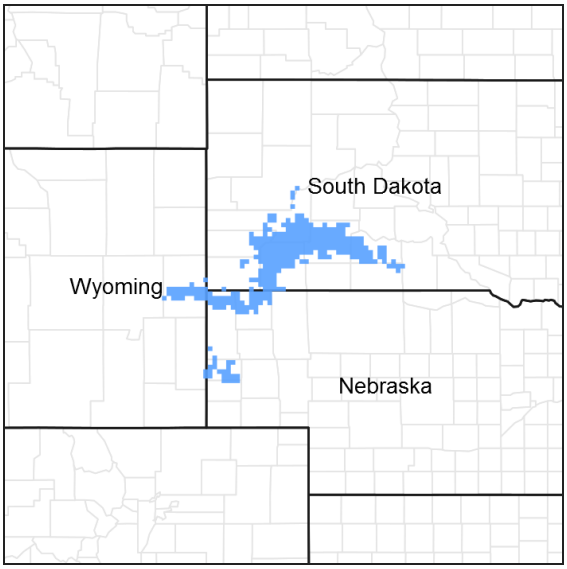

Figure 1. Mapped extent

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 Dense Clay ecological site occurs throughout the MLRA. It is located in uplands, valleys, alluvial fans, and stream terraces. Slopes range from 0 to 15 percent. Soils are formed from dense clayey alluvium or residuum from soft shale. The clay surface layer is 1 to 5 inches thick. Soils are greater than 20 inches deep, with a clay content exceeding 55 percent. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long can extend to a depth below 20 inches. Permeability is very slow unless the soil is dry. Bare ground will be common.

Vegetation in the Reference State (1.0) is dominated by cool-season rhizomatous wheatgrasses. Other grasses and grass-likes that occur in minor amounts include green needlegrass, buffalograss, blue grama, Sandberg bluegrass, and sedges. Dominant forbs include biscuitroot, wild parsley, and western yarrow. Shrubs, primarily occurring in the western portions of the MLRA, include Wyoming big sagebrush, saltbush, cactus, and possibly greasewood.

Associated sites

R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can be found on similar landscapes adjacent to the Dense Clay site. Soils will have less clay content than the Dense Clay site.
R064XY044NE	**Claypan** The Claypan ecological site can be found adjacent to or intermixed with the Dense Clay site. Claypan soils will have a sodium-affected claypan within 16 inches of the surface.
R064XY046NE	**Thin Claypan** The Thin Claypan ecological site can be found adjacent to or intermixed with the Dense Clay site. Thin Claypan soil will have a sodium-affected claypan within 4-6 inches of the surface.
R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can be found on similar landscapes adjacent to the Dense Clay site. Soils will have less clay content than the Dense Clay site.

Similar sites

R064XY046NE	**Thin Claypan** The Thin Claypan ecological site will occur on similar landscape positions but the soil will have an obvious sodium effected claypan within 4 to 6 inches of the surface. The plant community will have a greater dominance of shortgrasses and salt-tolerant species, and forage production will be less than the Dense Clay site.
R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can occur on similar landscape positions. The plant community will have more green needlegrass and higher forage production than the Dense Clay site.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can occur on similar landscape positions. The plant community will have more green needlegrass and higher forage production than the Dense Clay site.

Table 1. Dominant plant species

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

Physiographic features

The Dense Clay ecological site occurs on nearly level to sloping uplands, valleys, fans, and stream terraces.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace (2) Alluvial fan (3) Plain
Runoff class	Negligible to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–5,000 ft
Slope	0–15%
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)	92-121 days
Freeze-free period (characteristic range)	119-137 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)	129 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) MARTIN [USC00395281], Martin, SD

- (6) CEDAR BUTTE 1NE [USC00391539], White River, SD
- (7) LUSK 2 SW [USC00485830], Lusk, WY
- (8) TORRINGTON 29N [USC00488997], Jay Em, WY
- (9) INTERIOR 3 NE [USC00394184], Interior, SD
- (10) CHADRON 3NE [USC00251578], Chadron, NE

Influencing water features

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

Wetland description

Not Applicable.

Soil features

The common features of soils in this site are the clay-textured soils and slopes of 0 to 15 percent. The soils in this site are moderately well to well drained and formed in clayey alluvium or residuum from soft shale. The clay surface layer ranges from 1 inch to 5 inches thick. The soils have a slow to very slow infiltration rate, except after dry periods when initial uptake may be rapid due to cracking of the surface. Gilgai microrelief occurs in most areas. These soils crack when dry. Wet surface compaction can occur with heavy traffic. This site typically 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. The soil surface is stable and intact. Subsurface soil layers are moderately restrictive to water movement and root penetration.

Major soils correlated to the Dense Clay site: Swanboy and Whitewater.

These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about six percent.

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–shale (2) Residuum–shale
Surface texture	(1) Clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	20–80 in
Available water capacity (0-40in)	2–4 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–25
Soil reaction (1:1 water) (0-40in)	5.6–9

Ecological dynamics

The Dense 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.

These soils are high in clay and have a low available water capacity. The shrink-swell potential is very high, resulting in cracks greater than two inches wide during dry periods. Western wheatgrass, with its strong rhizomes and high tolerance to drought, is able to thrive in these soils. Western wheatgrass dominates the site and production is closely related to the vigor of western wheatgrass. The major drivers of the Dense Clay ecological site are drought, grazing, and the invasion of non-native cool-season grasses.

Slick spots are sometimes associated with the Dense Clay ecological site. They are areas of bare ground or sparsely vegetated areas that are affected by high sodium concentrations. Soil factors are the dominant influence on slick spots and grazing management does not appear to affect these areas.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1). 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

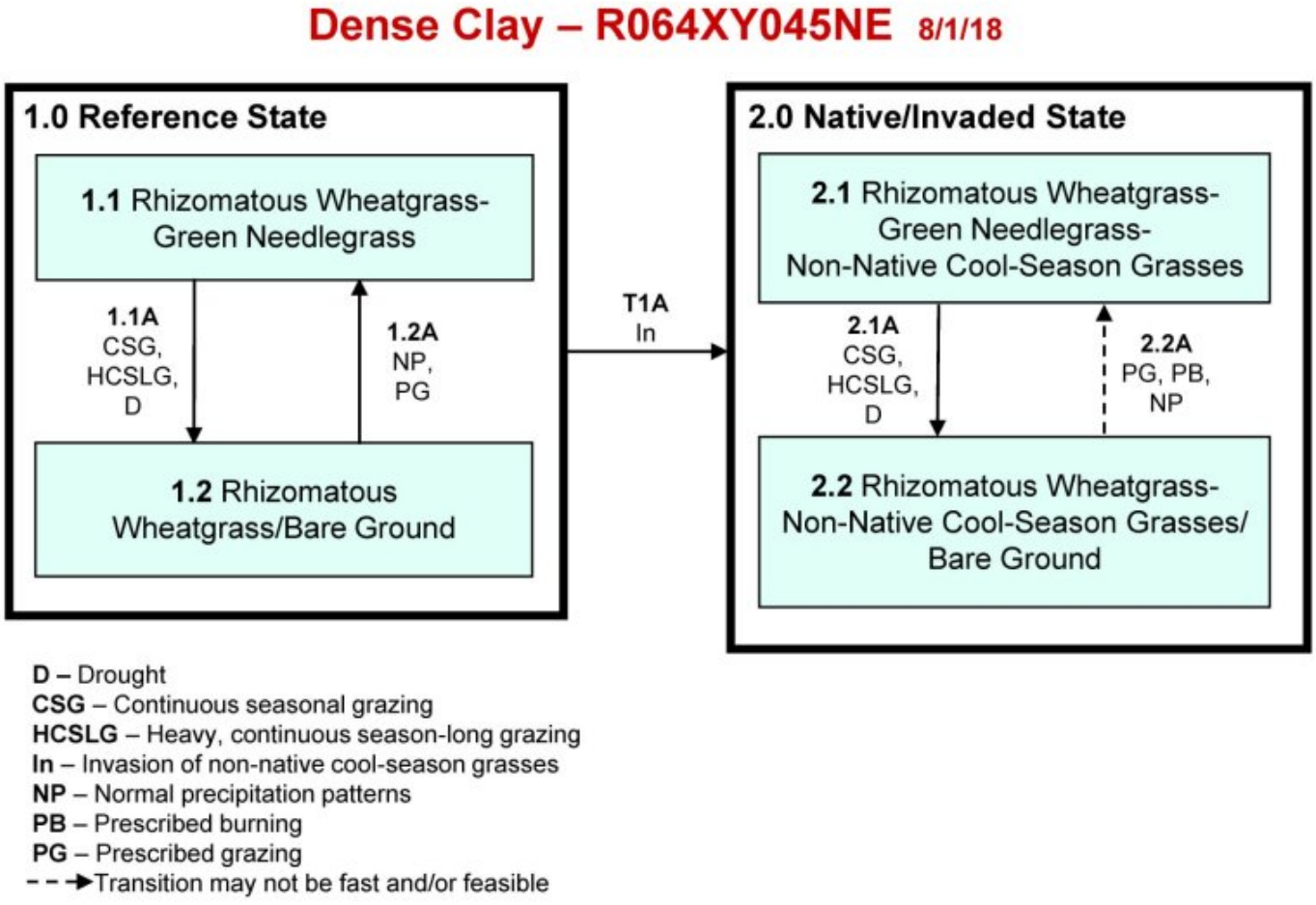

Diagram Legend - Dense Clay - R064XY045NE

T1A	**Invasion of non-native cool-season annual, and/or perennial grasses.**	
1.1A	**1.1 - 1.2**	**Continuous seasonal grazing or heavy, continuous season-long grazing, or heavy grazing in combination with drought.**
1.2A	**1.2 - 1.1**	**Prescribed grazing and a return to normal precipitation patterns following drought.**
2.1A	**2.1 - 2.2**	**Continuous seasonal grazing or heavy, continuous season-long grazing, and extended drought.**
2.2A	**2.2 - 2.1**	**Prescribed grazing, possibly prescribed burning, and a return to normal precipitation patterns following drought. This transition may take a considerable amount of time and, in the end, may not meet management goals.**

State 1
Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. Overall the plant diversity on this site is relatively low. The Reference State is dominated by cool-season grasses. Forbs will be common. Shrubs species, including pricklypear cactus, may or may not be present. In the far western portion of MLRA 64, Wyoming big sagebrush may be present in minor amounts. Grazing or the lack of grazing, and drought are the major drivers between plant communities. The Reference State is very susceptible to invasion of non-native cool-season annual grasses.

Community 1.1
Rhizomatous Wheatgrass-Green Needlegrass

Interpretations are primarily based on the Rhizomatous Wheatgrass-Green Needlegrass Plant Community. This is

also considered to be the Reference Plant Community (1.1). Potential vegetation consists of about 90 percent grasses or grass-like plants, 5 percent forbs, and 5 percent shrubs. Cool-season grasses dominate the plant community. The major grasses include western wheatgrass and green needlegrass. Other grasses and grass-likes that occur on this plant community include blue grama, buffalograss, Sandberg bluegrass, and sedge. Forbs growing in this plant community commonly include biscuitroot, wild parsley, scarlet globemallow, gumbo lily, and American vetch. Shrubs commonly found include brittle and pricklypear cacti, and in the western portion of MLRA 64, Wyoming big sagebrush may also be found. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. However, two to three years of drought can greatly reduce the vigor and abundance of the green needlegrass and western wheatgrass, increasing the percentage of bare ground and creating a moderate to high potential of soil erosion. The actual species composition may not be greatly changed; however, the production of this plant community varies greatly with fluctuations in precipitation. Water infiltration is low, and runoff is moderate to high because of the high clay content in the soil. Plant litter is properly distributed with some movement offsite and natural plant mortality is low.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	900	1402	1795
Forb	0	75	155
Shrub/Vine	0	23	50
Total	**900**	**1500**	**2000**

Figure 9. 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		

Community 1.2
Rhizomatous Wheatgrass/Bare Ground

This plant community develops under droughty conditions or continuous seasonal grazing, or heavy, continuous season-long grazing. The potential vegetation is made up of 90 percent grasses and grass-likes, 5 percent forbs, and 5 percent shrubs. The grass component consists almost entirely of western wheatgrass. Other perennial grasses are generally not found. Forbs found in this plant community include pennycress, curlycup gumweed, sweet clover, and annual forbs. Shrubs found include brittle cactus and plains pricklypear. When compared to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1), the vigor, production, and basal density of the grasses has been reduced. Often the site will consist of bare ground with a few sprigs of western wheatgrass. Cheatgrass will likely invade this plant community. The plant diversity is extremely low. Due to the low basal density, the hazard of soil erosion is high. Moving this plant community toward the Rhizomatous Wheatgrass-Green Needlegrass Plant Community can be accomplished through prescribed grazing and favorable climatic conditions.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	500	760	910
Forb	0	20	45
Shrub/Vine	0	20	45
Total	**500**	**800**	**1000**

Figure 11. 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		

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing, primarily in early spring and/or fall, or heavy, season-long grazing, or heavy grazing in combination with drought will convert this plant community to the Rhizomatous Wheatgrass/*Bare Ground* Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

With average or above-average precipitation and prescribed grazing that included proper stocking rates, change in season of use, and adequate time for plant recovery, this plant community will convert to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1).

State 2
Native/Invaded State

This State is dominated by rhizomatous wheatgrass, green needlegrass, and up to 30 percent non-native cool-season annual and/or perennial grasses. The Native/Invaded State can resemble the Reference State (1.0) in composition and production, except that the Native/Invaded State is invaded by non-native cool-season grasses. This plant community can maintain productivity if managed properly and does not degrade.

Community 2.1
Rhizomatous Wheatgrass-Green Needlegrass-Non-Native-Cool-Season Grasses

This plant community is the result of the invasion of non-native cool-season grasses, and forbs. Potential vegetation consists of about 90 percent grasses or grass-like plants, 5 percent forbs, and 5 percent shrubs. Cool-season grasses dominate the plant community. The major grasses include western wheatgrass, and green needlegrass. In MLRA 64 annual brome grasses, including cheatgrass and field brome are the most common invaders on this site. Other invasive species can include Kentucky bluegrass, smooth brome, crested wheatgrass, and sweetclover. This plant community will be similar to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1) in composition and production.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	800	1403	1995
Forb	0	75	155
Shrub/Vine	0	22	50
Total	**800**	**1500**	**2200**

Figure 13. 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		

Community 2.2
Rhizomatous Wheatgrass-Non-Native-Cool-Season Grasses/Bare Ground

This plant community develops under droughty conditions, heavy spring grazing, or long-term heavy continuous

grazing. The potential vegetation is made up of about 85 percent grasses and grass-like plants, 10 percent forbs, and 5 percent shrubs. The grass component is often completely dominated by rhizomatous wheatgrass and annual bromes. Other perennial grasses are generally not found on this site or are greatly diminished. Forbs will include field pennycress, curlycup gumweed, and sweetclover. Brittle cactus and pricklypear are the commonly found shrubs. When compared to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1), the vigor, production, and basal density of the native grasses have been reduced. Often the site will consist of bare ground with a few sprigs of western wheatgrass. Cool-season grass production is lessened, along with a reduction in warm-season grasses such as blue grama and buffalograss. Cheatgrass and field brome have the potential to increase dramatically on this site with the proper weather factors. Plant diversity is extremely low. Due to low basal density, the hazard of soil erosion is high. This plant community can be resistant to change.

Figure 14. 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		

Pathway 2.1A
Community 2.1 to 2.2

Continuous seasonal grazing (grazing at moderate to heavy stocking levels at the same time of year each year), or heavy, continuous season-long grazing, or extended periods of drought will shift this community to the Rhizomatous Wheatgrass-Non-Native-Cool-Season Grasses/*Bare Ground* Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing, including alternating season of use and providing adequate recovery periods, or periodic light to moderate grazing possibly including periodic rest, and a return to normal precipitation patterns following drought will convert this plant community to the Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses Plant Community (2.1). Prescribed burning may also be a tool to facilitate this transition.

Transition T1A
State 1 to 2

Invasion of non-native cool-season annual and perennial grasses, and other invasive and/or noxious species will lead this State (1.0) over a threshold to the Native/Invaded State (2.0). Once this threshold is crossed, it highly unlikely to return to the Reference State (1.0).

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	**Western Wheatgrass**			600–900	
	western wheatgrass	PASM	*Pascopyrum smithii*	600–900	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–150	–
2	**Cool-Season Bunchgrasses**			300–600	
	green needlegrass	NAVI4	*Nassella viridula*	300–600	–
3	**Warm-Season Grasses**			0–150	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–150	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–75	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–75	–

4	**Native Grasses and Grass-likes**			0–75	
	Grass, perennial	2GP	*Grass, perennial*	0–75	–
	sedge	CAREX	*Carex*	0–75	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–75	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–75	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–15	–
Forb					
6	**Forbs**			0–150	
	American vetch	VIAM	*Vicia americana*	0–75	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–75	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–75	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–75	–
	common yarrow	ACMI2	*Achillea millefolium*	0–45	–
	onion	ALLIU	*Allium*	0–45	–
	Forb, perennial	2FP	*Forb, perennial*	0–45	–
	deathcamas	ZIGAD	*Zigadenus*	0–30	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–30	–
	pussytoes	ANTEN	*Antennaria*	0–30	–
	milkvetch	ASTRA	*Astragalus*	0–30	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–30	–
	bastard toadflax	COUM	*Comandra umbellata*	0–30	–
	western wallflower	ERAS2	*Erysimum asperum*	0–30	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–30	–
	bladderpod	LESQU	*Lesquerella*	0–30	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–30	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–30	–
	bluebells	MERTE	*Mertensia*	0–30	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–30	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–30	–
	phlox	PHLOX	*Phlox*	0–30	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–30	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–30	–
Shrub/Vine					
7	**Shrubs**			0–45	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–45	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–30	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–30	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–30	–

Table 9. Community 1.2 plant community composition

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

Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			440–640	
	western wheatgrass	PASM	*Pascopyrum smithii*	440–640	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–80	–
2	**Cool-Season Bunchgrasses**			0–80	
	green needlegrass	NAVI4	*Nassella viridula*	0–80	–
3	**Warm-Season Grasses**			0–40	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–40	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–24	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–24	–
4	**Native Grasses & Grass-Likes**			0–24	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–24	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–24	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–24	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–24	–
5	**Non-Native Cool-Season Grasses**			0–8	
	cheatgrass	BRTE	*Bromus tectorum*	0–8	–
	field brome	BRAR5	*Bromus arvensis*	0–8	–
Forb					
6	**Forbs**			0–40	
	sweetclover	MEOF	*Melilotus officinalis*	0–40	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–24	–
	Forb, perennial	2FP	*Forb, perennial*	0–24	–
	Forb, annual	2FA	*Forb, annual*	0–24	–
	American vetch	VIAM	*Vicia americana*	0–24	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–24	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–24	–
	deathcamas	ZIGAD	*Zigadenus*	0–24	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–24	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–24	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–16	–
	onion	ALLIU	*Allium*	0–8	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–8	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–8	–
	western wallflower	ERAS2	*Erysimum asperum*	0–8	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–8	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–8	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–8	–
	milkvetch	ASTRA	*Astragalus*	0–8	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–8	–
	phlox	PHLOX	*Phlox*	0–8	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–8	–

	coneflower				
	pussytoes	ANTEN	*Antennaria*	0–8	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–8	–
	bastard toadflax	COMAN	*Comandra*	0–8	–
	bladderpod	LESQU	*Lesquerella*	0–8	–
	bluebells	MERTE	*Mertensia*	0–8	–
Shrub/Vine					
7	**Shrubs**			0–40	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–40	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–24	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–16	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–16	–

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			525–825	
	western wheatgrass	PASM	*Pascopyrum smithii*	525–825	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–75	–
2	**Cool-Season Bunchgrasses**			225–525	
	green needlegrass	NAVI4	*Nassella viridula*	225–525	–
3	**Warm-Season Grasses**			0–150	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–150	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–75	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–75	–
4	**Native Grasses & Grass-Likes**			0–75	
	threadleaf sedge	CAFI	*Carex filifolia*	0–75	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–30	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–30	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–30	–
5	**Non-Native Cool-Season Grasses**			75–450	
	cheatgrass	BRTE	*Bromus tectorum*	75–400	–
	field brome	BRAR5	*Bromus arvensis*	0–100	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–50	–
	smooth brome	BRIN2	*Bromus inermis*	0–50	–
Forb					
6	**Forbs**			0–150	
	sweetclover	MELIL	*Melilotus*	0–80	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–75	–
	American vetch	VIAM	*Vicia americana*	0–75	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–75	–
	textile onion	ALTE	*Allium textile*	0–45	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–45	–

	Forb, perennial	2FP	*Forb, perennial*	0–45	–
	Forb, annual	2FA	*Forb, annual*	0–45	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–30	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–30	–
	western wallflower	ERAS2	*Erysimum asperum*	0–30	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–30	–
	pussytoes	ANTEN	*Antennaria*	0–30	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–30	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–30	–
	deathcamas	ZIGAD	*Zigadenus*	0–30	–
	bastard toadflax	COMAN	*Comandra*	0–30	–
	bladderpod	LESQU	*Lesquerella*	0–30	–
	prairie bluebells	MELA3	*Mertensia lanceolata*	0–30	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–30	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–30	–
	milkvetch	ASTRA	*Astragalus*	0–15	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–15	–
	phlox	PHLOX	*Phlox*	0–15	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–15	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–15	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–15	–
Shrub/Vine					
7	**Shrubs**			0–45	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–45	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–30	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–30	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–30	–

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 Dense Clay ecological site provides upland grassland cover with an associated forb and shrub component. It was typically part of an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Claypan, Clayey, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Loamy Terrace ecological sites. This site provided habitat for species that require unfragmented grassland. Important habitat features include 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. Swift fox, black-footed ferret, and American bison have been reintroduced into certain areas within this MLRA.

The majority of the Dense 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-Green Needlegrass (1.1):
The predominance of grasses (mostly wheatgrass) and forbs 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 limited 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 northern harrier, ferruginous hawk, Swainson’s hawk, golden eagle, and prairie falcon.

Forbs provide high nutrition levels for small and large herbivores including mice, spotted ground squirrels, white- and black-tailed jackrabbit, desert cottontail, and deer. This Dense Clay ecological site provides suitable wintering habitat for pronghorn. 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. 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, along with lesser numbers of various lizard species.

Rhizomatous Wheatgrass-*Bare Ground* (1.2):
This plant community develops as a result of heavy, continuous grazing and precipitation cycles. Forb abundance and diversity decrease significantly. The loss of taller grasses limits species such as sharp-tailed grouse and desert cottontail. Species such as horned lark, long-billed curlew, upland sandpiper, and white- and black-tailed jackrabbit will increase due to the increase in open areas. Prey populations are limited reducing availability for grassland raptors such as golden eagle, ferruginous hawk, and Swainson’s hawk. Limited shade opportunities and prey will decrease reptile species such as gopher snake, milk snake, and western ornate box turtle. However, this site may contain increased numbers of prairie rattlesnake and various lizard species.

Native/Invaded State (2.0).
These plant communities can develop excessive litter and exhibits a reduction in plant density. The shift to a lower plant density with excessive litter 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. These plant communities may continue to provide areas suitable for lek sites.
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-Green Needlegrass (1.1)
Average Production (lb/acre, air-dry): 1,500
Stocking Rate (AUM/acre): 0.41

Plant Community: Rhizomatous Wheatgrass-*Bare Ground* (1.2)
Average Production (lb/acre, air-dry): 800
Stocking Rate (AUM/acre): 0.22

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (2.1)
Average Production (lb/acre, air-dry): 1,500
* Stocking Rate (AUM/acre): 0.41

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 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.

NRI - 1 Record from 2005, Shannon Co, SD
NRI - 1 Record from 2005, Jackson Co, SD

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Contributors

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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 1/10/2019.

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:** None. Rills are not expected on this site.

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2. **Presence of water flow patterns:** Typically, none. When present water flow patterns will be barely visible and discontinuous.

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3. **Number and height of erosional pedestals or terracettes:** None. Pedestals and/or terracettes should not be present on this site.

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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 of 5 to 30 percent is typical. The higher bare ground levels will occur during extended dry periods. Bare ground patches are 6 to 8 inches (15-20 cm) in diameter.

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5. **Number of gullies and erosion associated with gullies:** None. Gullies should not be present.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Typically, none. Litter should fall in place. Slight amount of movement (less than 6 inches or 10.5 cm) of fine litter is possible, but not normal.

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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 3 or greater. Surface organic matter usually adheres to the soil surface. Soil surface fragments will typically retain structure for at least short periods when dipped in distilled water. In soils with visible salts near the surface, fragments may dissolve in less than 1 minute.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon should be 1 to 5 inches (2.5-12.7 cm) thick. Soil colors are light olive gray to gray when dry (values of 3-5) and olive or dark gray (value of 5) when moist. Structure typically is platy parting to subangular blocky or occasionally fine granular in the upper 0.5 inch (1.25 cm). Soil cracking is natural and not caused by erosion.

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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. Infiltration is not often affected by a change in plant composition as rhizomatous cool-season species typically dominate the site.

    Relative composition is approximately 90 percent grasses or grass-like plants, 5 percent forbs, and 5 percent shrubs. The grass and grass-like component is composed of C3, rhizomatous grasses (40-60%), C3, bunchgrasses (20-40%), C4, mid- and shortgrasses (0-10%), and grass-likes (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. A-horizon naturally has some platy structure. Compaction layers, if formed by management, do not typically persist. Compaction will be difficult to determine due to the nature of soils in this ecological site. Compaction can sometimes occur with heavy traffic (livestock or vehicles) when wet.

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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, 600-900, 40-60% (1 species minimum): western wheatgrass, thickspike wheatgrass.
    2. Native, perennial, C3, bunchgrass, 300-600 #/ac, 20-40% (3 species minimum): green needlegrass, needle and thread, porcupinegrass, prairie Junegrass, Sandberg bluegrass.

    Phase 1.2
    1. Native, perennial, C3, rhizomatous grass, 440-640 #/ac, 55-80% (1 species minimum): western wheatgrass,

thickspike wheatgrass

Sub-dominant: Phase 1.1
1. Native, perennial, C4, mid- and shortgrass, 80-240 #/ac, 4-15% (1 species minimum): blue grama, buffalograss, sideoats grama.

Other: Minor - Phase 1.1
1. Native forbs, 0-150 #/ac (0-10%): forbs present will vary from location to location.
2. Native grass-likes, 0-75 #/ac, 0-5%: threadleaf sedge.
3. Shrubs, 0-45 #/ac, 0-3%: shrubs present will vary from location to location.

Minor - Phase 1.2
1. Native, perennial, C3, bunchgrass, 0-80 #/ac, 0-10%: green needlegrass, prairie Junegrass, Sandberg bluegrass.
2. Native, perennial, C4, mid- and shortgrass, 0-40 #/ac, 0-5%: blue grama, buffalograss, sideoats grama.
3. Native forbs, 0-40 #/ac, 0-5%: forbs present will vary from location to location.
4. Shrubs, 0-40 #/ac, 0-5%: shrubs present vary from location to location.
5. Native grass-likes, 0-24 #/ac, 0-3%: threadleaf sedge.

Trace - Phase 1.1
1. Native, annual grass, 0-15 #/ac, 0-1%: six-weeks fescue.

Trace - Minor - Phase 1.2
1. Non-native, annual, C3 grass, 0-8 #/ac, 0-1%: cheatgrass, field brome.

Additional: The Rhizomatous Wheatgrass-Needlegrass Community or Reference Community (1.1) is composed of seven F/S groups. These groups, in order of relative abundance, are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4, mid- and shortgrass; native forbs; native grass-likes; shrubs; and native, annual grass.

The Rhizomatous Wheatgrass-*Bare Ground* Community (1.2) is composed of seven F/S groups which are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4 mid- and shortgrass; native forbs; shrubs; grass-likes, and non-native C3 grasses.

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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.

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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 20 to 60 percent and at a depth of approximately 0.25 inch (0.65 cm).

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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 1,500 pounds per acre on an air dry basis. Low and high production years should yield 900 and 2,000 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: No non-native invasive species are present. Annual bromes, crested wheatgrass, and smooth brome 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.

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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.
