USDA Natural Resources Conservation Service

Ecological site R064XY035NE
Clayey 17-20 PZ

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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.

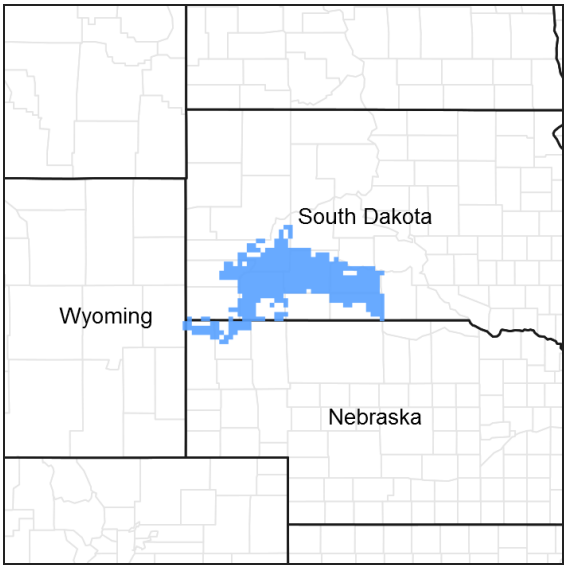


Figure 1. Mapped extent

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 is 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 ranges from 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, and 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: 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—311Fh.
Pine Ridge Escarpment—311Fj.
High Plains—311Fk.
Hartville Uplift—311Fm.
Western Nebraska Sandy and Silty Tablelands—311Fn.
Keye Paha Tablelands—331Ft.

Powder River Basin Section—311G:
Subsection: Powder River Basin—311Ge.

Ecological site concept

The Clayey 17-20" PZ ecological site is throughout the wetter portion of MLRA 64. It is on upland landscapes and does not receive additional moisture from runoff or overflow. Slopes typically range from 0 to 20 percent. Soils are deep (greater than 20 inches). Surface textures range from silty loam to clay, and the surface layer is 3 to 7 inches thick. The subsurface ranges from silty clay to clay.

The vegetation in the Reference State consists of a mix of cool- and warm-season grasses. Mid-statured, cool-season grasses are the dominant group. Western wheatgrass and green needlegrass are the dominant cool-season grasses. Buffalograss, blue grama, and sideoats grama are the dominant warm-season grasses. Forbs are common and diverse. Shrubs, such as rose and western snowberry, are present in minor amounts in some places. The Clayey 17-20” PZ site is susceptible to invasion by non-native, cool-season grasses.

Associated sites

R064XY027NE	**Clayey Overflow** The Clayey Overflow ecological site is lower on the landscape than the Clayey 17-20” PZ ecological site on flood plains and along creek channels.
GX064X01X036	**Loamy 17-20" PZ** The Loamy 17-20” PZ ecological site is in landscape positions that are similar and adjacent to the Clayey 17-20” PZ ecological site.
R064XY037NE	**Thin Upland** The Thin Upland ecological site is on steeper slopes adjacent to the Clayey 17-20” PZ ecological site.
R064XY039NE	**Shallow Clay** The Shallow Clay ecological site is on ridgetops and steep slopes adjacent to the Clayey 17-20” PZ ecological site.

Similar sites

GX064X01X036	**Loamy 17-20" PZ** The Loamy 17-20” PZ ecological site has more needle and thread than the Clayey 17-20” PZ ecological site and has green needlegrass as a minor component.
R064XY027NE	**Clayey Overflow** The Clayey Overflow ecological site has more big bluestem and greater forage production than the Clayey 17-20” PZ ecological site.

Table 1. Dominant plant species

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

Physiographic features

The Clayey 17-20” PZ ecological site is on nearly level to steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Plain (3) Stream terrace (4) Hill

Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–5,000 ft
Slope	0–20%
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 speed averages 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)	106-114 days
Freeze-free period (characteristic range)	122-134 days
Precipitation total (characteristic range)	18-20 in
Frost-free period (actual range)	102-119 days
Freeze-free period (actual range)	121-148 days
Precipitation total (actual range)	17-20 in
Frost-free period (average)	110 days
Freeze-free period (average)	131 days
Precipitation total (average)	19 in

Climate stations used

- (1) CEDAR BUTTE 1NE [USC00391539], White River, SD
- (2) CHADRON 3NE [USC00251578], Chadron, NE
- (3) PORCUPINE 11 N [USC00396736], Kyle, SD
- (4) HARRISON 4NW [USC00253617], Harrison, NE
- (5) FT ROBINSON [USC00253015], Crawford, NE
- (6) GORDON 6N [USC00253355], Gordon, NE
- (7) PINE RIDGE AP [USW00094039], Pine Ridge, SD
- (8) INTERIOR 3 NE [USC00394184], Interior, SD
- (9) LONGVALLEY [USC00394983], Long Valley, SD

- (10) MARTIN [USC00395281], Martin, SD

Influencing water features

No riparian areas or wetland features are directly associated with the Loamy 17-20” PZ ecological site.

Wetland description

Not Applicable.

Soil features

The soils in this site commonly have a surface layer of silty loam to clay and have slopes of 0 to 20 percent. The soils are well-drained and formed in alluvium, colluvium, and residuum derived primarily from shale. The surface layer is 3 to 7 inches thick. The texture of the subsurface ranges from silty clay to clay. The soils have a moderately slow or slow infiltration rate. When dry, these soils crack. Surface compaction can occur if the soils are subject to heavy traffic when wet. This site typically has slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous and obstructed by numerous debris dams or vegetative barriers. The soil surface is stable and intact. Subsurface soil layers are not restrictive to water movement and root penetration.

Soils correlated to the Clay 17-20” PZ site: Blackpipe, Bufton, Cactusflats, Denby, Higgins, Kyle, Larvie, Metre, Norrest, Okreek, Pierre, and Savo.

Blackpipe and Savo can also be correlated to the Loamy 17–20” PZ ecological site.

The 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 shift the species composition, production, or both.

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

Table 4. Representative soil features

Parent material	(1) Clayey shale
Surface texture	(1) Silty clay loam (2) Clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	20–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	4–7 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–10
Soil reaction (1:1 water) (0-40in)	6.1–9

Subsurface fragment volume <=3" (Depth not specified)	0–13%
Subsurface fragment volume >3" (Depth not specified)	0–6%

Ecological dynamics

The Clayey 17-20” PZ 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.

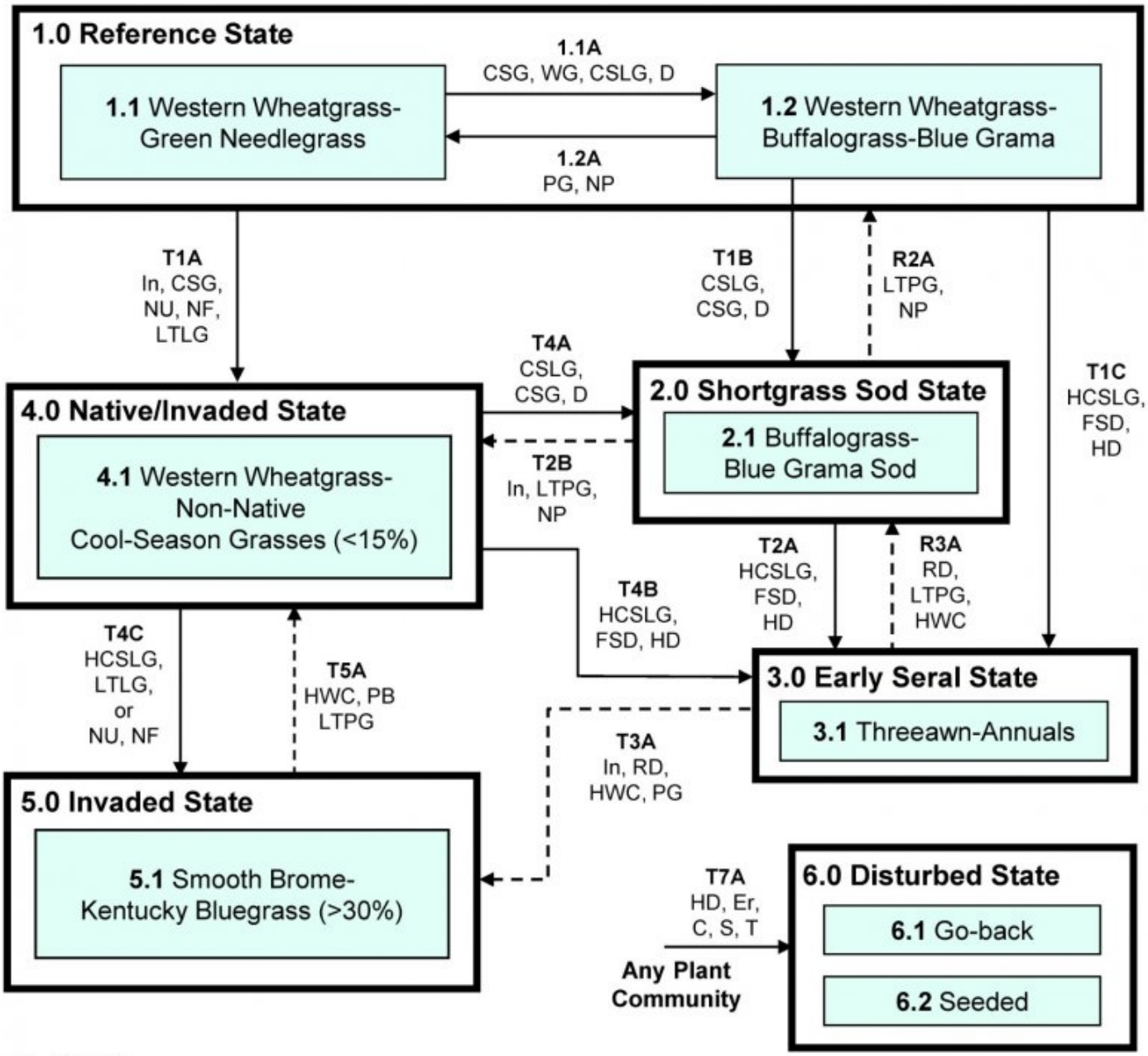
Continuous season-long grazing (during the typical growing season of May through October) or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence results in the site departing from the Western Wheatgrass-Green Needlegrass Plant Community (1.1). Buffalograss and blue grama increase and eventually develop into a sod. Western wheatgrass increases initially but then begins to decrease. Green needlegrass, needle and thread, porcupine grass, sideoats grama, and little bluestem decrease in extent and production. Excessive defoliation can cause threeawns and annuals to increase and dominate the site. Extended periods of non-use and lack of fire or continuous seasonal grazing result in a plant community dominated by cool-season grasses, such as western wheatgrass, Kentucky bluegrass, smooth brome, and annual brome grasses.

Interpretations are primarily based on the Western Wheatgrass-Green Needlegrass Plant Community (1.1). The composition of the community was determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Also studied were trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal-use pastures, and historical accounts. Plant communities, states, transitional pathways, and thresholds were 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

Clayey 17- 20" PZ – R064Y035NE 04/3/19



C – Cropping
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
Er – Eroded
FSD – Frequent and severe defoliation
HCSG – Heavy continuous seasonal grazing
HCSLG – Heavy continuous season-long grazing
HD – Heavy disturbance
WG – Winter grazing
HWC – Herbaceous weed control
In – Invasion of non-native cool-season grasses

LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NF – No fire
NP – Normal precipitation
NU – No use
PB – Prescribed burning
PG – Prescribed grazing
RD – Removal of disturbance
S – Seeding
T – Tillage
- - → Transition may not be rapid or feasible

Diagram Legend: Clayey 17-20" PZ - R064XY035NE

T1A	1.0 to 4.0	Invasion of non-native cool-season grasses; continuous seasonal grazing (summer); long-term light grazing; or non-use and no fire.
T1B	1.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T1C	1.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2A	2.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2B	2.0 to 4.0	Invasion of non-native cool-season grasses; long-term prescribed grazing with change in season of use, adequate time for recovery, and a return to normal precipitation patterns. Transition may not be fast or feasible.
T3A	3.0 to 5.0	Removal of disturbance; herbaceous weed control; and prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery. The invasion of non-native cool-season perennial grasses will dictate the transition. Transition may not be fast or feasible.
T4A	4.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T4B	4.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T4C	4.0 to 5.0	Heavy, continuous season-long grazing; or long-term light grazing; or long-term non-use and no fire.
T5A	5.0 to 4.0	Herbaceous weed control; possibly prescribed burning; followed by long-term prescribed grazing. Transition may not be fast or feasible.
T7A	Any plant community	Heavy disturbance such as soil erosion, tillage, abandoned cropland; or tillage and seeding to introduced perennial forage crops.
R2A	2.0 to 1.0	Long-term prescribed grazing with change in season of use, adequate time for recovery, and a return to normal precipitation patterns. This transition may not be fast or feasible.
R3A	3.0 to 2.0	Removal of disturbance coupled with long-term prescribed grazing including, change in season of use, and adequate recovery following grazing event. Herbaceous weed control may be needed. Transition may not be fast or feasible.
1.1A	1.1 to 1.2	Continuous seasonal grazing (spring); late winter grazing; continuous season-long grazing; or heavy grazing in combination with drought.
1.2A	1.2 to 1.1	Prescribed grazing with proper stocking, change in season of use, adequate time for recovery, and a return to normal precipitation patterns following drought.

State 1
Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. The Reference State (1.0) is dominated by cool-season grasses and subdominant warm-season grasses. Grazing, the lack of grazing, fire, and drought are the major drivers between plant communities. Continuous season-long grazing can push the site into a state dominated by warm-season shortgrasses (2.0). Non-use, no fire, and invasion of non-native cool-season grasses result in a transition to a Native/Invaded State (4.0).

Community 1.1
Western Wheatgrass-Green Needlegrass

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass Plant Community, which is also considered to be the Reference Plant Community (1.1). This plant community is in areas that are properly managed with grazing or prescribed burning and sometimes in areas receiving occasional short periods of rest. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. Cool-season grasses dominate the plant community. The major grasses include western wheatgrass and green needlegrass, needle and thread, and porcupine grass. Other grasses include buffalograss, blue grama, sideoats grama, and sedge. Significant forbs include vetch, white sagebrush (cudweed sagewort), and scurfpea. This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Plant litter is properly distributed. Some movement to off-site occurs, and natural plant mortality is low. Drought tolerance is high because of the diversity in plant species. Moderate or high available water capacity provides a favorable soil-water-plant

relationship. This plant community is sustainable in regard to soil stability, site stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1105	1800	2590
Forb	95	150	205
Shrub/Vine	0	50	105
Total	**1200**	**2000**	**2900**

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
Western Wheatgrass-Buffalograss-Blue Grama

This plant community develops under continuous seasonal grazing (i.e., grazing an area during the same season every year), winter grazing that extends into the early growing season, or over utilization during extended drought periods. The potential vegetation is approximately 80 percent grasses and grass-like species, 10 percent forbs, and 10 percent shrubs. Dominant grasses include western wheatgrass, buffalograss, and blue grama. Grasses of secondary importance include sedge, sideoats grama, green needlegrass, and needle and thread. Common forbs include fringed sagewort, white sagebrush (cudweed sagewort), prairie coneflower, and western yarrow. Shrub canopy ranges from 0 to 10 percent. Compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), the extent of blue grama and buffalograss is increased in the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2). Green needlegrass and sideoats grama are decreased in extent, and production of medium and tall warm-season grasses has also been reduced. Plant Community 1.2 is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. The herbaceous component tends to be resilient if it is intact and the 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	870	1424	2170
Forb	30	96	165
Shrub/Vine	0	80	165
Total	**900**	**1600**	**2500**

Figure 11. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

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

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing (every spring) or winter grazing that extends into the early part of the growing season, continuous season-long grazing without adequate recovery periods, or heavy grazing in combination with drought

convert Plant Community 1.1 to the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing that has proper stocking rates, change in season of use, adequate time for recovery following grazing, and a return to normal precipitation patterns after drought convert Plant Community 1.2 to the Western Wheatgrass-Green Needlegrass Plant Community (1.1).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

The Shortgrass Sod State (2.0) is dominated by shortgrass species and upland sedges. This state is the result of grazing patterns that did not provide adequate recovery time for cool-season wheat and needlegrasses. The hydrologic function of this site is dramatically altered from the reference state. Runoff is high, and infiltration is low. State 2.0 is very resistant to change through grazing management alone. Historically, rangeland mechanical treatment has been an option to improve forage production and plant species composition on this site. These mechanical treatments included contour furrowing, contour pitting, terracing, chiseling, and disking. The purpose of the treatments was to mechanically break up a sod-bound vegetative condition or compacted soils, resulting in less runoff and better infiltration. Many of these treatments were implemented during the 1930s through the 1970s. The results were mixed, primarily due to improper grazing management following the renovation practice. Another drawback, in addition to the cost, is that these practices result in a nearly permanently roughed ground surface.

Community 2.1
Buffalograss-Buffalograss Sod

This plant community is the result of continuous season-long grazing, repeated seasonal grazing (typically in the spring or in the spring and fall), or heavy grazing in combination with drought. The potential vegetation is approximately 80 percent grasses and grass-like species, 10 percent forbs, and 10 percent shrubs. Buffalograss and blue grama are the dominant species. Grasses of secondary importance include western wheatgrass, threeawn, prairie Junegrass, and sedges. Forbs include fringed sagewort, wild parsley, and scarlet globemallow. The dominant shrubs include broom snakeweed and cactus. There is usually less than 10 percent bare ground. The extent of blue grama and buffalograss in the Buffalograss-Blue Grama Sod Plant Community (2.1) is increased significantly compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1). The mid-stature cool-season grasses are dramatically decreased, and annual production is significantly decreased. This plant community is resistant to change because the dominant species are resistant to overgrazing. The thick sod prevents other species from becoming established. This plant community has diminished potential for grazing use. Infiltration decreases, and runoff increases. Soil erosion is minimal due to the sod-forming nature of buffalograss and blue grama.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	550	845	940
Forb	45	100	155
Shrub/Vine	5	55	105
Total	**600**	**1000**	**1200**

Figure 13. Plant community growth curve (percent production by month). NE6405, Pine Ridge/Badlands, warm-season dominant. Warm-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	7	15	20	30	15	5	5		

State 3
Early Seral State

This state is the result of very heavy, concentrated disturbance, such as concentrated rodent activity or livestock concentration. This state can also develop as a result of invasion by highly competitive or noxious weeds. Extended periods of drought accompanied by heavy grazing can also push an at-risk plant community phase to this state. In most cases, this state is dominated by pioneer perennial and annual grasses and forbs. The extent of bare ground is also much greater than in any other plant community phase.

Community 3.1
Threeawn-Annuals

This plant community developed under heavy, continuous season-long grazing, frequent and severe defoliation, or heavy disturbances (e.g., heavy use, defoliation by rodents). The potential plant community is made up of approximately 80 percent grasses and grass-like species and 20 percent forbs. The dominant grasses include threeawn and annual brome grasses. Other grasses include little bluestem, blue grama, buffalograss, sedges, western wheatgrass, and sixweeks fescue. The dominant forbs include fringed sagewort, fetid marigold, Cuman ragweed, pussytoes, prostrate verbena, and other invader-like species. Other plant species from adjacent ecological sites can become minor components of this plant community. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percent of bare ground. The extent of red threeawn and annual brome grasses and the percent of bare ground are increased compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1). Western wheatgrass, needlegrasses, and other cool-season grasses and grass-like species have decreased in extent. The warm-season species, including little bluestem, sideoats grama, blue grama, and buffalograss, are also decreased. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species and are uneven). This plant community is difficult to return to the Western Wheatgrass-Green Needlegrass Plant Community (1.1) because of the loss of plant diversity and overall soil disturbance. The hazard of soil erosion is very high because of the bare ground and the shallow rooted, herbaceous plant community. Water runoff increases and infiltration decreases due to animal-related soil compaction and loss of root mass, which results from low plant diversity and vigor. This plant community requires significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This variability is due to the loss of diversity (including the loss of the seed bank) within the existing plant community and the plant communities on adjacent sites. This community can be renovated to improve the production capability; however, if management changes are not made, the vegetation could revert back to a threeawn-annual community. This community produces 400 to 1,000 pounds/acre (air-dry weight) annually, depending on the growing conditions.

Figure 14. Plant community growth curve (percent production by month). NE0603, Warm-season grass. Warm-season grass - statewide.

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

State 4
Native/Invaded State

The Native/Invaded State is dominated by native cool- and warm-season grasses. Subdominant species are non-native cool-season grasses. This state is in areas that are properly managed for grazing and possibly prescribed burning and in areas receiving occasional short periods of rest. If the native cool-season grasses decrease, a corresponding increase of non-native cool-season grasses can occur. The non-native cool-season grasses include Kentucky bluegrass, smooth brome, cheatgrass, field brome, and possibly crested wheatgrass.

Community 4.1
Western Wheatgrass–Non-Native Cool-Season Grasses (<15%)

This plant community develops when non-native cool-season grasses, such as Kentucky bluegrass or smooth brome, invade and become established. This may occur because an area is in close proximity to seed sources, expansion from road ditches, improved pastures, or other invaded sites or from contaminated hay. Repeated seasonal grazing (typically during the summer), long-term light grazing, or extended periods of non-use and no fire allow these non-native cool-season grasses to increase in the plant community. Plant litter accumulates in large amounts when this community first develops. Litter buildup reduces the vigor and density of mature native plants, and seedling recruitment declines. Eventually, litter levels become high enough that plant density decreases. Typically, rhizomatous grasses form small colonies because of a lack of tiller stimulation. The potential vegetation is 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The dominant grasses are western wheatgrass and non-native cool-season grasses, primarily smooth brome or Kentucky bluegrass. Warm-season grasses include patches of buffalograss, blue grama, and sideoats grama. Forbs are common and diverse, and some shrubs persist. Forage production can vary.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	970	1513	1835
Forb	30	145	275
Shrub/Vine	0	43	90
Total	**1000**	**1701**	**2200**

Figure 16. 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		

State 5
Invaded State

This state is the result of invasion and dominance by non-native cool-season grass species. This state is characterized by the dominance of smooth brome and Kentucky bluegrass. Heavy grazing or long-term light grazing (understocked) tend to result in an increase of smooth bromegrass. Non-use and no fire tend to benefit Kentucky bluegrass because of an increasing thatch layer that effectively blocks the introduction of other plants into the system. Accumulation of plant litter favors the more shade-tolerant introduced grass species. The nutrient cycle is impaired, and the result is typically a higher level of nitrogen, which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns, thereby shifting competitive advantage to shade-tolerant, introduced grass species. Studies indicate that biological activity is altered in the soil, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot reduce the dominance of the invasive grasses. Preliminary studies indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo et al., 2014).

Community 5.1
Smooth Brome-Kentucky Bluegrass (>30%)

This plant community evolved under no use and no fire; heavy, continuous season-long grazing with no change in season of use; or long-term light grazing. This plant community is typically dominated by smooth brome and Kentucky bluegrass. The composition is approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses include Kentucky bluegrass and smooth brome. Western wheatgrass and some needlegrass may be in the plant community. Common forbs include white sagebrush (cudweed sagewort), goldenrod, scurfpea, and Cuman ragweed. Infiltration, runoff, and energy capture are moderately reduced compared to other states. Production can be relatively high. The period that palatability is high, however, is relatively short because these cool-season species mature rapidly.

State 6
Disturbed State

Any plant community can transition to the Disturbed State (6.0). The two separate vegetative plant communities, Go-Back and Seeded, are highly variable in nature. They are derived through different management scenarios and are not related by succession. Infiltration, runoff, and soil erosion vary depending on the vegetation. The Go-Back Plant Community (6.1) is in areas that were previously tilled for crop production and then abandoned. The plant community is greatly influenced by the plant communities on adjacent land. The Seeded Plant Community (6.2) is typically in areas that were tilled and then seeded to a perennial forage species or mix of species.

Community 6.1
Go-Back

The Go-Back Plant Community (6.1) can develop whenever severe mechanical disturbance occurs (e.g., tilled and abandoned cropland). During the early successional stages, the plant community is mainly dominated by annual grasses and forbs. Later, they are replaced by native and introduced perennials. The vegetation on this site varies greatly. In places, the site is dominated by threeawn, bluegrass, smooth brome, annual bromegrass, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly grow on the site include western wheatgrass, prickly lettuce, horseweed, mullein, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and low overall soil health.

Community 6.2
Seeded

The Seeded Plant Community (6.2) normally grows in those areas that are seeded to pubescent or intermediate wheatgrass, alfalfa, switchgrass, or other forage species. For a description of adapted species and expected production, refer to the appropriate Forage Suitability Group in the USDA-NRCS electronic field office technical guide (eFOTG).

Transition T1B
State 1 to 2

Continuous season-long grazing, continuous seasonal grazing, or heavy grazing in combination with drought results in the Reference State transitioning to the Shortgrass Sod State (2.0). This transition is most likely to occur from the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2).

Transition T1C
State 1 to 3

Heavy, continuous season-long grazing, frequent and severe defoliation, or heavy disturbance results in the Reference State transitioning to the Early Seral State (3.0).

Transition T1A
State 1 to 4

Continuous summer seasonal grazing, long-term light grazing, or no use and no fire, and the subsequent invasion of non-native cool-season grasses, results in the Reference State (1.0) transitioning to the Native/Invaded State (4.0).

Transition T7A
State 1 to 6

Heavy disturbance, including soil erosion, tillage, abandoning cropland, or seeding to improved pasture species, results in a transition to the Disturbed State (6.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing may potentially convert the Buffalograss-Blue Grama Sod Plant Community (2.1) to the Reference State (1.0). The transition is most probably to the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2), assuming adequate seed and vegetative sources are present. This transition could require significant time and inputs to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 3

Heavy, continuous season-long grazing, frequent severe defoliation, or heavy disturbance typically convert Plant Community 2.0 to the Early Seral State (3.0).

Transition T2B
State 2 to 4

Long-term prescribed grazing that includes change in season of use, adequate time for recovery, and a return to normal precipitation patterns might transition Plant Community 2.0 to the Native/Invaded State (4.0). The direction of this transition towards the Native/Invaded State (4.0) is due to the invasion of non-native, cool-season perennial grasses. This transition may not be fast or feasible.

Conservation practices

Prescribed Grazing

Transition T7A
State 2 to 6

Heavy disturbance, including soil erosion, tillage, abandoning cropland, or seeding to improved pasture species, results in a transition to the Disturbed State (6.0).

Restoration pathway R3A
State 3 to 2

Removal of management-induced disturbance coupled with long-term prescribed grazing that includes change in season of use and adequate recovery time following grazing may return the Threeawn-Annual Plant Community (3.1) to the Shortgrass Sod State (2.0). Herbaceous weed control may also be needed. This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T3A
State 3 to 5

This transition results from removal of management-induced disturbance, herbaceous weed control, and prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery. The invasion of non-native cool-season perennial gasses likely transitions the Threeawn-Annuals Plant Community (3.1) to the Invaded State (5.0). This transition may not meet management objectives.

Conservation practices

Prescribed Grazing

Herbaceous Weed Control

Transition T7A
State 3 to 6

Heavy disturbance, including soil erosion, tillage, abandoning cropland, or seeding to improved pasture species, results in a transition to the Disturbed State (6.0).

Transition T4A
State 4 to 2

Continuous season-long grazing, continuous seasonal grazing, or heavy grazing in combination with drought results in the Native/Invaded State (4.0) transitioning to the Shortgrass Sod State (2.0).

Transition T4B
State 4 to 3

Heavy, continuous season-long grazing, frequent and severe defoliation, or heavy disturbance results in the Native/Invaded State (4.0) transitioning to the Early Seral State (3.0).

Transition T4C
State 4 to 5

Heavy, continuous season-long grazing or long-term light grazing results in the Native/Invaded State (4.0) transitioning to the Invaded State (5.0). Extended periods of non-use and no fire result in build-up of a heavy litter layer, which favors cool-season non-natives grasses, such as Kentucky bluegrass and other non-native species, leading to the transition.

Transition T7A
State 4 to 6

Heavy disturbance, including soil erosion, tillage, abandoning cropland, or seeding to improved pasture species, results in a transition to the Disturbed State (6.0).

Transition T5A
State 5 to 4

Herbaceous weed control followed by long-term prescribed grazing may result in this plant community transitioning to the Native/Invaded State (4.0). The prescribed grazing should include proper stocking, change in season of use, and deferment that provides time for adequate recovery. This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Burning
Prescribed Grazing
Herbaceous Weed Control

Transition T7A
State 5 to 6

Heavy disturbance, including soil erosion, tillage, abandoning cropland, or seeding to improved pasture species, results in a transition to the Disturbed State (6.0).

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**			600–1000	
	western wheatgrass	PASM	*Pascopyrum smithii*	600–1000	–
2	**Needlegrass**			300–700	
	green needlegrass	NAVI4	*Nassella viridula*	200–500	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	100–300	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	100–300	–
3	**Tall and Mid- Warm-Season Grasses**			0–400	
	big bluestem	ANGE	*Andropogon gerardii*	0–200	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–200	–
4	**Short Warm-Season Grasses**			100–200	
	buffalograss	BODA2	*Bouteloua dactyloides*	100–200	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–160	–
5	**Other Native Grasses & Grass-Likes**			100–300	
	sideoats grama	BOCU	*Bouteloua curtipendula*	100–200	–
	Grass, perennial	2GP	*Grass, perennial*	0–100	–
	threadleaf sedge	CAFI	*Carex filifolia*	40–100	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–100	–
	threeawn	ARIST	*Aristida*	0–60	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–60	–
	sedge	CAREX	*Carex*	0–40	–
	dropseed	SPORO	*Sporobolus*	–	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	–	–
6	**Non-Native Cool-Season Grasses**			0	
Forb					
7	**Forbs**			100–200	
	false boneset	BREU	*Brickellia eupatorioides*	0–100	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–100	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	20–100	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	20–60	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–60	–
	Forb, perennial	2FP	*Forb, perennial*	0–60	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–60	–
	vetch	VICIA	*Vicia*	0–40	–
	dotted blazing star	LIPU	*Liatris punctata*	0–40	–
	prairie sagewort	ARFR4	*Artemisia frigida*	20–40	–
	desertparsley	LOMAT	*Lomatium*	0–40	–
	beardtongue	PENST	*Penstemon*	0–40	–
	textile onion	ALTE	*Allium textile*	0–40	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	20–40	–
	scurfpea	PSORA2	*Pseoralidium*	0–40	

	scurfpea	PSORA2	*Psoralidium*	0–40	–
	spiderwort	TRADE	*Tradescantia*	0–40	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–40	–
	pussytoes	ANTEN	*Antennaria*	0–40	–
	field sagewort	ARCA12	*Artemisia campestris*	0–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–40	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–20	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–20	–
	deathcamas	ZIGAD	*Zigadenus*	0–20	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	–	–
	fetid marigold	DYPA	*Dyssodia papposa*	–	–
	sweetclover	MELIL	*Melilotus*	–	–
	horseweed	CONYZ	*Conyza*	–	–
	goatsbeard	TRAGO	*Tragopogon*	–	–
	Forb, annual	2FA	*Forb, annual*	–	–
Shrub/Vine					
8	**Shrubs**			0–100	
	leadplant	AMCA6	*Amorpha canescens*	0–100	–
	rose	ROSA5	*Rosa*	0–60	–
	snowberry	SYMPH	*Symphoricarpos*	0–40	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–40	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–40	–
	pricklypear	OPUNT	*Opuntia*	0–40	–

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**			240–560	
	western wheatgrass	PASM	*Pascopyrum smithii*	240–560	–
2	**Needlegrasses**			160–320	
	green needlegrass	NAVI4	*Nassella viridula*	80–160	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	80–160	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–128	–
3	**Tall and Mid- Warm-Season Grasses**			0–160	
	big bluestem	ANGE	*Andropogon gerardii*	0–80	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–80	–
4	**Short Warm-Season Grasses**			240–400	
	buffalograss	BODA2	*Bouteloua dactyloides*	160–400	–
	blue grama	BOGR2	*Bouteloua gracilis*	160–320	–
5	**Other Native Grasses & Grass-Likes**			32–160	
	threadleaf sedge	CAFI	*Carex filifolia*	80–160	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	32–128	–
	threeawn	ARIST	*Aristida*	16–80	–

	sedge	CAREX	*Carex*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–48	–
	Grass, perennial	2GP	*Grass, perennial*	0–48	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–48	–
	dropseed	SPORO	*Sporobolus*	0–32	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–16	–
6	**Non-Native Cool-Season Grasses**			0–80	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–48	–
	smooth brome	BRIN2	*Bromus inermis*	0–48	–
	cheatgrass	BRTE	*Bromus tectorum*	0–48	–
	field brome	BRAR5	*Bromus arvensis*	0–16	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–16	–
Forb					
7	**Forbs**			32–160	
	sweetclover	MELIL	*Melilotus*	0–160	–
	prairie sagewort	ARFR4	*Artemisia frigida*	32–128	–
	field sagewort	ARCA12	*Artemisia campestris*	0–80	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–80	–
	horseweed	CONYZ	*Conyza*	0–80	–
	false boneset	BREU	*Brickellia eupatorioides*	0–80	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	16–80	–
	scurfpea	PSORA2	*Psoralidium*	0–80	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–80	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	16–80	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–80	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–48	–
	dotted blazing star	LIPU	*Liatris punctata*	0–48	–
	textile onion	ALTE	*Allium textile*	0–48	–
	Forb, perennial	2FP	*Forb, perennial*	0–48	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–48	–
	goatsbeard	TRAGO	*Tragopogon*	0–48	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–48	–
	beardtongue	PENST	*Penstemon*	0–48	–
	pussytoes	ANTEN	*Antennaria*	0–32	–
	vetch	VICIA	*Vicia*	0–32	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	16–32	–
	deathcamas	ZIGAD	*Zigadenus*	0–32	–
	desertparsley	LOMAT	*Lomatium*	0–32	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–16	–
	Forb, annual	2FA	*Forb, annual*	0–16	–
	spiderwort	TRADE	*Tradescantia*	0–16	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–16	–
	fetid marigold	DYPA	*Dyssodia papposa*	–	–

	fetid marigold	DYPA	*Dyssodia papposa*		
Shrub/Vine					
8	**Shrubs**			0–160	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–80	–
	pricklypear	OPUNT	*Opuntia*	0–48	–
	leadplant	AMCA6	*Amorpha canescens*	0–48	–
	rose	ROSA5	*Rosa*	0–48	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–32	–
	snowberry	SYMPH	*Symphoricarpos*	0–16	–

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**			50–150	
	western wheatgrass	PASM	*Pascopyrum smithii*	50–150	–
2	**Needlegrasses**			0–100	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–80	–
	green needlegrass	NAVI4	*Nassella viridula*	0–50	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–20	–
3	**Tall and Mid- Warm-Season Grasses**			0–80	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–50	–
	big bluestem	ANGE	*Andropogon gerardii*	0–30	–
4	**Short Warm-Season Grasses**			200–500	
	buffalograss	BODA2	*Bouteloua dactyloides*	200–300	–
	blue grama	BOGR2	*Bouteloua gracilis*	150–250	–
5	**Other Native Grasses & Grass-Likes**			50–150	
	threadleaf sedge	CAFI	*Carex filifolia*	100–150	–
	threeawn	ARIST	*Aristida*	50–100	–
	dropseed	SPORO	*Sporobolus*	0–50	–
	sedge	CAREX	*Carex*	0–50	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–50	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	10–30	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–30	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–30	–
6	**Non-Native Cool-Season Grasses**			30–100	
	cheatgrass	BRTE	*Bromus tectorum*	30–100	–
	field brome	BRAR5	*Bromus arvensis*	0–50	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–20	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–10	–
	smooth brome	BRIN2	*Bromus inermis*	0–10	–
Forb					
7	**Forbs**			50–150	
	prairie sagewort	ARFR4	*Artemisia frigida*	30–100	–

	sweetclover	MELIL	*Melilotus*	0–100	–
	scurfpea	PSORA2	*Psoralidium*	10–70	–
	goatsbeard	TRAGO	*Tragopogon*	0–50	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	10–50	–
	field sagewort	ARCA12	*Artemisia campestris*	0–50	–
	false boneset	BREU	*Brickellia eupatorioides*	0–50	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–50	–
	horseweed	CONYZ	*Conyza*	0–50	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–50	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–50	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	10–40	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	10–30	–
	textile onion	ALTE	*Allium textile*	0–30	–
	Forb, perennial	2FP	*Forb, perennial*	0–30	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–30	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	10–30	–
	deathcamas	ZIGAD	*Zigadenus*	0–30	–
	dotted blazing star	LIPU	*Liatris punctata*	0–30	–
	beardtongue	PENST	*Penstemon*	0–30	–
	desertparsley	LOMAT	*Lomatium*	0–20	–
	pussytoes	ANTEN	*Antennaria*	10–20	–
	vetch	VICIA	*Vicia*	0–20	–
	Forb, annual	2FA	*Forb, annual*	0–20	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–10	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–10	–
	fetid marigold	DYPA	*Dyssodia papposa*	0–10	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–10	–
	spiderwort	TRADE	*Tradescantia*	–	–
Shrub/Vine					
8	**Shrubs**			10–100	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	10–50	–
	pricklypear	OPUNT	*Opuntia*	0–50	–
	leadplant	AMCA6	*Amorpha canescens*	0–20	–
	rose	ROSA5	*Rosa*	0–20	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–20	–
	snowberry	SYMPH	*Symphoricarpos*	0–10	–

Table 12. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			170–850	
	western wheatgrass	PASM	*Pascopyrum smithii*	170–850	–

2	**Needlegrasses**			0–170	
	green needlegrass	NAVI4	*Nassella viridula*	17–170	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–85	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–85	–
3	**Tall and Mid- Warm-Season Grasses**			0–85	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–51	–
	big bluestem	ANGE	*Andropogon gerardii*	0–34	–
4	**Short Warm-Season Grasses**			0–170	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–136	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–85	–
5	**Other Native Grasses & Grass-Likes**			85–340	
	threadleaf sedge	CAFI	*Carex filifolia*	34–170	–
	sedge	CAREX	*Carex*	0–85	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	17–85	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–85	–
	threeawn	ARIST	*Aristida*	17–85	–
	dropseed	SPORO	*Sporobolus*	0–85	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–51	–
	Grass, perennial	2GP	*Grass, perennial*	0–51	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–34	–
6	**Non-Native Cool-Season Grasses**			85–255	
	Kentucky bluegrass	POPR	*Poa pratensis*	85–255	–
	smooth brome	BRIN2	*Bromus inermis*	0–170	–
	cheatgrass	BRTE	*Bromus tectorum*	17–85	–
	field brome	BRAR5	*Bromus arvensis*	0–85	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–85	–
Forb					
7	**Forbs**			34–255	
	sweetclover	MELIL	*Melilotus*	0–170	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	17–85	–
	Forb, perennial	2FP	*Forb, perennial*	0–85	–
	Forb, annual	2FA	*Forb, annual*	0–85	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	17–51	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	17–51	–
	prairie sagewort	ARFR4	*Artemisia frigida*	17–51	–
	field sagewort	ARCA12	*Artemisia campestris*	17–51	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–34	–
	horseweed	CONYZ	*Conyza*	0–34	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–34	–
	goatsbeard	TRAGO	*Tragopogon*	17–34	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–34	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–34	–
	desertparsley	LOMAT	*Lomatium*	0–34	–

	textile onion	ALTE	*Allium textile*	0–34	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	17–34	–
	scurfpea	PSORA2	*Psoralidium*	0–34	–
	vetch	VICIA	*Vicia*	0–34	–
	spiderwort	TRADE	*Tradescantia*	0–17	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–17	–
	deathcamas	ZIGAD	*Zigadenus*	0–17	–
	dotted blazing star	LIPU	*Liatris punctata*	0–17	–
	false boneset	BREU	*Brickellia eupatorioides*	0–17	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–17	–
	pussytoes	ANTEN	*Antennaria*	0–17	–
	beardtongue	PENST	*Penstemon*	0–17	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–17	–
	fetid marigold	DYPA	*Dyssodia papposa*	–	–
Shrub/Vine					
8	**Shrubs**			0–85	
	rose	ROSA5	*Rosa*	0–51	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–34	–
	pricklypear	OPUNT	*Opuntia*	0–17	–
	snowberry	SYMPH	*Symphoricarpos*	0–17	–
	leadplant	AMCA6	*Amorpha canescens*	–	–

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 Badlands Overflow ecological site includes upland grassland cover with an associated forb and shrub component. It was typically part of an expansive grassland landscape that included combinations of Thin Breaks, Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Terrace ecological sites.

Although this ecological site is primarily dominated by tall and medium warm- and cool-season grasses, it can support a shrub community composed of big sagebrush, silver sagebrush, rose, silver buffaloberry, and western snowberry. The presence or absence of this shrub component is an important factor influencing wildlife species composition.

Some areas of the site contain remnant stands of plains cottonwood and other trees. Multiple successional changes can occur as a result of stream channel aggradation and degradation. During periods of favorable climatic conditions in areas that are not significantly grazed, midgrass- and tallgrass-habitat provides denser cover and stabilizes the area along the stream channel. When present, seeps and springs provide vital water supply and localized wildlife habitat, especially for reptiles, amphibians, bats, and game species (both predators and prey).

This site provides habitat for mule deer and pronghorn antelope; grassland- and shrub-steppe-nesting birds; small mammals; mammalian predators; and a variety of reptiles, amphibians, and insects. Within the MLRA, this site provides important riparian habitat. The site also provides foraging and brood rearing habitat for upland game birds, such as the sharp-tailed grouse.

Western Wheatgrass-Green Needlegrass (1.1): A predominance of grasses plus a high diversity of forbs and shrubs in this community favor grazers and mixed-feeders, such as deer and pronghorn. Insects, including pollinators, play a large role in maintaining the forb community and provide a forage base for grassland birds and other species. The complex diversity of plant structures provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, savannah sparrow, lark bunting, western meadowlark, and sharp-tailed grouse are common and benefit from the structure and composition of this plant community. This site provides important breeding habitat for the loggerhead shrike. This site also 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 and forbs provides high nutrition levels for small and large herbivores, including voles, mice, least chipmunk, spotted ground squirrel, desert cottontail rabbit, white-tailed jackrabbit, black-tailed jackrabbit, and deer. This ecological site provides excellent wintering habitat for pronghorn. The moderate stature of the plant community provides suitable thermal, protective, and escape cover for small herbivores and grassland birds. Predators that use this plant community include the coyote, American badger, red fox, and long-tailed weasel. This plant community provides habitat for the spadefoot toad and Great Plains toad. An abundance of prey and shade opportunities attract multiple reptile species to this site. Examples include gopher snake, milk snake, prairie rattlesnake, and western ornate box turtle. Lesser numbers of various lizard species are also present.

Western Wheatgrass-Buffalograss-Blue Grama (1.2): Areas that are subject to continuous season-long grazing or to overutilization during extended drought periods become dominated by blue grama and buffalograss. Also, forbs and shrubs increase in diversity and abundance. The density of species such as sharp-tail grouse and desert cottontail generally remain unchanged. However, the shift to shorter plant structure favors expansion of prairie dogs and associated species, such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox. Species such as the horned lark, long-billed curlew, upland sandpiper, white-tailed jackrabbit, and black-tailed jackrabbit increase. Some areas of this plant community are suitable for development of leks for sharp-tailed grouse. The short stature of this plant community limits thermal, protective, and escape cover. Predators that use this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Buffalograss-Blue Grama Sod (2.1): This plant community develops in areas that are subject to continuous season-long grazing or continuous seasonal grazing with concentrated use in the spring. As this community develops, the abundance of forbs increases and the diversity of forbs and shrubs decreases. A shift to short plant structure can favor prairie dogs, leading to an expansion of prairie dog towns and an increase in associated species, such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox. Species such as the horned lark, long-billed curlew, upland sandpiper, white-tailed jackrabbit, and black-tailed jackrabbit increase. This plant community may provide areas suitable for development of leks for sharp-tailed grouse. The short stature of this plant community limits thermal, protective, and escape cover. Predators that use this plant community include the coyote, American badger, red fox, and long-tailed weasel. Species such as the desert cottontail rarely use this site.

Extreme impairment of ecological processes affects offsite aquatic habitats by causing excessive runoff and nutrient loads. Reduced cover and litter result in elevated surface temperatures, which greatly reduce habitat for most

amphibians, grassland birds, and mammals.

Threeawn-Annuals (3.1): Areas that are subject to heavy, continuous season-long grazing over many years or to frequent and severe defoliation become dominated by threeawn and annuals. Forbs and shrubs increase in abundance but decrease in diversity. A shift to short plant structure and relatively high percent of bare ground favors prairie dogs, leading to an expansion of prairie dog towns and an increase in associated species, such as swift fox, ferruginous hawk, and burrowing owl. Species such as horned lark, long-billed curlew, upland sandpiper, and white-tailed jackrabbit increase. Species that require moderate cover height rarely use this site. Examples include desert cottontail and grassland nesting birds. The short stature of this plant community limits suitable thermal, protective, and escape cover. Prey populations are reduced and are more vulnerable to predation by raptors and mammals. Predators that use this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Extreme impairment of the ecological processes affects offsite aquatic habitats by causing excessive runoff, nutrient loads, and sediment loads. Reduced cover and litter result in elevated surface temperatures, which greatly reduce habitat for most amphibians, grassland birds, and mammals.

Western Wheatgrass–Non-Native Cool-Season Grasses (<15%) (4.1): Areas that are subject to continuous seasonal grazing, non-use, or no fire become dominated by western wheatgrass, bluegrass, and annuals. Forbs increase in diversity but decrease in abundance. Shrubs remain relatively unchanged in both diversity and abundance. A grass diversity shift to favor invasive species and excessive litter buildup substantially diminishes wildlife habitat quality for grassland nesting songbirds. Juniper and ponderosa pine provide habitat for various small mammals and songbirds in scattered areas.

Invaded State (5.0): This state includes areas that have been invaded and are dominated by species such as smooth brome, Kentucky bluegrass, crested wheatgrass, non-native thistles, field bindweed, hoary cress, and other introduced species. These sites have greatly reduced foraging, reproductive, and escape cover for grassland nesting bird species.

Go-Back (6.1) and Seeded (6.2): These plant communities have separate, highly variable vegetation states. They are derived through distinct management scenarios. These plant communities have been or are highly susceptible to invasion by annual bromegrasses, bluegrasses, crested wheatgrass, and other non-native species. Because secondary succession is highly variable, plant and wildlife species are also variable. This plant community provides habitat for generalist species or early successional species.

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: Western Wheatgrass-Green Needlegrass (1.1)
Average Production (lb/acre, air-dry): 2,000
Stocking Rate (AUM/acre): 0.55

Plant Community: Western Wheatgrass-Buffalograss-Blue Grama (1.2)
Average Production (lb/acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

Plant Community: Buffalo-Blue Grama Sod (2.1)

Average Production (lb/acre, air-dry): 1,000
Stocking Rate (AUM/acre): 0.27

Plant Community: Western Wheatgrass–Non-Native Cool-Season Grasses (4.1)
Average Production (lb/acre, air-dry): 1,700
Stocking Rate (AUM/acre): 0.46

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 has 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. This site is dominated by soils in hydrologic groups C and D. The infiltration rate is moderate. Runoff potential varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas that have greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An exception occurs 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 opportunities for hunting 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) passed quality control (QC) and quality assurance (QA) to ensure that 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; L. Michael Stirling, RMS, NRCS; Phil Young, soil scientist, NRCS; Kent Cooley, soil scientist, NRCS; and Wade Anderson, range professional and rancher.

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Contributors

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Approval

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Acknowledgments

This ecological site was reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS on 2/15/2019.

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.

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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 should not be present.

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2. **Presence of water flow patterns:** Typically, none. Water flow patterns may be present on slopes of 10% or greater. When present, they will be no longer than 2 to 4 inches (5-10 cm), less than 3 inches (8 cm) wide, and discontinuous. Water flow patterns, when present, are often associated with animal activity.

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

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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 5 percent or less.

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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 areas and depositional areas should not be present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement (less than 6 inches or 15 cm) of fine litter from water is possible, but not normal. Litter movement from wind is not expected.

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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 6 inches thick. Colors range from dark grayish brown, grayish brown, to gray (values of 3 to 5) when dry and dark grayish brown, very dark grayish brown, and very dark brown (values of 3 to 5) when moist. Structure typically is medium to fine granular or subangular blocky parting to granular. When wet, surface compaction can occur with heavy

traffic.

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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 Kentucky bluegrass and crested wheatgrass may have an adverse impact infiltration and runoff.

    Relative composition is approximately 85 percent grasses and/or grass-like plants, 10 percent forbs, and 5 percent shrubs. The grass component is composed of C3, rhizomatous grasses (30-50%), C3 bunchgrasses (15-35%), C4, tall- and midgrasses (5-25%), C4, shortgrasses (5-10%), grass-likes (2-5%).

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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, 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, 600- 1000 #/ac, 30-50%, (1 species minimum): western wheatgrass, thickspike wheatgrass.
    2. Native, perennial, C3 bunchgrass, 300-700 #/ac, 15-35% (1 species minimum): green needlegrass, needle and thread, Sandberg bluegrass, prairie Junegrass.

    Phase 1.2
    1. Native, perennial, C3, rhizomatous grass, 240-560 #/ac, 15-35% (1 species minimum): western wheatgrass.

    2. Native, perennial, C4, shortgrass, 240-400 #/ac, 15-25% (2 species minimum): blue grama, buffalograss, threeawn.

    Sub-dominant: Phase 1.1
    1. Native, perennial, C4 tall- and mid-grass, 100-500 #/ac, 5-25% (1 species minimum): big bluestem, little bluestem, sideoats grama.

    Phase 1.2
    1. Native, perennial, C3, bunchgrass, 160-320 #/ac, 10-20% (2 species minimum): green needlegrass, needle and thread, porcupinegrass, Sandberg bluegrass, prairie Junegrass.

    Other: Minor - Phase 1.1
    1. Native, perennial, C4, shortgrass, 100-200 #/ac, 5-10%: blue grama, buffalograss, threeawn.
    2. Native forbs, 100-200 #/ac, 5-10%: The species of forbs will vary from location to location.
    3. Native grass-likes: 40-100 #/ac, 2-5%: sedges.
    4. Shrubs, 0-100 #/ac, 0-5%: shrubs present vary from location to location.

    Minor - Phase 1.2
    1. Native grass-like, 80-160 #/ac, 5-10%: threadleaf sedge, sedge.
    2. Native, perennial, C4, tall- and midgrass, 32-160 #/ac, 2-10%: big bluestem, little bluestem, sideoats grama, dropseed.
    3. Native forbs, 32-160 #/ac, 2-10%: forbs present vary from location to location.

4. Shrubs, 0-160 #/ac, 0-10%: shrubs present vary from location to location.
5. Non-native, C3 grass, 0-80 #/ac, 0-5%: Kentucky bluegrass, smooth brome, cheatgrass, field brome, crested wheatgrass.

Trace - Phase 1.2
1. Native, annual grass, 0-16 #/ac, 0-1%: sixweeks fescue.

Additional: The Western Wheatgrass-Green Needlegrass Community or Reference Community (1.1) consists 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, tall- and midgrass; native, perennial, C4 shortgrass = native forbs; native grass-likes; and shrubs.

The Western Wheatgrass-Buffalograss-Blue Grama Community (1.2) consists of nine F/S groups, which in order of abundance, are native, perennial, C3, rhizomatous grass; native, perennial, C4 shortgrass; native, perennial, C3 bunchgrass; native grass-likes; native, perennial, C4, tall- and midgrass; native forbs; shrubs; non-native, C3 grass, and native, annual grass.

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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 60 to 70 percent and at a depth of 0.25 to 0.50 inches (0.65-1.30 cm). Kentucky bluegrass excessive litter can negatively impact the functionality of this site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production is 2,000 pounds per acre in a year with normal precipitation and temperatures. Low and High production years should yield 1,200 and 2,900 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, Kentucky bluegrass, smooth brome, crested wheatgrass, and sweet clover 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.
