USDA Natural Resources Conservation Service

Ecological site R064XY044NE
Claypan

Last updated: 1/15/2019
Accessed: 05/18/2024

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.

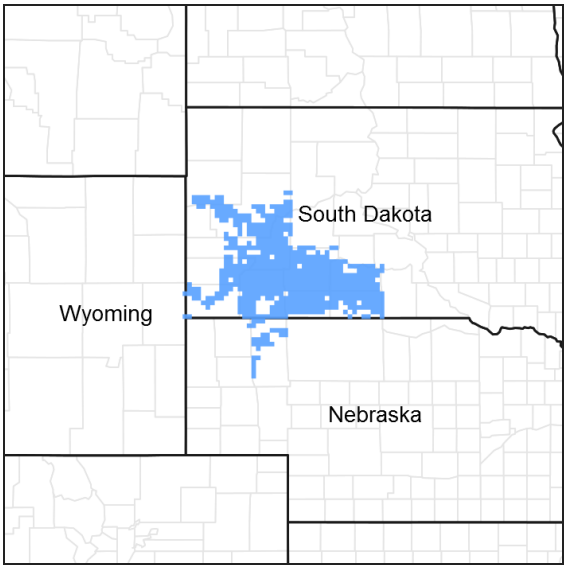

Figure 1. Mapped extent

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 almost equally shared between South Dakota (42 percent) and Nebraska (41 percent), with a small portion in Wyoming (17 percent). The MRLA is 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron, Alliance, and Scottsbluff, Nebraska; and Lusk, Wyoming are all within the boundaries of this MLRA.

Badlands National Park, a portion of the Nebraska National Forest, and parts of the Oglala and Buffalo Gap National Grasslands, Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation are in this MLRA. 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 feet to 5,073 feet as one moves east to west. The main drainageway through the Badlands National Park is the White River. The headwaters of both the White and Niobrara Rivers are located in MLRA 64. The Pine Ridge escarpment is located 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, and are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer months. 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 occurs 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 four percent is forested. Major resource concerns include the hazards of wind and 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 and 17 to 20 inches of precipitation per year. The drier zone, 14 to 17 inches, extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. The wetter 17 to 20 inches 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. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

In the far southwest corner of the 14 to 17-inch PZ, there is a unique geologic area known as the Hartville Uplift. The Hartville Uplift is an elongated, north-northwest oriented, broad domal arch, of Laramide age (70-50 Ma). 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 that occur in the 14-17-inch PZ of MLRA 64, three unique ecological sites were added to help describe the soils and plant community dynamics that occur 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

US 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, and Sandy and Silty Tablelands—25g
Northwestern Great Plains—43; White River Badlands—43h, and Keya Paha Tablelands—43i

Ecological site concept

The Claypan sites occurs throughout MLRA 64. It is located on gently undulating to rolling sedimentary uplands with slopes ranging from 0 to 6 percent. Soil are formed from soft siltstone, shales, and alluvium. The soil surface texture is loam to silt loam, 4 to 10 inches thick, and the subsurface textures range from silt loam to clay. The Btn horizon creates a claypan of extremely hard sodium-affected clay (natric), which occurs between 5 and 16 inches of the surface. This root-restricting layer has round-topped or “biscuit-shaped” columnar structure. Vegetation in the Reference State (1.0) consists primarily of cool-season rhizomatous wheatgrasses and needlegrasses and warm-season shortgrasses. Prickly pear cactus is typically present in the plant community but in minor amounts. Wyoming big sagebrush can occur on this site, primarily in the western portion of the MLRA.

Associated sites

R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can be found adjacent to the Claypan ecological site.
GX064X01X015	**Loamy 14-17" PZ** The Loamy 14-17” PZ ecological site can be found adjacent to the Claypan ecological site.

R064XY030NE	**Saline Lowland** On lower landscape positions the Saline Lowland ecological site can be found adjacent to or intermixed with the Claypan ecological site.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can be found adjacent to the Claypan ecological site.
GX064X01X036	**Loamy 17-20" PZ** The Loamy 17-20” PZ ecological site can be found adjacent to the Claypan ecological site.
R064XY046NE	**Thin Claypan** The Thin Claypan ecological site can be found adjacent to or intermixed with the Claypan ecological site.

Similar sites

R064XY046NE	**Thin Claypan** The Thin Claypan ecological site will have more shortgrasses and salt-tolerant species and lower forage production than the Claypan ecological site. The claypan soil feature will occur within 4 inches of the surface in the Thin Claypan site and between 5 and 16 inches in the Claypan site.
R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site will have more green needlegrass and higher forage production than the Claypan ecological site. The Clayey 14- 17” PZ site will not have the claypan soil feature in the soil profile.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site will have more green needlegrass and higher forage production than the Claypan ecological site. The Clayey 17- 20” PZ site will not have the claypan soil feature in the soil profile.

Table 1. Dominant plant species

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

Physiographic features

The Claypan ecological site occurs on nearly level or gently sloping upland fans and flats. In some cases, it also occurs on flood plains, terraces along drainageways and on foot slopes on uplands. This site receives runoff from adjacent sites.

Table 2. Representative physiographic features

Landforms	(1) Alluvial flat (2) Alluvial fan (3) Flood plain
Flooding frequency	None to rare
Ponding frequency	None
Elevation	884–1,219 m
Slope	0–6%
Water table depth	91–203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 64 is considered to have a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature may also abound. The climate is the result of the location of

MLRA 64 near the geographic center of North America. There are few natural barriers on the Northern Great Plains, and air masses move freely across the plains and account for rapid changes in temperature.
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 temperatures averaging 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 this area's climate.
Hourly winds 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 and occasional strong storms may 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. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	137 days
Precipitation total (average)	457 mm

Climate stations used

- (1) AGATE 3 E [USC00250030], Harrison, NE
- (2) HARRISON [USC00253615], Harrison, NE
- (3) HEMINGFORD [USC00253755], Hemingford, NE
- (4) INTERIOR 3 NE [USC00394184], Interior, SD
- (5) MARTIN [USC00395281], Martin, SD
- (6) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (7) CHADRON MUNI AP [USW00024017], Chadron, NE
- (8) WOOD [USC00399442], Wood, SD
- (9) LUSK 2 SW [USC00485830], Lusk, WY
- (10) TORRINGTON 29N [USC00488997], Jay Em, WY

Influencing water features

No riparian areas or wetland features are directly associated with this site.

Soil features

The features common to soils in this site is the silt loam surface texture, which changes abruptly at about 6 to 11 inches below the surface, to an extremely hard clayey Bt horizon having round-topped or “bun shaped” columnar or prismatic structured subsoil. These subsoils are high in sodium. Saturated hydraulic conductivity is very slow, available water capacity is moderate and permeability is very slow. Slopes range from 0 to 6 percent. The soils on this site are moderately deep to deep, somewhat poorly to well drained and were formed in residuum from siltstone or in silty and clayey alluvium. The surface layer is 4 to 10 inches thick. The texture of the subsoil ranges from loam to clay. The soils have a slow to very slow infiltration rate.

Major soils correlated to the Claypan site include: Beckton, Cedar Butte, Mosher, Weta, and Wortman.

This site should show slight to no evidence of rills, or wind-scoured areas, but can exhibit moderate pedestalling of plants. Water flow paths are sometimes apparent and somewhat continuous. The soil surface is stable and intact. Sub-surface soil layers are restrictive to water movement and root penetration.

More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location.

Table 4. Representative soil features

Parent material	(1) Alluvium–shale and siltstone
Surface texture	(1) Silt loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to well drained
Permeability class	Very slow
Soil depth	51–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–20
Soil reaction (1:1 water) (0-101.6cm)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Claypan 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/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, 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/or species composition.

Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1). Blue grama and buffalograss will increase and may eventually dominate the plant community. Western wheatgrass, thickspike wheatgrass, green needlegrass and needle and thread will decrease in frequency and production. Excessive defoliation can cause threeawns and annuals to increase and dominate the site. This site is also susceptible to the invasion of non-native cool-season grasses. In the drier 14-17 inch precipitation zone, cheatgrass and field brome are most likely to invade, where as in the wetter 17-20 inch precipitation zone annual and perennial non-native cool-season grasses are likely to invade.
Interpretations are primarily based on the Rhizomatous Wheatgrass-Needlegrass-Blue Grama 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 is a diagram that illustrates the common plant communities that can occur on the site and the transitions between communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State and transition model

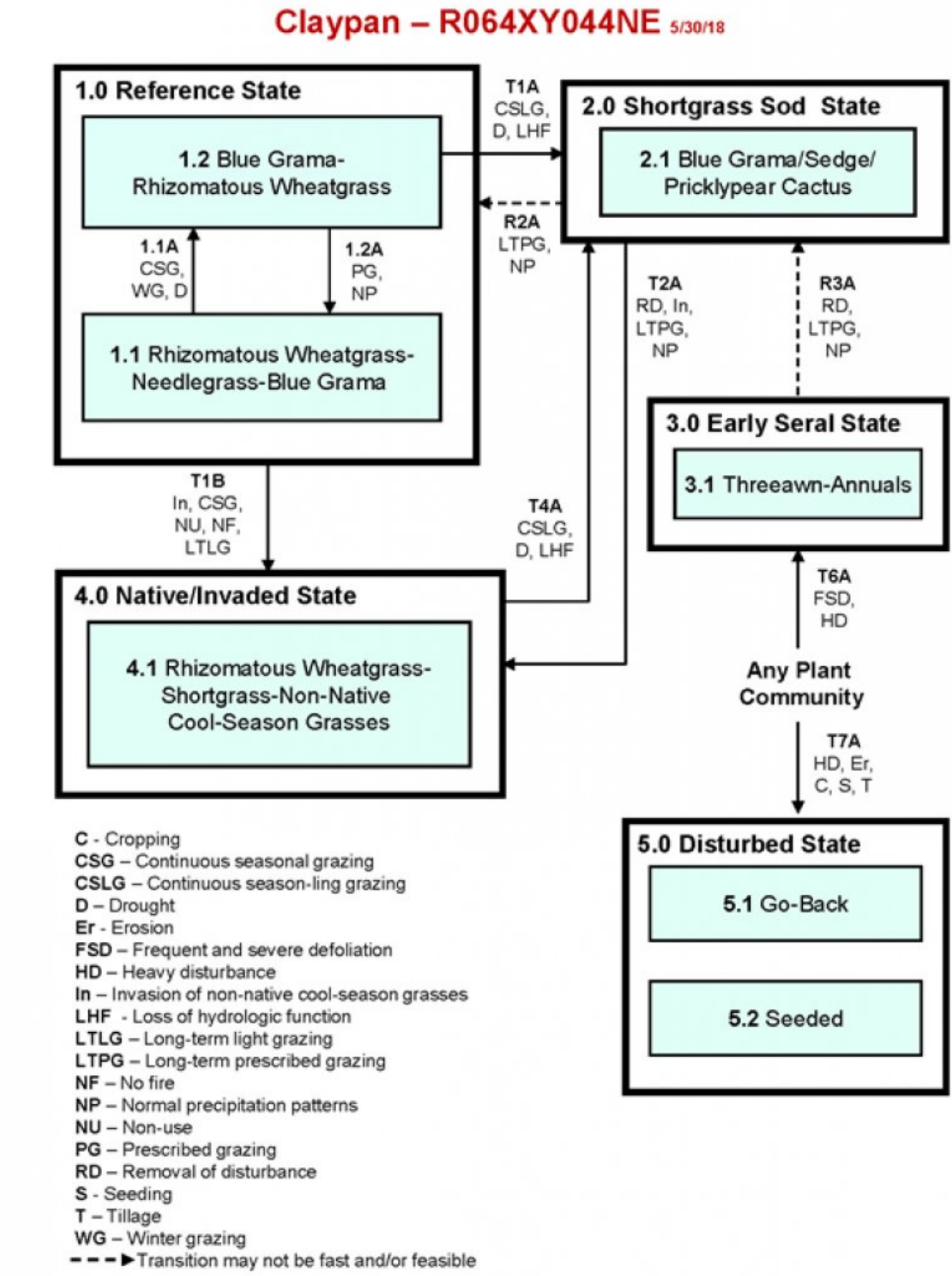

Figure 6. Claypan - R064XY044NE.

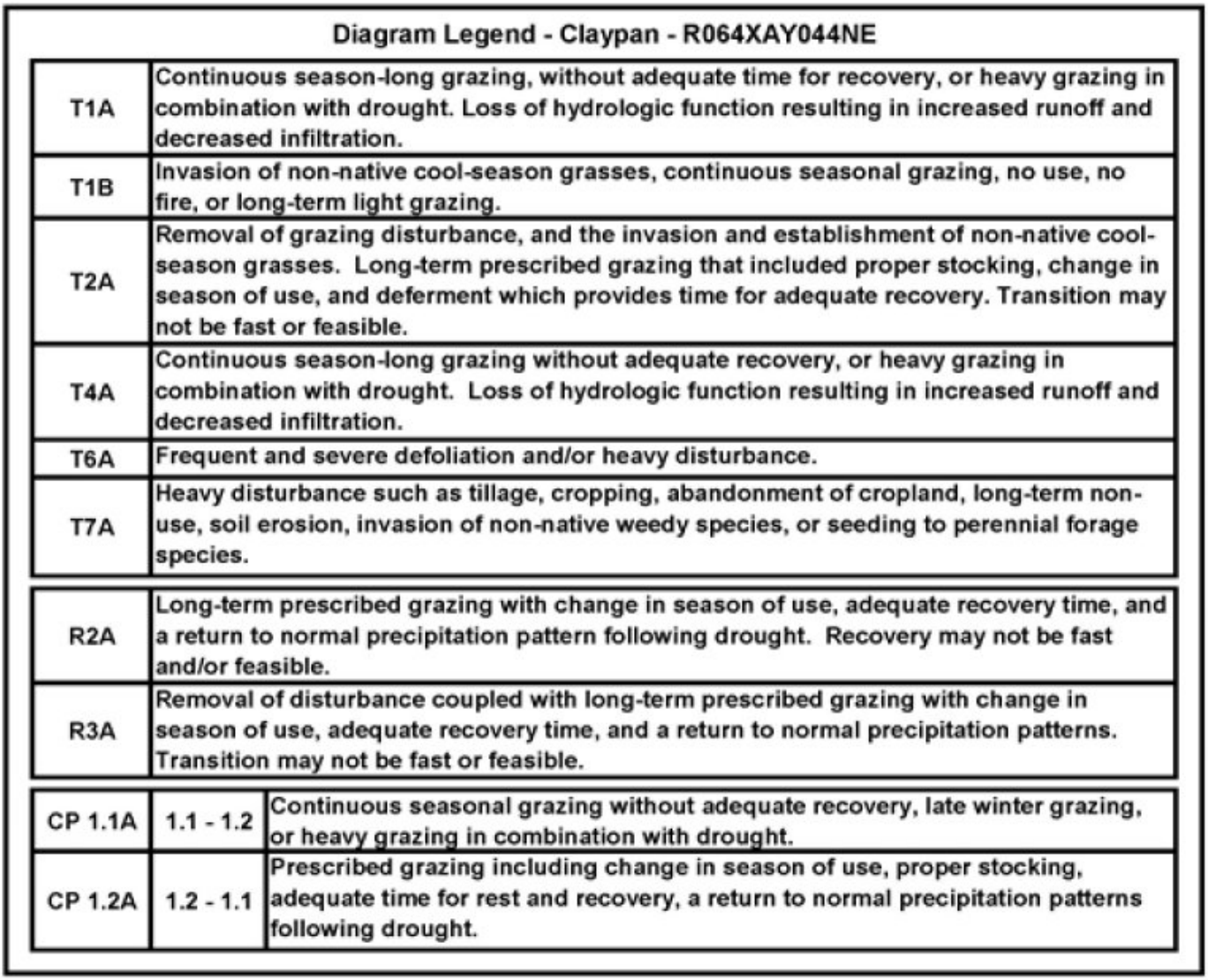

Figure 7. Claypan - R064XY044NE.

State 1
Reference State

This State represents what is believed to show the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This site, in the Reference State, is dominated by a mix of cool-season rhizomatous wheatgrasses and needlegrasses, and warm-season shortgrasses. Heavy grazing will cause the plant community to transition to a community dominated by warm-season shortgrasses, and cool-season rhizomatous wheatgrasses. Erosion of the surface horizon is a potential outcome with heavy grazing. In pre- European times the primary disturbances included grazing by large ungulates and small mammals, and drought. Favorable growing conditions occurred during the spring and warm months of June through August. Today a similar state can be found in areas where proper livestock use has occurred.

Community 1.1
Rhizomatous Wheatgrass-Needlegrass-Blue Grama

Interpretations are based primarily on the Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community which is also considered to be Reference Plant Community (1.1). This plant community evolved with grazing by large herbivores and occasional prairie fires. This plant community can be found on areas having a history of proper grazing management, including adequate recovery periods between grazing events. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. Cool-season grasses dominate the community. The co-dominant grasses are western wheatgrass, thickspike wheatgrass, and green needlegrass. Other grasses and grass-like plants occurring include blue grama, needle and thread, buffalograss, dropseed, inland saltgrass, and sedges. Significant forbs include cudweed sagewort, biscuitroot, wild parsley,

scarlet globemallow, and scurfpea. Shrubs present on this plant community include fringed sagewort, silver sagebrush, rubber rabbitbrush, plains pricklypear, and brittle cactus. In the far western portion of MLRA 64, Wyoming big sagebrush can occur on this site in small amounts. 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). The diversity in plant species allows for high drought tolerance. This is a fragile, but sustainable plant community. Low to moderate available water holding capacity coupled with high accumulations of sodium and slow permeability strongly influences the soil-water-plant relationships.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1244	1605	1961
Forb	84	135	185
Shrub/Vine	17	54	95
Total	**1345**	**1794**	**2241**

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
Blue Grama-Rhizomatous Wheatgrass

This plant community develops under continuous seasonal grazing (i.e., grazing an area during the same season every year) or from overutilization during extended drought periods. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. A fairly even mix of cool-season grasses and short warm-season grasses dominate this plant community. Blue grama and western wheatgrass are the dominant grasses. Other grasses and grass-like plants occurring include green needlegrass, needle and thread, buffalograss, prairie Junegrass, threadleaf sedge, dropseed, Sandberg bluegrass, and inland saltgrass. Significant forbs include silverleaf scurfpea, cudweed sagewort, western yarrow, and heath aster. Shrubs include fringed sagewort, rubber rabbitbrush, broom snakeweed, and cactus. This plant community is somewhat resistant to change. The dominant herbaceous species are very adapted to grazing; however, the mid-grass species and the more palatable forbs will decrease in the community through continuous seasonal grazing. If the herbaceous component is intact, it tends to be resilient if disturbance is not long-term. Because of the sod-forming habit of the shortgrass species, water infiltration decreases and runoff increases when compared to the Reference Plant Community.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1037	1365	1692
Forb	73	157	241
Shrub/Vine	11	47	84
Total	**1121**	**1569**	**2017**

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 during the active growing period of cool-season plants, or late-season winter grazing, or heavy grazing in combination with drought will lead to the Blue Grama-Rhizomatous Wheatgrass Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, which allows for adequate plant recovery periods, and a return to normal precipitation patterns will move this plant community to the Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1). Periods of non-use or deferment may be a management option to reach the Plant Community Phase (1.1).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

The Shortgrass Sod State is dominated by shortgrass species; blue grama, buffalograss, upland sedges, and pricklypear cactus. This state is the result of grazing patterns that did not provide adequate recovery time for cool-season wheatgrasses and needlegrasses. If heavy disturbance such as, frequent and sever defoliation, and livestock concentration continues, pioneer perennials and annual grass and forb species may become dominant. The hydrologic function of this state is dramatically altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 2.1
Blue Grama/Sedge/Prickly Pear Cactus

This plant community results from heavy, continuous grazing and/or annual, early spring seasonal grazing. Shortgrasses and forbs increase to dominate the plant community and annual production decreases dramatically. Lack of litter and short plant heights result in high soil temperatures, high soil water loss, and poor water infiltration rates, which gives blue grama a competitive advantage over cool-season mid-grasses. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. Blue grama and sedge are the prominent species with the balance being lesser amounts of buffalograss, inland saltgrass, prairie Junegrass, western wheatgrass, thickspike wheatgrass, green needlegrass, and needle and thread. Forbs and shrubs such as fringed sagewort, cudweed sagewort, heath aster, broom snakeweed, cactus, and western yarrow may also be present. This plant community is very stable. The thick sod and competitive advantage prevents other species from establishing. This plant community is less productive than the Reference State (1.0). Soil erosion will be minimal due to the sod-forming habit of blue grama and buffalograss.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	370	762	1154
Shrub/Vine	39	67	95
Forb	39	67	95
Total	**448**	**896**	**1344**

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 areas. Extended periods of drought accompanied by heavy grazing can also push an ‘At Risk’ Plant Community Phase to this State. In most cases, this phase is dominated by pioneer perennial and annual grass and forb species. The percentage of bare ground is also much higher than on any other plant community phase.

Community 3.1
Threeawn-Annual

This plant community develops under severe disturbance and/or excessive defoliation. This can result from heavy livestock or wildlife concentration (i.e., water locations, bedding, or loafing grounds, feeding areas), or prairie dog habitation. The dominant vegetation includes pioneer annual grasses and forbs and early successional biennial and perennial species. Grasses may include threeawn, sixweeks fescue, bluegrass, cheatgrass, needleandthread, prairie Junegrass, and western wheatgrass. The dominant forbs include curlycup gumweed, marestail, salsify, kochia, field bindweed, thistles, fringed sagewort, pussytoes, prostrate verbena, and other early successional species. Shrubs that may be present include rubber rabbitbrush and broom snakeweed. Plant species from adjacent ecological sites may become minor components of this plant community. The community also is susceptible to invasion of non-native annual and perennial forbs due to severe soil disturbances and relatively high percent of bare ground. Compared to the Western Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1), western wheatgrass, green needlegrass, needle and thread, and blue grama have decreased. This plant community is resistant to change as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. Soil erosion is potentially high in this vegetation state. Reduced surface cover, low plant density, low plant vigor, loss of root biomass, and soil compaction, all contribute to decreased water infiltration, increased runoff, and accelerated erosion rates. Significant economic inputs and time would be required to move this plant community toward a higher successional stage and a more productive plant community. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing plant community and neighboring plant communities. The total annual production ranges from 200 to 1,000 lbs./ac. (air-dry weight) depending upon growing conditions.

Figure 14. 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		

State 4
Native/Invaded State

This State has been invaded by cheatgrass, field brome, crested wheatgrass, smooth brome, and/or Kentucky bluegrass, but not at the levels where the plant communities are dominated by these species. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community composition (lbs./ac) and native grasses represent less than 40 percent of the plant community composition. (Toledo, D. et al., 2014). Other non-native perennial cool-season grasses may result in the same transition but is not documented. Long-term non-use and/or no fire, in combination with above average precipitation, may transition a native/invaded plant community to a plant community phase that is predominantly non-native cool-season grasses. Plant litter accumulation tends to favor 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. This scenario has not been observed on this ecological site in MLRA 64, however it may exist. Cheatgrass and field brome will always be present in these plant communities but during years with very wet falls and early springs, these two species can make up a significant percentage of the

total annual production. As the seed bank of these species grows, the more difficult they will be to control. Once these non-native cool-season species are established, it is unlikely that an invaded plant community will be returned to the Reference State (1.0).

Community 4.1
Rhizomatous Wheatgrass-Shortgrass-Non-Native Cool-Season Grasses

This plant community phase is similar to Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1), but it also contains minor amounts of non-native invasive grass species such as crested wheatgrass, smooth brome, and Kentucky bluegrass (up to about 15 percent by air-dry weight). Cheatgrass and field brome will almost always be present. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses with subdominant warm-season shortgrasses. The major grasses include western wheatgrass, thickspike wheatgrass, green needlegrass, blue grama, and sideoats grama. Other grass or grass-like species include needle and thread, Sandberg bluegrass, buffalograss, and sedges. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought. This is a sustainable plant community regarding site/soil stability, watershed function, and biologic integrity.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	953	1373	1715
Forb	101	118	202
Shrub/Vine	67	78	101
Total	**1121**	**1569**	**2018**

Figure 16. 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		

State 5
Disturbed State

This State can be transitioned to from any plant community. The two separate vegetative plant communities are highly variable in nature. They are derived through different management scenarios, and are not related successionally. Infiltration, runoff, and soil erosion varies depending on the vegetation present on the site. The Go-back (6.1) plant community was previously tilled for crop production and then abandoned. The plant community that develops on this site will be greatly influenced by the plant communities that are located on adjacent land. The Seeded (6.2) plant community was typically tilled and then seeded to a perennial forage species or mix of species. Infiltration, runoff, and soil erosion will vary depending upon the vegetation present on the site.

Community 5.1
Go-back

The Go-back Plant Community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned cropland). During the early successional stages, the species that mainly dominate are annual grasses and forbs, later being replaced by both native and introduced perennials. The vegetation on this site varies greatly, sometimes being dominated by threeawn, crested wheatgrass, bluegrass, smooth brome, annual brome, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site can include western wheatgrass, prickly lettuce, horseweed, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 5.2

Seeded

The Seeded Plant Community normally consists of those areas seeded to pubescent or intermediate wheatgrass, alfalfa, switchgrass, or other forage species. For adapted species and expected production, refer to the USDA-NRCS eFOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

With continuous season-long grazing, or heavy grazing during extended period of drought will transition the Blue Grama-Rhizomatous Wheatgrass Plant Community (1.2) to the Shortgrass Sod State (2.0). Once this site becomes sod-bound there will be a loss of hydrologic function resulting in increased run-off and less infiltration.

Transition T6A
State 1 to 3

Frequent and severe defoliation, or heavy disturbances causing soil compaction, and a loss of hydrologic function will result in a transition to the Early Seral State (3.0). Examples include; livestock concentration areas (feeding), prairie dog activity, and small horse pastures, etc. Runoff will increase and infiltration will decrease.

Transition T1B
State 1 to 4

Continuous season-long grazing, or long-term light grazing, or non-use and no fire, and invasion of non-native cool-season grasses will cause a transition to the Native/Invaded State (4.0).

Transition T7A
State 1 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing may potentially convert the plant community to the Blue Grama-Rhizomatous Wheatgrass Plant Community (1.2), assuming an adequate seed/vegetative source is present. A return to normal precipitation patterns will help expedite this transition. This transition could require significant time and input to achieve, and in the end may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T6A
State 2 to 3

Frequent and severe defoliation, or heavy disturbances causing soil compaction, and a loss of hydrologic function will result in a transition to the Early Seral State (3.0). Examples include; livestock concentration areas (feeding), prairie dog activity, and small horse pastures, etc. Runoff will increase and infiltration will decrease.

Transition T2A
State 2 to 4

Removal of management-induced disturbance, the invasion of non-native cool-season grasses, and long-term prescribed grazing may result in a transition to the Native/Invaded State (4.0). A return to normal precipitation patterns will help expedite this transition. This could require significant time and input to achieve and in the end may

not meet management objectives.

Transition T7A
State 2 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Restoration pathway R3A
State 3 to 2

Removal of the management-induced disturbance, in association with long-term prescribed grazing and favorable climatic conditions, may allow for adequate plant recovery, and a transition to the Shortgrass Sod State (2.0). Periods of non-use or deferment may be a management option to facilitate this movement. This transition will not be rapid and may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T7A
State 3 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Transition T4A
State 4 to 3

Continuous season-long grazing, or heavy grazing during extended period of drought will transition this plant community to the Shortgrass State (3.0). Once this site becomes sod-bound there will be a loss of hydrologic function, resulting in increased run-off and less infiltration.

Transition T6A
State 4 to 3

Frequent and severe defoliation, or heavy disturbances causing soil compaction, and a loss of hydrologic function will result in a transition to the Early Seral State (3.0). Examples include; livestock concentration areas (feeding), prairie dog activity, and small horse pastures, etc. Runoff will increase and infiltration will decrease.

Transition T7A
State 4 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			359–717	
	western wheatgrass	PASM	*Pascopyrum smithii*	359–673	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–168	–
2	**Needlegrasses**			448–628	

	green needlegrass	NAVI4	*Nassella viridula*	179–538	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	90–359	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–179	–
3	**Short Warm-Season**			90–269	
	blue grama	BOGR2	*Bouteloua gracilis*	90–269	–
4	**Grass-Likes**			36–90	
	sedge	CAREX	*Carex*	36–90	–
5	**Other Native Grasses**			36–179	
	Grass, perennial	2GP	*Grass, perennial*	0–90	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–72	–
	dropseed	SPORO	*Sporobolus*	18–54	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	18–54	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–36	–
	threeawn	ARIST	*Aristida*	0–36	–
	saltgrass	DISP	*Distichlis spicata*	0–18	–
Forb					
7	**Forbs**			90–179	
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	18–36	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	18–36	–
	scurfpea	PSORA2	*Psoralidium*	18–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	18–36	–
	Forb, perennial	2FP	*Forb, perennial*	0–36	–
	common yarrow	ACMI2	*Achillea millefolium*	18–36	–
	onion	ALLIU	*Allium*	18–36	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	18–36	–
	desertparsley	LOMAT	*Lomatium*	18–36	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–18	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–18	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–18	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–18	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–18	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–18	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–18	–
	deathcamas	ZIGAD	*Zigadenus*	0–18	–
	Forb, annual	2FA	*Forb, annual*	0–18	–
Shrub/Vine					
8	**Shrubs**			18–90	
	plains pricklypear	OPPO	*Opuntia polyacantha*	18–36	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–36	–
	prairie sagewort	ARFR4	*Artemisia frigida*	18–36	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–36	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–36	–

	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–18	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–18	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			235–471	
	western wheatgrass	PASM	*Pascopyrum smithii*	235–448	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–90	–
2	**Needlegrasses**			78–224	
	green needlegrass	NAVI4	*Nassella viridula*	78–202	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–90	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–78	–
3	**Short Warm-Season**			112–359	
	blue grama	BOGR2	*Bouteloua gracilis*	112–336	–
4	**Grass-Likes**			78–157	
	sedge	CAREX	*Carex*	78–157	–
5	**Other Native Grasses**			78–235	
	threeawn	ARIST	*Aristida*	31–157	–
	dropseed	SPORO	*Sporobolus*	31–157	–
	Grass, perennial	2GP	*Grass, perennial*	0–78	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	31–63	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–47	–
	saltgrass	DISP	*Distichlis spicata*	0–16	–
6	**Non-Native Grasses**			0–78	
	field brome	BRAR5	*Bromus arvensis*	0–78	–
	cheatgrass	BRTE	*Bromus tectorum*	0–78	–
Forb					
7	**Forbs**			78–235	
	Forb, annual	2FA	*Forb, annual*	0–78	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	16–78	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–78	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	16–47	–
	white heath aster	SYER	*Symphyotrichum ericoides*	16–47	–
	yellow salsify	TRDU	*Tragopogon dubius*	16–47	–
	deathcamas	ZIGAD	*Zigadenus*	0–31	–
	scurfpea	PSORA2	*Psoralidium*	16–31	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	16–31	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	16–31	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	16–31	–
	Forb, perennial	2FP	*Forb, perennial*	0–31	–
	common yarrow	ACMI2	*Achillea millefolium*	16–31	–
	onion	ALLIU	*Allium*	0–16	–

	rosy pussytoes	ANRO2	*Antennaria rosea*	0–16	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–16	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–16	–
Shrub/Vine					
8	**Shrubs**			16–78	
	prairie sagewort	ARFR4	*Artemisia frigida*	16–47	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–31	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–31	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–31	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	16–31	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–16	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–16	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			0–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–90	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–22	–
2	**Needlegrasses**			45–90	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	45–90	–
3	**Short Warm-Season**			224–314	
	blue grama	BOGR2	*Bouteloua gracilis*	224–314	–
4	**Grass-Likes**			45–135	
	sedge	CAREX	*Carex*	45–135	–
5	**Other Native Grasses**			45–179	
	threeawn	ARIST	*Aristida*	18–90	–
	dropseed	SPORO	*Sporobolus*	18–90	–
	Grass, perennial	2GP	*Grass, perennial*	0–45	–
	saltgrass	DISP	*Distichlis spicata*	9–27	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	9–27	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–27	–
6	**Non-Native Grasses**			22–90	
	smooth brome	BRIN2	*Bromus inermis*	0–90	–
	cheatgrass	BRTE	*Bromus tectorum*	18–90	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–90	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–90	–
	field brome	BRAR5	*Bromus arvensis*	0–45	–
Forb					
7	**Forbs**			45–90	
	common yarrow	ACMI2	*Achillea millefolium*	18–45	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	9–45	–
	Forb, annual	2FA	*Forb, annual*	0–27	–

	Forb, annual	2FA	*Forb, annual*	0–27	
	yellow salsify	TRDU	*Tragopogon dubius*	9–27	–
	deathcamas	ZIGAD	*Zigadenus*	0–27	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	9–27	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	9–27	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	9–18	–
	white heath aster	SYER	*Symphyotrichum ericoides*	9–18	–
	Forb, perennial	2FP	*Forb, perennial*	0–18	–
	onion	ALLIU	*Allium*	9–18	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	9–18	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	9–18	–
	woolly plantain	PLPA2	*Plantago patagonica*	9–18	–
	scurfpea	PSORA2	*Psoralidium*	0–9	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–9	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–9	–
Shrub/Vine					
8	**Shrubs**			45–90	
	prairie sagewort	ARFR4	*Artemisia frigida*	9–45	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–36	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–27	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–27	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	9–27	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	9–18	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	9–18	–

Animal community

Wildlife Interpretations
MLRA 64 lies within the drier portion of northern mixed-grass prairie ecosystem where sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this area consisted of diverse grass/shrub land habitats interspersed with varying densities of depressional, instream wetlands, and woody riparian corridors. These habitats provided critical life cycle components for many of its users. Many species of grassland birds, small mammals, reptiles, 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 small mammal and insect species, were the primary consumers linking the grassland resources to predators such as the wolf, mountain lion, and grizzly bear, and smaller carnivores such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant; however, the species remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox were associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning 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 impacted plant and animal communities. The bison was a historical keystone species but have been extirpated as a free-ranging herbivore. The loss of the bison and 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 has reduced habitat quality for area-sensitive species.

Within MLRA 64, the Claypan ecological site provides upland grassland cover with an associated forb, and shrub

component. It was typically part of a an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Clayey, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Terrace ecological sites. This site provided habitat for species requiring 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. This site provides habitat for grassland nesting birds, small rodents, bats, mammalian predators, and a variety of reptiles and insects. Invasive species such as perennial non-native cool-season grasses, cheatgrass, and field brome 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-Needlegrass-Blue Grama (1.1): This site is dominated by rhizomatous wheatgrass and green needlegrass with a minor shrub community generally dominated by cactus, broom snakeweed, sagewort, sagebrush, and rubber rabbitbrush. Raptors such as red-tailed hawk, Ferruginous hawk, northern harrier, and golden eagle may use this site. Insects, such as pollinators, play a limited role in maintaining the forb community but do provide a significant forage base for birds and various bats, especially species such as the Western small-footed Myotis, the fringe-tailed Myotis, and the Townsend’s big-eared bat. Prey populations are available for grassland raptors and mammalian predators. Other mammalian predators utilizing this plant community include the coyote, red fox, and badger.
The relatively tall stature of this plant community provides suitable thermal, protective, and escape cover for small and large mammals. This site provides a diversity of grasses, forbs, and shrubs for small and large herbivores including shrews, mice, spotted ground squirrel, desert cottontail rabbit, white-tailed and black-tailed jackrabbits, deer and pronghorn. This site provides limited habitat for sharp-tailed grouse, white-tailed deer, and amphibians, mostly toads (i.e., Great Plains, Woodhouse’s, and Plains spade-foot). Prey abundance and shade opportunities may attract multiple reptile species such as gopher snake, milk snake, prairie rattlesnake, and lesser numbers of various lizard species.

Blue Grama/Sedge/Pricklypear Cactus (2.1): Resulting from continuous season-long grazing or from heavy grazing, blue grama and buffalograss will become dominant. The forb diversity and abundance has remained relatively unchanged. Shrub abundance increases significantly, especially sagewort and sagebrush. A shift to shorter plant structures will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, and swift fox. Species such as horned lark, long-billed curlew, upland sandpiper, desert cottontail, and white-tailed jackrabbit may be present or increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits suitable thermal, protective, escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Threeawn-Annual Plant Community (3.1): This plant community develops under severe disturbance and/or excessive defoliation. This can result from heavy livestock or prairie dog concentration. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Plant species from adjacent ecological sites may become minor components of this plant community. A shift to shorter plant structure will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, and swift fox. Species such as horned lark, long-billed curlew, upland sandpiper, desert cottontail, and white-tailed jackrabbit may be present or increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits suitable thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.
Soil erosion is potentially high, impacting offsite aquatic habitats through increased runoff, nutrient, and sediment loads. Reduced surface cover, low plant density, low plant vigor, loss of root biomass, and soil compaction all contribute to decreased wildlife abundance and diversity. Since secondary succession is highly variable, plant and wildlife species will vary. This plant community provides habitat for generalist or early successional species.

Grazing Interpretations
The following table lists the suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, 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 carrying capacity estimates 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. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

The following stocking rates are based on 912 lbs./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-Needlegrass-Blue Grama (1.1) Average Production (lbs./acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

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

Plant Community: Blue Grama/Sedge/Pricklypear Cactus (2.1) Average Production (lbs./acre, air-dry): 800
Stocking Rate (AUM/acre): 0.22

*Plant Community: Threeawn-Annuals (3.1) Average Production (lbs./acre, air-dry): Variable Stocking Rate (AUM/acre): Variable

*Plant Community: Rhizomatous Wheatgrass-Shortgrass-Non-Native Cool-Season Grasses (4.1) Average Production (lbs./acre, air-dry): 1,400
Stocking Rate (AUM/acre): 0.38

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

* Total annual production and stocking rates are highly variable and will require on-site sampling.

Total annual production on-site 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 will likely be lacking protein to meet livestock requirements, and added protein will allow 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 and runoff potential for this site varies from moderate to high depending upon soil hydrologic group, slope, and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for higher 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 for hydrologic soil groups, runoff quantities, and hydrologic curves, Part 630.).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide variety of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Seed harvest of native plant species can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site concept has passed Quality Control (QC) and Quality Assurance (QA) to ensure that the site meets the 2014 NESH standards for a Provisional ecological site description. This is an updated “Previously Approved” ESD that represents a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 (rev.1, 2003) National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All 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 does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that the “Previously Approved” ESD will continue refinement toward an “Approved” status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to validate the information in this Provisional Ecological Site Description. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. The final field review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final document.

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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, NRCS; Jill Epley, Range Management Specialist, NRCS; Rick Peterson, Range Management Specialist, NRCS; David Steffen, Range Management Specialist, NRCS; Jeff Vander Wilt; Range Management Specialist, NRCS; Phil Young, Soil Scientist, NRCS.

Other references

EPA Level III and Level IV Ecoregions of the Conterminous United States. Available online: https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions- conterminous -united-states. Accessed 04/26/18.

High Plains Regional Climate Center, University of Nebraska. Available online: http://www.hprcc.unl.edu/. Accessed 04/6/18.

Toledo, D., M. Sanderson, K. Spaeth, J. Hendrickson, and J. Printz. 2014. Extent of Kentucky bluegrass and its effect on native plant species diversity and ecosystem services in the Northern Great Plains of the United States. Invasive Plant Science and Management. 7 (4):543-522. Weed Science Society of America.

USDA, NRCS. Electronic Field Office Technical Guide. Available online: https://efotg.sc.egov.usda.gov. Accessed 05/23/18.

USDA, NRCS. Soil Survey Staff. Official Soil Series Descriptions. Available online: https://soilseries.sc.egov.usda.gov/osdname.aspx. Accessed 05/23/18.

USDA, NRCS. Soil Survey Staff. Web Soil Survey. Available online: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed 05/23/18.

USDA, NRCS. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.

Ag Handbook 296. Available online: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050898.pdf. Accessed 1/17/18.

USDA, NRCS. 2014. National Ecological Site Handbook, 1st Ed. Available online: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcseprd1291232. Accessed 1/27/18.

USDA, NRCS. 2012. National Engineering Handbook, Part 630. Hydrology chapters from e-Directives. Available online: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/hydrology/?cid=STELPRDB1043063. Accessed 1/17/18.

USDA, NRCS. National Water and Climate Center. Available online: http://www.wcc.nrcs.usda.gov/. Accessed 05/30/18.

USDA, NRCS. 1997, rev. 1, 2003. National Range and Pasture Handbook. Available online: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043055.pdf. Accessed 11/7/17.

USDA, NRCS. National Soil Information System, Information Technology Center. Available online: http://nasis.nrcs.usda.gov. Accessed 11/7/17.

USDA, NRCS. PLANTS Database. Available online: http://plants.usda.gov. Accessed 05/29/18. USDA, NRCS.

Various Published Soil Surveys.

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Approval

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Acknowledgments

ESD updated by Rick L. Peterson on 5/30/18.
Editorial Review by Carla Green Adams.

Rangeland health reference sheet

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

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Date	01/05/2010
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Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** None, or barely visible and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0 to 15 percent is typical.

5. **Number of gullies and erosion associated with gullies:** None should be present.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate 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.

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 with mollic (dark) colors when moist. Structure typically is medium to fine granular at least

in the upper A-horizon.

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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 & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration.

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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" appearance at top of – natural pan appears at roughly 4 to 16 inches with "biscuit-top pan.

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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: Mid cool-season rhizomatous grasses > Mid/tall cool-season bunchgrasses >>

    Sub-dominant: Short warm-season grasses >

    Other: Forbs > Grass-likes = Shrubs

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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14. **Average percent litter cover (%) and depth (in):** Litter cover is typically 40 to 70 percent, with the depth about 0.25 inches.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 1,200 to 2,000 pounds/acre, with the reference value being 1,600 pounds/acre (air-dry basis).

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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:** State and local noxious weeds.

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.