USDA Natural Resources
Conservation Service

Ecological site R061XY022SD
Loamy Terrace

Last updated: 7/17/2024
Accessed: 05/10/2025

General information

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

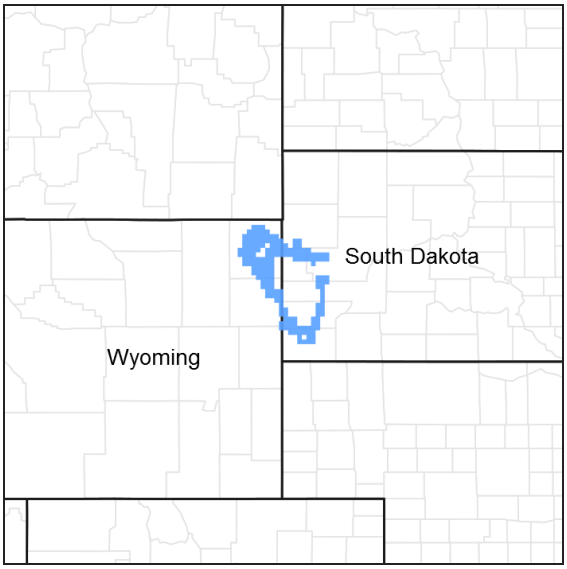


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 061X–Black Hills Foot Slopes

The Black Hills Foot Slopes (MLRA 61) is shared between Wyoming (WY) (58 percent) and South Dakota (SD) (42 percent). The MLRA is approximately 1,865 square miles. The towns of Spearfish, Sturgis, and Hot Springs, South Dakota, and Newcastle and Sundance, Wyoming, are all in this MLRA. Rapid City, South Dakota, is on the eastern edge of the MLRA. Wind Cave National Park, Devils Tower National Monument, and parts of Thunder Basin National Grassland and the Black Hills National Forest are also in MLRA 61. Devils Tower was the nation’s first National Monument, designated by President Theodore Roosevelt in 1906.

The Black Hills Foot Slopes consists of steeply dipping rocks circling the domed mountains of the Black Hills. As the mountains were uplifted, older sediments were tipped up and dipped away from the core of the mountains. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones, which are on the outside edge of the area, are referred to as the Dakota Hogback. The next geologic formation is the Triassic-aged red beds of the Spearfish shale. It forms a low valley. This “red valley” surrounds the Black Hills between the two ridges formed by the Inyan Kara (hogback) and Minnekahta Formations associated with the Black Hills (MLRA 62). The Lakota referred to the red valley as the “Big Racecourse or the Red Racetrack.” The red beds have gypsum and anhydrous layers. Ground water seepage can dissolve these layers, creating sinkholes on the surface.

The average elevation of MLRA 61 ranges from 2,950 to 3,940 feet with extremes to 5,580 feet. Slopes are

generally hilly; however, the interior red beds are nearly level to moderately sloping. The exterior hogback is steep, erosion-resistant rock. The Belle Fourche River is the only river flowing through MLRA 61. It passes through Hulett, Wyoming.

The dominant soil orders in this MLRA are Alfisols, Entisols, and Mollisols. The soils in the area predominantly have frigid or mesic soil temperature regimes and aridic or ustic soil moisture regimes. The soils are shallow to very deep, generally well drained, and loamy.

Average annual precipitation is 16 to 22 inches. The majority of rainfall occurs early in the growing season. Some high-intensity thunderstorms occur in mid-late summer. This MLRA supports open grassland, open ponderosa forest, and savanna-like vegetation. The grassland is characterized by native grasses, such as big bluestem, little bluestem, western wheatgrass, needle and thread, prairie dropseed, and green needlegrass. Bur oak grows throughout the northern area and can develop into nearly pure stands.

The major resource concerns are urban expansion, water quality, wind erosion, and water erosion.

MLRA 61 is 54 percent privately owned rangeland and 19 percent forest land. Federal lands make up 7 percent of the rangeland and 5 percent of the forest land. The remaining 15 percent of the MLRA is privately owned cropland and urban development (USDA-NRCS, 2006: Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 61 is divided into three precipitation zones (PZ).
The northern area (18–22” PZ) extends from just south of Rapid City, South Dakota, north to the Wyoming border.

The southern area (16–18” PZ) extends from Newcastle, Wyoming, south to Hot Springs, South Dakota, then north to just south of Rapid City.

The western area (16–20” PZ) is primarily located in Wyoming, extending from Newcastle in the south, to north of the Bear Lodge Mountains, then south through the gap between the Bear Lodge Mountains and the Black Hills.

One additional grouping of ecological sites represents sites that are common for the entire MLRA and do not have a precipitation zone designation.

The forest lands in MLRA 61 are represented by three forest ecological sites, which are currently correlated to MLRA 62 Black Hills.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 61—Black Hills Foot Slopes

US Environmental Protection Agency (EPA)
Level IV Ecoregions of the Conterminous United States:
Black Hills Foothills—17a

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Black Hills Coniferous Forest Province—M334:
Black Hills Foothills Subsection—M334Aa

Ecological site concept

The Loamy Terrace ecological site occurs throughout MLRA 61. It is located on old, nearly level stream terraces adjacent to overflow and lowland sites. This site does not typically receive additional moisture from overflow, however, runoff from adjacent upland sites and high-water events during flooding may provide some additional moisture. Soils are deep with a surface layer 3 to 25 inches thick and textures ranging from very fine sandy loam to silty clay. This site can have similar vegetative characteristics as the Overflow or Lowland ecological sites,

especially the woody components.

Vegetation in the Reference State (1.0) consists of a mix of cool- and warm-season grasses, however, mid-statured, cool-season grasses tend to be the dominant group. Rhizomatous wheatgrass and green needlegrass are the dominant cool-season grasses. Forbs are common and diverse. Silver sagebrush is usually present, and western snowberry and rose are common. Remnant trees will be scattered across the site and can include green ash, boxelder, bur oak, and plains cottonwood. There will be little if any regeneration of trees. In most cases sites with remnant trees are historic floodplains that have been altered by the natural lateral movements of drainages and stream channels across the valley floor. Additionally, various disturbances have widely resulted in the incision of stream channels and drainageways that has altered hydrology and lowered adjacent water tables. These processes have altered the site and created conditions no longer suitable for tree recruitment.

This ecological site is susceptible to invasion of non-native cool-season grasses.

Associated sites

R061XN010SD	**Loamy-North (18-22" PZ)** The Loamy 18-22” PZ ecological site is found on upland landscapes above the Loamy Terrace ecological site.
R061XS010SD	**Loamy-South (16-18" PZ)** The Loamy 16-18” PZ ecological site is found on upland landscapes above the Loamy Terrace ecological site.
R061XY020SD	**Overflow** The Overflow ecological site is found on lower landscapes below the Loamy Terrace ecological site in flood plains and creek channels.
R061XW112WY	**Loamy-West (16-20" PZ)** The Loamy 16-20” PZ ecological site is found on upland landscapes above the Loamy Terrace ecological site.

Similar sites

R061XW112WY	**Loamy-West (16-20" PZ)** The Loamy 16-20’ PZ ecological site will have fewer shrubs and lower vegetative production than the Loamy Terrace ecological site.
R061XN010SD	**Loamy-North (18-22" PZ)** (The Loamy 18-22” PZ ecological site will have fewer shrubs and lower vegetative production than the Loamy Terrace ecological site.
R061XY020SD	**Overflow** The Overflow ecological site will have more big bluestem and higher vegetative production than the Loamy Terrace ecological site.
R061XS010SD	**Loamy-South (16-18" PZ)** The Loamy 16-18’ PZ ecological site will have fewer shrubs and lower vegetative production than the Loamy Terrace ecological site.

Table 1. Dominant plant species

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

Physiographic features

The Loamy Terrace ecological site occurs on nearly level to gently sloping alluvial fans and low stream terraces.

Table 2. Representative physiographic features

Landforms	(1) Valley > Flood plain (2) Valley > Terrace
Runoff class	Low to medium
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	2,900–4,000 ft
Slope	0–4%
Water table depth	80 in
Aspect	Aspect is not a significant factor

Climatic features

The climate in MLRA 61 is typical of the drier portions of the Northern Great Plains where sagebrush steppes to the west yield to grassland steppes to the east. Average annual precipitation ranges from 16 to 22 inches with most falling during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums. The wide range is due to the high elevation and dry air, which permit rapidly incoming and outgoing radiation. In winter, cold air outbreaks from Canada move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in the winter and bring rapid rises in temperature. Extreme storms may occur during the winter. They most severely affect ranch operations during late winter and spring.

The average annual temperature is about 47 °F. January and December are the coldest months with average temperatures ranging from about 23 °F (NNW of Edgemont, SD) to about 26 °F (Fort Meade, SD). July is the warmest month with average temperatures ranging from about 69 °F (Fort Meade, WY) to about 73 °F (Hot Springs, SD). The range of average monthly temperatures between the coldest and warmest months is about 47 °F. Wind speeds are estimated to 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. Winds are generally stronger during the day than at night. Occasionally, 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)	94-114 days
Freeze-free period (characteristic range)	119-144 days
Precipitation total (characteristic range)	18-21 in
Frost-free period (actual range)	80-125 days
Freeze-free period (actual range)	115-158 days
Precipitation total (actual range)	16-22 in
Frost-free period (average)	106 days
Freeze-free period (average)	132 days
Precipitation total (average)	19 in

Climate stations used

- (1) EDGEMONT [USC00392557], Edgemont, SD
- (2) EDGEMONT 23 NNW [USC00392565], Custer, SD

- (3) HOT SPRINGS [USC00394007], Hot Springs, SD
- (4) RAPID CITY WFO [USC00396948], Rapid City, SD
- (5) FT MEADE [USC00393069], Fort Meade, SD
- (6) SPEARFISH [USC00397882], Spearfish, SD
- (7) HULETT [USC00484760], Hulett, WY
- (8) DEVILS TWR #2 [USC00482466], Devils Tower, WY
- (9) SUNDANCE [USC00488705], Sundance, WY
- (10) UPTON 14ENE [USC00489208], Newcastle, WY
- (11) NEWCASTLE [USC00486660], Newcastle, WY
- (12) BEAR RIDGE [USC00390554], Spearfish, SD

Influencing water features

No riparian areas or wetland features are directly associated with the Loamy Terrace ecological site.

Wetland description

Not Applicable.

Soil features

The common features of soils in this site are 3 to 10 inches thick silt loam to very fine sandy loam surface layer and sub-surface textures that are loam to clay loam. Slopes range from about 0 to 4 percent. The soils in this site are well drained and formed in alluvium. The soils have a moderate to moderately slow infiltration rate. At one time, this site was in the active floodplain zone but downcutting of the channel has left this site out of reach of the water table except for during the most extreme flooding events. This site typically should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. If present, water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact. Sub-surface soil layers are nonrestrictive to water movement and root penetration.

Major Soils correlated to the Loamy Terrace ecological site include, Barnum, Coaliams, Rapid Creek, Rocky Point, and Sodawells. These soils will typically have a rarely flooded Local Phase, and a Flooding rating of very rare to rare.

When these soils have a Local Phase of occasionally flooded, they will typically be correlated to the Overflow ecological site (R061XY020SD).

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 10 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

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

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Very fine sandy loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	40–80 in
Surface fragment cover <=3"	0–10%

Surface fragment cover >3"	0%
Available water capacity (0-40in)	5–8 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–33%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

The Loamy Terrace ecological site developed under the 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.

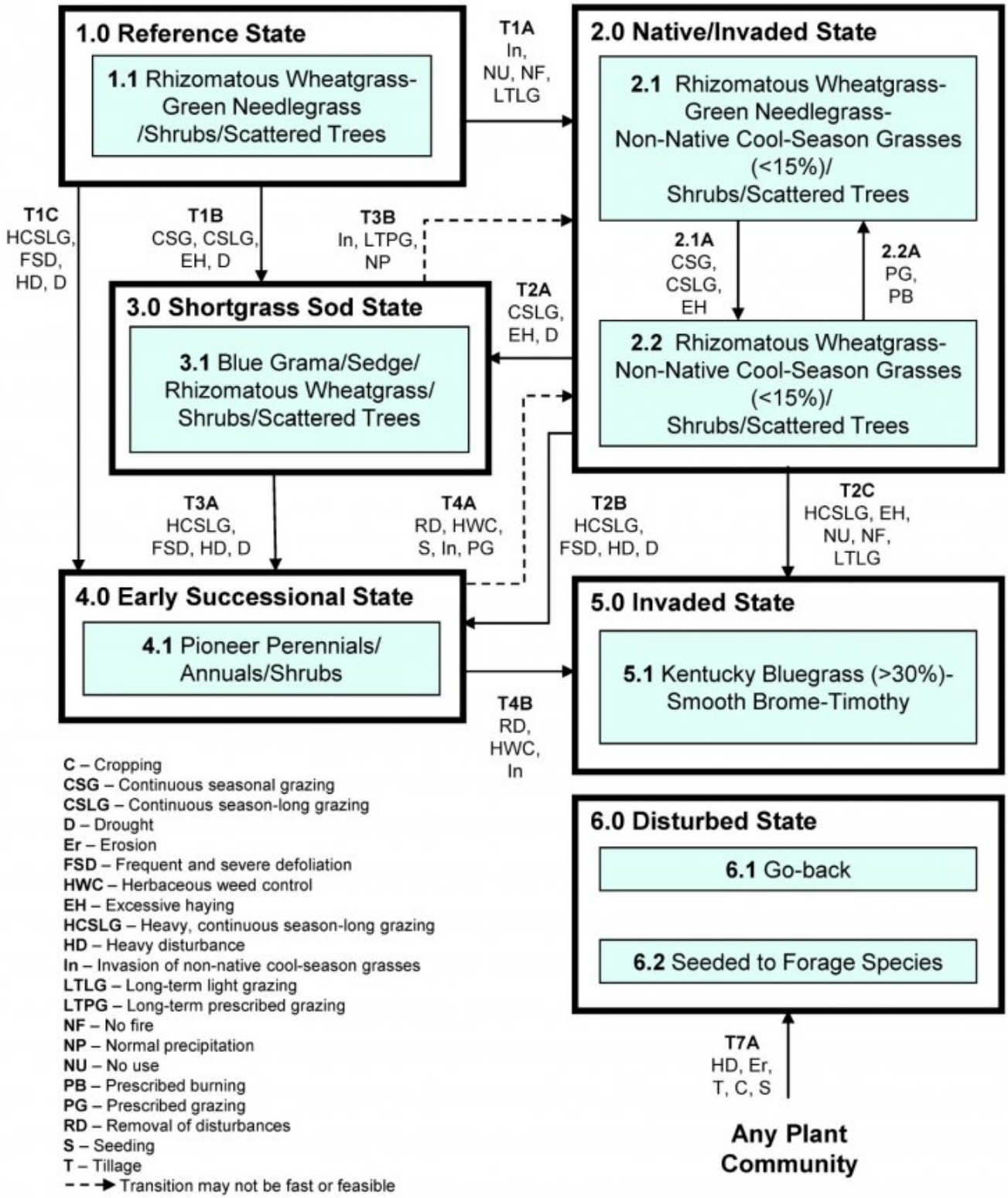
Continuous season-long grazing (during the typical growing season of May through October) or heavy continuous grazing (e.g., every spring or every summer at moderate to heavy stocking levels) without adequate recovery periods following grazing events causes departure from the Rhizomatous Wheatgrass-Green Needlegrass/Shrubs/Scattered Trees Plant Community (1.1). Short grass and grass-like species such as sedge, blue grama, and bluegrass will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass and big bluestem will decrease in frequency and production. Excessive defoliation can cause threeawn and annuals to increase and dominate the site. Extended periods of non-use and lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as green needlegrass, western wheatgrass, Kentucky bluegrass, smooth brome, and timothy. Remnant mature trees are randomly present across this site, but recruitment does not typically occur.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Green Needlegrass/Shrub/Scattered Trees 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 community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

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

State and transition model

Loamy Terrace – R061XY022SD 10/3/19



C – Cropping
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
Er – Erosion
FSD – Frequent and severe defoliation
HWC – Herbaceous weed control
EH – Excessive haying
HCSLG – Heavy, continuous season-long grazing
HD – Heavy disturbance
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 disturbances
S – Seeding
T – Tillage
- - → Transition may not be fast or feasible

Diagram Legend: Loamy Terrace - R061XY022SD

T1A	1.0 to 2.0	Invasion of non-native cool-season grasses; no use and no fire; or long-term light grazing.
T1B	1.0 to 3.0	Continuous seasonal grazing (spring or winter); continuous season-long grazing, without adequate recovery; heavy grazing in combination with drought; excessive haying.
T1C	1.0 to 4.0	Heavy, continuous season-long grazing; frequent and severe defoliation; heavy disturbance; heavy grazing in combination with drought.
T2A	2.0 to 3.0	Continuous season-long grazing, without adequate recovery; excessive grazing in combination with drought; or excessive haying.
T2B	2.0 to 4.0	Heavy, continuous season-long grazing; or frequent and severe defoliation; heavy disturbance;heavy or grazing in combination with drought.
T2C	2.0 to 5.0	Heavy, continuous season-long grazing; excessive haying; no use and no fire; or long-term light grazing.
T3A	3.0 to 4.0	Heavy, continuous season-long grazing; frequent and severe defoliation; heavy disturbance; heavy grazing in combination with drought.
T3B	3.0 to 2.0	Invasion of non-native cool-season grasses; long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for recovery; a return to normal precipitation patterns following drought. This transition may not be fast or feasible.
T4A	4.0 to 2.0	Removal of disturbance; herbaceous weed control; seeding, followed by prescribed grazing; invasion and establishment of non-native cool-season grasses.
T4B	4.0 to 5.0	Removal of disturbance; herbaceous weed control; invasion and establishment of non-native cool-season grasses.
T7A	Any Plant Community to 6.0	Heavy disturbance such as tillage, cropping; abandonment of cropland; soil erosion; invasion of non-native weedy species; seeding to perennial forage species.

2.1A	2.1 to 2.2	Continuous seasonal grazing (spring or winter); continuous season-long grazing, without adequate recovery; or excessive haying.
2.2A	2.2 to 2.1	Prescribed grazing with proper stocking, change in season of use, adequate recovery time; possibly prescribed burning in combination with prescribed grazing.

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. This site in the Reference State (1.0) was typically dominated by cool-season grasses, with occasional shifts to a near co-dominance of cool- and warm-season grasses. In pre-European times, the primary disturbance mechanisms included frequent fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. A combination of disturbances would likely have caused a shift to shorter statured grasses and grass-likes with a corresponding decrease in taller cool-season grasses. An increase in fire frequency or fire followed by occasional grazing would have caused an increase in warm-season grasses. Today, a similar state can be difficult to find due to the predominance and invasiveness of non-native cool-season perennial gasses.

Community 1.1
Rhizomatous Wheatgrass-Green Needlegrass/Shrubs/Scattered Trees

Interpretations are based primarily on the Rhizomatous Wheatgrass/Green Needlegrass/Shrub/Scattered Trees Plant Community. This is also considered to be the Reference Plant Community (1.1). The potential vegetation was about 70 percent grasses or grass-like plants, 10 percent forbs, 20 percent shrubs, and scattered mature trees in some locations. The community was dominated by cool-season grasses. The major grasses included western wheatgrass and green needlegrass. Other grass or grass-like species included big bluestem, prairie sandreed, needle and thread, slender wheatgrass, Canada wildrye, little bluestem, sideoats grama, sedge, and blue grama. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regard to soil and 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	1645	2128	2615
Shrub/Vine	220	420	600
Forb	135	210	300
Tree	0	42	85
Total	**2000**	**2800**	**3600**

Figure 9. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, 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
		3	10	23	34	15	6	5	4		

State 2
Native/Invaded State

The Native/Invaded State represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by cool-season grasses, with warm-season grasses being subdominant. It can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Native cool- and warm-season species can decline and a corresponding increase in non-native cool-season grasses will occur. Non-Native cool-season grasses will make up less than 15 percent of total annual production. Preliminary studies tend to indicate that when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition a threshold has been crossed to an Invaded State (5.0). These invaded plant communities that are dominated by Kentucky bluegrass will have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014).

Community 2.1

Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (<15%)/Shrub/Scattered Trees

This plant community phase is similar to the Rhizomatous Wheatgrass-Green Needlegrass/Shrub /Scattered Trees Plant Community (1.1) but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass. smooth brome, and possibly timothy (up to about 15 percent by air-dry weight). The potential vegetation is about 70 percent grasses or grass-like plants, 10 percent forbs, 20 percent shrubs, and scattered mature trees in some locations. The community is dominated by cool-season grasses. The major grasses include western wheatgrass and green needlegrass. Other grass or grass-like species include big bluestem, prairie sandreed, needle and thread, slender wheatgrass, Canada wildrye, little bluestem, sideoats grama, sedge, Kentucky bluegrass, smooth bromegrass, and blue grama. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1450	2052	2615
Shrub/Vine	220	405	600
Forb	130	203	300
Tree	0	40	85
Total	**1800**	**2700**	**3600**

Figure 11. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, 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
		3	10	23	34	15	6	5	4		

Community 2.2
Rhizomatous Wheatgrass-Non-Native Cool-Season Grasses (<15%)/Shrubs/Scattered Trees

This plant community is a result of continuous seasonal grazing, continuous season-long grazing at moderate to heavy levels, excessive haying, or from long-term light grazing. The potential plant community is made up of approximately 90 percent grass and grass-like species, 5 percent forbs, 5 percent shrubs, and occasional scattered, mature trees. The community is dominated by western wheatgrass and bluegrass. This plant community is resistant to change but will shift back to the 2.1 Plant Community with a cessation of haying and implementation of prescribed grazing and possibly prescribed burning. If the trees and shrubs were largely removed during haying operations (instead of just avoided as is sometimes the case), the resulting plant community will resemble the 2.1 plant community but lacking the woody species.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1385	1830	2265
Shrub/Vine	0	80	165
Forb	15	60	105
Tree	0	30	65
Total	**1400**	**2000**	**2600**

Figure 13. Plant community growth curve (percent production by month). SD6101, Black Hills Foot Slopes, cool-season dominant. Cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		4	12	25	36	10	5	4	4		

Pathway 2.1A
Community 2.1 to 2.2

Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year; continuous season-long grazing; excessive haying; or long-term light grazing will shift this community to the Rhizomatous Wheatgrass-Non-Native Cool-Season Grasses (<15%)/Shrubs/Scattered Trees Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or possibly prescribed burning in combination with prescribed grazing will convert this plant community to the Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grass (<15%)/Shrubs/Scattered Trees Plant Community (2.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Shortgrass Sod State

The Shortgrass Sod State occurs as a result of heavy stocking levels, inadequate recovery periods between grazing events, or a combination of these disturbances. This state is dominated by warm-season grasses, with cool-season grasses being subdominant. The shallow, compact nature of the roots of the dominant species causes increased runoff and reduced infiltration. In addition, reduced shading due to a lesser amount of foliar cover causes increased soil temperatures and increased evaporation of the surface soil moisture. These conditions combine to cause the site to become more droughty and thus reduce the opportunity for recruitment and establishment of the taller statured grasses. This state is relatively stable and resistant to change.

Community 3.1
Blue Grama/Sedge/Rhizomatous Wheatgrass/Shrubs/Scattered Trees

This plant community evolved under continuous seasonal grazing, continuous season-long grazing, or from over utilization during extended drought periods. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 15 percent forbs, 10 percent shrubs, and scattered mature trees. Dominant grass and grass-likes species include blue grama, sedge and western wheatgrass. Grasses of secondary importance include needle and thread, sand dropseed, and sometimes Kentucky bluegrass. Forbs commonly found in this plant community included white sagebrush (cudweed sagewort), goldenrod, green sagewort, scurfpea, Cuman ragweed, and western yarrow. When compared to the Rhizomatous Wheatgrass-Green Needlegrass/Shrub/Scattered Trees Plant Community (1.1), blue grama, sedge and western wheatgrass dominate this plant community. This vegetation state is very resistant to change. The herbaceous species present are well adapted to grazing. This plant community is less productive than most other phases. The thick sod prevents other species from establishing.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	810	1155	1495
Forb	65	140	215
Shrub/Vine	25	84	145
Tree	0	21	45
Total	**900**	**1400**	**1900**

Figure 15. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	10	20	28	21	10	5	3		

State 4
Early Successional State

This state occurs as a result of extreme disturbance that typically removes most of the native species normally present on this site. Disturbance in the form of severe grazing over several years are the most typical. Occupation by black-tailed prairie dogs may also result in this transition. The dominant species present is highly variable, but the common characteristics include high amounts of bare ground, reduced soil aggregate stability, increased runoff and increased erosion (including increased sediment loads in the runoff). Restoration of the ecological processes will be very difficult.

Community 4.1
Pioneer Perennials/Annuals/Shrubs

This plant community developed under continuous heavy grazing or other excessive disturbances (e.g., heavy use areas, livestock concentration areas, defoliation by rodents, etc.). The potential plant community is made up of approximately 60 to 80 percent grasses and grass-like species, 15 to 35 percent forbs, and 2 to 5 percent shrubs. The dominant grass is often threeawn. Other grasses may include cheatgrass, field brome, sedge, blue grama, sand dropseed, bluegrass, and western wheatgrass. The dominant forbs include fetid marigold, sweetclover, Cumin ragweed, white sagebrush (cudweed sagewort), and other invader-like species. The dominant shrubs include fringed sagewort, broom snakeweed and cactus. A wide variety of other early successional plant species can occupy this site in varying amounts. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percent of bare ground. Compared to the Rhizomatous Wheatgrass-Green Needlegrass/Shrubs/Scattered Trees Plant Community (1.1), threeawn, annual brome grasses, and percent of bare ground has increased. Western wheatgrass, needlegrasses, and other cool-season grasses have decreased as have the warm-season species including prairie sandreed and sideoats grama. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase, and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This 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.

State 5
Invaded State

The Invaded State is the result of invasion and dominance of non-native cool-season grass species. This State is characterized by the dominance of smooth brome and Kentucky bluegrass and an increasing thatch layer that effectively blocks introduction of other plants into the system. Heavy grazing or long-term light grazing (understocked) will tend to result in an increase of smooth brome. Non-use and no fire will tend to benefit Kentucky bluegrass due to an increasing thatch layer that effectively blocks the introduction of other plants into the system.

Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is also 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 soil biological activity is altered, 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 cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014). Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch may not result in more than a very short-term reduction of Kentucky bluegrass. These events may reduce the dominance of Kentucky bluegrass, but due to the large amount of rhizomes in the soil, there is little opportunity for the native species to establish and dominate before Kentucky bluegrass rebounds and again dominates the system.

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

This plant community phase is a result of heavy, continuous season-long grazing, excessive haying, or long-term light grazing, or non-use and no fire. It is characterized by a dominance of Kentucky bluegrass, smooth brome, and possibly timothy. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface. Nutrient cycling is greatly reduced, and native plants have great difficulty becoming established. When dominated by smooth brome, infiltration is moderately reduced, and runoff is moderate. Production can be equal to or higher than the interpretive plant community (1.1). However, when dominated by Kentucky bluegrass, infiltration can be reduced, and runoff can be high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short as these cool-season species mature rapidly. Energy capture is also reduced. Along with smooth brome and Kentucky bluegrass, other species that will be present at varying amounts can include cheatgrass, field brome, and other invasive species that can tolerate repeated heavy grazing. Native species such as western wheatgrass and green needlegrass may be present in minor amounts.

State 6
Disturbed State

This State can be transitioned to from any plant community. 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 successionally. Infiltration, runoff, and soil erosion will vary depending on the vegetation present on the site. The Go-Back Plant Community (6.1) 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 Plant Community (6.2) was typically tilled and then seeded to a perennial forage species or mix of species.

Community 6.1
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 the plant community 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, bluegrasses, smooth brome, annual bromes, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site can include western wheatgrass, prickly lettuce, horseweed, mullein, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 6.2
Seeded to Forage Species

The Seeded Plant Community is normally 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

Heavy continuous season-long grazing, or long-term light grazing, or no use and no fire, and the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (2.0).

Transition T1B
State 1 to 3

Continuous seasonal grazing (spring or winter) or continuous season-long grazing, without adequate recovery following grazing even, grazing in combination with drought, or excessive haying will transition the Reference State (1.0) to the Shortgrass Sod State (3.0).

Transition T1C
State 1 to 4

Heavy, continuous season-long grazing, or frequent and severe defoliation, or heavy disturbance, or heavy grazing in combination with drought will transition the Reference State (1.0) to the Early Successional State (4.0).

Transition T7A
State 1 to 6

Heavy disturbance including soil erosion; tillage; abandoned cropland; or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Transition T2A
State 2 to 3

Continuous season-long grazing, without adequate recovery following grazing event; grazing in combination with drought; or excessive haying will transition the Native/Invaded State (2.0) to the Shortgrass Sod State (3.0).

Transition T2B
State 2 to 4

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Native/Invaded State (2.0) to the Early Successional State (4.0).

Transition T2C
State 2 to 5

Heavy, continuous season-long grazing; excessive haying; or long-term light grazing will result in an increase in non-native cool-season grasses and cause a transition to the Native/Invaded State (2.0) to the Invaded State (5.0). With extended periods of non-use and no fire, heavy litter layer build-up will favor cool-season non-natives grasses such as Kentucky bluegrass, smooth brome and other non-native species, also resulting in a transition the Invaded State (5.0).

Transition T7A
State 2 to 6

Heavy disturbance including soil erosion; tillage; abandoned cropland; or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Transition T3B

State 3 to 2

Long-term prescribed grazing, including proper stocking rates, change in season of use, adequate time for recovery; or periodic light to moderate stocking levels possibly including periodic rest; the invasion of non-native cool-season grasses; a return to normal precipitation patterns following drought, may transition the Shortgrass Sod State (3.0) to the Native/Invaded State (2.0). This transition may not be fast or meet management objectives.

Conservation practices

Prescribed Grazing

Transition T3A
State 3 to 4

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance; will transition the Shortgrass Sod State (3.0) to the Early Successional State (4.0).

Transition T7A
State 3 to 6

Heavy disturbance including soil erosion; tillage; abandoned cropland; or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Transition T4A
State 4 to 2

Removal of management induced disturbance; herbaceous weed control; and seeding to native species; followed by prescribed grazing that includes proper stocking, change in season of use, and deferment; along with invasion of non-native cool-season perennial gasses this plant community will likely transition to the Native/Invaded State (2.0).

Conservation practices

Prescribed Grazing
Range Planting
Herbaceous Weed Control

Transition T4B
State 4 to 5

Removal of management induced disturbance; herbaceous weed control; and invasion of non-native cool-season grasses will likely transition the Early Successional State (4.0) to the Invaded State (5.0).

Conservation practices

Herbaceous Weed Control

Transition T7A
State 4 to 6

Heavy disturbance including soil erosion; tillage; abandoned cropland; or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Transition T7A
State 5 to 6

Heavy disturbance including soil erosion; tillage; abandoned cropland; or seeding to improved pasture species result 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**			560–980	
	western wheatgrass	PASM	*Pascopyrum smithii*	560–840	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–280	–
2	**Cool-Season Bunchgrass**			420–700	
	green needlegrass	NAVI4	*Nassella viridula*	280–700	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	56–280	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–140	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–140	–
3	**Tall Warm-Season Grasses**			140–560	
	prairie sandreed	CALO	*Calamovilfa longifolia*	84–420	–
	big bluestem	ANGE	*Andropogon gerardii*	56–224	–
4	**Mid- Warm-Season Grasses**			56–280	
	sideoats grama	BOCU	*Bouteloua curtipendula*	28–140	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–140	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–84	–
5	**Short Warm-Season Grasses**			28–140	
	blue grama	BOGR2	*Bouteloua gracilis*	28–140	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–84	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–56	–
6	**Other Native Grasses**			28–140	
	Grass, perennial	2GP	*Grass, perennial*	0–140	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	28–84	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–56	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–56	–
7	**Grass-Likes**			28–196	
	sedge	CAREX	*Carex*	28–196	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–84	–
8	**Non-Native Cool-Season Grasses**			0	
Forb					
9	**Forbs**			140–280	
	Forb, native	2FN	*Forb, native*	28–140	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	28–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	–
	goldenrod	SOLID	*Solidago*	28–84	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	28–84	–
	prairie clover	DALEA	*Dalea*	28–56	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	28–56	–

	scurfpea	PSORA2	*Psoralidium*	28–56	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	28–56	–
	field sagewort	ARCA12	*Artemisia campestris*	0–56	–
	American vetch	VIAM	*Vicia americana*	28–56	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	28–56	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	28–56	–
	hoary verbena	VEST	*Verbena stricta*	28–56	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–56	–
	wood lily	LIPH	*Lilium philadelphicum*	0–28	–
	dotted blazing star	LIPU	*Liatris punctata*	0–28	–
	false boneset	BREU	*Brickellia eupatorioides*	0–28	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–28	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–28	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–28	–
	Forb, introduced	2FI	*Forb, introduced*	–	–
Shrub/Vine					
10	**Shrubs**			280–560	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	56–280	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	28–224	–
	silver sagebrush	ARCA13	*Artemisia cana*	56–224	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–224	–
	leadplant	AMCA6	*Amorpha canescens*	28–140	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–112	–
	American plum	PRAM	*Prunus americana*	0–112	–
	chokecherry	PRVI	*Prunus virginiana*	0–112	–
	rose	ROSA5	*Rosa*	28–84	–
Tree					
11	**Trees**			0–84	
	American elm	ULAM	*Ulmus americana*	0–84	–
	boxelder	ACNE2	*Acer negundo*	0–84	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–84	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–84	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–28	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–28	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–28	–

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			540–945	
	western wheatgrass	PASM	*Pascopyrum smithii*	540–810	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–270	–
2	**Cool-Season Bunchgrass**			135–540	

2	**Cool Season Bunchgrass**			135–540	
	green needlegrass	NAVI4	*Nassella viridula*	135–540	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–135	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–135	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–54	–
3	**Tall Warm-Season Grasses**			135–540	
	prairie sandreed	CALO	*Calamovilfa longifolia*	81–405	–
	big bluestem	ANGE	*Andropogon gerardii*	54–216	–
4	**Mid- Warm-Season Grasses**			54–270	
	sideoats grama	BOCU	*Bouteloua curtipendula*	27–135	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–135	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–81	–
5	**Short Warm-Season Grasses**			27–135	
	blue grama	BOGR2	*Bouteloua gracilis*	27–135	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–81	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–54	–
6	**Other Native Grasses**			0–135	
	Grass, perennial	2GP	*Grass, perennial*	0–135	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–81	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–54	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–54	–
7	**Grass-Likes**			27–189	
	sedge	CAREX	*Carex*	27–189	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–81	–
8	**Non-Native Cool-Season Grasses**			54–270	
	Kentucky bluegrass	POPR	*Poa pratensis*	27–270	–
	smooth brome	BRIN2	*Bromus inermis*	0–135	–
	timothy	PHPR3	*Phleum pratense*	0–54	–
	cheatgrass	BRTE	*Bromus tectorum*	0–54	–
	field brome	BRAR5	*Bromus arvensis*	0–27	–
Forb					
9	**Forbs**			135–270	
	white sagebrush	ARLU	*Artemisia ludoviciana*	27–81	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	27–81	–
	Forb, native	2FN	*Forb, native*	27–81	–
	Forb, introduced	2FI	*Forb, introduced*	27–81	–
	prairie clover	DALEA	*Dalea*	27–54	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	27–54	–
	wood lily	LIPH	*Lilium philadelphicum*	0–54	–
	dotted blazing star	LIPU	*Liatris punctata*	0–54	–
	false boneset	BREU	*Brickellia eupatorioides*	0–54	–
	goldenrod	SOLID	*Solidago*	27–54	–
	scurfpea	PSORA2	*Psoralidium*	27–54	–

	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–54	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	27–54	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–54	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	27–54	–
	American vetch	VIAM	*Vicia americana*	27	–
	field sagewort	ARCA12	*Artemisia campestris*	0–27	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	27	–
	hoary verbena	VEST	*Verbena stricta*	27	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–27	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–27	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	27	–
Shrub/Vine					
10	**Shrubs**			270–540	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	54–270	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	27–216	–
	silver sagebrush	ARCA13	*Artemisia cana*	54–216	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–216	–
	American plum	PRAM	*Prunus americana*	0–108	–
	chokecherry	PRVI	*Prunus virginiana*	0–108	–
	leadplant	AMCA6	*Amorpha canescens*	0–108	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–108	–
	rose	ROSA5	*Rosa*	27–81	–
Tree					
11	**Trees**			0–81	
	American elm	ULAM	*Ulmus americana*	0–81	–
	boxelder	ACNE2	*Acer negundo*	0–81	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–81	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–81	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–27	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–27	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–27	–

Table 11. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			1000–1400	
	western wheatgrass	PASM	*Pascopyrum smithii*	1000–1300	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	20–100	–
2	**Cool-Season Bunchgrass**			0–100	
	green needlegrass	NAVI4	*Nassella viridula*	0–60	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–60	–
3	**Tall Warm-Season Grasses**			0–60	
	big bluestem	ANGE	*Andropogon gerardii*	0–60	–

	prairie sandreed	CALO	*Calamovilfa longifolia*	0–40	–
4	**Mid- Warm-Season Grasses**			20–120	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–80	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	20–40	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–20	–
5	**Short Warm-Season Grasses**			40–200	
	blue grama	BOGR2	*Bouteloua gracilis*	40–200	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–120	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–60	–
6	**Other Native Grasses**			0–60	
	Grass, perennial	2GP	*Grass, perennial*	0–60	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–20	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–20	–
7	**Grass-Likes**			20–200	
	sedge	CAREX	*Carex*	20–200	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–60	–
8	**Non-Native Cool-Season Grasses**			40–300	
	Kentucky bluegrass	POPR	*Poa pratensis*	40–200	–
	smooth brome	BRIN2	*Bromus inermis*	20–100	–
	timothy	PHPR3	*Phleum pratense*	0–80	–
	cheatgrass	BRTE	*Bromus tectorum*	0–40	–
	field brome	BRAR5	*Bromus arvensis*	0–40	–
Forb					
9	**Forbs**			20–100	
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	20–60	–
	Forb, introduced	2FI	*Forb, introduced*	20–60	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–40	–
	Forb, native	2FN	*Forb, native*	0–40	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–40	–
	goldenrod	SOLID	*Solidago*	0–20	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–20	–
Shrub/Vine					
10	**Shrubs**			0–160	
	silver sagebrush	ARCA13	*Artemisia cana*	0–160	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–100	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–80	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–40	–
	rose	ROSA5	*Rosa*	0–20	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–20	–
Tree					
11	**Trees**			0–60	
	American elm	ULAM	*Ulmus americana*	0–60	

	American elm	ULAM	*Ulmus americana*	0–60	–
	boxelder	ACNE2	*Acer negundo*	0–60	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–60	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–60	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–20	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–20	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–20	–

Table 12. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			70–210	
	western wheatgrass	PASM	*Pascopyrum smithii*	70–210	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–70	–
2	**Cool-Season Bunchgrass**			0–70	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–70	–
	green needlegrass	NAVI4	*Nassella viridula*	0–56	–
3	**Tall Warm-Season Grasses**			0–42	
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–42	–
	big bluestem	ANGE	*Andropogon gerardii*	0–28	–
4	**Mid- Warm-Season Grasses**			14–70	
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	14–56	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–28	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–14	–
5	**Short Warm-Season Grasses**			280–560	
	blue grama	BOGR2	*Bouteloua gracilis*	210–490	–
	buffalograss	BODA2	*Bouteloua dactyloides*	28–112	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–70	–
6	**Other Native Grasses**			0–70	
	Grass, perennial	2GP	*Grass, perennial*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–14	–
7	**Grass-Likes**			140–280	
	sedge	CAREX	*Carex*	140–280	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–42	–
8	**Non-Native Cool-Season Grasses**			14–140	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–140	–
	smooth brome	BRIN2	*Bromus inermis*	0–70	–
	cheatgrass	BRTE	*Bromus tectorum*	14–70	–
	field brome	BRAR5	*Bromus arvensis*	0–14	–
Forb					
9	**Forbs**			70–210	
	Forb, introduced	2FI	*Forb, introduced*	14–98	–

	Forb, introduced	2FF	*Forb, introduced*	14–56	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	14–70	–
	field sagewort	ARCA12	*Artemisia campestris*	14–70	–
	hoary verbena	VEST	*Verbena stricta*	14–70	–
	scurfpea	PSORA2	*Psoralidium*	14–56	–
	goldenrod	SOLID	*Solidago*	14–56	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	14–42	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	14–42	–
	Forb, native	2FN	*Forb, native*	0–28	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–14	–
Shrub/Vine					
10	**Shrubs**			28–140	
	silver sagebrush	ARCA13	*Artemisia cana*	14–112	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–98	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–56	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–56	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–42	–
	rose	ROSA5	*Rosa*	14–28	–
Tree					
11	**Trees**			0–42	
	American elm	ULAM	*Ulmus americana*	0–42	–
	boxelder	ACNE2	*Acer negundo*	0–42	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–42	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–42	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–14	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–14	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–14	–

Animal community

Wildlife Interpretations:
MLRA 61 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 gray 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 61, the Loamy Terrace ecological site provides upland grassland cover with an associated forb component. It was typically part of an expansive grassland landscape that included combinations of Clayey, Loamy, Shallow, Stony Hills, Overflow, and Subirrigated ecological sites.

This site provided habitat for species requiring unfragmented grassland. Important habitat features, and components found commonly or exclusively on this site may include sharp-tailed grouse leks; upland nesting habitat for grassland birds, forbs and insects for brood habitat; and a forage source for small and large herbivores. Many grassland and shrub steppe nesting bird populations are declining. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Loamy Terrace ecological site has remained relatively intact and provides increasingly important habitat for grassland and shrub steppe nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as Kentucky bluegrass, smooth brome, timothy, and annual brome grasses 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.

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

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

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass/Shrubs/Scattered Trees (1.1)
Average Production (lb/acre, air-dry): 2,800
Stocking Rate (AUM/acre): 0.77

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (<15%)/Shrubs/Scattered Trees (2.1)
Average Production (lb/acre, air-dry): 2,700
Stocking Rate (AUM/acre): 0.74

*Plant Community: Rhizomatous Wheatgrass-Non-Native Cool-Season Grasses (<15%)/Shrubs/Scattered Trees (2.2)
Average Production (lb/acre, air-dry): 2,000*
Stocking Rate (AUM/acre): 0.55*

Plant Community: Blue Grama/Sedge/Rhizomatous Wheatgrass/Shrubs/Scattered Trees (3.1)
Average Production (lb/acre, air-dry): 1,400
Stocking Rate (AUM/acre): 0.38

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

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

Total onsite annual production may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may need to be 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 forage production on this site. This site is dominated by soils in hydrologic groups B. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, slope, and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrasses, or smooth brome will result in reduced infiltration and increased runoff. 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 typically present on this site.

Other products

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

Other information

Revision Notes: “Previously Approved” Provisional
This provisional ecological site description (ESD) has passed quality control (QC) and quality assurance (QA) to ensure the it meets the 2014 NESH standards for a provisional ecological site description.

This ESD is an updated “Previously Approved” ESD that represented a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 National Range and Pasture Handbook (NRPH). The document fully described the reference state and community phase in the state-and-transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of 5 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 continued refinement toward an “Approved” status is expected.

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, NRCS; Cynthia Englebert, Range Management Specialist, Forest Service; George Gamblin, Range Management Specialist, NRCS; Ryan Murray, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

Other references

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C.A. Carpenter, and W.H McNab. 2007. Ecological subregions: Sections and subsections of the conterminous United States. USDA Forest Service, General Technical Report WO-76D. https://www.fs.fed.us/research/publications/misc/73326-wo-gtr-76d-cleland2007.pdf (accessed 31 January 2019).

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
U.S. Environmental Protection Agency. 2018.

EPA level III and level IV ecoregions of the conterminous United States. https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions- conterminous-united-states (accessed 26 April 2018).

High Plains Regional Climate Center, University of Nebraska. 2018. http://www.hprcc.unl.edu/ (accessed 6 April 2018).

Larson, Gary E. and James R. Johnson. 1999. Plants of the Black Hills and Bear Lodge Mountains. South Dakota State University, College of Agriculture and Biological Sciences and Agriculture Experiment Station, Bulletin 732, Brookings, SD.

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.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. Electronic field office technical guide. https://efotg.sc.egov.usda.gov (accessed 24 September 2018).

Soil Survey Staff. 2018. Official soil series descriptions. USDA Natural Resources Conservation Service. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053587 (accessed 20 December 2018).

Soil Survey Staff. 2018. Web Soil Survey. USDA Natural Resources Conservation Service. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx (accessed 20 December 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. Agriculture Handbook 296. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050898.pdf (accessed 17 January 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2014. National ecological site handbook, 1st ed. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcseprd1291232 (accessed 27 January 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2012. National engineering handbook, part 630. Hydrology chapters from e-Directives. https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21422 (accessed 17 January 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. Climate data. National Water and Climate Center. http://www.wcc.nrcs.usda.gov/ (accessed 2 December 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 1997. National range and pasture handbook, rev. 1, 2003. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043055.pdf (accessed 7 January 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. National Soil Information System, Information Technology Center. http://nasis.nrcs.usda.gov (accessed 25 May 2018.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. PLANTS database. National Plant Data Team, Greensboro, NC. http://plants.usda.gov (accessed 27 December 2018).

U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. National engineering handbook, part 654. Rosgen Stream Classification Technique – Supplemental Materials, Technical Supplement 3E. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17833.wba (accessed 4 March 2019).

Vore Buffalo Jump Foundation. 2019. Vore Buffalo Jump. https://www.vorebuffalojump.org/content/ (accessed 20 June 2019).

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Rick L. Peterson

Approval

Suzanne Mayne-Kinney, 7/17/2024

Acknowledgments

All ecological sites were written to the Provisional Level by Rick L. Peterson, ESS, Rapid City, SSO in FY20.

The ESDs were reviewed for quality control by Emily Helms, John Hartung, Mitch Faulkner, and Ryan Murray.

All ecological sites were then reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS in September 2020.

Rangeland health reference sheet

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

Author(s)/participant(s)	Stan Boltz
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	09/30/2009
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

2. **Presence of water flow patterns:** Barely observable or not present.

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground less than 5 percent and pathces less than two inches in diameter.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Plant litter remains in place and is not moved by erosional forces.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability normally a 6 rating. Typically high root content and organic matter in the soil surface. Soil surface is very resistant to erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is typically granular or subangular blocky parting to granular, and mollic (higher organic matter) colors of A-horizon down to about 4 to 10 inches deep. If conditions are other than this, refer to map unit component

descriptions for component on which the site occurs.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy, deep-rooted native grass and grass-like species enhance infiltration and reduce runoff.

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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):** No compaction layer should 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: Wheatgrasses (mid, cool-season grasses) > mid and tall, cool-season bunchgrasses >

    Sub-dominant: Tall and mid, warm-season grasses = shrubs >

    Other: Forbs > grass-like species > short, warm-season grasses > trees

    Additional: Other native grasses occur in other functional groups in minor amounts.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little to no evidence of decadence or mortality.

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14. **Average percent litter cover (%) and depth (in):** 80-90 percent plant litter cover, roughly 0.5 to 1 inch in depth. Litter cover is in contact with the soil surface.

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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 2,000 to 3,600 pounds/acre, with the reference value being 2,800 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:** Refer to State and local Noxious Weed List; also Kentucky bluegrass and smooth bromegrass.

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17. **Perennial plant reproductive capability:** Perennial grasses have vigorous rhizomes and/or tillers.
