Ecological site R063BY021SD
Clayey Overflow

Last updated: 9/27/2018
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General information

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

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 063B–Southern Rolling Pierre Shale Plains

MLRA Notes:
The Southern Rolling Pierre Shale Plains (MLRA 63B) is approximately 4,460 square miles in size. The majority of the MLRA is located in South Dakota (82 percent), and the remaining 18 percent is located in Nebraska. Interstate 90 crosses the northern portion through Chamberlin, SD. There are several American Indian Reservations, including the Lower Brule, Crow Creek, Santee, and Yankton Reservations.
This MLRA is an area of old plateaus and terraces that have been deeply eroded, with nearly level to rolling long slopes and well-defined dendritic drainage systems. The rivers and creek valleys have smooth floors and steep walls. The majority of the MLRA is located in the unglaciated section of the Missouri Plateau, Great Plains Province. The northeastern corner of the MLRA, east of the Missouri River, is located in the glaciated section with deposits of glacial drift on the higher areas. The southwestern tip is located in the High Plains Section.
Elevations range from 1,310 feet to 1,640 feet on the bottom lands along the Missouri River, and from 1,310 feet to 1,970 feet on the shale plains uplands.
The Missouri and Niobrara Rivers, and the confluence of the White and Missouri Rivers, occur within this MLRA. Lake Francis Case, Fort Randall Dam, and Lewis and Clark Lake are also within the borders of MLRA 63B.
Cretaceous Pierre Shale underlies most of the area. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they become wet, causing significant problems for road and structural foundations.

Younger Niobrara chalk occurs in the southern part of the MLRA. Alluvial sand and gravel underlie the valley floors along major streams.

The soils are shallow to very deep, generally well drained, and have loamy or clayey textures. Annual precipitation is 19 to 26 inches, mostly falling during the growing season, as frontal storms during the spring and convective thunderstorms in summer. The average annual temperature is 45°-50°F. The freeze-free period averages 165 days, and ranges from 145 to 185 days.

Vegetation is a transition between tall prairie grasses and mixed prairie grasses. Green needlegrass, porcupinegrass, western wheatgrass, and big bluestem are the major species. Little bluestem, buffalograss, sideoats grama, and sedges are dominant on the shallow soils. Buffaloberry, skunkbush sumac, and prairie rose are common on steep slopes along the major streams. Prairie cottonwood and a variety of willow species are common on flood plains along the major streams. Green ash, boxelder, chokecherry, bur oak, and buffaloberry occur in draws and narrow valleys. Encroachment of Rocky Mountain juniper and eastern redcedar on to the river breaks is becoming a concern.
The majority of the land is utilized for ranching (60 percent) and farming (27 percent). Major resource concerns for the area are the hazards of wind and water erosion, maintenance of the content of organic matter and soil productivity, and management of soil moisture.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 63B – Southern Rolling Pierre Shale Plains (USDA-NRCS, Ag Handbook 296).

EPA - Level IV Ecoregions of the Continental United States:

Northwestern Glaciated Plains - 42f – Southern Missouri Coteau Slopes, 42g – Ponca Plains, 42h – Southern River Breaks, 42p – Holt Tablelands

North Western Great Plains - 43C – River Breaks, 43f – Subhumid Pierre Shale Plains, 43r – Niobrara River Breaks.

Ecological site concept

The Clayey Overflow ecological site occurs throughout the MLRA. It is located on Stream Orders 2 or greater. This site is a run-in site and receive additional moisture through runoff from adjacent sites and overflow during occasional flooding. The slopes typically range from 0 to 3 percent. The soil surface layer is 5 to 11 inches in depth with a texture range of silty clay to clay. The natural vegetation will gradually shift from almost exclusively herbaceous species in the upper reaches of a drainage to a mix of species including; grasses, forbs, and scattered shrubs and an occasional tree, in the lower reaches. Vegetation in Reference consists of a mix of cool- and warm-season tall and midgrasses. Western wheatgrass and green needlegrass are dominant, and big bluestem and switchgrass are sub-dominant. Forbs are common and very diverse. Scattered patches of western snowberry, American plum, chokecherry, and willow can be present. An occasional plains cottonwood, green ash, or boxelder may occur. When disturbed, this site is very susceptible to invasion of non-native cool-season grasses, Canada thistle, hound’s tongue, and other weedy forbs.

Associated sites

R063BY010SD	**Loamy** The Loamy site can be located adjacent to the Clayey Overflow site, but will be on higher landscape positions.
R063BY011SD	**Clayey** The Clayey site can be located adjacent to the Clayey Overflow site, but will be on higher landscape positions.

Similar sites

R063BY011SD	**Clayey** The Clayey will have less big bluestem, more needlegrass, and lower forage production than the Clayey Overflow site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Andropogon gerardii*

Physiographic features

This site occurs on nearly level swales and drainageways.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Plain (3) Swale
Runoff class	Medium to high
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	1,300–2,000 ft
Slope	0–3%
Water table depth	24–80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 63B is considered to have a continental climate: cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature may also abound. The climate is the result of MLRA 63B's location 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 typically ranges from 18 to 25 inches per year. The average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, SD) to about 22°F (Winner, SD). July is the warmest month with temperatures averaging from about 73°F (Stephan, SD), to about 76°F (Winner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 56°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph 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 mph. 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 (characteristic range)	113-122 days
Freeze-free period (characteristic range)	130-154 days
Precipitation total (characteristic range)	21-24 in
Frost-free period (actual range)	110-126 days
Freeze-free period (actual range)	127-155 days

Precipitation total (actual range)	20-25 in
Frost-free period (average)	118 days
Freeze-free period (average)	141 days
Precipitation total (average)	23 in

Climate stations used

- (1) STEPHAN 2 NW [USC00397992], Highmore, SD
- (2) PICKSTOWN [USC00396574], Lake Andes, SD
- (3) WINNER [USC00399367], Winner, SD
- (4) LYNCH [USC00255040], Lynch, NE
- (5) NIOBRARA [USC00255960], Niobrara, NE
- (6) GANN VALLEY 4NW [USC00393217], Gann Valley, SD
- (7) WOOD [USC00399442], Wood, SD

Influencing water features

Riparian areas or wet land features are not necessarily associated with this site. However, in some areas, adjacent intermittent and/or perennial streams occur and would be classified as follows: Stream Type: B6, C6 (Rosgen System).

Wetland Description (Cowardin System)

System	Subsystem	Class
Riverine	Intermittent	Unknown

Rosgen Stream Classification

Stream type	Description
B6,B6a,B6c	This stream is a single-thread channel that is moderately entrenched, it gets out of bank infrequently. It has a moderate width to depth ratio and moderate sinuosity. Its slope is typically in the range of 2 to 3.9 percent, but it can range from 4 to 9.9 percent (a modifier) or be less than 2 percent (c modifier). It is a silt/clay-bottom stream.
C6,C6b,C6c-	This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a silt/clay-bottom stream.

Figure 8.

Soil features

The common features of soils in this site are the silty clay- or clay-textured surface with slopes of 0 to 3 percent and are exposed to frequent to rare flooding. The soils in this site are very deep, well to poorly drained, and formed in alluvium. The surface layer is typically 5 to 11 inches thick but can be deeper on some soils. The surface has a slow to very slow permeability rate and low to moderately low saturated hydraulic conductivity. These soils are typically calcareous at or near the surface; however, carbonates are not always distinguishable in the surface layer. The subsoil is silty clay or clay and some soils may have carbonates, gypsum, or other salts. Some soils show development with the presence of an argillic horizon or slickensides, but most soils show little or no evidence of soil development in the subsoil. The subsoil has a slow to very slow permeability rate and low to moderately low saturated hydraulic conductivity. This site does not pond but flooding is possible on some sites in the spring during snow melt or after heavy rains. Flooding typically lasts less than 7 days. Some soils have a zone of water saturation within a depth of 12 to 48 inches. Available water capacity ranges from low to very low throughout the soil.

When dry, these soils crack due to the high shrink-swell potential of smectitic clays. When the soils are wet, surface compaction can occur with heavy traffic. This site typically should show 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. There are no root restrictive layers in these soils; however, the high shrink-swell potential can cause damage and/or inhibit root growth.

Major soils correlated to the Clayey Overflow ecological site include: Albaton, Wendte, and Witten

These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. A drastic loss of soil surface layer on this site can result in a shift in species composition and/or production.

Access Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Alluvium–clayey shale
Surface texture	(1) Silty clay (2) Clay (3) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to well drained
Permeability class	Very slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2–6 in
Calcium carbonate equivalent (0-40in)	0–30%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–4
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, natural influences of large herbivores, occasional fire, 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, 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 heavy, continuous seasonal grazing (i.e., grazing at the same time of year every year) without adequate recovery periods following each grazing occurrence, or excessive haying, will causes this site to depart from the Western Wheatgrass-Bluestem-Needlegrass Plant Community (1.1). Western wheatgrass increases initially and will eventually decrease with continuous grazing. Grasses such as green needlegrass, big bluestem, and switchgrass

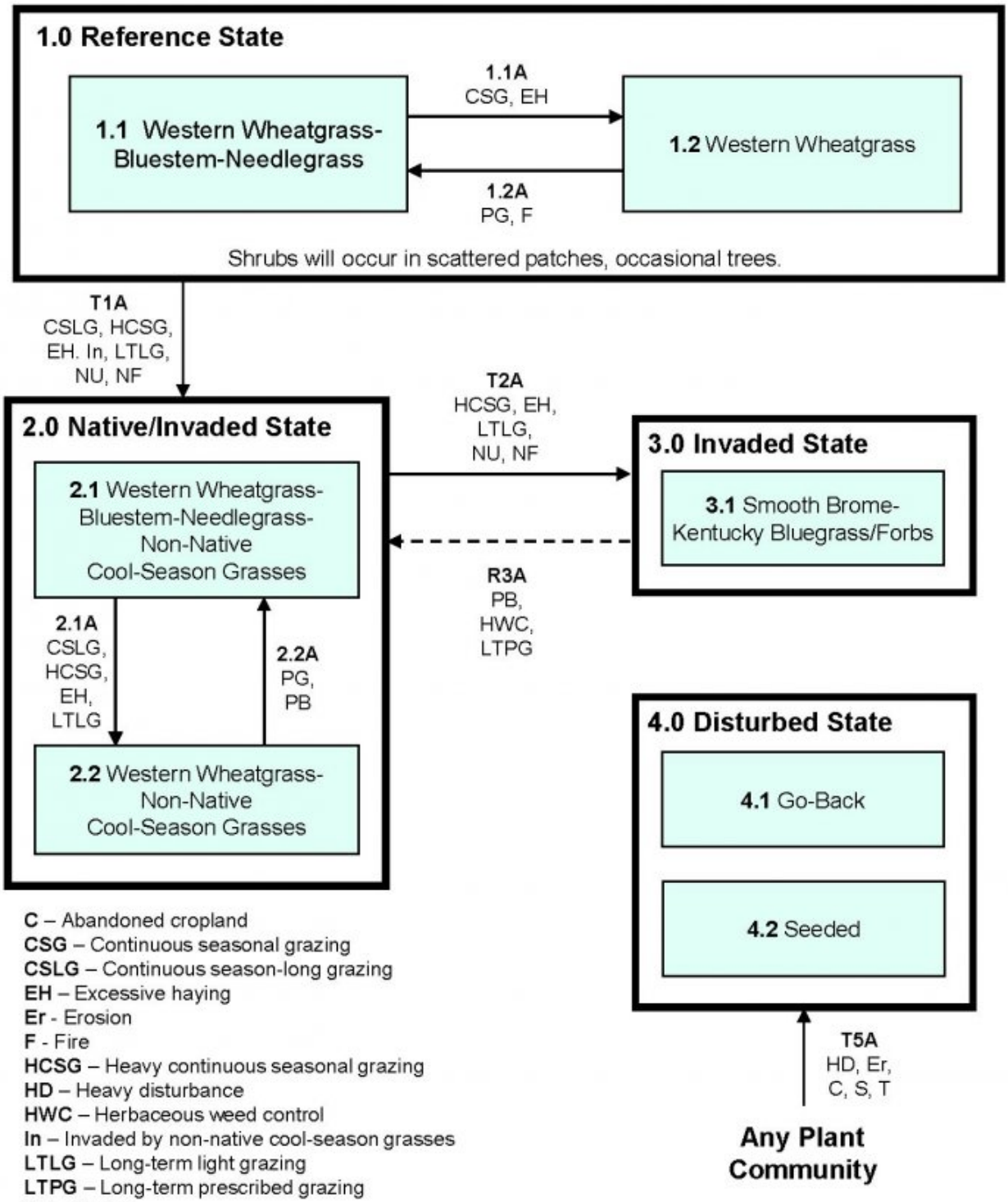
will decrease in frequency and production. With continued disturbance, this site is susceptible to invasion of non-native species such as Kentucky bluegrass and smooth bromegrass. These species can become dominant and alter the ecological processes drastically.

Interpretations are primarily based on the Western Wheatgrass-Bluestem-Needlegrass Plant Community (1.1). It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases, based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model

Clayey Overflow – R063BY021SD 1/10/18



C – Abandoned cropland
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
EH – Excessive haying
Er - Erosion
F - Fire
HCSG – Heavy continuous seasonal grazing
HD – Heavy disturbance
HWC – Herbaceous weed control
In – Invaded by non-native cool-season grasses
LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NF – No fire
NU – Non use
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding to introduced forage species
T – Tillage
- - ➤ Transition may not be fast or feasible

Diagram Legend - Clayey Overflow - R063BY021SD	
T1A	Continuous season-long grazing, or heavy, continuous seasonal grazing, invasion and establishment of non-native cool-season grasses, no use, no fire, or long-term light grazing or excessive haying.
T2A	Heavy, continuous seasonal grazing, no use, no fire, or long-term light grazing or excessive haying.
T5A	Heavy disturbance, soil erosion, abandonment of cropland, tillage, or seeding to introduces forage species.
R3A	Herbaceous weed control, prescribed burning followed by long-term prescribed grazing with change in season of use and time for adequate recovery.

CP 1.1A	1.1 - 1.2	Continuous seasonal grazing (spring) or excessive haying.
CP 1.2A	1.2 - 1.1	Prescribed grazing with proper stocking, change in season of use, and adequate time for recovery, prescribed burning.
CP 2.1A	2.1 - 2.2	Continuous season-long grazing or heavy, continuous seasonal grazing (spring), long-term light grazing, or excessive haying.
CP 2.2A	2.2 - 2.1	Prescribed grazing with proper stocking, change in season of use and adequate time for recovery, prescribed burning.

State 1
Reference State

This State represents the natural range of variability that dominated the dynamics of this ecological site. This State was dominated by cool- season grasses. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included somewhat 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 such as fire followed by grazing during below average precipitation periods, or a severe single disturbance such as extended periods of below average precipitation would have caused a decline in tall warm-season grasses and green needlegrass. This would have resulted in a simplification of the plant community with dominance by western wheatgrass. The Reference State may be difficult to locate in this MLRA with the introduction of non-native cool-season grasses. Plant Community Phase 2.1 is most similar to the Reference Plant Community but because of the persistence of non-native cool-season grasses, a restoration pathway to the Reference State is not believed to be achievable.

Community 1.1
Western Wheatgrass-Bluestem-Needlegrass

Figure 9. Clayey Overflow - R063BY021SD - PCP 1.1 (Swale).

Interpretations are based primarily on the Western Wheatgrass-Bluestem-Needlegrass Plant Community. This plant community is also considered to be the Reference Plant Community (1.1). 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. The major grasses include western wheatgrass, big bluestem, and green needlegrass. Other grass and grass-like species include switchgrass, little bluestem, sideoats grama, Indiangrass, tall dropseed, blue grama, 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 in regard to site/soil 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	2140	2685	3290
Forb	135	225	345
Shrub/Vine	25	90	165
Total	**2300**	**3000**	**3800**

Figure 11. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

Community 1.2
Western Wheatgrass

This plant community evolved under continuous seasonal grazing or from over utilization during extended drought periods, or excessive haying. The potential plant community is made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. The dominant grass is western wheatgrass. Grass and grass-like species of secondary importance included big bluestem, tall dropseed, foxtail barley, and sedge. Forbs commonly found in this plant community included American licorice, white sagebrush (cudweed sagewort), western yarrow, and woolly verbena. This plant community will have similar plant composition to the Western Wheatgrass-Non-Native Cool-Season Grasses Plant Community (2.2) (refer to the 2.2 plant composition tables). The main difference is that non-native species such as Kentucky bluegrass and smooth bromegrass would not be present in this plant community. When compared to the Western Wheatgrass-Bluestem-Needlegrass Plant Community (1.1), big bluestem and green needlegrass decreased significantly, while western wheatgrass would have increased. Production and litter cover would have decreased as well and bare ground would have increased. The site would have been the most susceptible to erosion and gully formation during this phase. However, once conditions became more favorable, this plant community phase would have readily shifted back to the Western Wheatgrass-Bluestem-Needlegrass Plant Community (1.1).

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1690	2040	2450
Shrub/Vine	105	180	275
Forb	105	180	275
Total	**1900**	**2400**	**3000**

Figure 13. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing, which includes grazing at moderate to heavy stocking levels at the same time of year each year, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing, or excessive haying, will shift this community to the Western Wheatgrass Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing and fire returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the Western Wheatgrass-Bluestem-Needlegrass Plant Community (1.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Native/Invaded State

This State is similar to the Reference State in terms of dominant plant composition and production. However, the invasion of introduced non-native cool-season sodgrasses alters the natural range of variability for this ecological site. This state is still dominated by mid- and tall native warm- and cool-season grasses, but invasive introduced cool-season sodgrasses are now present in all community phases of this state. The primary disturbance mechanisms for the Native/Invaded State include grazing by domestic livestock and infrequent fires. Timing and intensity of grazing events coupled with weather dictate the dynamics that occur within this state. The cool-season native grass can decline and an increase in introduced sodgrasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing. This state represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire followed by short-term intensive grazing. 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.

Community 2.1
Western Wheatgrass-Bluestem-Needlegrass-Non-Native Cool-Season Grasses

This plant community phase is similar to the Reference Plant Community (1.1), but it also contains up to 20 percent by air-dry weight, of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (refer to the 1.1 plant composition table for details). 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 warm-season grasses being subdominant. The major grasses include western wheatgrass, big bluestem, and green needlegrass. Other grass and grass-like species include switchgrass, little bluestem, sideoats grama, Indiangrass, tall dropseed, blue grama, buffalograss, and sedges. Major forbs and shrubs include American licorice, sunflower, goldenrod, and western snowberry. 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 regards to site/soil stability, watershed function, and biologic integrity. Refer to the 1.1 plant community composition table for details.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1660	2295	2880
Shrub/Vine	120	202	310
Forb	120	203	310
Total	**1900**	**2700**	**3500**

Figure 15. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

Community 2.2
Western Wheatgrass-Non-Native Cool-Season Grasses

This phase is characterized by a shift to mid-cool-season rhizomatous grasses with lesser amounts of tall warm-season and mid-cool-season bunchgrasses. The vegetation is about 85 percent grasses and grass-like plants, 10 percent forbs, and 5 percent shrubs. Dominant grasses would include western wheatgrass, Kentucky bluegrass, or smooth bromegrass (up to 15 percent by air-dry weight), with minor amounts of needlegrasses, big bluestem, and switchgrass. Major forbs are Cuman ragweed (western ragweed), goldenrods, and western yarrow. Snowberry would be the dominant shrub. Energy capture by this plant community phase has shifted from late spring and summer to early spring through early summer. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1675	2059	2515
Forb	105	173	260
Shrub/Vine	20	68	125
Total	**1800**	**2300**	**2900**

Figure 17. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Pathway 2.1A
Community 2.1 to 2.2

Continuous season-long grazing (grazing at light to moderate stocking levels for a majority of or the entire growing season), heavy continuous seasonal grazing (grazing at moderate to heavy stocking levels for extended portions of the growing season at the same time each year), excessive haying, long-term light grazing, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the Western Wheatgrass-Non-Native Cool-Season Grasses 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 periodic light to

moderate grazing possibly including periodic rest, and possible prescribed burning, will convert this plant community to the Western Wheatgrass-Bluestem-Needlegrass-Non-Native Cool-Season Grasses Plant Community (2.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Invaded State

This State is the result of invasion and dominance of introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth brome, and an increasing thatch layer that effectively blocks 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).

Community 3.1
Smooth Bromegrass-Kentucky Bluegrass/Forbs

This plant community phase is a result of extended periods of non-use and no fire, or heavy continuous grazing, excessive haying or long-term light grazing. It is characterized by a dominance of smooth bromegrass and Kentucky bluegrass. 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 bromegrass, infiltration is moderately reduced and runoff is moderate. When the plant community is dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production 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.

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2150	2576	3055
Forb	25	126	255
Shrub/Vine	25	98	190
Total	**2200**	**2800**	**3500**

Figure 19. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

State 4
Disturbed State

This State can be transitioned 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.

Community 4.1
Go-Back

The Go-back plant community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned land, either past or present). 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, bluegrass, smooth brome, annual bromegrass, 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 4.2
Seeded

The Seeded Plant Community normally is defined as 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 e-FOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

Continuous season-long grazing (grazing at light to moderate stocking levels for a majority of or the entire growing season), or heavy, continuous seasonal grazing (stocking levels well above carrying capacity at the same time of year each year), or long-term light grazing, or excessive haying, invasion of non-native cool-season grasses will convert this plant community to the Native/Invaded State (2.0). Non-use and no fire for extended periods of time (typically for 10 or more years) can also lead to a transition to the Invaded State (2.0).

Transition T5A
State 1 to 4

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (4.0).

Transition T2A
State 2 to 3

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year), or long-term light grazing, or excessive haying will convert this plant community to the Invaded State (3.0). Or Non-use and no fire for extended periods of time (typically for 10 or more years) can also lead to a transition to the Invaded State (3.0).

Transition T5A
State 2 to 4

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (4.0).

Restoration pathway R3A
State 3 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning and/or herbaceous weed control (herbicide) may lead this plant community back to the Native/Invasive State (2.0). This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Success depends on whether

native reproductive propagules remain intact on the site.

Conservation practices

Prescribed Burning
Prescribed Grazing
Herbaceous Weed Control

Transition T5A
State 3 to 4

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (4.0).

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			750–1350	
	western wheatgrass	PASM	*Pascopyrum smithii*	750–1350	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–150	–
2	**Tall Warm-Season Grasses**			300–750	
	big bluestem	ANGE	*Andropogon gerardii*	300–750	–
	switchgrass	PAVI2	*Panicum virgatum*	30–240	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–150	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–150	–
3	**Cool-Season Bunchgrasses**			150–450	
	green needlegrass	NAVI4	*Nassella viridula*	150–450	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–150	–
	foxtail barley	HOJU	*Hordeum jubatum*	30–150	–
4	**Mid Warm-Season Grasses**			30–300	
	little bluestem	SCSC	*Schizachyrium scoparium*	30–240	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–150	–
5	**Short Warm-Season Grasses**			0–150	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–150	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–150	–
	saltgrass	DISP	*Distichlis spicata*	0–90	–
6	**Other Native Grasses**			30–150	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–150	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	30–90	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–60	–
7	**Grass-likes**			30–150	
	sedge	CAREX	*Carex*	30–150	–
	Grass-like (not a true	2GL	*Grass-like (not a true grass)*	0–90	–

	grass)				
Forb					
8	**Forbs**			150–300	
	Forb, native	2FN	*Forb, native*	0–90	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	30–60	–
	American vetch	VIAM	*Vicia americana*	30–60	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–60	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	30–60	–
	false boneset	BREU	*Brickellia eupatorioides*	0–60	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–60	–
	scorpion's-tail	HEAN5	*Heliotropium angiospermum*	0–60	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	30–60	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	30–60	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	30–60	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	30–60	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	30–60	–
	goldenrod	SOLID	*Solidago*	30–60	–
	white heath aster	SYER	*Symphyotrichum ericoides*	30–60	–
	swamp verbena	VEHA2	*Verbena hastata*	0–30	–
	hoary verbena	VEST	*Verbena stricta*	0–30	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–30	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–30	–
	northern bedstraw	GABO2	*Galium boreale*	0–30	–
	Carolina geranium	GECAC4	*Geranium carolinianum var. carolinianum*	0–30	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–30	–
Shrub/Vine					
9	**Shrubs**			30–150	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–60	–
	leadplant	AMCA6	*Amorpha canescens*	30–60	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–60	–
	rose	ROSA5	*Rosa*	30–60	–
	snowberry	SYMPH	*Symphoricarpos*	30–60	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–30	–

Table 11. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			690–1265	
	western wheatgrass	PASM	*Pascopyrum smithii*	690–1265	–
2	**Tall Warm-Season Grasses**			23–230	
	big bluestem	ANGE	*Andropogon gerardii*	23–184	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–138	–

	switchgrass	PAVI2	*Panicum virgatum*	0–92	–
3	**Cool-Season Bunchgrasses**			23–230	
	foxtail barley	HOJU	*Hordeum jubatum*	23–230	–
	green needlegrass	NAVI4	*Nassella viridula*	0–69	–
4	**Mid Warm-Season Grasses**			0–69	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–46	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–46	–
5	**Short Warm-Season Grasses**			0–115	
	saltgrass	DISP	*Distichlis spicata*	0–115	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–69	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–46	–
6	**Other Native Grasses**			23–115	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–115	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	23–46	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–23	–
7	**Grass-likes**			23–115	
	sedge	CAREX	*Carex*	23–115	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–69	–
8	**Non-Native Grasses**			115–460	
	Kentucky bluegrass	POPR	*Poa pratensis*	115–345	–
	brome	BROMU	*Bromus*	0–161	–
	smooth brome	BRIN2	*Bromus inermis*	0–115	–
Forb					
9	**Forbs**			115–230	
	Forb, introduced	2FI	*Forb, introduced*	0–92	–
	sweetclover	MELIL	*Melilotus*	0–92	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	23–69	–
	Forb, native	2FN	*Forb, native*	0–69	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	23–69	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–69	–
	common sunflower	HEAN3	*Helianthus annuus*	0–46	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–46	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	23–46	–
	goldenrod	SOLID	*Solidago*	23–46	–
	white heath aster	SYER	*Symphyotrichum ericoides*	23–46	–
	hoary verbena	VEST	*Verbena stricta*	0–46	–
	Canada thistle	CIAR4	*Cirsium arvense*	0–46	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	23–46	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–23	–
	curly dock	RUCR	*Rumex crispus*	0–23	–
	American vetch	VIAM	*Vicia americana*	0–23	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–23	–

	burningbush	BASC5	*Bassia scoparia*	0–23	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–23	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–23	–
Shrub/Vine					
10	**Shrubs**			23–115	
	snowberry	SYMPH	*Symphoricarpos*	23–69	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–46	–
	rose	ROSA5	*Rosa*	23–46	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–46	–
	leadplant	AMCA6	*Amorpha canescens*	0–23	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–23	–

Table 12. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			56–420	
	western wheatgrass	PASM	*Pascopyrum smithii*	56–420	–
2	**Tall Warm-Season Grasses**			0–56	
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–56	–
	big bluestem	ANGE	*Andropogon gerardii*	0–28	–
3	**Cool-Season Bunchgrasses**			28–140	
	foxtail barley	HOJU	*Hordeum jubatum*	28–140	–
	green needlegrass	NAVI4	*Nassella viridula*	0–140	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–84	–
4	**Short Warm-Season Grasses**			0–28	
	saltgrass	DISP	*Distichlis spicata*	0–28	–
5	**Other Native Grasses**			0–140	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–140	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–28	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	–
6	**Grass-likes**			0–84	
	sedge	CAREX	*Carex*	0–84	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–56	–
7	**Non-Native Grasses**			1120–2240	
	smooth brome	BRIN2	*Bromus inermis*	560–1960	–
	Kentucky bluegrass	POPR	*Poa pratensis*	280–840	–
	brome	BROMU	*Bromus*	0–140	–
Forb					
8	**Forbs**			28–224	
	sweetclover	MELIL	*Melilotus*	0–196	–
	Canada thistle	CIAR4	*Cirsium arvense*	0–112	–

	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	–
	burningbush	BASC5	*Bassia scoparia*	0–84	–
	Forb, introduced	2FI	*Forb, introduced*	0–84	–
	curly dock	RUCR	*Rumex crispus*	0–84	–
	Forb, native	2FN	*Forb, native*	0–56	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	28–56	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–56	–
	hoary verbena	VEST	*Verbena stricta*	0–56	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–28	–
	goldenrod	SOLID	*Solidago*	0–28	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–28	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–28	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–28	–
Shrub/Vine					
9	**Shrubs**			28–168	
	snowberry	SYMPH	*Symphoricarpos*	28–140	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–84	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	–
	rose	ROSA5	*Rosa*	0–28	–

Animal community

Grazing Interpretations:
The following table lists annual 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 ESD). Because of this, 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. An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow with calf up to 6 months of age for one month (refer to USDA NRCS, National Range and Pasture Handbook).

Plant Community: Western Wheatgrass-Bluestem-Needlegrass (1.1)
Average Annual Production (lbs./acre, air-dry): 3,000
Stocking Rate (AUM/acre): 0.82

Plant Community: Western Wheatgrass (1.2)
Average Annual Production (lbs./acre, air-dry): 2,400
Stocking Rate (AUM/acre): 0.66
(Reference PCP 2.2 - Plant Community Table)

Plant Community: Western Wheatgrass-Bluestem-Needlegrass-Non-Native Cool-Season Grasses (2.1)
Average Annual Production (lbs./acre, air-dry): 2,700
Stocking Rate (AUM/acre): 0.74
(Reference PCP 1.1 - Plant Community Table)

Plant Community: Western Wheatgrass-Non-Native Cool-Season Grasses (2.2)
Average Annual Production (lbs./acre, air-dry): 2,300
Stocking Rate (AUM/acre): 0.63

Plant Community: Smooth Bromegrass-Kentucky Bluegrass/Forbs (3.1)
Average Annual Production (lbs./acre, air-dry): 2,800
Stocking Rate (AUM/acre): 0.77

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 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. 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 forage production on this site. The Clayey Overflow ecological site is dominated by soils in hydrologic group D. 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 exception would be if shortgrasses form a strong sod that dominate the site. Dominance by Kentucky bluegrass and/or smooth bromegrass 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 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 varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this 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 National Ecological Site Handbook (NESH) standards for a Provisional ecological site. This is an updated “Previously Approved” ESD which 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.

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: April Boltjes, Range Management Specialist (RMS), NRCS; Stan Boltz, RMS, NRCS; Rick Peterson, RMS, NRCS; and Dana Larsen, RMS, NRCS.

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Approval

David Kraft, 9/27/2018

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ESD updated by Rick Peterson on 1/12/17
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.

Author(s)/participant(s)	Stan Boltz
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	02/20/2009
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground 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 5 to 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):** Wendte soils are platy parting to granular in the surface horizon. Witten soils have a granular surface structure. Mollic (higher organic matter) colors of A-horizon down to about 6 to 9 inches. If conditions are other than this, refer to map unit component descriptions for component on which the site occurs.

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.

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. Some soils have platy stucture in the surface and this should not be confused with a compaction layer.

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 rhizomatous) >>

    Sub-dominant: Tall, warm-season grasses > mid and tall, cool-season bunchgrasses >

    Other: Forbs = mid, warm-season grasses > short, warm-season grasses = grass-likes species = shrubs

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

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.

14. **Average percent litter cover (%) and depth (in):** 75-85 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 2,300 to 3,800 pounds/acre, with the reference value being 3,000 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 grass and grass-like species have vigorous rhizomes and/or tillers.
