USDA Natural Resources Conservation Service

Ecological site R055CY013SD
Claypan

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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): 055C–Southern Black Glaciated Plains

The Southern Black Glaciated Plains (55C) is located within the Northern Great Plains Region. It is entirely within South Dakota encompassing about 10,835 square miles (Figure 1). The elevation ranges from 1,310 to 1,970 square feet. The MLRA is on nearly level to undulating glacial till plains interrupted by steeper slopes adjacent to streams and moraines. The James River is an under-fit stream. Its valley was carved by floodwaters draining glacial Lake Dakota and is filled with glacial outwash and alluvial deposits. (USDA-NRCS, 2006).

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained to very poorly drained, and clayey or loamy. This area supports natural prairie vegetation characterized by western wheatgrass (Pascopyrum smithii), green needlegrass (Nassella viridula), needle and thread (Hesperostipa comata), and porcupinegrass (Hesperostipa spartea) with Prairie cordgrass (Spartina pectinata), and reed canarygrass (Phalaris arundinacea) as the dominant vegetation on the poorly drained soils. (USDA-NRCS, 2006).

Classification relationships

Major Land Resource Area (MLRA): Southern Black Glaciated Plains (55C) (USDA-NRCS, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Yankton Hills and Valleys Subsection (251Bf); Western Glaciated Plains Section (332B); James River Lowland Subsection (332Bb); North Central Great Plains Section (332D); Southern Missouri Coteau Slope Subsection (332Dd); Southern Missouri Coteau Subsection (332De) - (Cleland et al., 2007).

US EPA Level IV Ecoregion: Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f); James River Lowland (46n) - (USEPA, 2013)

Ecological site concept

The Claypan ecological site typically occurs on nearly level slopes in the upland areas. Soils are moderately well drained and has a claypan (columnar structure) within 16 inches of the soil surface due to the sodium affected subsoil. The natric horizon in the subsoil typically has a Sodium Absorption Ratio (SAR) greater than 13 and/or an Exchangeable Sodium Percentage (ESP) greater than 15. The root restriction of the Natric horizon limits plant growth, production is lower, and species composition will tend towards shallow rooted and more tolerant of the higher sodium levels. Slopes can range from 0 to 3 percent. Vegetation in the Reference State is dominated by cool-season grasses and short warm-season grasses. This includes western wheatgrass, green needlegrass, and blue grama. Non-native grasses such as smooth bromegrass and Kentucky bluegrass may invade due to shifts in disturbance regime.

Associated sites

R055CY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series are Clarno and Houdek, but other series are included.
R055CY011SD	**Clayey** These sites occur on upland areas. The soils are well drained, have greater than 40 percent clay in the surface and subsoil, and do not have a claypan between 6 and 16 inches. The central concept soil series is Beadle, but other series are included.

Similar sites

R055CY011SD	**Clayey** The Clayey site occurs in a similar landscape position and does not have a claypan (columnar structure) between 6 and 16 inches of the soil surface. The Clayey site will have more green needlegrass, less blue grama, and higher production than a Claypan site.

Table 1. Dominant plant species

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

Physiographic features

This site typically occurs on nearly level to gently sloping, undulating uplands.

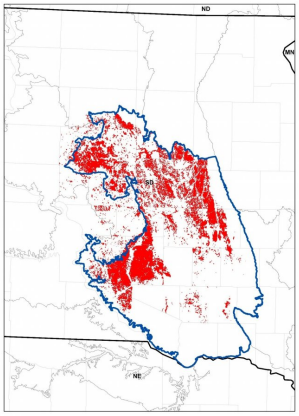


Figure 2. Distribution Map of the Claypan Site within MLRA 55C. In many cases, data is not spatially consistent across political boundaries due to the method with which soils were mapped; e. g. county subsets.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Till plain (3) Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	396–610 m
Slope	1–5%
Water table depth	91–203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 55C is considered to have a continental climate: Cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA'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 19 to 25 inches per year. The average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 15°F (Howard, South Dakota [SD]), to about 20°F (Wagner, SD). July is the warmest month with temperatures averaging from about 73°F (Howard, SD), to about 77°F (Wagner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 58°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 12 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 11 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)	123-129 days
Freeze-free period (characteristic range)	139-148 days

Precipitation total (characteristic range)	559-660 mm
Frost-free period (actual range)	120-130 days
Freeze-free period (actual range)	134-155 days
Precipitation total (actual range)	533-686 mm
Frost-free period (average)	126 days
Freeze-free period (average)	144 days
Precipitation total (average)	610 mm

Climate stations used

- (1) REDFIELD [USC00397052], Redfield, SD
- (2) MILLER [USC00395561], Miller, SD
- (3) HURON RGNL AP [USW00014936], Huron, SD
- (4) DE SMET [USC00392302], De Smet, SD
- (5) HOWARD [USC00394037], Howard, SD
- (6) FORESTBURG 4 NNE [USC00393029], Artesian, SD
- (7) CHAMBERLAIN MUNI AP [USW00094943], Chamberlain, SD
- (8) CHAMBERLAIN 5 S [USC00391621], Chamberlain, SD
- (9) ACADEMY 2NE [USC00390043], Platte, SD
- (10) MITCHELL MUNI AP [USW00094950], Mitchell, SD
- (11) MITCHELL [USC00395669], Mitchell, SD
- (12) BRIDGEWATER [USC00391032], Bridgewater, SD
- (13) MARION [USC00395228], Marion, SD
- (14) SALEM 5NE [USC00395360], Salem, SD
- (15) ARMOUR [USC00390296], Armour, SD
- (16) WAGNER [USC00398767], Wagner, SD
- (17) TYNDALL [USC00398472], Tyndall, SD
- (18) MENNO [USC00395481], Menno, SD

Influencing water features

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

Soil features

The common features of soils in this site are clay loam to clay textured subsoils and slopes of 1 to 5 percent. The soils in this site are moderately well to somewhat poorly drained and formed in till and drift over till, or alluvium. The loam to silt loam surface layer is 4 to 11 inches thick. The extremely hard clayey Btn horizon has round-topped or “biscuit shaped” columnar structure. These Btn horizons are high in sodium. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

Soil series is Dudley.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetation is diminished. Low available water capacity and very slow permeability strongly influences the soil-water-plant relationship.

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

Table 4. Representative soil features

Surface texture	(1) Loam (2) Silt loam
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow
Soil depth	203 cm
Surface fragment cover <=3"	0–4%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	2–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–20
Soil reaction (1:1 water) (0-101.6cm)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

State and Community Phases
The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

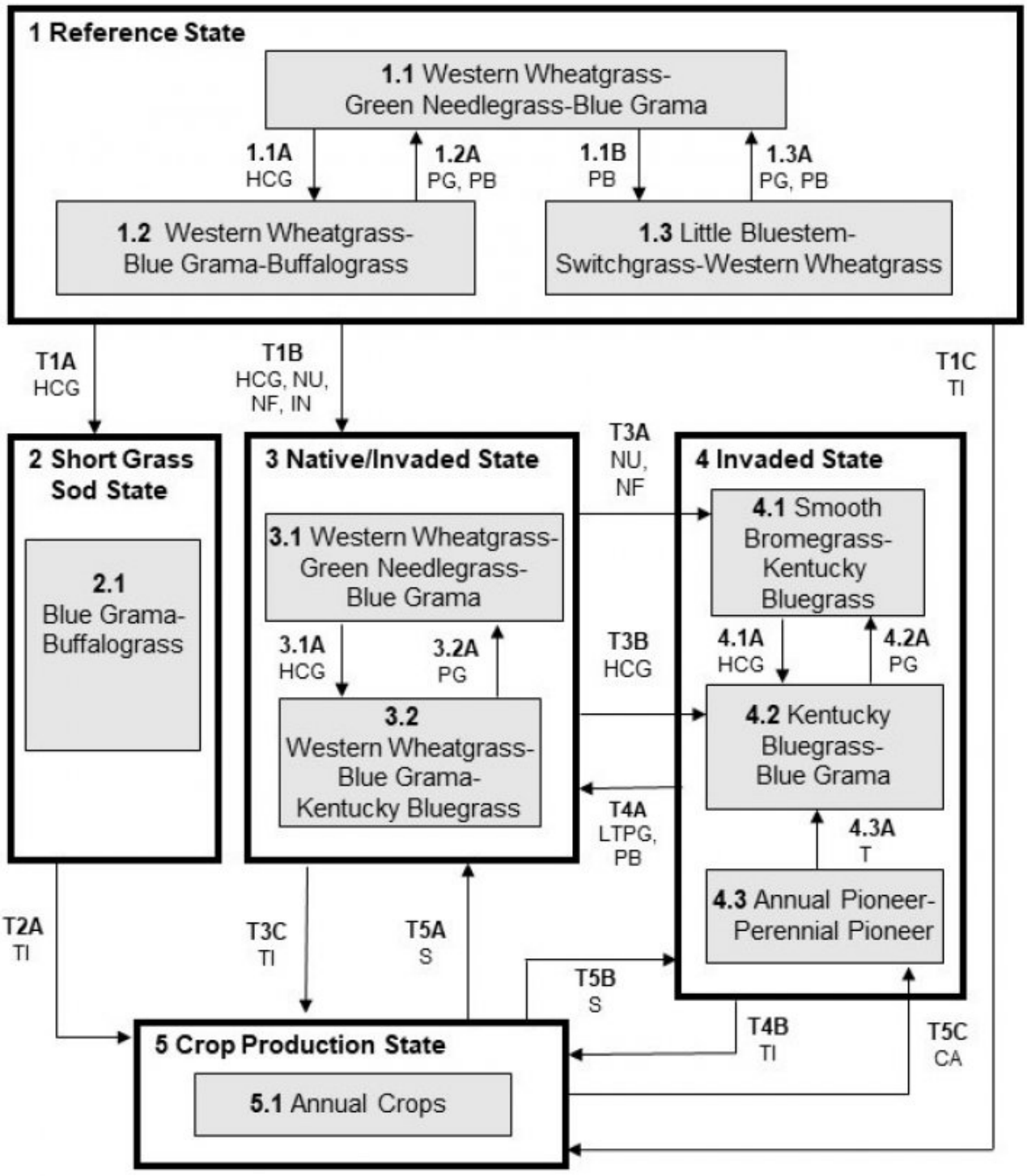
The site which is located in the Southern Black Glaciated Plains Region developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions, the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase. This community phase and the Reference State have 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 considered. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

This ecological site (ES) has been grazed by domestic livestock since they were introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have changed the ecological dynamics of this site. Continuous season-long grazing (during the typical growing season of May through October) or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following grazing events causes departure from the 3.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase. Blue grama (*Bouteloua gracilis*) will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needle and thread, porcupinegrass, sideoats grama (*Bouteloua curtipendula*), big bluestem (*Andropogon gerardii*), and little bluestem (*Schizachyrium scoparium*) will decrease in frequency and production. Extended periods of nonuse and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as Kentucky bluegrass (*Poa pratensis*), smooth bromegrass (*Bromus inermis*), green needlegrass, and cheatgrass (*Bromus tectorum*).

Following the state-and-transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states and community phases. The associated plant composition tables have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

State and transition model

Claypan – R055CY013SD



LEGEND
Claypan – R055CY013SD

CA – Cropped and abandoned
HCG – Heavy continuous grazing
IN – Invasion
LTPG – Long-term prescribed grazing
NU – Non-use
NF – No fire
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding
T – Time w/wo disturbances
TI – Tillage

Figure 9. State-And-Transition Model and Legend for the Claypan Site in MLRA 55C.

Code	Process
T1A	Heavy continuous grazing
T1B	Heavy continuous grazing, non-use, no fire, invasion
T1C	Tillage
T2A	Tillage
T3A	Non-use, no fire
T3B	Heavy continuous grazing
T3C	Tillage
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T5A	Seeding
T5B	Seeding
T5C	Abandonment of cropping
1.1A	Heavy continuous grazing
1.1B	Prescribed burning
1.2A	Prescribed grazing with recovery periods, prescribed burning
1.3A	Prescribed grazing with recovery periods, prescribed burning
3.1A	Heavy continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time, w/wo disturbances

Figure 10. Matrix for the Claypan Site in MLRA 55C.

State 1
Reference State

The Reference State represents the natural range of variability that dominated the dynamics of this ecological site (ES). This state was dominated by cool-season grasses, with warm-season grasses being subdominant. Prior to European settlement in North America, the primary disturbance mechanisms for this site in the Reference condition included periods of below and above average precipitation, periodic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. Cool-season and taller warm-season grasses would have declined and a corresponding increase in short, warm-season grasses would have occurred. Today, a similar state, the Native/Invaded State (State 3) 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 1.1
Western Wheatgrass-Green Needlegrass-Blue Grama

Interpretations are based primarily on the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase (this is also considered to be the Reference Community). The potential vegetation was about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community was dominated by cool-season grasses. The major grasses included western wheatgrass, green needlegrass, and blue grama. Other grass or grass-like species included needle and thread, big bluestem, little bluestem, sideoats grama, slender wheatgrass (*Elymus trachycaulus*), porcupinegrass, and fowl bluegrass (*Poa palustris*). This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high tolerance to drought. This was a sustainable plant community in regard to site and soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1737	2294	2819
Forb	118	194	291
Shrub/Vine	50	90	140
Total	**1905**	**2578**	**3250**

Figure 12. Plant community growth curve (percent production by month). SD5502, Southern Black Glaciated Plains, cool-season dominant, warm-season . Cool-season dominant, warm-season subdominant..

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-Blue Grama-Buffalograss

This plant community evolved under heavy, continuous grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses included western wheatgrass, blue grama, buffalograss (*Bouteloua dactyloides*), green needlegrass, sideoats grama, and needle and thread. Grasses of secondary importance included little bluestem, porcupinegrass, big bluestem, and sedge (Abildgaardia). Forbs commonly found in this plant community included cudweed sagewort (*Artemisia ludoviciana*), prairie coneflower (*Ratibida columnifera*), and western yarrow (*Achillea millefolium*). This plant community had similar plant composition to the 3.2 Western Wheatgrass-Blue Grama-Kentucky Bluegrass Plant Community Phase. The main difference is that this plant community phase did not have the presence of non-native invasive species such as Kentucky bluegrass and smooth bromegrass. When compared to the 1.1 Western Wheatgrass-Green Needlegrass-Big Bluestem Plant Community Phase, blue grama and buffalograss increased. Green needlegrass and porcupinegrass decreased and production of mid- and tall warm-season grasses was also reduced. This plant community was moderately resistant to change. The herbaceous species present were well adapted to grazing; however, species composition could be altered through long-term overgrazing. If the herbaceous component was intact, it tended to be resilient if the disturbance was not long-term.

Figure 13. Plant community growth curve (percent production by month). SD5503, Southern Black Glaciated Plains, cool-season/warm-season codominant.. Cool-season, warm-season codominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

Community 1.3
Little Bluestem-Switchgrass-Western Wheatgrass

This plant community was a result of fire occurring at relatively frequent intervals. This phase could have also resulted from a combination of grazing events immediately following early season fire (i.e., large ungulates attracted to highly nutritious vegetative growth following a fire). These events would have caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire and would have increased in vigor and production leading to a temporary shift to this phase. Needlegrasses would have decreased most significantly amongst the cool-season grasses. The potential vegetation was about 80 percent grasses or grass-like plants, 15 percent forbs, and 5 percent shrubs. The community was dominated by warm-season grasses. The major grasses included little bluestem, big bluestem, switchgrass, Indiangrass (Sorhgastrum nutans), sideoats grama, and western wheatgrass. Other grass or grass-like species included green needlegrass, porcupinegrass, needle and thread, blue grama, slender wheatgrass, tall dropseed (*Sporobolus compositus*), and sedges (Cyperaceae). This plant community was not resistant to change and would have readily shifted back to the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase with a return of more normal fire return intervals.

Figure 14. Plant community growth curve (percent production by month). SD5504, Southern Black Glaciated Plains, warm-season dominant, cool-season . Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	24	25	15	7	1	0	0

Pathway 1.1A
Community 1.1 to 1.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, will shift this community to the 1.2 Western Wheatgrass-Blue Grama-Buffalograss Plant Community Phase.

Pathway 1.1B
Community 1.1 to 1.3

Prescribed burning (occurring at relatively frequent intervals every 3 to 5 years), a return to normal disturbance regime levels and frequencies, periodic light to moderate grazing possibly including periodic rest, and occasional grazing events immediately following early season fire caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire and would increase in vigor and production leading to a temporary shift to the 1.3 Little Bluestem-Switchgrass-Western Wheatgrass Plant Community Phase.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, and/or prescribed burning (occurring at relatively frequent intervals, every 3 to 5 years), a return to normal disturbance regime levels and frequencies, or periodic light to moderate grazing, possibly including periodic rest, will convert this plant community to the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase.

Pathway 1.3A
Community 1.3 to 1.1

Prescribed grazing (alternating season of use and providing adequate recovery periods), periodic light to moderate grazing (possibly including periodic rest, or occurring at relatively frequent intervals, every 3 to 5 years), and a return to normal disturbance regime levels may convert this plant community to the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase.

State 2
Shortgrass Sod State

The Shortgrass Sod State is the result of heavy, continuous grazing, and in the absence of periodic fire due to fire suppression. This state is dominated by blue grama and buffalograss forming a dense sod layer that effectively blocks introduction of other plants into the system. Taller cool-season species will decline and a corresponding increase in short-statured grass will occur. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the sod grass dominance.

Community 2.1
Blue Grama-Buffalograss

This plant community evolved under heavy, continuous season grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses typically included blue grama and buffalograss. Grasses of secondary importance included sedge and western wheatgrass. Forbs commonly found in this plant

community included cudweed sagewort, scurfpea (Cullen), and western yarrow. When compared to the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase, blue grama and buffalograss (*Bouteloua dactyloides*) were dominant on this plant community. Cool-season grasses decreased significantly. This vegetation state was very resistant to change. The herbaceous species present were well adapted to grazing. This plant community was less productive than other phases. The thick sod prevented other species from getting established.

Figure 15. Plant community growth curve (percent production by month). SD5505, Southern Black Glaciated Plains, warm-season dominant.. Warm-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	5	15	25	30	15	7	1	0	0

State 3
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. 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. Taller cool-season species can decline and a corresponding increase in short statured grass will occur.

Community 3.1
Western Wheatgrass-Green Needlegrass-Blue Grama

This plant community phase is similar to the 1.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). 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, green needlegrass, and blue grama. Other grass or grass-like species include needle and thread, big bluestem, little bluestem, sideoats grama, slender wheatgrass, porcupinegrass, and fowl bluegrass. 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 regards to site and soil stability, watershed function, and biologic integrity.

Figure 16. Plant community growth curve (percent production by month). SD5502, Southern Black Glaciated Plains, cool-season dominant, warm-season . Cool-season dominant, warm-season subdominant..

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 3.2
3.2 Western Wheatgrass-Blue Grama-Kentucky Bluegrass

This plant community is a result of heavy, continuous grazing, continuous season-long grazing, or from over utilization during extended drought periods. The potential plant community is made up of approximately 80 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grasses include western wheatgrass, blue grama, and Kentucky bluegrass. Grasses of secondary importance include sideoats grama, little bluestem, green needlegrass, needle and thread, porcupinegrass, big bluestem, buffalograss, smooth bromegrass, and sedge. Forbs commonly found in this plant community include cudweed sagewort, prairie coneflower, and western yarrow. When compared to the 3.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase, blue grama has increased. Green needlegrass and sideoats grama have decreased and production of mid- and tall warm-season grasses has also been reduced. This plant community is moderately resistant to change. 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 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1239	1706	2152
Forb	90	143	213
Shrub/Vine	17	56	101
Total	**1346**	**1905**	**2466**

Figure 18. Plant community growth curve (percent production by month). SD5502, Southern Black Glaciated Plains, cool-season dominant, warm-season . Cool-season dominant, warm-season subdominant..

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

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, will shift this community to the 3.2 Western Wheatgrass-Blue Grama-Kentucky Bluegrass Plant Community Phase.

Pathway 3.2A
Community 3.2 to 3.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 3.1 Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase.

State 4
Invaded State

The Invaded State is the result of invasion and dominance of introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth bromegrass 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 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 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. Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch will 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 no opportunity for the native species to establish before Kentucky bluegrass rebounds.

Community 4.1
Smooth Bromegrass-Kentucky Bluegrass

This plant community phase is a result of extended periods of non-use and no fire. 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. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is 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.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1536	2508	2998
Forb	123	211	319
Shrub/Vine	22	83	157
Total	**1681**	**2802**	**3474**

Figure 20. Plant community growth curve (percent production by month). SD5501, Southern Black Glaciated Plains, cool-season dominant.. Cool-season dominant..

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

Community 4.2
Kentucky Bluegrass-Blue Grama

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing. It is characterized by a dominance of Kentucky bluegrass and blue grama. The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and eventually a thatch-mat layer may develop at the surface as well.. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	824	1170	1496
Forb	62	135	224
Shrub/Vine	11	40	73
Total	**897**	**1345**	**1793**

Figure 22. Plant community growth curve (percent production by month). SD5502, Southern Black Glaciated Plains, cool-season dominant, warm-season . Cool-season dominant, warm-season subdominant..

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 4.3
Annual Pioneer-Perennial Pioneer

The Annual Pioneer-Perennial Pioneer plant community developed under continuous, heavy grazing or other excessive disturbances. The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable but often include non-native invasive and early seral species. 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. This community can be renovated to improve the production capability; however, if management changes are not made the vegetation could revert back to early seral species.

Pathway 4.1A
Community 4.1 to 4.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites, will shift this community to the 4.2 Kentucky Bluegrass-Blue Gama Plant Community Phase.

Pathway 4.2A
Community 4.2 to 4.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing (possibly including periodic rest) will convert this plant community to the 4.1 Smooth Bromegrass-Kentucky Bluegrass Plant Community Phase.

Conservation practices

Prescribed Grazing

Pathway 4.3A
Community 4.3 to 4.2

This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the 4.2 Kentucky Bluegrass-Blue Grama Plant Community Phase.

Conservation practices

Integrated Pest Management (IPM)

State 5
Crop Production State

The Crop Production State is characterized by the production of annual crops using a variety of tillage and cropping systems along with management practices.

Community 5.1
Annual Crops

This plant community developed with the use of a variety of tillage and cropping systems for the production of annual crops including corn, soybeans, wheat, and a variety of other crops.

Transition T1A
State 1 to 2

Heavy, continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year, typically beginning early in the season) will convert this plant community to the 2.1 Blue Grama-Buffalograss Plant Community Phase within the Shortgrass Sod State (State 2).

Transition T1B
State 1 to 3

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, heavy continuous grazing, or invasion of non-native plant species will likely lead this state over a threshold resulting in the Native/Invaded State (State 3).

Transition T5
State 1 to 4

Encroachment of non-native invasive and noxious species, abandonment of cropping, or seeding of introduced or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4), and more specifically to the 4.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group (FSG) description for adapted species and expected production (production estimates in the FSG description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T1C
State 1 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Transition T5
State 2 to 4

Encroachment of non-native invasive or noxious species, abandonment of cropping, or seeding of introduced or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4), and more specifically to the 4.3 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group (FSG) description for adapted species and expected production (production estimates in the FSG description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T2A
State 2 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Transition T3A, T3B
State 3 to 4

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will likely lead this state over a threshold leading to the 4.1 Smooth Bromegrass-Kentucky Bluegrass Community Phase within the Invaded State (State 4) Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season and often at the same time of year each year), will likely lead this state over a threshold leading to the 4.2 Kentucky Bluegrass-Blue Grama Community Phase within the Invaded State (State 4). Grazing repeatedly in the early growing season can expedite this shift by causing mechanical disturbance due to trampling.

Transition T3C
State 3 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Restoration pathway T4A
State 4 to 3

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 occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this plant community phase over a threshold to the Native/Invaded State (State 3).

Transition T4B
State 4 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Community Phase within the Crop Production State (State 5).

Restoration pathway T5A
State 5 to 3

Seeding may lead this Crop Production State (State 5) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T5B, T5C
State 5 to 4

Seeding may lead this Crop Production State (State 5) over a threshold to the Invaded State (State 4). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.3 Annual Pioneer-Perennial Pioneer Plant Community Phase.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			387–773	
	green needlegrass	NAVI4	*Nassella viridula*	258–773	–
	fowl bluegrass	POPA2	*Poa palustris*	129–516	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	129–516	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	129–516	–
2	**Wheatgrass**			387–773	
	western wheatgrass	PASM	*Pascopyrum smithii*	387–773	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	52–258	–
3	**Short Warm-Season Grasses**			129–387	
	blue grama	BOGR2	*Bouteloua gracilis*	129–387	–
	buffalograss	BODA2	*Bouteloua dactyloides*	52–206	–
	saltgrass	DISP	*Distichlis spicata*	0–77	–
	threeawn	ARIST	*Aristida*	0–52	–
4	**Tall Warm-Season Grasses**			129–258	
	big bluestem	ANGE	*Andropogon gerardii*	52–258	–
	switchgrass	PAVI2	*Panicum virgatum*	0–206	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–129	–
5	**Mid Warm-Season Grasses**			129–258	

	sideoats grama	BOCU	*Bouteloua curtipendula*	52–258	–
	little bluestem	SCSC	*Schizachyrium scoparium*	52–258	–
6	**Other Native Grasses**			26–129	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–129	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–77	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–52	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–52	–
7	**Grass-likes**			52–258	
	sedge	CAREX	*Carex*	52–206	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–77	–
Forb					
8	**Forbs**			129–258	
	Forb, native	2FN	*Forb, native*	26–77	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–77	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	26–52	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	26–52	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	26–52	–
	goldenrod	SOLID	*Solidago*	26–52	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	26–52	–
	white heath aster	SYER	*Symphyotrichum ericoides*	26–52	–
	American vetch	VIAM	*Vicia americana*	26–52	–
	field sagewort	ARCA12	*Artemisia campestris*	0–52	–
	Nuttall's violet	VINU2	*Viola nuttallii*	0–26	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–26	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–26	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–26	–
	textile onion	ALTE	*Allium textile*	0–26	–
	pussytoes	ANTEN	*Antennaria*	0–26	–
	milkweed	ASCLE	*Asclepias*	0–26	–
	mouse-ear chickweed	CERAS	*Cerastium*	0–26	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–26	–
Shrub/Vine					
9	**Shrubs**			52–129	
	snowberry	SYMPH	*Symphoricarpos*	26–77	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–52	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–52	–
	rose	ROSA5	*Rosa*	26–52	–

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			95–286	

	green needlegrass	NAVI4	*Nassella viridula*	38–286	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	19–152	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	19–152	–
	fowl bluegrass	POPA2	*Poa palustris*	0–114	–
2	**Wheatgrass**			286–572	
	western wheatgrass	PASM	*Pascopyrum smithii*	286–572	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–76	–
3	**Short Warm-Season Grasses**			286–476	
	blue grama	BOGR2	*Bouteloua gracilis*	191–476	–
	buffalograss	BODA2	*Bouteloua dactyloides*	38–229	–
	saltgrass	DISP	*Distichlis spicata*	0–95	–
	threeawn	ARIST	*Aristida*	0–57	–
4	**Tall Warm-Season Grasses**			0–95	
	big bluestem	ANGE	*Andropogon gerardii*	0–57	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–57	–
	switchgrass	PAVI2	*Panicum virgatum*	0–57	–
5	**Mid Warm-Season Grasses**			0–95	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–95	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–95	–
6	**Other Native Grasses**			19–95	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–95	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–38	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	19–38	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–38	–
7	**Grass-likes**			19–191	
	sedge	CAREX	*Carex*	19–191	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–57	–
8	**Non-Native Grasses**			95–476	
	Kentucky bluegrass	POPR	*Poa pratensis*	57–476	–
	brome	BROMU	*Bromus*	19–191	–
	quackgrass	ELRE4	*Elymus repens*	0–95	–
	smooth brome	BRIN2	*Bromus inermis*	0–95	–
Forb					
9	**Forbs**			95–191	
	sweetclover	MELIL	*Melilotus*	0–95	–
	Forb, introduced	2FI	*Forb, introduced*	0–76	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	19–76	–
	Forb, native	2FN	*Forb, native*	19–57	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	19–57	–
	white heath aster	SYER	*Symphyotrichum ericoides*	19–57	–
	goldenrod	SOLID	*Solidago*	19–57	–

	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	19–38	–
	common dandelion	TAOF	*Taraxacum officinale*	0–38	–
	yellow salsify	TRDU	*Tragopogon dubius*	19–38	–
	field sagewort	ARCA12	*Artemisia campestris*	0–38	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	19–38	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–38	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–19	–
	mouse-ear chickweed	CERAS	*Cerastium*	0–19	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–19	–
	pussytoes	ANTEN	*Antennaria*	0–19	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–19	–
	American vetch	VIAM	*Vicia americana*	0–19	–
Shrub/Vine					
10	**Shrubs**			19–95	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–57	–
	snowberry	SYMPH	*Symphoricarpos*	19–57	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–38	–
	rose	ROSA5	*Rosa*	0–19	–

Table 11. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			0–224	
	green needlegrass	NAVI4	*Nassella viridula*	0–196	–
	fowl bluegrass	POPA2	*Poa palustris*	0–112	–
2	**Wheatgrass**			0–280	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–280	–
3	**Short Warm-Season Grasses**			0–196	
	blue grama	BOGR2	*Bouteloua gracilis*	0–140	–
	saltgrass	DISP	*Distichlis spicata*	0–84	–
	threeawn	ARIST	*Aristida*	0–56	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–56	–
4	**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	–
5	**Grass-likes**			0–140	
	sedge	CAREX	*Carex*	0–140	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–84	–
6	**Non-Native Grasses**			841–1961	
	smooth brome	BRIN2	*Bromus inermis*	560–1821	–
	Kentucky bluegrass	POPR	*Poa pratensis*	140–701	–

	brome	BROMU	*Bromus*	28–420	–
	quackgrass	ELRE4	*Elymus repens*	0–224	–
Forb					
7	**Forbs**			140–280	
	sweetclover	MELIL	*Melilotus*	0–224	–
	Forb, introduced	2FI	*Forb, introduced*	0–168	–
	Forb, native	2FN	*Forb, native*	0–84	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–84	–
	goldenrod	SOLID	*Solidago*	28–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	–
	common dandelion	TAOF	*Taraxacum officinale*	28–84	–
	yellow salsify	TRDU	*Tragopogon dubius*	28–84	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–56	–
	white heath aster	SYER	*Symphyotrichum ericoides*	28–56	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–56	–
	pussytoes	ANTEN	*Antennaria*	0–28	–
	field sagewort	ARCA12	*Artemisia campestris*	0–28	–
	mouse-ear chickweed	CERAS	*Cerastium*	0–28	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–28	–
Shrub/Vine					
8	**Shrubs**			28–140	
	snowberry	SYMPH	*Symphoricarpos*	28–112	–
	rose	ROSA5	*Rosa*	28–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–28	–

Table 12. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrasses**			0–67	
	fowl bluegrass	POPA2	*Poa palustris*	0–67	–
2	**Wheatgrass**			0–67	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–67	–
3	**Short Warm-Season Grasses**			135–336	
	blue grama	BOGR2	*Bouteloua gracilis*	67–336	–
	buffalograss	BODA2	*Bouteloua dactyloides*	13–135	–
	saltgrass	DISP	*Distichlis spicata*	0–108	–
	threeawn	ARIST	*Aristida*	0–40	–
4	**Other Native Grasses**			13–67	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–67	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–27	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–13	–
	Scribner's rosette grass	DIOL5	*Dichanthelium oligosanthes var.*	0–13	–

	Scribner's rosette grass	DICLS	*Dichanthelium oligosanthes var. scribnerianum*	0–13	
5	**Grass-likes**			40–202	
	sedge	CAREX	*Carex*	40–202	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–27	–
6	**Non-Native Grasses**			336–673	
	Kentucky bluegrass	POPR	*Poa pratensis*	135–605	–
	brome	BROMU	*Bromus*	27–269	–
	quackgrass	ELRE4	*Elymus repens*	27–161	–
	smooth brome	BRIN2	*Bromus inermis*	0–108	–
Forb					
7	**Forbs**			67–202	
	Forb, introduced	2FI	*Forb, introduced*	13–108	–
	sweetclover	MELIL	*Melilotus*	0–94	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	13–67	–
	goldenrod	SOLID	*Solidago*	13–54	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	13–54	–
	field sagewort	ARCA12	*Artemisia campestris*	0–40	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	13–40	–
	common dandelion	TAOF	*Taraxacum officinale*	13–40	–
	yellow salsify	TRDU	*Tragopogon dubius*	13–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–27	–
	Forb, native	2FN	*Forb, native*	0–27	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	13–27	–
	pussytoes	ANTEN	*Antennaria*	0–13	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	–
Shrub/Vine					
8	**Shrubs**			13–67	
	snowberry	SYMPH	*Symphoricarpos*	0–40	–
	prairie sagewort	ARFR4	*Artemisia frigida*	13–40	–
	rose	ROSA5	*Rosa*	0–13	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–13	–

Animal community

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 ES description). 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. Stocking rates are calculated using Animal-Unit-Month (AUM), which is the amount of air-dry forage required to feed a cow, with or without calf, for one month.

Western Wheatgrass/Needlegrass/Blue Grama (1.1 & 3.1)
Average Annual Production (lbs./acre, air-dry): 2,300
Stocking Rate* (AUM/acre): 0.63

Western Wheatgrass/Blue Grama/Kentucky Bluegrass (3.2)
Average Annual Production (lbs./acre, air-dry): 1,700
Stocking Rate* (AUM/acre): 0.47

Smooth Bromegrass/Kentucky Bluegrass (4.1)
Average Annual Production (lbs./acre, air-dry): 2,500
Stocking Rate* (AUM/acre): 0.69

Kentucky Bluegrass/Blue Grama (4.2)
Average Annual Production (lbs./acre, air-dry): 1,200
Stocking Rate* (AUM/acre): 0.33

Annual/Pioneer, Non-Native Perennial (4.3)
Average Annual Production (lbs./acre, air-dry): 800
Stocking Rate* (AUM/acre): 0.22

*Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM) and on 25 percent harvest efficiency (refer to United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), National Range and Pasture Handbook).

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. This site is dominated by soils in hydrologic group D. Infiltration varies from very slow to slow and runoff potential for this site varies from high to very 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, bluegrass, and 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 Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

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

Ecological Site Correlation Issues and Questions:

• SD069 Hyde County, SD did not use the (CnA) Cavo-Glenham loams, nearly level (national symbol ctwt) as used in the adjoining SD059 Hand County, SD.

• SD115 Spink County, SD did not use the (HlA) Houdek-Dudley complex, 0 to 2 percent slopes (national symbol 2wbpw) as used in the adjoining SD059 Hand County, SD.
• SD115 Spink County, SD did not use the (DtA) Dudley-Tetonka silt loams (national symbol cwym) as used in the adjoining SD005 Beadle County, SD.
• SD111 Sanborn County, SD did not use the (DtA) Dudley-Tetonka silt loams (national symbol cwym) as used in the adjoining SD005 Beadle County, SD.
• SD073 Jerauld County, SD did not use the (DtA) Dudley-Tetonka silt loams (national symbol cwym) as used in the adjoining SD005 Beadle County, SD.
• SD035 Davison County, SD did not use the (HdA) Houdek-Dudley complex, 0 to 2 percent slopes (national symbol 2wbpw) as used in the adjoining SD003 Aurora County, SD.
• SD097 Miner County, SD did not use the (DsA) Stickney-Dudley silt loams, 0 to 2 percent slopes (national symbol 2wkpg) as used in the adjoining SD602 Hanson and Hutchinson Counties, SD.
• SD005 Beadle County, SD did not use the (Ws) Woonsocket-Whitelake fine sandy loams, 0 to 2 percent slopes (national symbol cz6g) as used in the adjoining SD115 Spink County, SD.
• SD005 Beadle County, SD did not use the (Nv) Northville-Farmsworth-Hoven silt loams, 0 to 2 percent slopes (national symbol cz59) as used in the adjoining SD115 Spink County, SD.
• SD005 Beadle County, SD did not use the (Su) Stickney-Dudley-Hoven silt loams, 0 to 2 percent slopes (national symbol 2wkpf) as used in the adjoining SD115 Spink County, SD.
• Reference and alternative states within the state and transition model are may not be fully documented and may require additional field sampling for refinement.

Inventory data references

Information presented here has been derived using field observations from range-trained personnel. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; and Bruce Kunze, Soil Scientist, NRCS.

Data Source Sample Period State County
SCS-RANGE-417 (0028546097) 10/9/1985 SD Miner

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Approval

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Acknowledgments

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. Officially approved for publication by David Kraft as of 11/12/2020.

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)	David Schmidt, Tim Nordquist, Stan Boltz
Contact for lead author	david.schmidt@sd.usda.gov 605-352-1236
Date	12/07/2004
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.

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 15 percent and less than 2 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.

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):** Stability class roughly 3-5. Relatively high root content. Soil surface is resistant to erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Use soil series description for depth and color of A-horizon.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy, deep rooted native grasses 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 evident. At less than eight inches, an extremely dense clay B horizon with round-topped columnar or prismatic structure exists.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Mid cool-season rhizomatous grasses > mid and tall cool-season bunchgrasses >>

    Sub-dominant: Short warm-season grasses > tall warm-season rhizomatous grass = short warms eason grass = short cool-season grass = forb

    Other: Tall warm-season grasses = mid warm-season grasses = forbs = short grass-likes > short cool-season grasses = shrubs.

    Additional: Due to differing root structure and distribution, Kentucky bluegrass and smooth bromegrass do not fit into reference plant community F/S groups.

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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):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1,700–2,900 lbs./acre air-dry weight, average 2,300 lbs./acre air-dry weight.

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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, smooth bromegrass.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing.
