USDA Natural Resources
Conservation Service

Ecological site R053CY011SD
Clayey

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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.

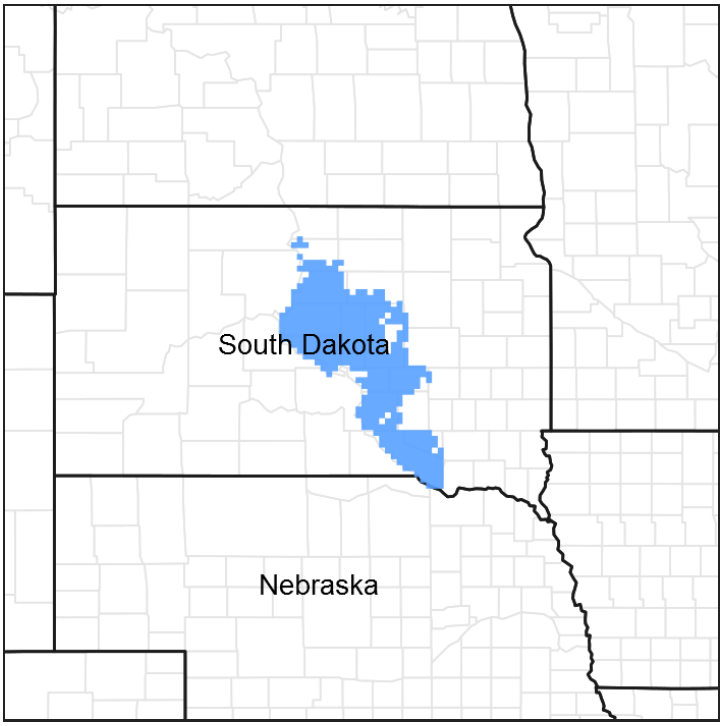

Figure 1. Mapped extent

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): 053C–Southern Dark Brown Glaciated Plains

The Southern Dark Brown Glaciated Plains (53C) is located within the Northern Great Plains Region. It is entirely in South Dakota encompassing about 3,990 square miles

(Figure 1). The elevation ranges from 1,300 to 2,300 feet. The MLRA is level to gently rolling till plains including many areas of potholes. A terminal moraine occurs in the southern end of the MLRA. Moderately steep and steep slopes are adjacent to the major valleys. The headwaters of many creeks in central South Dakota occur in the high-lying MLRA. (USDA-NRCS 2006).

The dominant soil orders in this MLRA are Mollisols and Inceptisols. 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 or moderately well drained, and are loamy or clayey. This area supports natural prairie vegetation characterized by western wheatgrass (Pascopyrum smithii), big bluestem (Andropogon gerardii), needleandthread (Hesperostipa comata), and green needlegrass (Nassella viridula). Little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), and prairie sandreed (Calamovilfa longifolia) are important species on steeper sites. Western snowberry (Symphoricarpos occidentalis) and prairie rose (Rosa arkansana) are commonly dispersed throughout the area. (USDA-NRCS 2006).

Classification relationships

Major Land Resource Area (MLRA): Southern Dark Brown Glaciated Plains (53C) (USDA-NRCS 2006)

USFS Subregions: Northeastern Glaciated Plains Section (331E); Missouri Coteau Subsection (331Ea); Western Great Plains Section (331F); Missouri Breaks Subsection (331Fe); Western Glaciated Plains Section (332B); Southern Missouri Coteau Slope Subsection (332Bd, 332Be); 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: Missouri Coteau (42a); Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f) - (USEPA 2013)

Ecological site concept

The Clayey ecological site occurs on upland areas. Soils are well drained and have greater than 40 percent clay in the surface and/or subsoil. The surface and subsoil textures typically are silty clay or clay. Some soils have a loamy surface and a clayey subsoil. In some areas the surface layer may consist of stony to extremely stony. Slopes can range from 0 to 6 percent.

Vegetation in the Reference State is dominated by cool season grasses such as western wheatgrass and needlegrasses. Forbs include cudweed sagewort, western ragweed. Non-native grasses such as smooth bromegrass and Kentucky bluegrass or native conifers such as Eastern Red Cedar may invade due to shifts in disturbance regime.

Associated sites

R053CY010SD	**Loamy** These sites occur on uplands. Soils are well drained and have less than 40 percent clay in the subsoil. The central concept soil series are Agar, Glenham, and Highmore, but other series are included.
R053CY013SD	**Claypan** These sites occur on uplands. Soils are moderately well drained and have a claypan (columnar structure) greater than 4 inches from the soil surface. The central concept soil series are Cavo and DeGrey, but other series are included.
R053CY012SD	**Thin Upland** These sites occur on uplands. Soils are well drained and will effervesce with acid at or near the surface. The central concept soil series are Ethan, Java, and Betts, but other series are included.

Similar sites

R053CY013SD	**Claypan** The Loamy site is in a similar landscape position, but the soils have less than 40 percent clay in the surface and/or subsoil.

Table 1. Dominant plant species

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

Physiographic features

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

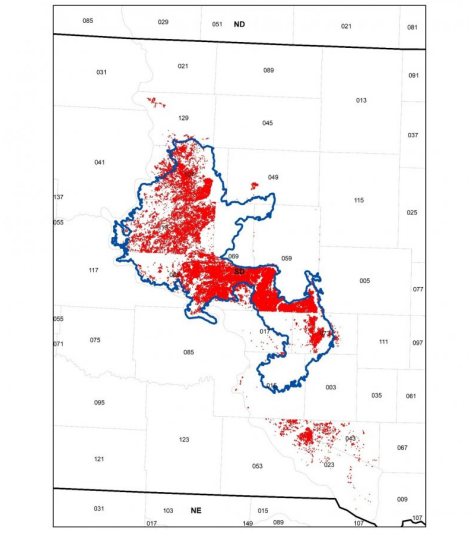

Figure 2. Distribution map

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Till plain (3) Flood plain
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,300–2,300 ft
Slope	1–20%
Water table depth	51–80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 53C 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 15 to 25 inches per year. The average annual temperature is about 45°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, South Dakota (SD)), to about 16°F (Onida 4 NW, SD). July is the warmest month with temperatures averaging from about 72°F (Stephan, SD), to about 74°F (Onida 4 NW, 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. Greenup 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)	107-127 days
Freeze-free period (characteristic range)	128-150 days
Precipitation total (characteristic range)	20-21 in
Frost-free period (actual range)	104-129 days
Freeze-free period (actual range)	127-159 days
Precipitation total (actual range)	19-24 in
Frost-free period (average)	117 days
Freeze-free period (average)	139 days
Precipitation total (average)	21 in

Climate stations used

- (1) GETTYSBURG 13W [USC00393302], Gettysburg, SD
- (2) GETTYSBURG [USC00393294], Gettysburg, SD
- (3) HIGHMORE 23 N [USC00393838], Highmore, SD
- (4) ONIDA 4 NW [USC00396292], Onida, SD
- (5) PIERRE RGNL AP [USW00024025], Pierre, SD
- (6) HARROLD 12 SSW [USC00393608], Pierre, SD
- (7) STEPHAN 2 NW [USC00397992], Highmore, SD
- (8) WESSINGTON SPRINGS [USC00399070], Wessington Springs, 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 the clay loam to clay textured subsoils and slopes of 1 to 20 percent. The soils in this site are well to moderately well-drained and formed in alluvium and clayey till. The loam to clay surface layer is 5 to 10 inches thick. The soils have a very slow infiltration rate. When dry these soils crack. When the soils are wet, surface compaction can occur with heavy traffic. This site typically should show slight to no evidence of rills, wind scoured areas, or pedestalled plants. If present, water flow paths are broken, irregular in appearance, or discontinuous. The soil surface is stable and intact. Subsurface soil layers are nonrestrictive to water movement and root penetration.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about five percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and/or production. The central concept soil series for this site are Demky, Oko, and Raber, but other series are included.

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

Table 4. Representative soil features

Surface texture	(1) Loam (2) Clay loam (3) Clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–2%
Available water capacity (0-40in)	4–7 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–20
Soil reaction (1:1 water) (0-40in)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–8%

Subsurface fragment volume >3" (Depth not specified)	0–4%

Ecological dynamics

The site which is located in the Southern Dark Brown 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/or 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 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. Due to a general invasion of exotic species (such as Kentucky bluegrass (*Poa pratensis*) and smooth bromegrass (*Bromus inermis*) across the MLRA within this site, returning to the 1.1 Western Wheatgrass-Needleandthread Plant Community Phase may not be possible.

This ecological site (ES) has been grazed by domestic livestock since they have been 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. Heavy continuous grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following grazing events cause departure from the 3.1 Western Wheatgrass-Green Needlegrass Plant Community Phase. This plant community is the most frequently occurring plant community phase in the ecological site (ES) in MLRA 53C. Continued heavy seasonal and season-long grazing use will result in an increase in blue grama (Bouteloua gracillis) that will eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needleandthread, porcupine grass (*Hesperostipa spartea*), sideoats grama, and big bluestem, 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 and smooth bromegrass.

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/community phases. The plant composition tables shown below 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/or 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.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition and community pathways between them. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Clayey – R053CY011SD

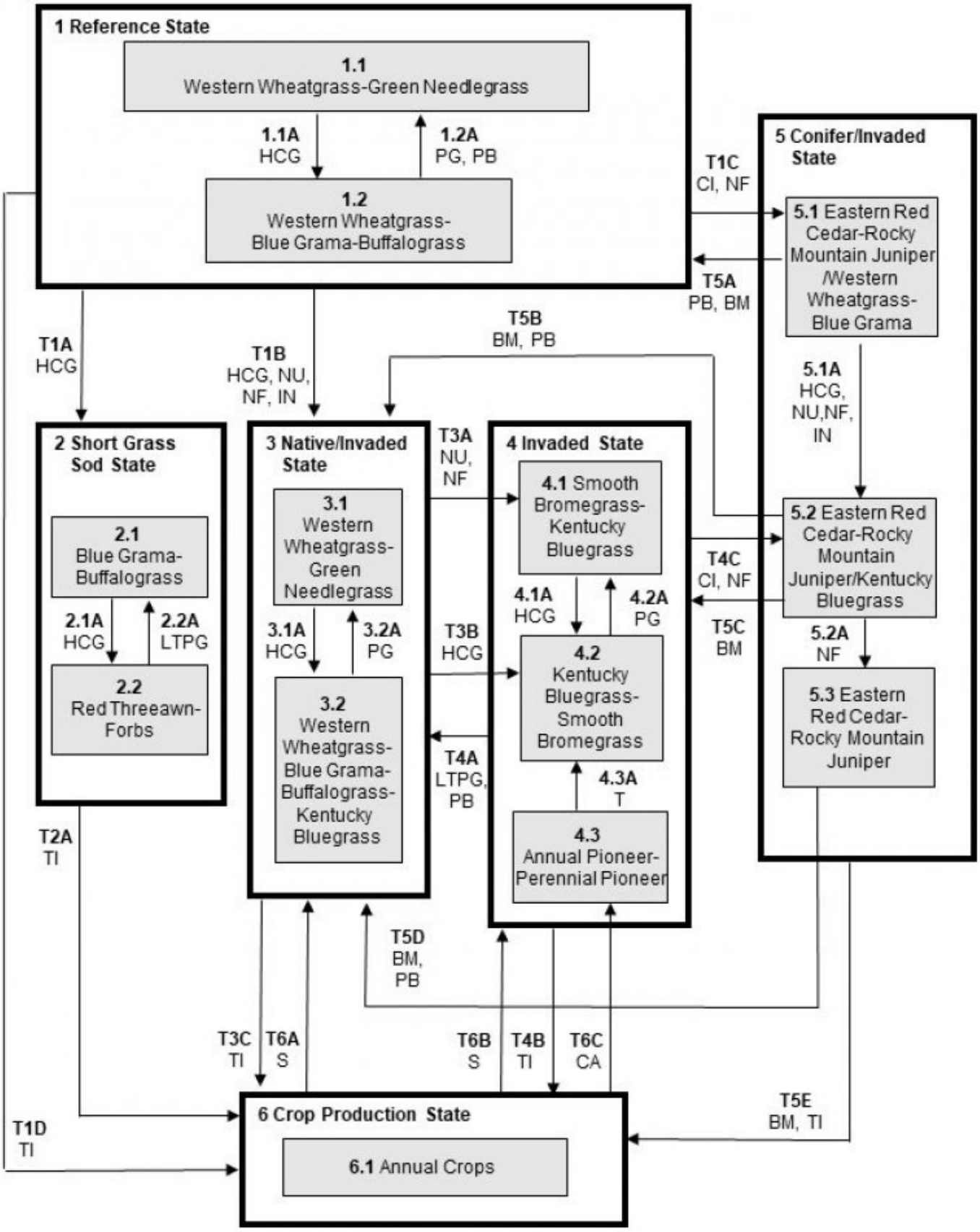

Figure 9. State-And-Transition model

Clayey – R053CY011SD

LEGEND
Clayey – R053CY011SD

BM – Brush management
CA – Cropped and abandoned
CI – Conifer invasion
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 10. Legend

Code	Process
T1A	Heavy continuous grazing
T1B	Heavy continuous grazing, non-use, no fire, invasion
T1C	Conifer invasion, no fire
T1D	Tillage
T2A	Tillage
T3A	Non-use, no fire
T3B	Heavy continuous grazing
T3C	Tillage
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T4C	Conifer invasion, no fire
T5A	Prescribed burning, brush management
T5B	Brush management, prescribed burning
T5C	Brush management
T5D	Brush management, prescribed burning
T5E	Brush management, tillage
T6A	Seeding
T6B	Seeding
T6C	Cropped and abandoned
1.1A	Heavy continuous grazing
1.2A	Prescribed grazing with recovery periods, prescribed burning
2.1A	Heavy continuous grazing
2.2A	Long-term prescribed grazing
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
5.1A	Heavy continuous grazing, non-use, no fire, invasion
5.2A	No fire

Figure 11. Matrix

State 1
Reference State

The Clayey site occurs on upland areas. Soils are well drained and have greater than 40 percent clay in the surface and subsoil. The surface and subsoil textures typically are silty clay or clay. Some soils have a loamy surface and a clayey subsoil. In some areas the surface layer may consist of stony to extremely stony. The central concept soil series are Demky, Oko, and Raber, but other soil series are included. This state represents the natural range of variability that dominates the dynamics of this ES. This state was dominated by cool-season grasses, with warm-season grasses being subdominant. Before European settlement, the primary disturbance mechanisms for this site in the reference condition included periodic fire and grazing by large herding ungulates. Frequent surface fires (3 to 5 years) and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. In some locations, this site likely received relatively heavy grazing pressure. 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 prescribed burning and sometimes on areas receiving occasional short periods of rest. These sites are differentiated by the presence of exotic species such as Kentucky bluegrass and smooth bromegrass.

Community 1.1
Western Wheatgrass-Green Needlegrass

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass Plant Community Phase. 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, with warm-season grasses being subdominant. The major grasses included western wheatgrass and green needlegrass. Other grass or grass-like species included big bluestem, little bluestem, sideoats grama, porcupine grass, and blue grama. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

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, and needleandthread. Grasses of secondary importance included little bluestem, sideoats grama, and big bluestem. Forbs commonly found in this plant community included cudweed sagewort (*Artemisia ludoviciana*) and Cuman ragweed (*Ambrosia psilostachya*). This plant community had similar plant composition to the 3.2 Western Wheatgrass-Blue Grama-Buffalograss-Kentucky Bluegrass Plant Community Phase. The main difference is that this plant community phase did not have the presence of nonnative invasive cool-season species, such as Kentucky bluegrass and smooth bromegrass. When compared to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community Phase, blue grama and buffalograss increased due to their relatively high tolerance of heavy continuous grazing pressure. Green needlegrass decreased and composition of mid- and tall warm-season grasses were 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 tall and mid-grasses remain intact, this plant community tended to be resilient if the disturbance was not long-term. Most of the components of the ecological processes would have been functioning at optimum levels. However, the vigor and reproductive capability of the tall warm-season grasses would have been reduced due to grazing pressure or a combination of stressors. A

reduction of this dominant functional group allowed for an increase in shorter-statured (and shallower rooted) species.

Pathway 1.1A
Community 1.1 to 1.2

Heavy continuous grazing will shift this community to the 1.2 Western Wheatgrass-Blue Grama-Buffalograss Plant Community Phase. This can be in the form of 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

Pathway 1.2A
Community 1.2 to 1.1

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

State 2
Short Grass Sod State

This 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. Low growth forms and low and late growing points allow blue grama, buffalograss, and upland sedges to tolerate and sometimes avoid heavy continuous grazing. 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 included blue grama and buffalograss. Grasses of secondary importance included sedges (Cyperaceae) and western wheatgrass. Forbs commonly found in this plant community included cudweed sagewort and scarlet globemallow (*Sphaeralcea coccinea*). When compared to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community Phase, mid- and tall grasses decreased significantly. This vegetation state was very resistant to change especially if the disturbance continued and the short-statured species such as blue grama increased. The

herbaceous species present were well adapted to grazing. This plant community was less productive than other phases. A thick “sod” of blue grama and buffalograss reduces the opportunity for other species to establish on this site.

Community 2.2
Red Threeawn-Forbs

This plant community is a result of heavy continuous grazing, frequent severe defoliation, or from over utilization during extended drought periods. This is a short, warm-season dominated state with cool-season subdominant grasses. The potential plant community is made up of approximately 65 percent grasses and grass-like species, 30 percent forbs, and 5 percent shrubs. Dominant grasses include red threeawn (*Aristida purpurea*) and annual grasses. Grasses of secondary importance include cheatgrass and Kentucky bluegrass. When compared to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community Phase, western wheatgrass and green needlegrass have been greatly reduced. Production of mid- and tall warm-season grasses has also been reduced and invasive and less desirable grasses dominate. Percent bare ground is also increased. This plant community is resistant to change to a different state but is very sensitive to becoming an annual grass and invader state. The herbaceous species present are not well adapted to grazing and composition can be easily altered through long-term overgrazing.

Pathway 2.1A
Community 2.1 to 2.2

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 2.2 Red Threeawn-Forbs Plant Community Phase.

Pathway 2.2A
Community 2.2 to 2.1

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) will convert this plant community to the 2.1 Blue Grama-Buffalograss Plant Community Phase.

State 3
Native/Invaded State

This 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 and the

presence of exotic species such as Kentucky bluegrass and smooth bromegrass. 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 cooler-season species can decline and a corresponding increase in short statured grass will occur.

Community 3.1
Western Wheatgrass-Green Needlegrass

This plant community phase is similar to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community Phase but it also contains minor amounts of nonnative invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 20 percent by air-dry weight). The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. This community is dominated by cool-season grasses with warm-season grasses being subdominant. The major grasses include western wheatgrass and green needlegrass. Other grass or grass-like species include big bluestem, little bluestem, sideoats grama, slender wheatgrass (Elymmus trachycaulus), porcupine grass, and blue grama. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Community 3.2
Western Wheatgrass-Blue Grama-Buffalograss-Kentucky Bluegrass

This plant community is a result of heavy continuous 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, buffalograss, and Kentucky bluegrass. Grasses of secondary importance include sideoats grama, little bluestem, green needlegrass, needleandthread, porcupine grass, big bluestem, smooth bromegrass, and sedges. Forbs commonly found in this plant community include cudweed sagewort and Cuman ragweed. When compared to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community Phase, blue grama has increased. Green needlegrass and sideoats grama have decreased and production of mid- and tall warm-season grasses was 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. Most of the components of the ecological processes are functioning at optimum levels. However, the vigor and reproductive capability of the tall warm-season grasses are reduced due to grazing pressure or a combination of stressors. A reduction of this dominant functional group allows for an increase in shorter-statured (and shallower rooted) species. The introduction of nonnative invasive species such as Kentucky bluegrass and smooth bromegrass results in alterations to the soil profile. Organic matter levels tend to decrease and begin to be concentrated more in the surface

layers and the structure will begin to be modified. These changes favor the shallow-rooted species and hasten their eventual dominance if steps are not taken to reduce these species.

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-Buffalograss-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 Plant Community Phase.

State 4
Invaded State

This state is a result of encroachment mainly by invasive introduced cool-season grasses. This state is characterized by the dominance of smooth bromegrass, crested wheatgrass, Kentucky bluegrass, 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 The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. 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. The opportunity for high intensity spring burns is severely reduced by early green up and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sod grass dominance. Production is limited to the sod forming species. Infiltration continues to decrease, runoff increases, and energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominant species.

Community 4.1

Smooth Bromegrass-Kentucky Bluegrass

This plant community phase is a result of extended periods of nonuse and no fire or occasionally light levels of grazing over several years. It is characterized by dominance of smooth bromegrass and to a lesser extent 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 and eventually a thatch-mat layer may develop.. 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. The dominance of these introduced species has been shown to alter the biotic component of the soil, organic matter levels, and eventually the soil structure. These alterations perpetuate the dominance of Kentucky bluegrass and smooth bromegrass and tend to make establishment of native species extremely difficult.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1820	2450	3025
Forb	125	210	320
Shrub/Vine	55	140	255
Total	**2000**	**2800**	**3600**

Figure 13. Plant community growth curve (percent production by month). SD5302, Southern Dark Brown Glaciated Plains, cool-season dominant, warm-season subdominant.. 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 4.2
Kentucky Bluegrass-Smooth Bromegrass

This plant community phase is a result of heavy, continuous grazing. It is characterized by a dominance of Kentucky bluegrass. 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 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1280	1539	1750
Forb	85	180	310
Shrub/Vine	35	81	140
Total	**1400**	**1800**	**2200**

Figure 15. Plant community growth curve (percent production by month). SD5301, Southern Dark Brown 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 4.3
Annual Pioneer-Perennial Pioneer

This 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 nonnative 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-Smooth Bromegrass 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 4.2B
Community 4.2 to 4.3

Heavy Continuous Season Long Grazing with stocking levels well above carrying capacity utilizing available forage through the majority of the growing season in the absence of adequate rest periods, grazing at the same period each year will shift this plant community to the 4.3 Annual/Pioneer, Non-Native Perennial Plant Community Phase.

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-Smooth Bromegrass Plant Community Phase.

State 5
Conifer/Invaded State

This state is dominated (canopy exceeds 20 percent of total surface area) by areas where trees have become established or have encroached onto the site due to the absence of periodic fire. This state is dominated by eastern redcedar and/or Rocky Mountain juniper with cool-season grasses being subdominant. The plant community can develop into a closed canopy that impedes the reproductive capability of the major native perennial grass species. A single eastern red cedar tree with a 7 foot crown diameter eliminates the equivalent of 3 pounds of forage. Further, the forage potential of a pasture with 250 mature eastern red cedar trees per acre (or one tree every thirteen feet) is reduce by 50 percent. It is suggested that reducing stocking rates by 10 percent for every 50 trees per acre. The increase in tree canopy which is a result of a disruption of the natural, and human related fire regimes that occurred prior to European settlement, which kept trees

from encroaching much of the grasslands.

Community 5.1
Eastern Red Cedar-Rocky Mountain Juniper/Western Wheatgrass-Blue Grama –

This plant community evolved due to the invasion of conifers, such as eastern redcedar and Rocky Mountain juniper. This phase was a result of the absence of periodic fire. These events may cause a reduction in warm-season grasses and an increase in cool-season grasses and allow for the encroachment of conifers. The potential plant community is made up of approximately 50 percent grasses and grass-like species, 10 percent forbs, 10 percent shrubs, and 30 percent trees. Dominant grasses and grass-likes include western wheatgrass, green needlegrass, blue grama, buffalograss, big bluestem, and sideoats grama. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses increase. Forbs will be diverse. Trees species will include eastern redcedar and Rocky Mountain juniper. When compared to the 1.1 Western Wheatgrass-Green Needlegrass Plant Community, coniferous trees have increased significantly and herbaceous component has decreased. This plant community is susceptible to the encroachment of eastern redcedar and Rocky Mountain juniper.

Community 5.2
Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing or non-use or no surface fire for extended periods of time (typically for 10 or more years). When compared to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Western Wheatgrass-Blue Grama Plant Community, the amount of nonnative invasive cool-season grasses such as Kentucky bluegrass and smooth bromegrass have increased significantly. It is characterized by a dominance of Kentucky bluegrass, smooth bromegrass, and blue grama. The dominance of Kentucky bluegrass 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. Production is limited to the sod forming species. The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Infiltration continues to decrease and runoff increases, energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominate species. Biological activity in the soil is likely reduced significantly in this phase.

Community 5.3
Eastern Red Cedar-Rocky Mountain Juniper

This plant community phase is a result of no surface fire for extended periods of time (typically for 10 or more years). Coniferous trees have increased significantly, and the herbaceous component has decreased. With the dominance of the coniferous trees such

as eastern redcedar and Rocky Mountain juniper, the canopy covers the area and grass species are unable to survive. Grass production for livestock is severely limited. Prescribed burning before the juniper species reach maturity and are still susceptible to fire (< 5 foot in height), or mechanical brush management can be used to maintain or recover 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

Pathway 5.1A
Community 5.1 to 5.2

Non-use 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, or heavy continuous grazing or invasion of non-native plant species will shift this plant community to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase.

Pathway 5.2A
Community 5.2 to 5.3

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 shift this plant community to the 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

State 6
Crop Production State

This state is characterized by the production of annual crops using a variety of tillage and cropping systems along with management practices. Cropping on this site is enabled during years with drier than normal precipitation or with artificial drainage (surface or subsurface).

Community 6.1
Annual Crops

This plant community developed with the use of a variety of tillage systems 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 likely lead this state over a threshold resulting in the

Short Grass Sod State (State 2).

Transition T1B
State 1 to 3

Non-use and 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, or 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 T1C
State 1 to 5

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, and invasion of conifer will likely lead this state over a threshold leading to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Western Wheatgrass-Blue Grama Plant Community Phase within the Conifer/Invaded State (State 5).

Transition T1D
State 1 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Transition T2A
State 2 to 3

Heavy Continuous Seasonal Grazing with stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year, each year, and/or Heavy Continuous Season-Long Grazing with stocking levels well above carrying capacity utilizing available forage through the majority of the growing season in the absence of adequate rest periods will shift this plant community to the 3.1 Blue Grama/Buffalograss Sod Plant Community Phase within the 3.0 Degraded State.

Transition T2B
State 2 to 4

Non-Use and No Fire for extended periods of time (typically for 10 or more years) can lead this state over a threshold to the 4.0 Invaded State. Heavy Continuous Seasonal Grazing at the same time of year, each year, without adequate recovery periods or chronic heavy grazing will also result in crossing this threshold.

Transition T2A

State 2 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway R3
State 3 to 2

Long Term Prescribed Grazing with moderate stocking levels coupled with adequate recovery periods, or grazing systems such as high-density, low-frequency, etc., intended to treat specific species or periodic light to moderate stocking levels including possible rest periods will shift this community to the 2.0 Native/Invaded Grass State.

Transition T3A T3B
State 3 to 4

T3A-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 Plant Community Phase within the Invaded State (State 4). T3B – 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-Smooth Bromegrass Plant 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 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway R4
State 4 to 2

Prescribed Fire occurring at relatively frequent intervals and occasional grazing events immediately following early season fire will cause a reduction in cool-season grasses such as Kentucky bluegrass and smooth brome and an increase in warm-season and later growing cool-season grasses. Warm-season grasses are more tolerant of short fire return intervals. Fire will temporarily increase the vigor and production of warm-season grasses and many native cool-season grasses when fire is timed properly. This results in a shift to the 2.0 Native/Invaded Grass State. This would also require Long-Term Management with Prescribed Grazing (periodic light to moderate grazing with possible periodic rest). This may take up to 10 years or more and recovery may not be attainable. Pest Management

using chemical or mechanical treatment to suppress invasive cool-season grasses may also be required.

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 T4C
State 4 to 5

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, and invasion of conifer will likely lead this state over a threshold leading to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5).

Transition T4B
State 4 to 6

Tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway T5A
State 5 to 1

Brush management, which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years), and a return to normal disturbance regime levels may lead this 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Western Wheatgrass-Blue Grama Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Reference State (State 1).

Restoration pathway T5B
State 5 to 3

Brush management, which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years), and a return to normal disturbance regime levels may lead this 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded

State (State 5) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T5C
State 5 to 4

Brush management which would include the mechanical removal of the conifers may lead this 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Invaded State (State 4).

Transition T5E
State 5 to 6

Brush management which would include the mechanical removal of the conifers, coupled with tillage will cause a shift over a threshold leading to the 6.1 Annual Crops Plant Community Phase within the Crop Production State (State 6).

Restoration pathway T6A
State 6 to 3

Seeding may lead this Crop Production State (State 6) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T6B and T6C
State 6 to 4

T6B: Seeding may lead this Crop Production State (State 6) over a threshold to the Invaded State (State 4) T6C: 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 7. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–280	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–280	–
2	**Needlegrass**			0–140	
	green needlegrass	NAVI4	*Nassella viridula*	0–140	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–84	–

3	**Tall/Mid Warm-Season Grasses**			0–140	
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–140	–
	big bluestem	ANGE	*Andropogon gerardii*	0–84	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–56	–
	switchgrass	PAVI2	*Panicum virgatum*	0–28	–
4	**Short Warm-Season Grasses**			0–140	
	threeawn	ARIST	*Aristida*	0–84	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–84	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–28	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–28	–
5	**Other Native Grasses**			0–112	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–112	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–28	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	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)*	0–28	–
7	**Non-Native Grasses**			980–2240	
	smooth brome	BRIN2	*Bromus inermis*	700–2100	–
	bluegrass	POA	*Poa*	140–700	–
	brome	BROMU	*Bromus*	28–140	–
Forb					
8	**Forbs**			140–280	
	sweetclover	MELIL	*Melilotus*	28–224	–
	goldenrod	SOLID	*Solidago*	28–140	–
	Forb, introduced	2FI	*Forb, introduced*	0–112	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	28–112	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	28–84	–
	scurfpea	PSORA2	*Psoralidium*	0–84	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–84	–
	upright prairie	RACO3	*Ratibida columnifera*	0–56	–

	upright prairie coneflower	RATCO	*Ratibida columnifera*	0–56	
	whorled milkweed	ASVE	*Asclepias verticillata*	0–56	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–56	–
	Forb, native	2FN	*Forb, native*	0–56	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	28–56	–
	textile onion	ALTE	*Allium textile*	0–28	–
	pussytoes	ANTEN	*Antennaria*	0–28	–
	milkvetch	ASTRA	*Astragalus*	0–28	–
	dotted blazing star	LIPU	*Liatris punctata*	0–28	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–28	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–28	–
Shrub/Vine					
9	**Shrubs**			56–224	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	28–224	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–84	–
	rose	ROSA5	*Rosa*	0–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
	leadplant	AMCA6	*Amorpha canescens*	0–28	–
	pricklypear	OPUNT	*Opuntia*	0–28	–

Table 8. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–90	–
2	**Needlegrass**			0–54	
	green needlegrass	NAVI4	*Nassella viridula*	0–54	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–18	–
3	**Short Warm-Season Grasses**			54–270	
	threeawn	ARIST	*Aristida*	18–180	–
	blue grama	BOGR2	*Bouteloua gracilis*	36–180	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–72	–

	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–72	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–54	–
4	**Other Native Grasses**			0–72	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–54	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–18	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–18	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–18	–
5	**Grass-likes**			18–144	
	sedge	CAREX	*Carex*	18–144	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–36	–
6	**Non-Native Grasses**			450–1260	
	bluegrass	POA	*Poa*	360–1080	–
	smooth brome	BRIN2	*Bromus inermis*	0–270	–
	brome	BROMU	*Bromus*	18–180	–
Forb					
7	**Forbs**			90–270	
	sweetclover	MELIL	*Melilotus*	0–180	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–90	–
	goldenrod	SOLID	*Solidago*	0–90	–
	Forb, introduced	2FI	*Forb, introduced*	0–72	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–72	–
	scurfpea	PSORA2	*Psoralidium*	0–54	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	18–54	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–54	–
	Forb, native	2FN	*Forb, native*	0–36	–
	pussytoes	ANTEN	*Antennaria*	0–36	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–18	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–18	–
Shrub/Vine					
8	**Shrubs**			36–126	
	prairie sagewort	ARFR4	*Artemisia frigida*	18–90	–
	pricklypear	OPUNT	*Opuntia*	18–90	–

	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–18	–

Animal community

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 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.

Western Wheatgrass/Green Needlegrass (1.1)
Average Annual Production (lbs./acre, air-dry): 2,600
Stocking Rate* (AUM/acre): 0.71

W. Wheatgrass/B. Grama/Buffalograss/K. Bluegrass (2.2)
Average Annual Production (lbs./acre, air-dry): 2,200
Stocking Rate* (AUM/acre): 0.60

Blue Grama/Buffalograss Plant Community Phase (3.1)
Average Annual Production (lbs./acre, air-dry): 1,500
Stocking Rate* (AUM/acre): 0.41

Threeawn/Forbs Plant Community Phase(3.2)
Average Annual Production (lbs./acre, air-dry): 900
Stocking Rate* (AUM/acre): 0.25

Smooth Brome/Crested Wheatgrass/Kentucky Bluegrass (4.1)
Average Annual Production (lbs./acre, air-dry): 2,800
Stocking Rate* (AUM/acre): 0.77

Kentucky Bluegrass Plant Community Phase (4.2)
Average Annual Production (lbs./acre, air-dry): 1,800
Stocking Rate* (AUM/acre): 0.49

*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 groups C and 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/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 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:

• SD129 Walworth County, SD did not use the (EbB) Eakin-Peno complex, 2 to 6 percent slopes (national symbol cxr2) as used in the adjoining SD107 Potter County, SD.
• SD129 Walworth County, SD did not use the (EaA) Eakin-Raber complex, 0 to 2 percent slopes (national symbol 2wbpy) as used in the adjoining SD107 Potter County, SD.
• SD119 Sully County, SD did not use the (EbC) Eakin-Peno complex, 6 to 9 percent

slopes (national symbol cxr3) as used in the adjoining SD107 Potter County, SD.
• SD119 Sully County, SD did not use the (EaA) Eakin-Raber complex, 0 to 2 percent slopes (national symbol 2wbpy) as used in the adjoining SD107 Potter County, SD.
• SD107 Potter County, SD did not use the (RgB) Eakin-Raber complex, 2 to 6 percent slopes (national symbol 2wbpz) as used in the adjoining SD119 Sully County, SD.
• SD069 Hyde County, SD did not use the (RgB) Eakin-Raber complex, 2 to 6 percent slopes (national symbol 2wbpz) as used in the adjoining SD119 Sully County, SD.
• SD069 Hyde County, SD did not use the (RpB) Raber-Peno loams, 2 to 6 percent slopes (national symbol 2wkpd) as used in the adjoining SD119 Sully County, SD.
• SD065 Hughes County, SD did not use the (OkC) Oko clay loam, 6 to 9 percent slopes (national symbol cw5q) (R63BY011SD ESD) as used in the adjoining SD069 Hyde County. SD069 Hyde County, SD (OkC) Oko clay loam, 6 to 9 percent slopes (national symbol cw5q) (R63BY011SD ESD) will need to be split correlated to match SD064 Hughes County, SD ESD.
• SD065 Hughs County, SD did not use the (PgD) Peno-Gettys clay loams, 9 to 15 percent slopes (national symbol 2wkqf) as used in the adjoining SD069 Hyde County, SD.
• SD017 Buffalo County (SD603 Brule and Buffalo Counties Soil survey), SD did not use the (ReB) Eakin-Raber complex, 2 to 6 percent slopes (national symbol 2wbpz) as used in the adjoining SD059 Hand County, SD.
• SD017 Buffalo County (SD603 Brule and Buffalo Counties Soil survey), SD did not use the (RrC) Raber-Peno loams, 6 to 9 percent slopes (national symbol 2wbp6) as used in the adjoining SD059 Hand County, SD.
• SD059 Hand County, SD did not use the (BgB) Beadle-Jerauld-Dudley complex, 1 to 5 percent slopes (national symbol cycy) (R55CY011SD ESD) as used in the adjoining SD073 Jerauld County. SD073 Jerauld County, SD (BgB) Beadle-Jerauld-Dudley complex, 1 to 5 percent slopes (national symbol cycy) (R55CY011SD ESD) will need to be split correlated to match SD059 Hand County, SD ESD.
• SD073 Jerauld County, SD did not use the (ReB) Eakin-Raber complex, 2 to 6 percent slopes (national symbol 2wbpz) as used in the adjoining SD059 Hand County, SD
• SD059 Hand County, SD did not use the (St) Stickney-Jerauld silt loams, (national symbol cwzr) (R55CY011SD ESD) as used in the adjoining SD005 Beadle County. SD005 Beadle County, SD (St) Stickney-Jerauld silt loams, (national symbol cwzr) (R55CY011SD ESD) will need to be split correlated to match SD059 Hand County, SD ESD.
• SD059 Hand County, SD did not use the (BaB) Beadle loam, 2 to 6 percent slopes (national symbol 2wkqw) (R55CY011SD ESD) as used in the adjoining SD005 Beadle County. SD005 Beadle County, SD (BaB) Beadle loam, 2 to 6 percent slopes (national symbol 2wkqw) (R55CY011SD ESD) will need to be split correlated to match SD059 Hand County, SD ESD.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; and Bruce Kunze, Soil Scientist,, NRCS; Shane Deranleau, RMS, NRCS; and Mitch

Faulkner, RMS, NRCS.

Data Source Sample Period State County
SCS-Range-417 (0177046129) 8/25/1970 SD Walworth
SCS-Range-417 (0777146065) 9/14/1971 SD Hughes
SCS-Range-417 (0757146119) 9/15/1971 SD Sully
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Approval

Suzanne Mayne-Kinney, 1/22/2024

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. Quality Assurance was approved by David Kraft, NRCS Regional Ecologist as of 11/12/2020.

addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632- 9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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, Mitch Faulkner, Shane Deranleau
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Date	03/15/2011
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.

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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 6 rating. Typically high root content and organic matter in the soil surface. Soil surface is very resistant to erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is typically granular, or subangular blocky parting to granular, and mollic (higher organic matter) colors of A-horizon down to about 4 to 8 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. Somewhat restrictive layers of clayey texture can occur at depths of less than 14 inches.

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) > needlegrasses (mid and tall, cool-season bunchgrasses) >

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

Other: Forbs > grass-like species = shrubs

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

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

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14. **Average percent litter cover (%) and depth (in):** 70-80 percent plant litter cover, roughly 0.25 to 0.5 inches 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):** 2,600 pounds/acre (air-dry basis)

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Refer to State and local Noxious Weed List; also Kentucky bluegrass and smooth bromegrass.

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