

## Ecological site R102AY008SD Sands

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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.

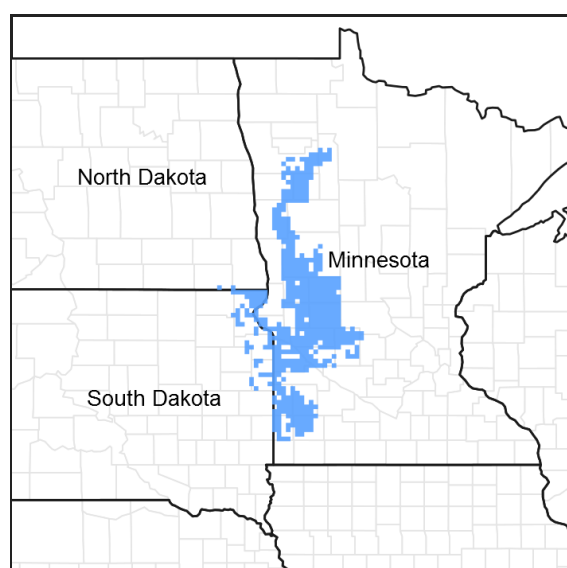


Figure 1. Mapped extent

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): 102A–Rolling Till Prairie

The Rolling Till Prairie (102A) is located within the Central Feed Grains and Livestock Land Resource Region. It spans 3 states (Minnesota 58 percent, South Dakota 42 percent, and small part in North Dakota), encompassing over 16,000 square miles (Figure 1). The elevation ranges from approximately over 2,000 feet above sea level (ASL) on the Prairie Coteau in Northeastern South Dakota to about 1,000 feet ASL on lowlands. The dominate landform in this area are stagnation moraines, end moraines, glacial outwash plains, terraces, and flood plains. The area is dominated by till covered moraines. The stagnation moraines are gently undulating to steep and have many depressions and poorly defined drainages. Small outwash areas are adjacent to the watercourses. The Cretaceous Pierre Shale underlies the till in the most of the area. Precambrian rocks also occur at depth. Granite is quarried near Milbank, South Dakota and outcrops of Sioux Quartzite are common. (USDA-NRCS 2006).

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a frigid soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, well drained to very poorly drained. This area supports true prairie vegetation characterized by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), porcupinegrass (*Hesperostipa spartea*), and green needlegrass (*Nassella viridula*). Prairie cordgrass (*Spartina pectinata*) commonly grows in wet areas. (USDA-NRCS 2006).

## Classification relationships

Major Land Resource Area (MLRA): Rolling Till Prairie (102A) (USDA-NRCS 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Upper Minnesota River-Des Moines Lobe Subsection (251Ba); Outer Coteau des Prairies Subsection (251Bb); Northwest Iowa Plains Subsection (251Bd); Minnesota and Northeast Iowa Morainal-Oak Savannah Section (222M); Alexandria Moraine-Hardwood Hills Subsection (222Ma) (Cleland et al. 2007).

US EPA Level IV Ecoregion: Tewaukon/Big Stone Stagnation Moraine (46e), Prairie Coteau (46k), Prairie Coteau Escarpment (46l), Big Sioux Basin (46m), Minnesota River Prairie (46o), Des Moines Lobe (47b) , Lake Agassiz Plains (48d), Alexandria Moraines and Detroit Lakes Outwash Plain (51j) (USEPA 2013)

## Ecological site concept

The Sands ecological site typically occurs in an upland area. Soils vary from moderately well drained to excessively drained. The surface and subsoil textures are sand, loamy sand, loamy fine sand. Slopes can range from 0 to 40 percent. Vegetation in the Reference State is dominated by warm season grasses such as sand bluestem and prairie sandreed, and cool-season needlegrasses. Forbs include sageworts, ragweed, and scurfspea. Non-native grasses such as Kentucky bluegrass, smooth brome, and/or annual bromes may invade due to shifts in disturbance regime.

## Associated sites

R102AY009SD	<b>Sandy</b> These sites occur on upland areas. Soils vary from moderately well drained to somewhat excessively well drained. The surface and subsoil textures are sandy loam, fine sandy loam, and loamy very fine sand. The central concept soil series is Egeland, Embden, and Swenoda, but other series are included.
R102AY010SD	<b>Loamy</b> These sites occur on upland areas. Soils are well drained. The surface and subsoil textures are loam, silt loam, silty clay loam, clay loam, sandy clay loam, and very fine sandy loam. The central concept soil series is Barnes, Forman, and Poinsett, but other series are included.
R102AY012SD	<b>Thin Upland</b> These sites occur on uplands. Soils are well drained and will effervesce with acid at or near the surface. The central concept soil series is Buse, Langhei, and Zell, but other series are included.

## Similar sites

R102AY009SD	<b>Sandy</b> The Sandy site is in a similar landscape position, but the surface and subsoil textures are sandy loam, fine sandy loam, and loamy very fine sand. A Sandy site will have more needlegrass, less prairie sandreed and higher production than a Sands site.
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Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Andropogon hallii</i> (2) <i>Calamovilfa longifolia</i>

## Physiographic features

This site occurs on gently to moderately steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Upland
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Elevation	305–610 m
Slope	0–40%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

## Climatic features

MLRA 102A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate 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 21 to 27 inches per year. The average annual temperature is about 43°F. January is the coldest month with average temperatures ranging from about 5°F (Mahnomen 1 W, Minnesota (MN)), to about 14°F (Tracy, MN). July is the warmest month with temperatures averaging from about 69°F (Mahnomen 1 W, MN), to about 73°F (Tracy, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 62°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. 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)	114-127 days
Freeze-free period (characteristic range)	137-152 days
Precipitation total (characteristic range)	635-660 mm
Frost-free period (actual range)	103-130 days
Freeze-free period (actual range)	133-156 days
Precipitation total (actual range)	635-686 mm
Frost-free period (average)	120 days
Freeze-free period (average)	144 days
Precipitation total (average)	660 mm

## Climate stations used

- (1) MORRIS WC EXP STN [USC00215638], Hancock, MN
- (2) SISSETON [USC00397742], Sisseton, SD
- (3) FOSSTON 1 E [USC00212916], Fosston, MN
- (4) MAHNOMEN [USC00215012], Mahnomen, MN
- (5) FERGUS FALLS [USC00212768], Fergus Falls, MN
- (6) MILAN 1 NW [USC00215400], Milan, MN
- (7) BENSON [USC00210667], Benson, MN
- (8) GLENWOOD 2 WNW [USC00213174], Glenwood, MN
- (9) ARTICHOKE LAKE [USC00210287], Correll, MN
- (10) BROWNS VALLEY [USC00211063], Beardsley, MN

## Influencing water features

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

## Soil features

The Sands ecological site typically occurs in an upland area. Soils vary from moderately well drained to excessively drained. The surface and subsoil textures are sand, loamy sand, loamy fine sand. The central concept soil series is Hecla and Serden, but other series are included.

**Table 4. Representative soil features**

Surface texture	(1) Sand (2) Loamy sand (3) Loamy fine sand
Family particle size	(1) Sandy
Drainage class	Moderately well drained to excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	203 cm
Available water capacity (0-101.6cm)	10.16–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

## Ecological dynamics

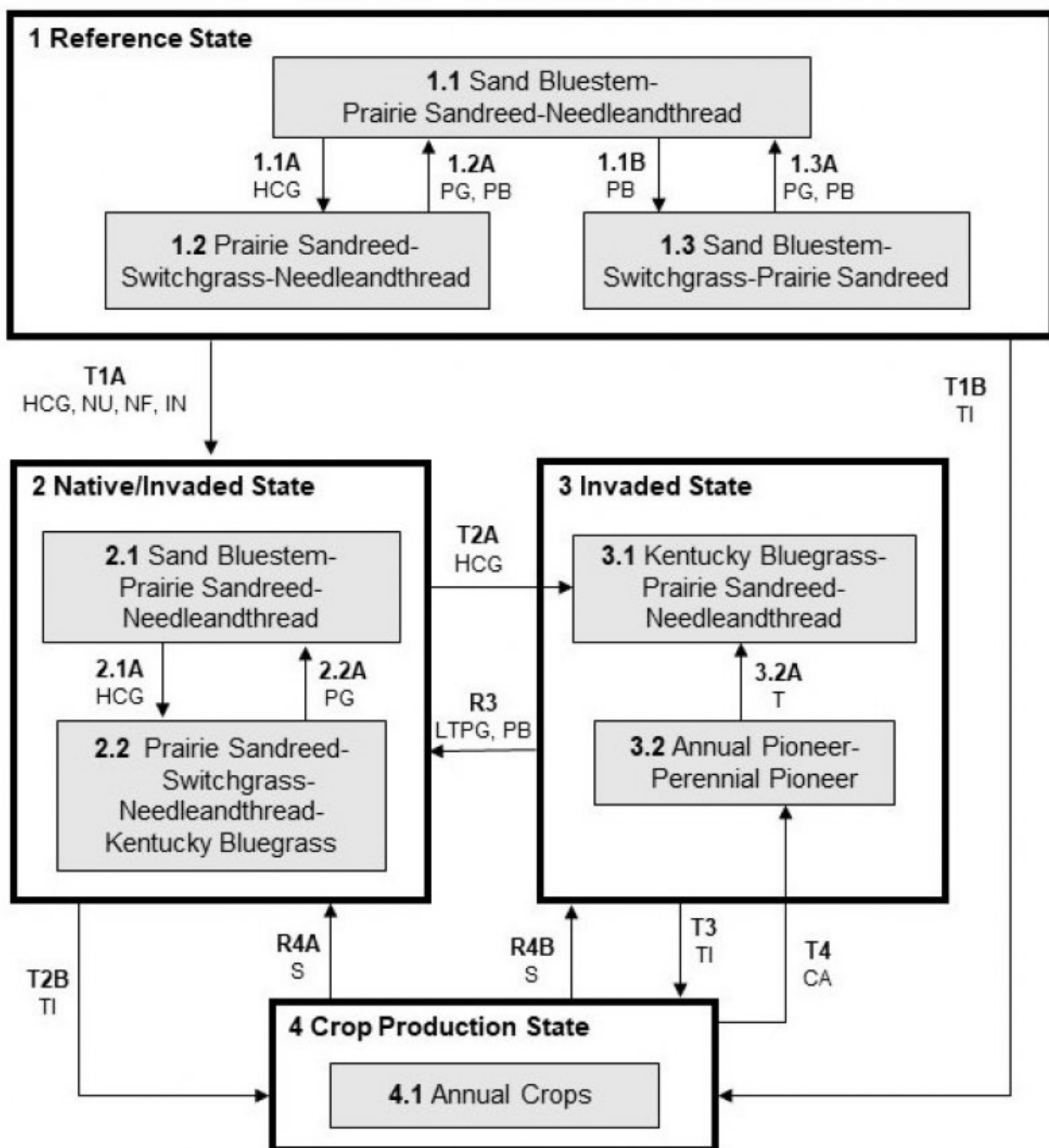
The site which is located in the Prairie Pothole Region developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse 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 are primarily based on the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase. It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

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 without adequate recovery periods following each grazing occurrence causes this site to depart from the Reference State due to the compaction and overgrazing. Sedge (Cyperaceae) and blue grama (*Bouteloua gracilis*) will increase and eventually develop into a sod. Western wheatgrass (*Pascopyrum smithii*) will increase initially and then begin to decrease. Needleandthread, porcupine grass (*Hesperositta spartea*), sideoats grama (*Bouteloua curtipendula*), sand bluestem, 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 partensis*), smooth brome grass (*Bromus inermis*), 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/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.

## State and transition model

### Sands – MLRA 102A



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

Code	Process
T1A	Heavy continuous grazing, no use, no fire, invasion
T1B	Tillage
T2A	Heavy continuous grazing
T2B	Tillage
T3	Tillage
T4	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
2.1A	Heavy continuous grazing
2.2A	Prescribed grazing with recovery periods
3.2A	Time w/wo disturbances
R3	Long term prescribed grazing, prescribed burning
R4A	Seeding
R4B	Seeding

## 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 warm-season grasses with cool-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included periods of below and/or above average precipitation, sporadic fire, and herbivory by insects and large 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. The less grazing tolerant tall warm-season grasses and cool-season grasses would have declined. Prairie sandreed would have increased with ongoing disturbance. With severe, prolonged disturbance plant vigor can rapidly decline and this state can move towards an active blowout. Today, a similar state 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

### Sand Bluestem-Prairie Sandreed-Needleandthread

Interpretations are based primarily on the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthead Plant Community Phase (this is also considered to be climax). The potential vegetation was about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses included sand and/or big bluestem, prairie sandreed, needleandthread, switchgrass (*Panicum virgatum*), little bluestem, and porcupine grass. Other grass or grass-like species included sideoats grama, western wheatgrass, blue grama, hairy grama (*Bouteloua hirsuta*), threadleaf sedge (*Carex filifolia*), Indiangrass (*Sorghastrum nutans*), and sand dropseed (*Sporobolus cryptandrus*). 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/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	2354	3311	3990
Forb	163	278	432
Shrub/Vine	62	110	174
<b>Total</b>	<b>2579</b>	<b>3699</b>	<b>4596</b>

Figure 9. Plant community growth curve (percent production by month).  
SD0204, Rolling Till Prairie, warm-season dominant, cool-season  
subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

## Community 1.2

### Prairie Sandreed-Switchgrass-Needleandthread

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 prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary importance included little bluestem, purple lovegrass (*Eragrostis spectabilis*), hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community included cudweed sagewort, green sagewort, western ragweed, and scurfpea. This plant community had similar plant composition to the 2.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase. The main difference is that this plant community phase did not have the presence of nonnative invasive species such as Kentucky bluegrass. When compared to the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase, prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increased. Bluestems and porcupine grass decreased and production was 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 10. Plant community growth curve (percent production by month).  
SD0204, Rolling Till Prairie, warm-season dominant, cool-season  
subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

## Community 1.3

### Sand Bluestem-Switchgrass-Prairie Sandreed

This plant community was a result of fire occurring at relatively frequent intervals (3 to 5 years). 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 sand and/or big bluestem, switchgrass, prairie sandreed, Indiangrass, little bluestem, and sideoats grama. Other grass or grass-like species included blue grama, hairy grama, sand dropseed, needleandthread, porcupine grass, and threadleaf sedge. This plant community was not resistant to change and would have readily shifted back to the 1.1 Sand Bluestem-Prairie Sandreed-Needlegrass Plant Community Phase with a return of more normal fire return intervals.

Figure 11. Plant community growth curve (percent production by month). SD0205, Rolling Till Prairie, 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

**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 Prairie Sandreed-Switchgrass-Needleandthread Plant Community Phase.

**Pathway 1.1B**  
**Community 1.1 to 1.3**

Prescribed burning occurring at relatively frequent intervals (3 to 5 years), 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 Sand Bluestem-Switchgrass-Prairie Sandreed Plant Community Phase.

**Pathway 1.2A**  
**Community 1.2 to 1.1**

Prescribed grazing, and/or prescribed burning returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase.

**Pathway 1.3A**  
**Community 1.3 to 1.1**

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest and/or prescribed burning with late season fire or at infrequent intervals (greater than 5 years) will convert this plant community to the 1.1 Sand Bluestem-Prairie Sandreed-Needlegrass Plant Community Phase.

**State 2**  
**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. This state is dominated by warm-season grasses with cool-season grasses being subdominant. It can be found on areas that are properly managed with grazing and/or prescribed burning and sometimes on areas receiving occasional short periods of rest. Grazing tolerant will increase with disturbance.

**Community 2.1**  
**Sand Bluestem-Prairie Sandreed-Needleandthread**

This plant community phase is similar to the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase but it also contains minor amounts of nonnative invasive grass species such as Kentucky bluegrass and smooth brome grass (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 warm-season grasses, with cool-season grasses subdominant. The major grasses include sand and/or big bluestem, prairie sandreed, switchgrass, little bluestem, needleandthread, and porcupine grass. Other grass or grass-like species include sideoats grama, western wheatgrass, blue grama, hairy grama, threadleaf sedge,



Indiangrass, and sand dropseed. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

Figure 12. Plant community growth curve (percent production by month). SD0205, Rolling Till Prairie, 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

## Community 2.2

### Prairie Sandreed-Switchgrass-Needleandthread-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 85 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grasses include prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary importance include little bluestem, purple lovegrass, hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community include cudweed sagewort (*Artemisia ludoviciana*), green sagewort (*Artemisia dracunculus*), western ragweed (*Ambrosia psilostachya*), and scurfpea (*Psoralidium*). When compared to the 1.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase, prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increase. Bluestems and porcupine grass decrease and production is 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.

### 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 Prairie Sandreed-Switchgrass-Needleandthread-Kentucky Bluegrass Plant Community Phase.

### Pathway 2.2A

#### Community 2.2 to 2.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 2.1 Sand Bluestem-Prairie Sandreed-Needleandthread Plant Community Phase.

## State 3

### Invaded State

This state is a result of encroachment mainly by invasive introduced cool-season grasses. 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 greenup and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sodgrass dominance. Production is limited to the sod forming species. 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.

### Community 3.1

## Kentucky Bluegrass-Prairie Sandreed-Needleandthread

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, prairie sandreed, needleandthread, sedge, 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 a thatch-mat layer often develops at the surface. 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.

Figure 13. Plant community growth curve (percent production by month).  
SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

### Community 3.2 Annual Pioneer-Perennial Pioneer

This plant community developed under continuous heavy grazing or other excessive disturbances (e.g., heavy use areas, defoliation by rodents, etc.). 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/or 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 invasive or early seral species.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1760	2507	3222
Forb	123	211	319
Shrub/Vine	22	84	157
Total	1905	2802	3698

Figure 15. Plant community growth curve (percent production by month).  
SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

### Pathway 3.2A Community 3.2 to 3.1

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 3.1 Kentucky Bluegrass-Prairie Sandreed-Needleandthread Plant Community Phase.

## Conservation practices

Prescribed Grazing

## State 4

### 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.

## Community 4.1

### 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, sugar beet and a variety of other crops.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1463	2141	2572
Forb	106	177	269
Shrub/Vine	—	36	73
<b>Total</b>	<b>1569</b>	<b>2354</b>	<b>2914</b>

Figure 17. Plant community growth curve (percent production by month).  
SD0202, Rolling Till Prairie, 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

## Transition T1A

### State 1 to 2

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, and/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 2).

## Transition T1B

### State 1 to 4

Tillage will cause a shift over a threshold leading to the 4.1 Annual Crops Plant Community Phase within the Crop Production State (State 4).

## Transition T2A

### State 2 to 3

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 3.1 Kentucky Bluegrass-Prairie Sandreed-Needleandthread Community Phase within the Invaded State (State 3). Grazing repeatedly in the early growing season can expedite this shift by causing mechanical disturbance due to trampling.

## Transition T2B

### State 2 to 4

Tillage will cause a shift over a threshold leading to the 4.1 Annual Crops Plant Community Phase within the Crop Production State (State 4).

### Transition R3 State 3 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning may lead the Invaded State (State 3) over a threshold to the Native/Invaded State (State 2).

### Transition T3 State 3 to 4

Tillage will cause a shift over a threshold leading to the 4.1 Annual Crops Plant Community Phase within the Crop Production State (State 4).

### Restoration pathway R4A State 4 to 2

Seeding may lead this Crop Production State (State 4) over a threshold to the Native/Invaded State (State 2).

### Restoration pathway R4B State 4 to 3

Seeding may lead this Crop Production State (State 4) over a threshold to the Invaded State (State 3). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 3) and more specifically to the 3.2 Annual-Pioneer, Non-native Perennial Plant Community Phase.

### Conservation practices

Prescribed Grazing
--------------------

## Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Tall Warm-season Grasses</b>			925–2034	
	sand bluestem	ANHA	<i>Andropogon hallii</i>	555–1480	–
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	370–1110	–
	switchgrass	PAVI2	<i>Panicum virgatum</i>	185–740	–
	big bluestem	ANGE	<i>Andropogon gerardii</i>	0–555	–
	Indiangrass	SONU2	<i>Sorghastrum nutans</i>	0–185	–
2	<b>Mid Warm-season Grasses</b>			370–740	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	370–740	–
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	0–111	–
3	<b>Needlegrass</b>			370–555	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	185–555	–
	porcupinegrass	HESP11	<i>Hesperostipa spartea</i>	185–555	–
4	<b>Short Warm-season Grasses</b>			111–370	

	blue grama	BOGR2	<i>Bouteloua gracilis</i>	37–185	–
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	37–185	–
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	37–185	–
	thin paspalum	PASE5	<i>Paspalum setaceum</i>	0–111	–
5	<b>Other Native Grasses</b>			74–185	
	Graminoid (grass or grass-like)	2GRAM	<i>Graminoid (grass or grass-like)</i>	0–185	–
	Scribner's rosette grass	DIOLS	<i>Dichanthelium oligosanthes</i> var. <i>scribnerianum</i>	37–111	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	37–111	–
	fall rosette grass	DIWI5	<i>Dichanthelium wilcoxianum</i>	0–74	–
6	<b>Grass-likes</b>			37–185	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	37–185	–
	Grass-like (not a true grass)	2GL	<i>Grass-like (not a true grass)</i>	0–111	–
<b>Forb</b>					
7	<b>Forbs</b>			185–370	
	Forb, native	2FN	<i>Forb, native</i>	31–94	–
	field sagewort	ARCA12	<i>Artemisia campestris</i>	37–74	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	37–74	–
	false boneset	BREU	<i>Brickellia eupatorioides</i>	37–74	–
	purple prairie clover	DAPU5	<i>Dalea purpurea</i>	37–74	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–74	–
	stiff sunflower	HEPA19	<i>Helianthus pauciflorus</i>	37–74	–
	blazing star	LIATR	<i>Liatris</i>	37–74	–
	hoary puccoon	LICA12	<i>Lithospermum canescens</i>	37–74	–
	Carolina puccoon	LICA13	<i>Lithospermum carolinense</i>	0–74	–
	beardtongue	PENST	<i>Penstemon</i>	37–74	–
	scurfpea	PSORA2	<i>Psoralegium</i>	37–74	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	37–74	–
	goldenrod	SOLID	<i>Solidago</i>	37–74	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	37–74	–
	longbract spiderwort	TRBR	<i>Tradescantia bracteata</i>	37–74	–
	hoary verbena	VEST	<i>Verbena stricta</i>	0–37	–
	lacy tansyaster	MAPI	<i>Machaeranthera pinnatifida</i>	0–37	–
	prairie groundsel	PAPL12	<i>Packera plattensis</i>	0–37	–
	Carolina larkspur	DECAV2	<i>Delphinium carolinianum</i> ssp. <i>virescens</i>	0–37	–
	smooth horsetail	EQLA	<i>Equisetum laevigatum</i>	0–37	–
	yellow sundrops	CASE12	<i>Calylophus serrulatus</i>	0–37	–
	Flodman's thistle	CIFL	<i>Cirsium flodmanii</i>	0–37	–
	groundplum milkvetch	ASCR2	<i>Astragalus crassicaupus</i>	0–37	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–37	–
<b>Shrub/Vine</b>					
8	<b>Shrubs</b>			63–157	
	leadplant	AMCAF	<i>Amaranthus canescens</i>	21–64	

	reapplant	AMCAR0	<i>Amorpha canescens</i>	31–94	–
	rose	ROSA5	<i>Rosa</i>	31–63	–
	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	0–63	–
	snowberry	SYMPH	<i>Symphoricarpos</i>	0–31	–
	western sandcherry	PRPUB	<i>Prunus pumila var. besseyi</i>	0–31	–

**Table 9. Community 3.2 plant community composition**

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Tall Warm-season Grasses</b>			560–1261	
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	420–1121	–
	switchgrass	PAVI2	<i>Panicum virgatum</i>	140–560	–
	big bluestem	ANGE	<i>Andropogon gerardii</i>	0–84	–
	sand bluestem	ANHA	<i>Andropogon hallii</i>	0–84	–
2	<b>Mid Warm-season Grasses</b>			0–140	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	0–140	–
3	<b>Needlegrass</b>			280–560	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	280–560	–
	porcupinegrass	HESP11	<i>Hesperostipa spartea</i>	0–84	–
4	<b>Short Warm-season Grasses</b>			140–420	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–280	–
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	56–280	–
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	0–224	–
5	<b>Other Native Grasses</b>			28–224	
	Graminoid (grass or grass-like)	2GRAM	<i>Graminoid (grass or grass-like)</i>	0–140	–
	Scribner's rosette grass	DIOLS	<i>Dichanthelium oligosanthos var. scribnerianum</i>	0–56	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	28–56	–
	fall rosette grass	DIWI5	<i>Dichanthelium wilcoxianum</i>	0–28	–
6	<b>Grass-likes</b>			56–280	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	56–280	–
	Grass-like (not a true grass)	2GL	<i>Grass-like (not a true grass)</i>	0–84	–
7	<b>Non-Native Grasses</b>			84–336	
	Kentucky bluegrass	POPR	<i>Poa pratensis</i>	56–336	–
	brome	BROMU	<i>Bromus</i>	28–224	–
<b>Forb</b>					
8	<b>Forbs</b>			140–280	
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	28–112	–
	field sagewort	ARCA12	<i>Artemisia campestris</i>	28–84	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	28–84	–
	smooth horsetail	EQLA	<i>Equisetum laevigatum</i>	0–84	–
	goldenrod	SOLID	<i>Solidago</i>	28–84	–
	Forb, introduced	2FI	<i>Forb, introduced</i>	0–84	–

	Forb, native	2FN	<i>Forb, native</i>	0–56	–
	scurfpea	PSORA2	<i>Psoraleidium</i>	28–56	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	28–56	–
	hoary verbena	VEST	<i>Verbena stricta</i>	0–56	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–56	–
	blazing star	LIATR	<i>Liatis</i>	0–28	–
	prairie groundsel	PAPL12	<i>Packera plattensis</i>	0–28	–
	beardtongue	PENST	<i>Penstemon</i>	0–28	–
	Flodman's thistle	CIFL	<i>Cirsium flodmanii</i>	0–28	–
	purple prairie clover	DAPU5	<i>Dalea purpurea</i>	0–28	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	0–28	–
<b>Shrub/Vine</b>					
9	<b>Shrubs</b>			28–140	
	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	0–56	–
	snowberry	SYMPH	<i>Symphoricarpos</i>	0–56	–
	leadplant	AMCA6	<i>Amorpha canescens</i>	0–28	–
	rose	ROSA5	<i>Rosa</i>	0–28	–

**Table 10. Community 4.1 plant community composition**

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Tall Warm-season Grasses</b>			118–471	
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	47–471	–
	switchgrass	PAVI2	<i>Panicum virgatum</i>	0–235	–
2	<b>Needlegrass</b>			0–353	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	0–353	–
3	<b>Short Warm-season Grasses</b>			47–235	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	24–188	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–118	–
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	0–47	–
4	<b>Other Native Grasses</b>			0–118	
	Graminoid (grass or grass-like)	2GRAM	<i>Graminoid (grass or grass-like)</i>	0–94	–
	fall rosette grass	DIWI5	<i>Dichanthelium wilcoxianum</i>	0–47	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–24	–
	Scribner's rosette grass	DIOLS	<i>Dichanthelium oligosanthos var. scribnerianum</i>	0–24	–
5	<b>Grass-likes</b>			24–165	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	24–165	–
	Grass-like (not a true grass)	2GL	<i>Grass-like (not a true grass)</i>	0–47	–
6	<b>Non-Native Grasses</b>			588–1295	
	Kentucky bluegrass	POPR	<i>Poa pratensis</i>	471–1177	–
	brome	BROMU	<i>Bromus</i>	24–235	–
<b>Forb</b>					
7	<b>Forbs</b>			118–235	
	Forb, introduced	2FI	<i>Forb, introduced</i>	24–118	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	24–118	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	24–118	–
	field sagewort	ARCA12	<i>Artemisia campestris</i>	24–94	–
	Forb, native	2FN	<i>Forb, native</i>	0–71	–
	smooth horsetail	EQLA	<i>Equisetum laevigatum</i>	0–71	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–71	–
	scurfpea	PSORA2	<i>Psoralegium</i>	24–71	–
	goldenrod	SOLID	<i>Solidago</i>	0–71	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	0–47	–
	hoary verbena	VEST	<i>Verbena stricta</i>	0–47	–
<b>Shrub/Vine</b>					
8	<b>Shrubs</b>			0–71	
	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	0–24	–

## 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.

Bluestem/Prairie Sandreed/Needlegrass (1.1 & 3.1)  
Average Annual Production (lbs./acre, air-dry): 3300  
Stocking Rate\* (AUM/acre): 0.90

Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass (3.2)  
Average Annual Production (lbs./acre, air-dry): 2500  
Stocking Rate\* (AUM/acre): 0.69

Kentucky Bluegrass/Prairie Sandreed/Needleandthread (4.1)  
Average Annual Production (lbs./acre, air-dry): 2100  
Stocking Rate\* (AUM/acre): 0.58

Annual/Pioneer, Non-Native Perennial (4.2)  
Average Annual Production (lbs./acre, air-dry): 900  
Stocking Rate\* (AUM/acre): 0.25

\*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 A. Infiltration is typically moderate to rapid and runoff potential for this site varies from negligible to low 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 and/or bluegrass 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 esthetic 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.

## **Inventory data references**

There is no NRCS clipping data and other inventory currently available for this site. 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.

## **Other references**

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## **Contributors**

Lance Howe  
Megan Baxter  
Stan Boltz  
Steve Winter

## **Approval**

Suzanne Mayne-Kinney, 6/27/2024

## **Acknowledgments**

Contact for Lead Authors: Natural Resources Conservation Service (USDA-NRCS), Redfield Soil Survey Office Redfield, SD; Lance Howe ([Lance.Howe@usda.gov](mailto:Lance.Howe@usda.gov)), Soil Survey Office Leader, USDA-NRCS, Redfield, SD; and Steve Winter ([Steven.Winter@usda.gov](mailto:Steven.Winter@usda.gov)), Soil Scientist, USDA-NRCS, Redfield, SD

Additional Information Acknowledgment: Jason Hermann ([Jason.Hermann@usda.gov](mailto:Jason.Hermann@usda.gov)), Area Rangeland

## 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	
Date	12/04/2007
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.

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3. **Number and height of erosional pedestals or terracettes:** Slight pedestalling on bunch grasses.

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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 10% and less than 2 inches in diameter.

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

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

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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.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class usually 4-6. Typical high root content protects soil surface from erosion.

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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.
- 
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: Tall warm-season rhizomatous grass >> mid warm-season bunch grass
- Sub-dominant: > mid/tall cool-season bunch grass > short warm-season grass = forb = shrub
- Other:
- Additional:
- 
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little to no evidence of decadence or mortality.
- 
14. **Average percent litter cover (%) and depth ( in):** 60-70%, roughly 0.5 inch thick or less. Litter cover is in contact with soil surface.
- 
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2800 – 3700 lbs./acre air-dry weight, average 3,300 lbs./acre air-dry weight
- 
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
- 
17. **Perennial plant reproductive capability:** All species are capable of reproducing.
-