USDA Natural Resources
Conservation Service

Ecological site R102AY021SD
Clayey Overflow

Last updated: 6/27/2024
Accessed: 05/11/2025

General information

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

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 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 Clayey Overflow ecological site typically occurs in upland swales which receive additional run off moisture from adjoining slopes. Soils are moderately well drained which have water flow into and over/through the site and have greater than 40 percent clay in the surface and subsoil. Slopes typically range from 0 to 2 percent.

Associated sites

R102AY011SD	**Clayey** These sites occur on upland areas. The soils are well drained and have greater than 40 percent clay in the surface and subsoil. The central concept soil series is Mehurin and Peever, but other series are included.
R102AY012SD	**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 is Buse, Hattie, and Langhei, but other series are included.

Similar sites

R102AY011SD	**Clayey** The Clayey site occurs in a backslope landscape position. Soils are well drained and do not have water flow into and over/through the site.
R102AY020SD	**Loamy Overflow** The Loamy Overflow 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) *Andropogon gerardii* (2) *Nassella viridula*

Physiographic features

The Clayey Overflow ecological site typically occurs in upland swales which receive additional run off moisture from adjoining slopes.

Table 2. Representative physiographic features

Landforms	(1) Upland > Swale
Elevation	1,000–2,000 ft
Slope	0–2%
Water table depth	12–60 in

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)	124-126 days
Freeze-free period (characteristic range)	141-148 days
Precipitation total (characteristic range)	24-25 in
Frost-free period (actual range)	124-127 days
Freeze-free period (actual range)	141-151 days
Precipitation total (actual range)	24-25 in
Frost-free period (average)	125 days
Freeze-free period (average)	145 days
Precipitation total (average)	24 in

Climate stations used

- (1) BROWNS VALLEY [USC00211063], Beardsley, MN
- (2) MILBANK 4 NW [USC00395536], Milbank, SD
- (3) SISSETON [USC00397742], Sisseton, SD

Influencing water features

Soil features

The Clayey Overflow ecological site occurs in upland swales. Soils are moderately well drained which have water flow into and over/through the site and have greater than 40 percent clay in the surface and subsoil. The central concept soil series is Gwinner, but other series are included.

Table 4. Representative soil features

Surface texture	(1) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Poorly drained

Permeability class	Very slow
Soil depth	80 in
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	7 in
Calcium carbonate equivalent (0-40in)	0–10%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–2%
Subsurface fragment volume >3" (Depth not specified)	0%

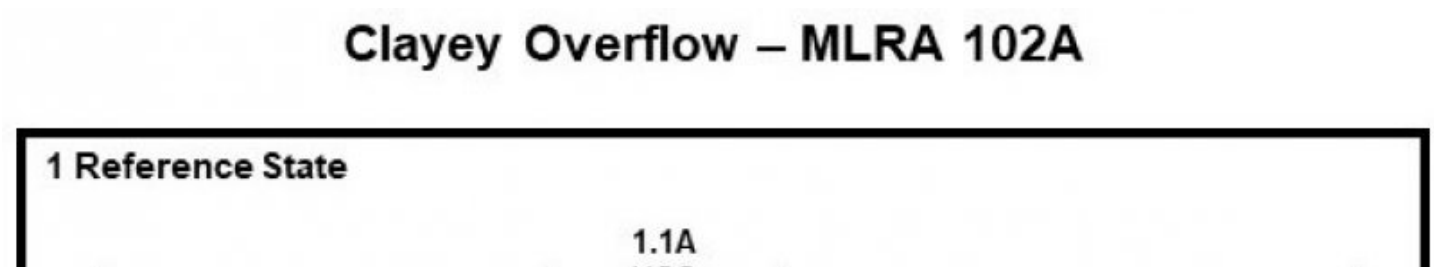
Ecological dynamics

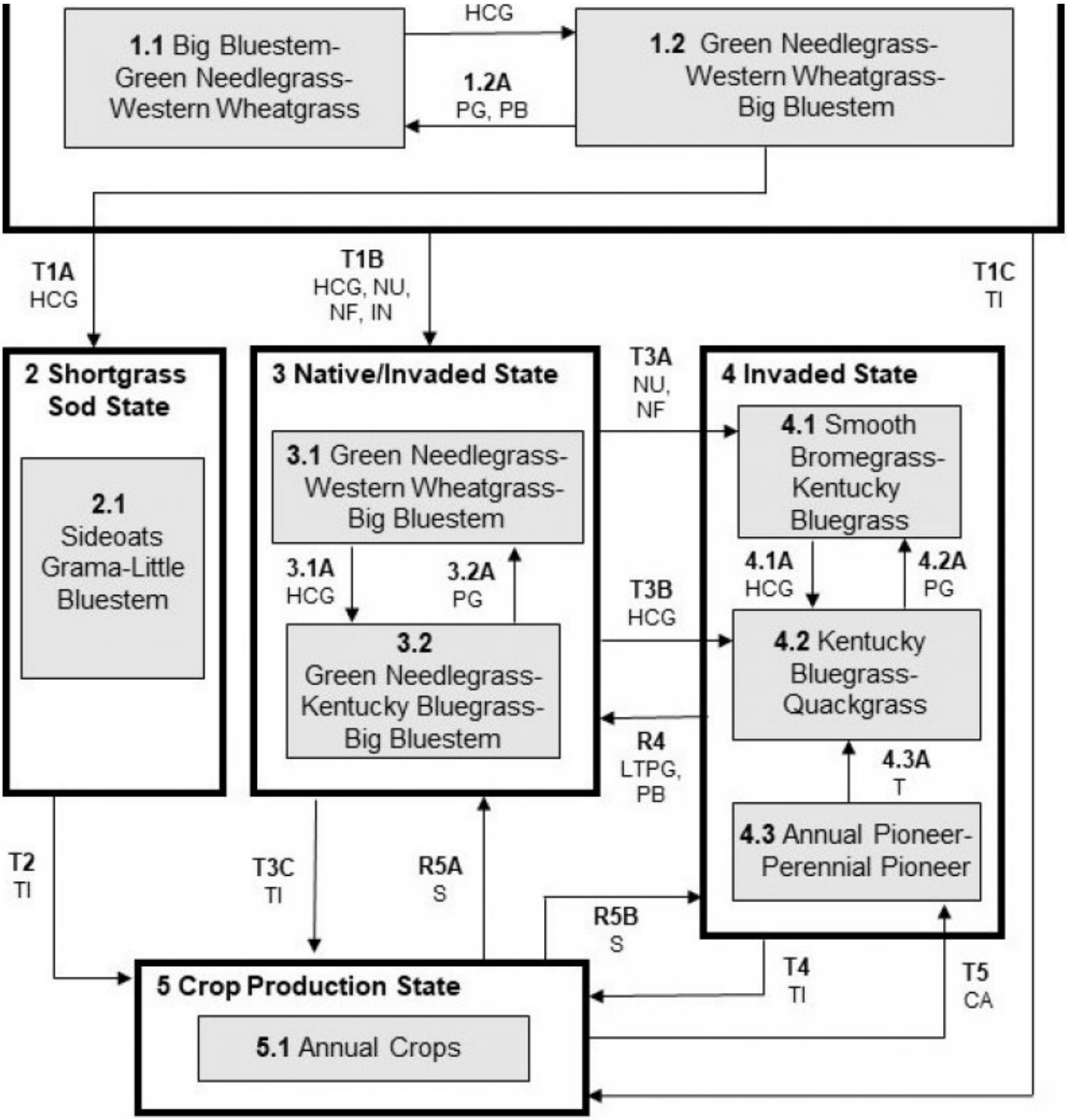
The site which is located in the Prairie Pothole Region developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse 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 for this site are based primarily on the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass 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.

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 dymanics of this site. Heavy continuous grazing causes Kentucky bluegrass (Poa pratentsis) to invade and eventually develop into a sod condition. Extended periods of nonuse and no fire will result in a plant community having high litter levels, which favors an increase in Kentucky bluegrass and smooth bromegrass (*Bromus inermis*). In time, shrubs such as western snowberry (*Symphoricarpos occidentalis*) will also increase.

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





LEGEND

Clayey Overflow – R102AY021SD

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
T1B	Heavy continuous grazing, no use, no fire, invasion
T1C	Tillage
T2	Tillage
T3A	No use, no fire
T3B	Heavy continuous grazing
T3C	Tillage
T4	Tillage
T5	Abandonment of cropping
1.1A	Heavy continuous grazing
1.2A	Prescribed grazing with recovery periods, prescribed burning
3.1A	Heavy continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time w/wo disturbances
R4	Long term prescribed grazing, prescribed burning
R5A	Seeding
R5B	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 and cool-season grasses. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included periods of below and/or above average precipitation, periodic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. In some locations, this site likely received relatively heavy grazing pressure. Tall warm-season grasses would have declined and shorter warm-season grasses would have increased. Today, a similar state, the Native/Invaded State (State 3) can be found on areas that are properly managed with grazing and/or prescribed burning and sometimes on areas receiving occasional short periods of rest.

Community 1.1
Big Bluestem-Green Needlegrass-Western Wheatgrass

Interpretations are based primarily on the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase (this is also considered to be climax). The potential vegetation was about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. The community was dominated by warm-season grasses. The major grasses included big bluestem, Green Needlegrass, and Western Wheatgrass. Other grass or grass-like species included porcupine grass (*Hesperostipa spartea*), Indiangrass (*Sorghastrum nutans*), slender wheatgrass (*Elymus trachycaulus*), Switchgrass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*). 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	3215	3780	4245
Forb	185	420	755
Total	**3400**	**4200**	**5000**

Figure 9. Plant community growth curve (percent production by month). SD0207, Rolling Till Prairie, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, lowland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	13	20	25	18	11	5	3	0	0

Community 1.2
Green Needlegrass-Western Wheatgrass-Big Bluestem

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 75 percent grasses and grass-like species, 15 percent forbs, and 10 percent shrubs. Dominant grasses included green needlegrass, western wheatgrass, and big bluestem. Grasses of secondary importance included Indiangrass, switchgrass, sideoats grama (*Bouteloua curtipendula*), tall dropseed (*Sporobolus compositus*), little bluestem, and slender wheatgrass. Forbs commonly found in this plant community included Canada goldenrod (Solidago Canadensis), cudweed sagewort (*Artemisia ludoviciana*), heath aster (*Symphyotrichum ericoides*), scurfpea (Psoralidium), stiff goldenrod (*Oligoneuron rigidum*), and western yarrow (*Achillea millefolium*). This plant community had similar plant composition to the 3.2 Green Needlegrass-Kentucky Bluegrass-Big Bluestem 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 and smooth bromegrass. When compared to the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase, sideoats grama and little bluestem increased. Production of tall warm-season grasses 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. 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.

Figure 10. Plant community growth curve (percent production by month). SD0206, Rolling Till Prairie, lowland cool-season dominant.. Cool-season dominant, lowland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	6	15	20	26	17	9	4	3	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 Green Needlegrass-Western Wheatgrass-Big Bluestem 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 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase.

State 2
Shortgrass 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. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the sod grass dominance.

Community 2.1
Sideoats Grama-Little Bluestem

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 80 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grass and grass-like species included sideoats grama, little bluestem, and sedge. Grasses of secondary importance included big bluestem, switchgrass, green needlegrass, slender wheatgrass, and tall dropseed. Forbs commonly found in this plant community included cudweed sagewort, goldenrod (Solidago), and western yarrow. When compared to the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase, tall warm-season grasses were reduced, and the more grazing tolerant species such as sideoats grama, little bluestem and sedge were dominant on this plant community. With the exception of green needlegrass, cool-season grasses decreased significantly. This vegetation state was very resistant to change, especially if the disturbance continued and the short-statured species such as sedge increased. The herbaceous species present were well adapted to grazing. This plant community was less productive than other phases.

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

Community 3.1
Green Needlegrass-Western Wheatgrass-Big Bluestem

This plant community phase is similar to the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 10 percent by air-dry weight). The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. This community is dominated by cool-season grasses. The major grasses include green needlegrass, western wheatgrass, and big bluestem. Other grass or grass-like species include porcupine grass, Indiangrass, switchgrass, slender wheatgrass, and little bluestem. 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.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2490	3230	3690
Forb	310	570	910
Total	**2800**	**3800**	**4600**

Figure 12. Plant community growth curve (percent production by month). SD0206, Rolling Till Prairie, lowland cool-season dominant.. Cool-season dominant, lowland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	6	15	20	26	17	9	4	3	0	0

Community 3.2
Green Needlegrass-Kentucky Bluegrass-Big Bluestem

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 75 percent grasses and grass-like species, 15 percent forbs, and 10 percent shrubs. Dominant grasses include green needlegrass, big bluestem, and Kentucky bluegrass. Grasses of secondary importance include Indiangrass, switchgrass, smooth bromegrass, sideoats grama, green needlegrass, tall dropseed, slender wheatgrass, and sedge. Forbs commonly found in this plant community include cudweed sagewort, heath aster, Canada goldenrod, stiff goldenrod, scurfpea, Indian hemp (*Apocynum cannabinum*), and western yarrow. When compared to the 1.1 Big Bluestem-Green Needlegrass-Western Wheatgrass Plant Community Phase, green needlegrass has increased and Kentucky bluegrass has invaded and become a codominant. Production of tall warm-season grasses 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. 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.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1585	2125	2600
Forb	215	375	600
Total	**1800**	**2500**	**3200**

Figure 14. Plant community growth curve (percent production by month). SD0206, Rolling Till Prairie, lowland cool-season dominant.. Cool-season dominant, lowland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	6	15	20	26	17	9	4	3	0	0

Pathway 3.1A
Community 3.1 to 3.2

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

Conservation practices

Prescribed Grazing

State 4
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 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. 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, as well as, 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.

Community 4.2
Kentucky Bluegrass-Quackgrass

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing. It is characterized by a dominance of Kentucky bluegrass and quackgrass. 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. 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.

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 non-native 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 to early seral species.

State 5
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 5.1
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.

Transition T1A
State 1 to 2

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year, typically beginning early in the season) will convert this 1.2 Green Needlegrass-Western Wheatgrass-Big Bluestem Plant Community Phase within the Reference State to the 2.1 Sideoats Grama-Little Bluestem Plant Community Phase within the Shortgrass Sod State.

Transition T1B
State 1 to 3

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, 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 3).

Transition T1C
State 1 to 5

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

Transition T2
State 2 to 5

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

Transition T3A
State 3 to 4

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

Transition T3C
State 3 to 5

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

Restoration pathway R4
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 may lead this plant community phase over a threshold to the Native/Invaded State (State 3).

Transition T4
State 4 to 5

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

Restoration pathway R5A
State 5 to 3

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

Restoration pathway R5B
State 5 to 4

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

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			630–2310	
	western wheatgrass	PASM	*Pascopyrum smithii*	630–2310	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–840	–
2	**Grass-likes**			210–1260	
	clustered field sedge	CAPR5	*Carex praegracilis*	42–840	–
	manyhead sedge	CASY	*Carex sychnocephala*	42–630	–
	fox sedge	CAVU2	*Carex vulpinoidea*	0–630	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	0–420	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–420	–
	rush	JUNCU	*Juncus*	0–420	–
	spikerush	ELEOC	*Eleocharis*	0–336	–
	woolly sedge	CAPE42	*Carex pellita*	0–168	–
3	**Native Cool-season Grasses**			630–1050	
	green needlegrass	NAVI4	*Nassella viridula*	420–840	–
	plains bluegrass	POAR3	*Poa arida*	42–420	–
	fowl bluegrass	POPA2	*Poa palustris*	42–420	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–210	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–126	–
	foxtail barley	HOJU	*Hordeum jubatum*	0–126	–
4	**Warm-season Grasses**			0–210	
	switchgrass	PAVI2	*Panicum virgatum*	0–210	–
	prairie cordgrass	SPPE	*Spartina pectinata*	0–126	–
Forb					
5	**Forbs**			210–630	

	Forb, native	2FN	*Forb, native*	42–210	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	42–126	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	42–84	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	42–84	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	0–84	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–84	–
	cinquefoil	POTEN	*Potentilla*	42–84	–
	scurfpea	PSORA2	*Psoralidium*	42–84	–
	Canadian anemone	ANCA8	*Anemone canadensis*	42–84	–
	Indianhemp	APCA	*Apocynum cannabinum*	42–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	42–84	–
	swamp milkweed	ASIN	*Asclepias incarnata*	0–84	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	42–84	–
	meadow zizia	ZIAP	*Zizia aptera*	0–84	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	0–84	–
	rough bugleweed	LYAS	*Lycopus asper*	0–84	–
	western dock	RUAQ	*Rumex aquaticus*	0–84	–
	goldenrod	SOLID	*Solidago*	42–84	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–42	–
	mint	MENTH	*Mentha*	0–42	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–42	–
	American vetch	VIAM	*Vicia americana*	0–42	–
	northern bedstraw	GABO2	*Galium boreale*	0–42	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–42	–
	Carolina geranium	GECAC4	*Geranium carolinianum var. carolinianum*	0–42	–
	false boneset	BREU	*Brickellia eupatorioides*	0–42	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–42	–
	Macoun's buttercup	RAMA2	*Ranunculus macounii*	0–42	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–42	–
	Rydberg's sunflower	HENUR	*Helianthus nuttallii ssp. rydbergii*	0–42	–

Table 9. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			76–570	
	western wheatgrass	PASM	*Pascopyrum smithii*	76–570	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–190	–
2	**Grass-likes**			76–570	
	clustered field sedge	CAPR5	*Carex praegracilis*	38–380	–
	spikerush	ELEOC	*Eleocharis*	0–304	–
	rush	JUNCU	*Juncus*	0–190	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–114	–

	manyhead sedge	CASY	*Carex sychnocephala*	0–114	–
3	**Native Cool-season Grasses**			190–1330	
	reed canarygrass	PHAR3	*Phalaris arundinacea*	76–1140	–
	plains bluegrass	POAR3	*Poa arida*	0–114	–
	fowl bluegrass	POPA2	*Poa palustris*	0–114	–
	foxtail barley	HOJU	*Hordeum jubatum*	0–114	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–114	–
	green needlegrass	NAVI4	*Nassella viridula*	0–76	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–38	–
4	**Non-Native Grasses**			570–1710	
	Kentucky bluegrass	POPR	*Poa pratensis*	570–1710	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–190	–
Forb					
5	**Forbs**			380–760	
	Forb, introduced	2FI	*Forb, introduced*	38–266	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	38–152	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	38–152	–
	scurfpea	PSORA2	*Psoralidium*	38–152	–
	goldenrod	SOLID	*Solidago*	38–114	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–114	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	38–114	–
	Forb, native	2FN	*Forb, native*	38–114	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	38–114	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–114	–
	Indianhemp	APCA	*Apocynum cannabinum*	38–114	–
	Carolina geranium	GECAC4	*Geranium carolinianum var. carolinianum*	0–76	–
	cinquefoil	POTEN	*Potentilla*	38–76	–
	mint	MENTH	*Mentha*	0–76	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	0–76	–
	meadow zizia	ZIAP	*Zizia aptera*	0–38	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–38	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	0–38	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–38	–
	rough bugleweed	LYAS	*Lycopus asper*	0–38	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–38	–
	swamp milkweed	ASIN	*Asclepias incarnata*	0–38	–

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–125	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–125	–
2	**Grass-likes**			0–250	
	clustered field sedge	CAPR5	*Carex praegracilis*	0–175	–
	rush	JUNCU	*Juncus*	0–175	–
	spikerush	ELEOC	*Eleocharis*	0–125	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–75	–
3	**Native Cool-season Grasses**			250–625	
	foxtail barley	HOJU	*Hordeum jubatum*	250–625	–
	reed canarygrass	PHAR3	*Phalaris arundinacea*	0–125	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–75	–
4	**Non-Native Grasses**			625–1750	
	Kentucky bluegrass	POPR	*Poa pratensis*	625–1750	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–125	–
Forb					
5	**Forbs**			250–500	
	Forb, introduced	2FI	*Forb, introduced*	50–250	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	25–200	–
	goldenrod	SOLID	*Solidago*	25–200	–
	scurfpea	PSORA2	*Psoralidium*	25–175	–
	Forb, native	2FN	*Forb, native*	0–125	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	25–125	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	25–100	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–75	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–50	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	0–25	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–25	–
	cinquefoil	POTEN	*Potentilla*	0–25	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–25	–

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/Sedge (1.1 & 2.1)
Average Annual Production (lbs./acre, air-dry):
4200
Stocking Rate* (AUM/acre): 1.15

Western Wheatgrass/Bluegrass/Foxtail Barley (2.2)
Average Annual Production (lbs./acre, air-dry):
3300
Stocking Rate* (AUM/acre): 0.90

Kentucky Bluegrass/Reed Canarygrass/Forbs (3.1)
Average Annual Production (lbs./acre, air-dry):
3800
Stocking Rate* (AUM/acre): 1.04

Kentucky Bluegrass/Foxtail Barley/Forbs (3.2)
Average Annual Production (lbs./acre, air-dry):
2500
Stocking Rate* (AUM/acre): 0.69

Annual/Pioneer, Non-Native Perennial (3.3)
Average Annual Production (lbs./acre, air-dry):
1200
Stocking Rate* (AUM/acre): 0.33

*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 is typically very slow and runoff potential for this site is normally negligible due to the concave feature of the landform.

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.

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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.

2. **Presence of water flow patterns:** Barely observable.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground less than 5% and less than 2 inches in diameter.

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class usually 6. Typically high root content, organic matter, and granular structure. Soil surface is very resistant to erosion.

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

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

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer should be evident.

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

    Dominant: Tall warm-season rhizomatous grass >> tall cool-season bunch grass

    Sub-dominant: > mid cool-season rhizomatous grass > mid warm-season bunch grass > short cool-season grass = forb > shrub > tree

    Other:

    Additional:

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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):** 85-90%, roughly 0.5 inch thick or less. Litter cover is in contact with soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 4000 – 5200 lbs./acre air-dry weight, average 4,600 lbs./acre air-dry weight

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

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