USDA Natural Resources Conservation Service

Ecological site R102DY015SD
Thin Claypan

Last updated: 8/14/2024
Accessed: 05/13/2025

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.

MLRA notes

Major Land Resource Area (MLRA): 102D–Prairie Coteau

This area makes up about 7,867 square miles (20,375 square kilometers), consisting mostly of nearly level to undulating till plains with potholes and moraines. Elevation ranges from 1,150 to 2,130 feet (350 to 650 meters). The average annual precipitation is 22 to 29 inches (559 to 734 millimeters). The average annual temperature is 42 to 45 degrees F (6 to 7 degrees C). The dominant soil order in this MLRA is Mollisols. The soils in this area dominantly have a frigid temperature regime, and an aquic or udic moisture regime. They are generally very deep and loamy. Soils range from well drained to very poorly drained. Parent materials are dominantly fine-loamy till to clayey material, with smaller amounts of outwash, glaciofluvial deposits, eolian deposits, alluvium, and, to a lesser extent, loess and organic materials.

Classification relationships

Fenneman (1916) Physiographic Regions
Division - Interior Plains
East:
Province - Central Lowland
Section - Western Lake / Dissected Till Plains (12b/12e)

USFS (2007) Ecoregions
Domain - Humid Temperate
Division - Prairie
Province - Prairie Parkland (Temperate)
Section - North-Central Glaciated Plains (251B)

EPA Ecoregions (Omernik 1997)
I - Great Plains (9)
II - Temperate Prairies (9.2)
III - Aspen Parkland/Northern Glaciated Plains (9.2.1)

Ecological site concept

The Thin Claypan ecological site occurs in micro-lows on a nearly level landscape. Soils are moderately well drained which have a claypan (columnar structure) within 6 inches of the soil surface. The natric horizon in the subsoil typically has a Sodium Absorption Ratio (SAR) greater than 13 and/or an Exchangeable Sodium Percentage (ESP) greater than 15. The root restriction of the Natric horizon limits plant growth, production is lower, and species composition will tend towards shallow rooted and more tolerant of the higher sodium levels. Slopes can range from 0 to 2 percent. Vegetation in the Reference State includes western wheatgrass and blue grama. Forbs include scarlet globemallow, cudweed sagewort, heath aster, and woolly Indianwheat. Non-native grasses such as Kentucky bluegrass may invade the site due to changes in disturbance regime.

Associated sites

R102AY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series is Barnes, Forman, and Kranzburg, but other series are included.
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 Cresbard, but other series are included.
R102AY013SD	**Claypan** These sites occur on upland areas. The soils are moderately well drained and have a claypan (columnar structure) within 16 inches, but greater than 6 inches of the soil surface. The central concept soil series is Cavour

Similar sites

R102AY013SD	**Claypan** The Claypan site occurs in a similar landscape position, but does not have a claypan (columnar structure) within 6 inches of the soil surface. The Claypan site will have more big bluestem and higher production than the Thin Claypan site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Bouteloua gracilis*

Physiographic features

The Thin Claypan ecological site occurs in micro-lows on nearly level landscapes and plains.

Table 2. Representative physiographic features

Landforms	(1) Plain
Runoff class	Medium to very high
Flooding frequency	None to rare
Ponding frequency	None
Elevation	396–610 m
Slope	0–2%
Ponding depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 22 to 28 inches. Half or more of the precipitation falls during the growing season. Rainfall typically occurs during high-intensity, convective thunderstorms in summer. In the western part of the MLRA, rainfall is less abundant and not always adequate for full maturation of crops. Precipitation in winter is typically snow. The average annual temperature is 42 to 45 degrees F. The freeze-free period averages 138 days and ranges from 128 to 145 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	106-127 days

Freeze-free period (characteristic range)	130-145 days
Precipitation total (characteristic range)	635 mm
Frost-free period (actual range)	98-130 days
Freeze-free period (actual range)	128-145 days
Precipitation total (actual range)	610-660 mm
Frost-free period (average)	117 days
Freeze-free period (average)	138 days
Precipitation total (average)	635 mm

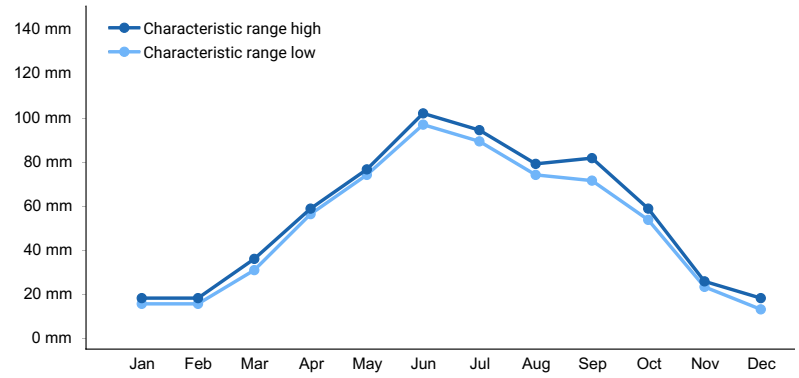


Figure 1. Monthly precipitation range

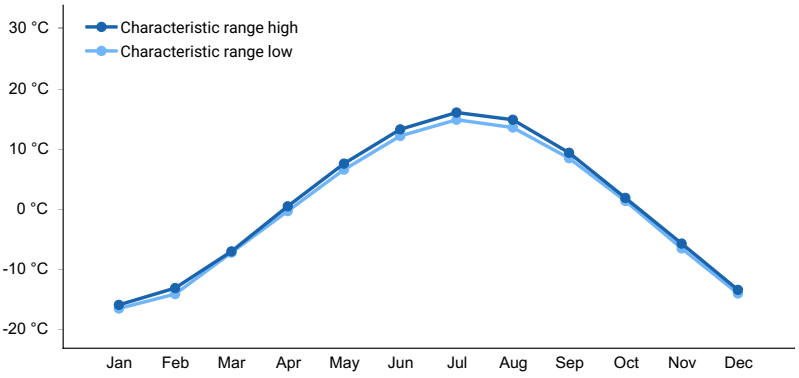


Figure 2. Monthly minimum temperature range

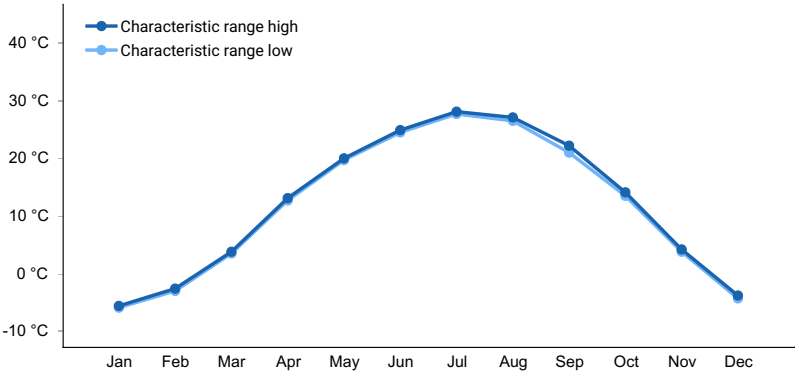


Figure 3. Monthly maximum temperature range

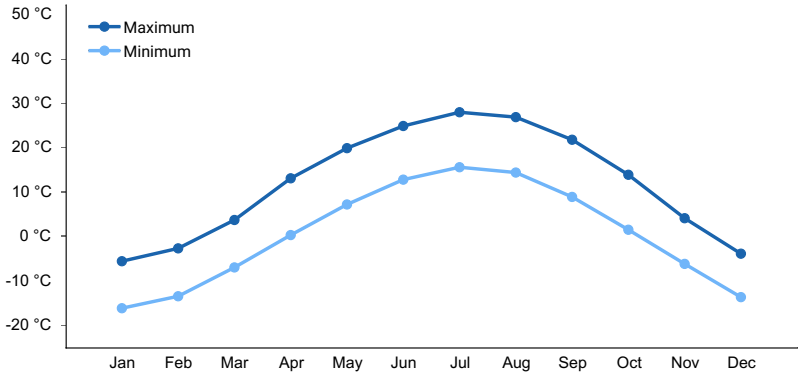


Figure 4. Monthly average minimum and maximum temperature

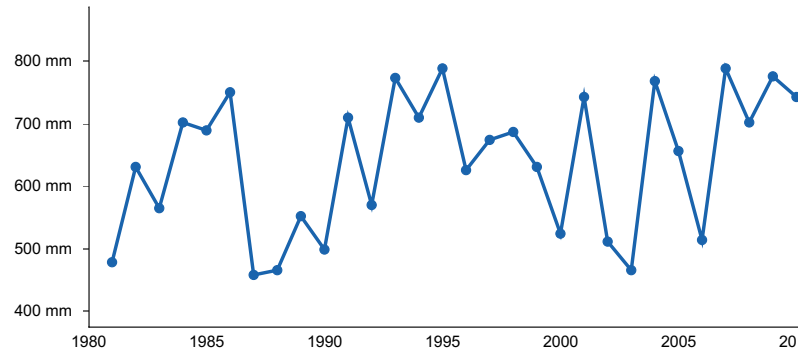


Figure 5. Annual precipitation pattern

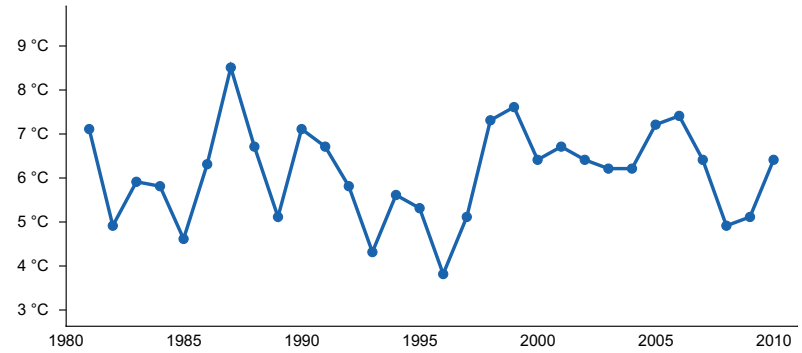


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CLARK [USC00391739], Clark, SD
- (2) CASTLEWOOD [USC00391519], Castlewood, SD
- (3) CLEAR LAKE [USC00391777], Clear Lake, SD
- (4) SUMMIT 1 W [USC00398116], Summit, SD
- (5) WATERTOWN 1W [USC00398930], Watertown, SD
- (6) WEBSTER [USC00399004], Webster, SD

Influencing water features

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

Wetland description

Not Applicable.

Soil features

The Thin Claypan ecological site occurs in micro-lows on nearly level landscapes and plains. Soils are moderately well to somewhat poorly drained which have a claypan (columnar structure) within 6 inches of the soil surface. The central concept soil series is Ferney.

Table 4. Representative soil features

Parent material	(1) Till
Surface texture	(1) Silt loam (2) Silty clay loam (3) Loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow
Depth to restrictive layer	0–15 cm
Soil depth	203 cm
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	4.83–6.86 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	2–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	2–25
Soil reaction (1:1 water) (0-101.6cm)	7.4–9
Subsurface fragment volume <=3" (0-101.6cm)	3–4%
Subsurface fragment volume >3" (0-101.6cm)	0–2%

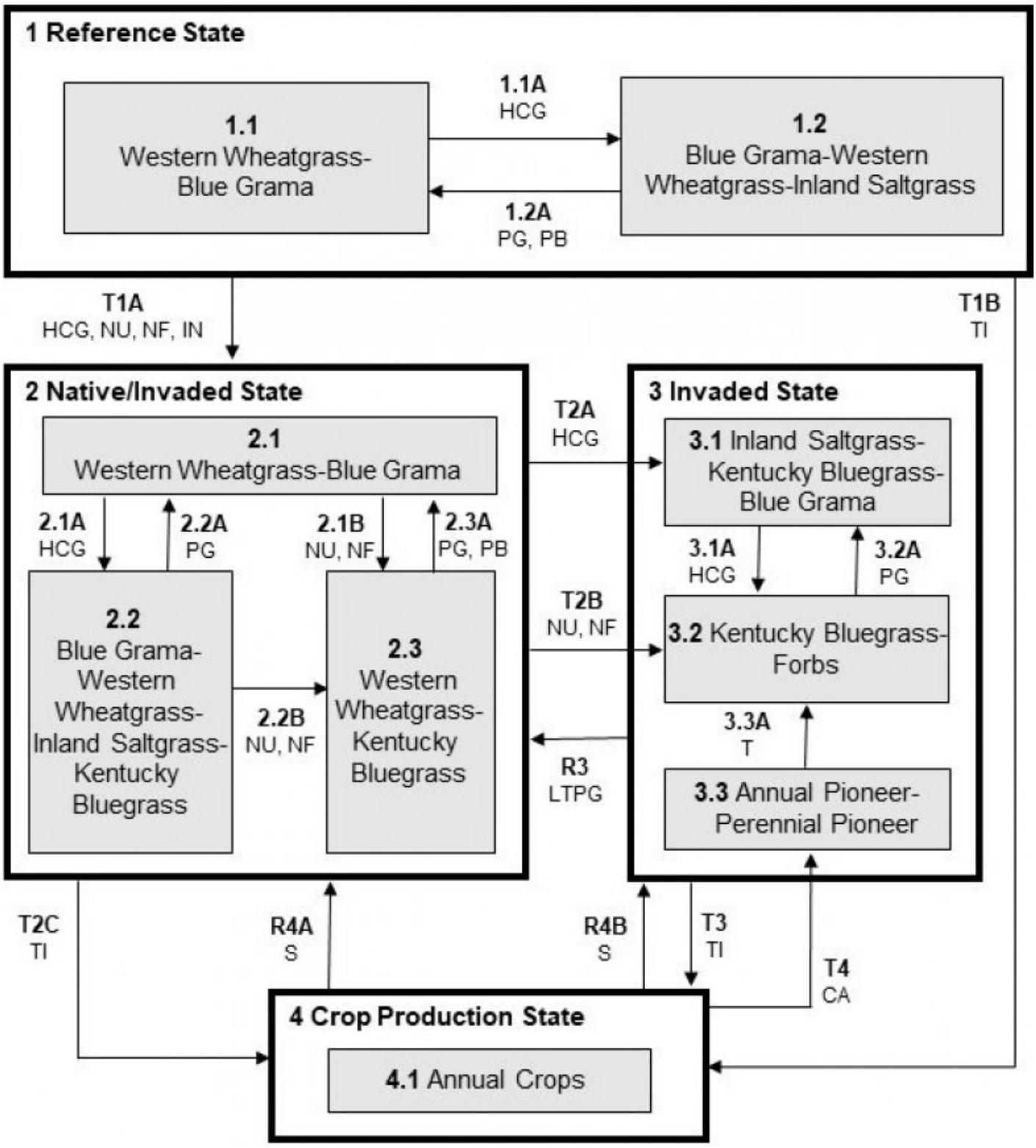
Ecological dynamics

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 Western Wheatgrass-Blue Grama Plant Community Phase. This community phase and the Reference State have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered.

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

Thin Claypan – MLRA 102A



LEGEND

Thin Claypan – R102AY015SD

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	No use, no fire
T2C	Tillage
T3	Tillage
T4	Abandonment of cropping
1.1A	Heavy continuous grazing
1.2A	Prescribed grazing with recovery periods, prescribed burning
2.1A	Heavy continuous grazing
2.1B	No use, no fire
2.2A	Prescribed grazing with recovery periods
2.2B	No use, no fire
2.3A	Prescribed grazing with recovery periods, prescribed burning
3.1A	Heavy continuous grazing
3.2A	Prescribed grazing with recovery periods
3.3A	Time w/wo disturbances
R3A	Long term prescribed grazing
R4A	Seeding
R4B	Seeding

State 1
Reference State

This state represents the natural range of variability that dominates the dynamics of this ecological site (ES). This state is dominated by cool-season grasses with warm-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included precipitation cycles and grazing by large herding ungulates. Timing of grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Today, this state can be found on areas that are properly managed with grazing and sometimes on areas receiving occasional short periods of rest. Cool-season species can decline and a corresponding increase in short, warm-season grasses will occur.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), grass
- needleleaf sedge (*Carex duriuscula*), grass
- western yarrow (*Achillea millefolium var. occidentalis*), other herbaceous
- textile onion (*Allium textile*), other herbaceous
- white heath aster (*Symphyotrichum ericoides*), other herbaceous

Community 1.1
Western Wheatgrass-Blue Grama

Interpretations are based primarily on the 1.1 Western Wheatgrass-Blue Grama Plant Community Phase (this is also considered to be climax). This plant community evolved with grazing by large herbivores and variations in precipitation cycles and can be maintained with prescribed grazing or by occasional short periods of rest or deferment. The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. Cool-season grasses dominate the plant community, while warm-season grasses are subdominant. The major grasses include western wheatgrass and blue grama. Other grasses and grass-likes occurring on this site include buffalograss (*Bouteloua dactyloides*), inland saltgrass (*Distichlis spicata*), needleandthread (*Hesperostipa comata*), and sedge (Carex). The dominant forbs include scarlet globemallow (*Sphaeralcea coccinea*), cudweed sagewort (*Artemisia ludoviciana*), heath aster (symphyotrichum ericoides), and woolly Indianwheat (*Plantago patagonica*). This plant community is well adapted to the Northern Great Plains climatic

conditions. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle, and energy flow are functioning at the sites potential. Plant litter is properly distributed with some movement offsite and natural plant mortality is low. Low to moderate available water capacity coupled with high accumulations of sodium and slow permeability strongly influences the soil-water-plant relationships

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	818	1304	1777
Forb	67	110	163
Shrub/Vine	11	44	78
Total	**896**	**1458**	**2018**

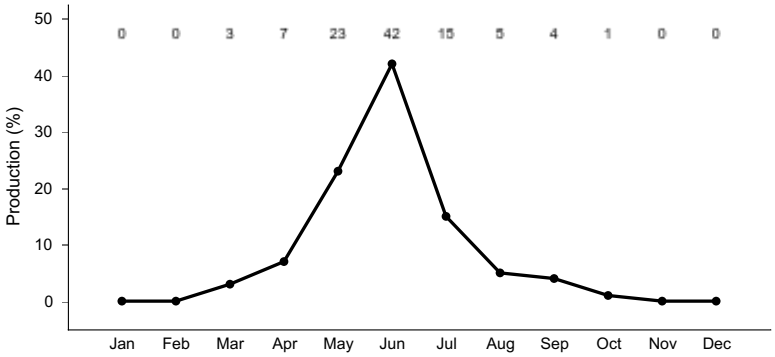


Figure 8. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Community 1.2
Blue Grama-Western Wheatgrass-Inland Saltgrass

This plant community can develop from the adverse effects of heavy continuous seasonal grazing. Short grasses tend to increase to dominate the site and annual production decreases dramatically. Lack of litter and short plant heights result in higher soil temperatures, poor water infiltration rates, and high evaporation, which gives blue grama a competitive advantage over cool-season midgrasses. This plant community can occur throughout the pasture, on spot grazed areas, and around water sources where season-long grazing patterns occur. Blue grama, western wheatgrass, and inland saltgrass are the dominant species. Other grasses and grass-likes occurring include buffalograss, Sandberg bluegrass (*Poa secunda*), sedge, and sometimes annual grasses. Forbs such as cudweed sagewort, scarlet globemallow, and woolly Indianwheat may also be present. Some nonnative species will begin to invade this plant community including western salsify (*Tragopogon dubius*), sweet clover (*Melilotus officinalis*), and annual bromegrass (*Bromus tectorum*). This plant community is quite resilient. The thick sod and competitive advantage prevents other species from establishing. This plant community is less productive than the 1.1 Western Wheatgrass-Blue Grama Plant Community Phase. Runoff increases and infiltration will decrease. Soil erosion will be minimal due to the sod forming habit of blue grama.

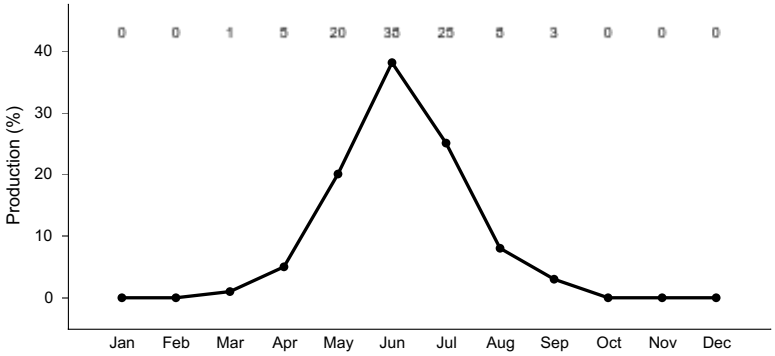


Figure 9. Plant community growth curve (percent production by month).

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 Blue Grama-Western Wheatgrass-Inland Saltgrass 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 would have converted this plant community to the 1.1 Western Wheatgrass-Blue Grama 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 cool-season and warm-season grasses. It can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Taller warm-season species can decline and a corresponding increase in short statured grass will occur.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), grass
- needleleaf sedge (*Carex duriuscula*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- western yarrow (*Achillea millefolium var. occidentalis*), other herbaceous
- textile onion (*Allium textile*), other herbaceous
- white heath aster (*Symphyotrichum ericoides*), other herbaceous
- scarlet globemallow (*Sphaeralcea coccinea*), other herbaceous

Community 2.1
Western Wheatgrass-Blue Grama

This plant community phase is similar to the 1.1 Western Wheatgrass-Blue Grama Plant Community Phase, but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 10 percent by air-dry weight). The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses, with warm-season grasses being subdominant. The major grasses include western wheatgrass and blue grama. Other grass or grass-like species include Nuttall's alkaligrass (*Puccinellia nuttalliana*), buffalograss, inland saltgrass, prairie junegrass (*Koeleria macrantha*), and needleleaf sedge (*Carex duriuscula*). Forbs would include cudweed sagewort, curlycup gumweed (*Grindelia squarrosa*), heath aster, scarlet globemallow, and western yarrow (*Achillea millefolium*). 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	818	1304	1777
Forb	67	110	163
Shrub/Vine	11	44	78
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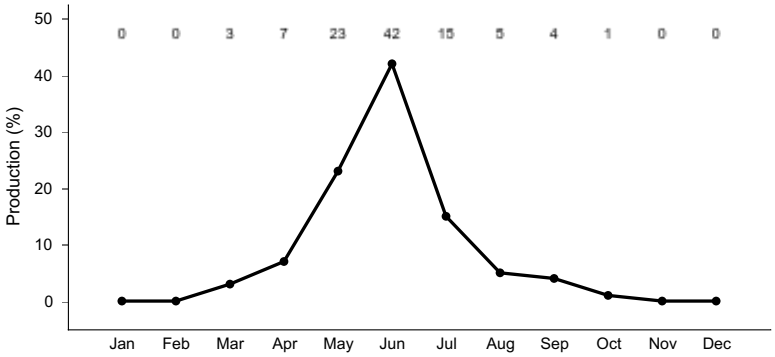

Figure 11. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Community 2.2
Blue Grama-Western Wheatgrass-Inland Saltgrass-Kentucky Bluegrass

This plant community is a result of heavy continuous grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 70 percent grasses and grass-like species, 25 percent forbs, and 5 percent shrubs. Dominant grass and grass-like species include western wheatgrass, blue grama, inland saltgrass with minor amounts of Kentucky bluegrass (*Poa pratensis*). Grass and grass-like species of secondary importance include needleandthread, buffalograss, tumblegrass (*Schedonnardus paniculatus*), and sedge. Forbs commonly found in this plant community included cudweed sagewort, prairie coneflower (*Ratibida columnifera*), and western yarrow. When compared to the 1.1 Western Wheatgrass-Blue Grama Plant Community Phase, blue grama and inland saltgrass have increased and Kentucky bluegrass has invaded. Needleandthread and prairie junegrass production has been reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. The increase of shorter-statured, more compact rooted species will result in somewhat higher runoff and decreased infiltration. This will cause the site to become drier. These species will also be more competitive.

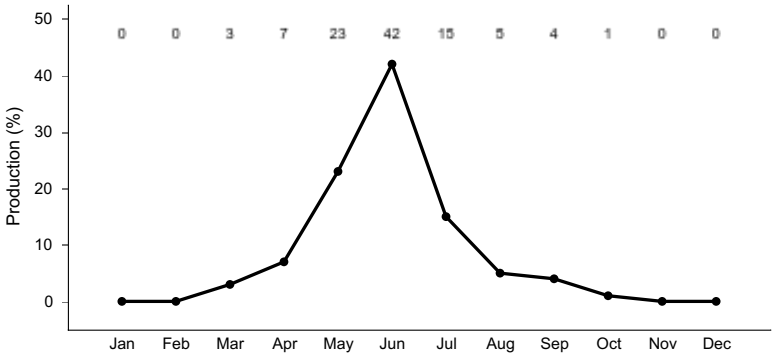

Figure 12. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Community 2.3
Western Wheatgrass-Kentucky Bluegrass

This plant community is a result of Non-use and/or no surface fire for extended periods of time (typically for 10 or

more years). This community phase is characterized by an increase in the introduced cool-season sodgrass, Kentucky bluegrass. The community phase is the most dominant both temporally and spatially. Kentucky bluegrass has become nearly co-dominant with western wheatgrass. Warm season grasses are present but minor and tap rooted perennial forbs have decrease. Production and infiltration both decrease and this community phase is at risk of transitioning across a state threshold. With natural or management actions that decrease the composition of the cool-season bunchgrasses and increase the composition of Kentucky bluegrass, transition T2B will be initiated.

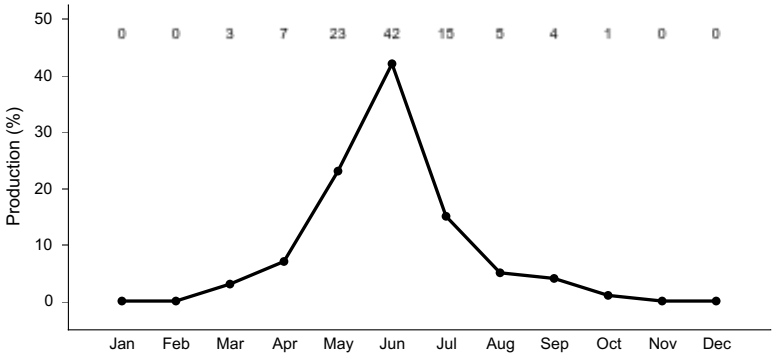

Figure 13. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

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 Blue Grama-Western Wheatgrass-Inland Saltgrass-Kentucky Bluegrass Plant Community Phase.

Pathway 2.1B
Community 2.1 to 2.3

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, will shift this community to the 2.3 Western Wheatgrass-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 Western Wheatgrass-Blue Grama Plant Community Phase. This pathway could also occur with a return to more normal precipitation levels and frequencies.

Pathway 2.2B
Community 2.2 to 2.3

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, will shift this community to the 2.3 Western Wheatgrass-Kentucky Bluegrass Plant Community Phase.

Pathway 2.3A
Community 2.3 to 2.1

Prescribed Grazing, and/or prescribed burning returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest would have converted this plant community to the 2.1 Western Wheatgrass-Blue Grama 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 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.

Dominant plant species

- snowberry (*Symphoricarpos*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- saltgrass (*Distichlis spicata*), grass
- threadleaf sedge (*Carex filifolia*), grass
- goldenrod (*Solidago*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- curlycup gumweed (*Grindelia squarrosa*), other herbaceous

Community 3.1
Inland Saltgrass-Kentucky Bluegrass-Blue Grama

This plant community phase is a result of heavy continuous grazing. It is characterized by a dominance of very grazing tolerant species such as Kentucky bluegrass, inland saltgrass, blue grama, sedges, and forbs. The dominance is at times so complete that other species are difficult to find on the site. Nutrient cycling is greatly reduced, and mid-statured 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. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in the phase.

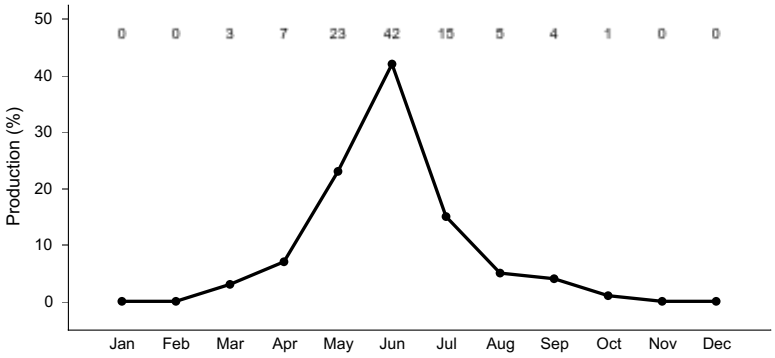

Figure 14. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Community 3.2
Kentucky Bluegrass-Forbs

This plant community phase is a result of heavy continuous grazing and/or extended periods of non-use and no fire. It is characterized by a dominance of Kentucky bluegrass and forbs. Smooth bromegrass may also be present on the site. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface and a thatch-mat layer often develops at the surface. Nutrient cycling is greatly reduced and native plants have a difficulty becoming established. When dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will be significantly less than the interpretive plant community. The period that forage palatability is high is relatively short. Energy capture is also

reduced due to the shorter active growth period and lack of warm season plant diversity.

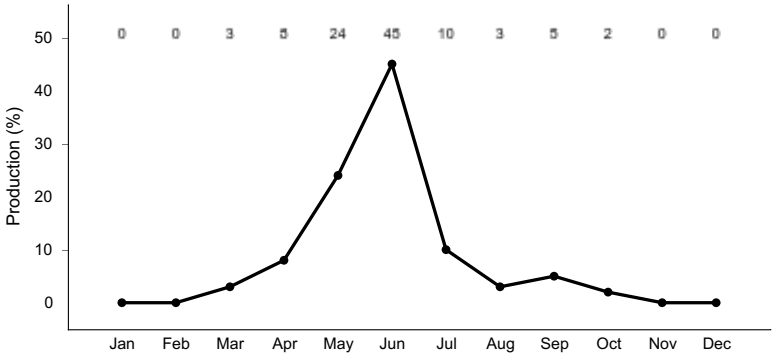

Figure 15. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

Community 3.3
Annual Pioneer-Perennial Pioneer

This plant community developed under continuous heavy grazing or other excessive disturbances. The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable, but often include nonnative invasive and/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.

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 and no surface fire for extended periods of time (typically for 10 years or more) causing litter levels to become high enough to reduce native grass vigor, diversity, and density will shift this community to the 3.2 Kentucky Bluegrass-Forbs 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 may convert this plant community to the 3.1 Inland Saltgrass-Kentucky Bluegrass-Blue Grama Plant Community Phase.

Pathway 3.3A
Community 3.3 to 3.2

This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the 3.2 Kentucky Bluegrass-Forbs Plant Community Phase.

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.

Dominant plant species

- corn (*Zea*), grass
- wheat (*Triticum*), grass
- soybean (*Glycine*), other herbaceous

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.

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 Inland Saltgrass-Kentucky Bluegrass-Blue Grama Plant 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. 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 3.2 Kentucky Bluegrass-Forbs Plant Community Phase within the Invaded State (State 3).

Transition T2C
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).

Restoration pathway 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) may lead this 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 3.3 Annual Pioneer-Perennial Pioneer Plant Community Phase within the Invaded State (State 3).

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			364–656	
	western wheatgrass	PASM	*Pascopyrum smithii*	364–656	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–73	–
2	**Short Warm-season Grasses**			219–364	
	blue grama	BOGR2	*Bouteloua gracilis*	146–291	–
	saltgrass	DISP	*Distichlis spicata*	15–73	–
	buffalograss	BODA2	*Bouteloua dactyloides*	15–73	–
	scratchgrass	MUAS	*Muhlenbergia asperifolia*	0–29	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–29	–
3	**Cool-season Bunchgrasses**			15–73	
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	15–73	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–44	–
4	**Other Native Grasses**			15–73	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–73	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	15–44	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–15	–
5	**Grass-likes**			15–73	
	needleleaf sedge	CADU6	*Carex duriuscula*	15–73	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	0–29	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–29	–
Forb					
6	**Forbs**			73–146	
	Forb, native	2FN	*Forb, native*	15–58	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	15–29	–
	textile onion	ALTE	*Allium textile*	15–29	–

	white heath aster	SYER	*Symphyotrichum ericoides*	15–29	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	15–29	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	15–29	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	15–29	–
	bladderpod	LESQU	*Lesquerella*	0–15	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–15	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–15	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–15	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–15	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0–15	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–15	–
	pussytoes	ANTEN	*Antennaria*	0–15	–
	field sagewort	ARCA12	*Artemisia campestris*	0–15	–
Shrub/Vine					
7	**Shrubs**			15–73	
	prairie sagewort	ARFR4	*Artemisia frigida*	15–44	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–29	–
	prairie rose	ROAR3	*Rosa arkansana*	0–29	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–29	–

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			364–656	
	western wheatgrass	PASM	*Pascopyrum smithii*	364–656	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–73	–
2	**Short Warm-season Grasses**			219–364	
	blue grama	BOGR2	*Bouteloua gracilis*	146–291	–
	saltgrass	DISP	*Distichlis spicata*	15–73	–
	buffalograss	BODA2	*Bouteloua dactyloides*	15–73	–
	scratchgrass	MUAS	*Muhlenbergia asperifolia*	0–29	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–29	–
3	**Cool-season Bunchgrasses**			15–73	
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	15–73	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–44	–
4	**Other Native Grasses**			15–73	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–73	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	15–44	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–15	–
5	**Grass-likes**			15–73	
	needleleaf sedge	CADU6	*Carex duriuscula*	15–73	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	0–29	–

	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–29	–
6	**Non-Native Grasses**			15–29	
	Kentucky bluegrass	POPR	*Poa pratensis*	15–29	–
	Grass, perennial	2GP	*Grass, perennial*	0–15	–
	smooth brome	BRIN2	*Bromus inermis*	0–15	–
Forb					
7	**Forbs**			73–146	
	Forb, native	2FN	*Forb, native*	15–58	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	15–29	–
	textile onion	ALTE	*Allium textile*	15–29	–
	white heath aster	SYER	*Symphyotrichum ericoides*	15–29	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	15–29	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	15–29	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	15–29	–
	bladderpod	LESQU	*Lesquerella*	0–15	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–15	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–15	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–15	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–15	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0–15	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–15	–
	pussytoes	ANTEN	*Antennaria*	0–15	–
	field sagewort	ARCA12	*Artemisia campestris*	0–15	–
Shrub/Vine					
8	**Shrubs**			15–73	
	prairie sagewort	ARFR4	*Artemisia frigida*	15–44	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–29	–
	prairie rose	ROAR3	*Rosa arkansana*	0–29	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–29	–

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.

Western Wheatgrass/Blue Grama (1.1)
Average Annual Production (lbs./acre, air-dry): 1,600
Stocking Rate* (AUM/acre): 0.44

Blue Grama/Western Wheatgrass/Inland Saltgrass (1.2)
Average Annual Production (lbs./acre, air-dry): 1,000

Stocking Rate* (AUM/acre): 0.27

Western Wheatgrass/Blue Grama (2.1)
Average Annual Production (lbs./acre, air-dry): 1,600
Stocking Rate* (AUM/acre): 0.44

Blue Grama/Western Wheatgrass/Inland Saltgrass/Bluegrass (2.2)
Average Annual Production (lbs./acre, air-dry): 1,000
Stocking Rate* (AUM/acre): 0.27

Western Wheatgrass/Kentucky Bluegrass (2.3)
Average Annual Production (lbs./acre, air-dry): 600
Stocking Rate* (AUM/acre): 0.16

Inland Saltgrass/Kentucky Bluegrass/Blue Grama (3.1)
Average Annual Production (lbs./acre, air-dry): 500
Stocking Rate* (AUM/acre): 0.14

Kentucky Bluegrass/Forbs (3.2)
Average Annual Production (lbs./acre, air-dry): 400
Stocking Rate* (AUM/acre): 0.11

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

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration varies from very slow to slow, and runoff potential for this site varies from high to very high depending on soil hydrologic group, slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, and/or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an 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

MLRA 102D was created in 2022 with Agricultural Handbook 296 updated. This area was MLRA 102A prior to this time. Information was copied from MLRA 102A ESDs to create the MLRA 102D ESDs.

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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Acknowledgments

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MLRA 102D was created in 2022 with Agricultural Handbook 296 updated. This area was MLRA 102A prior to this time. Information was copied from MLRA 102A ESDs to create the MLRA 102D ESDs.

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.

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Contact for lead author	stanley.boltz@sd.usda.gov 605-352-1236
Date	05/24/2018
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

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

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is 10 to 35% with patch size up to 6 inches and disconnected. Associated slick spots are not a part of this site, and will have considerably more bare ground.

5. **Number of gullies and erosion associated with gullies:** None.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Plant litter may be moved during ponding events and small accumulations of litter may be visible.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class roughly 2-4. Moderate root content. Soil surface is somewhat resistant to erosion. Crusts may be present (e.g., biological and physical crusts).

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

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Rhizomatous grasses provide for moderate infiltration, but shallow pan reduces effective infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer should be evident. At less than four inches, an extremely dense clay B horizon exists, which has a round-topped columnar structure.

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

    Dominant: Mid cool-season rhizomatous grass >

    Sub-dominant: Short warm-season grasses >>

    Other: Mid/tall cool-season bunchgrasses = short grass-likes = forbs = shrubs > mid warm-season grasses = short cool-season grasses.

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

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):** 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):** 1,100–2,100 lbs./acre air-dry weight, average 1,600 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: State and local noxious, Kentucky bluegrass, and smooth bromegrass.

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