USDA Natural Resources Conservation Service

Ecological site R102BY009SD
Sandy

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General information

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

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 102B–Till Plains

The Till Plains (102B) is located within the Western Lake Section of the Central Lowland Province of the Interior Plains. It is entirely in South Dakota, encompassing 2,215 square miles (Figure 1). The elevation ranges from 1,140 to 1,880 feet. The MLRA is characterized by glaciated, nearly level to hilly plains populated by stagnation and end moraines, glacial outwash terraces, and floodplains as the major landforms. The dominant parent materials are silty drift, glacial till, glacial outwash, and alluvium. (USDA-NRCS 2006)

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a mesic temperature regime, a udic ustic moisture regime and mixed or smectitic mineralogy. They generally are very deep, well drained to poorly drained, and clayey or loamy. This area is in the western area of the tall grass prairie and supports big bluestem (Andropogon gerardi), little bluestem (Schizachyrium scoparium), Indiangrass (Sorghastrum nutans), porcupine grass (Hesperostipa spartea), and green needlegrass (Nassella viridula) as the dominant native species. Cattails (Typha), prairie cordgrass (Spartina pectinate), bulrush (Cyperaceae) and reed canarygrass (Phalaris arundinacea) are commonly found on the poorly drained soils. (USDA-NRCS, 2006).

Classification relationships

Major Land Resource Area (MLRA): Till Plains (102B) (USDA-NRCS, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Outer Coteau des Prairies (251Bb); Yankton Hills and Valleys (251Bf); Northwest Iowa Plains (251Bd); (Cleland et al., 2007).

US EPA Level IV Ecoregion: Prairie Coteau (46k); James River Lowland (46n); Loess Prairies (47a); Big Sioux Basin (46m) - (USEPA, 2013)

Ecological site concept

The Sandy ecological site typically occurs in an upland area. Soils vary from moderately well drained to somewhat excessively drained. The surface and subsoil textures are sandy loam, fine sandy loam, and loamy very fine sand. Slopes can range from 0 to 40 percent.

Vegetation in the Reference State is dominated by warm-season grasses including big bluestem, switchgrass, and cool-season needlegrasses. Forbs include cudweed sagewort, prairie coneflower, and western yarrow. Non-native grasses such as Kentucky bluegrass and smooth bromegrass, and invasive woody species such as eastern redcedar may invade with shifts to the disturbance regime.

Associated sites

R102BY010SD	**Loamy** These sites occur on upland areas. Soils are well drained. The surface and subsoil textures are loam, silt loam, silty clay loam, clay loam, sandy clay loam, and very fine sandy loam. The central concept soil series are Egan and Wentworth but other series are included.
R102BY012SD	**Thin Upland** These sites occur on uplands. Soils are well drained and will effervesce with acid at or near the surface. The central concept soil series are Ethan and Betts but other series are included.
R102BY020SD	**Loamy Overflow** These sites occur in upland swales. Soils are moderately well drained. The surface and subsoil textures are loam, silt loam, silty clay loam, clay loam, sandy clay loam, and very fine sandy loam. The central concept soil series is Trent but other series are included.

Similar sites

R102BY020SD	**Loamy Overflow** The Loamy Overflow site may occur similar in landscape position, but the surface and subsoil textures are silt loam, silty clay loam, sandy clay loam, and very fine sandy loam. A Loamy Overflow site will have more big bluestem and higher production than a Sandy site.
R102BY010SD	**Loamy** The Loamy site may occur similar in landscape position, but the surface and subsoil textures are silt loam, silty clay loam, sandy clay loam, and very fine sandy loam. A Loamy site will have more green needlegrass and western wheatgrass and less needle and thread than a Sandy site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

This site occurs on nearly level to gently undulating uplands.

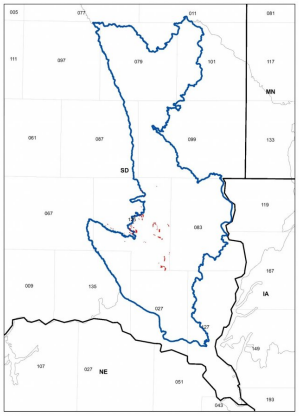

Figure 2. Site Distribution Map for the Sandy site in MLRA 102B.

Table 2. Representative physiographic features

Landforms	(1) Outwash plain (2) Outwash terrace (3) Till plain
Flooding frequency	None
Ponding frequency	None
Elevation	335–579 m
Slope	1–25%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

Major Land Resource Area 102B is considered to have a continental climate with 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 the location of this MLRA 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 24 to 26 inches per year. The average annual temperature is about 46°F. January is the coldest month with average temperatures ranging from about 14°F (Wentworth 2 WNW, South Dakota, to about 18°F (Canton 4 WNW, SD). July is the warmest month with temperatures averaging from about 72°F (Wentworth 2 WNW, SD), to about 73°F (Canton 4 WNW, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57°F. This large annual range attests to the continental nature of the climate of this area. 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. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	124-127 days
Freeze-free period (characteristic range)	138-140 days
Precipitation total (characteristic range)	660 mm

Frost-free period (actual range)	123-128 days
Freeze-free period (actual range)	137-141 days
Precipitation total (actual range)	660-686 mm
Frost-free period (average)	126 days
Freeze-free period (average)	139 days
Precipitation total (average)	660 mm

Climate stations used

- (1) CENTERVILLE 6 SE [USC00391579], Beresford, SD
- (2) CANTON [USC00391392], Canton, SD
- (3) MONTROSE 8N [USC00395738], Montrose, SD
- (4) MADISON 2SE [USC00395090], Madison, SD
- (5) WENTWORTH 2.5 WNW [USC00399042], Wentworth, SD

Influencing water features

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

Soil features

The features common to all soils in this site are the fine sandy loam or loamy fine sand textured surface layers and slopes of one to 25 percent. The soils in this site have moderately rapid drainage and formed in eolian deposits. The surface layer is seven to 19 inches thick. This site should show slight to no evidence of rills, wind scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous. The soil surface is stable and intact. Subsurface soil layers are not restrictive to water movement and root penetration.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases when vegetative cover is severely degraded. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

The central concept soil series for this site are Blendon and Henkin, but other series are included.

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

Table 4. Representative soil features

Surface texture	(1) Fine sandy loam (2) Loamy fine sand
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid
Soil depth	203 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	10.16–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–4%

Ecological dynamics

The site which is located in the Till Plains Region developed under Northern Great Plains climatic conditions and included the natural influences of large herding herbivores and occasional fire. Changes also occur in the plant communities due to weather fluctuations and management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase. This community phase and the Reference State have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

This ecological site (ES) has been grazed by domestic livestock since they have been introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have changed the ecological dynamics of this site. Heavy continuous grazing (season-long grazing during the typical growing season of April through October or repeated seasonal grazing during the same time of year each year) without adequate recovery periods following grazing events causes departure from the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase. Sedge (Carex), Scribner's panicum (Panicum) and blue grama (*Bouteloua gracilis*) will increase and eventually develop into a sod. Little bluestem will increase initially and then begin to decrease. Needle and thread (*Hesperostipa comata*), porcupinegrass, sideoats grama (*Bouteloua curtipendula*), big bluestem and little bluestem will decrease in frequency and production. Extended periods of non-use and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as Kentucky bluegrass (*Poa pratensis*) and smooth bromegrass (*Bromus inermis*). Extended periods of no surface fire could result in the invasion of conifers in which eastern redcedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) will increase and could eventually dominate the site.

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

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

State and transition model

Sandy – R102BY009SD

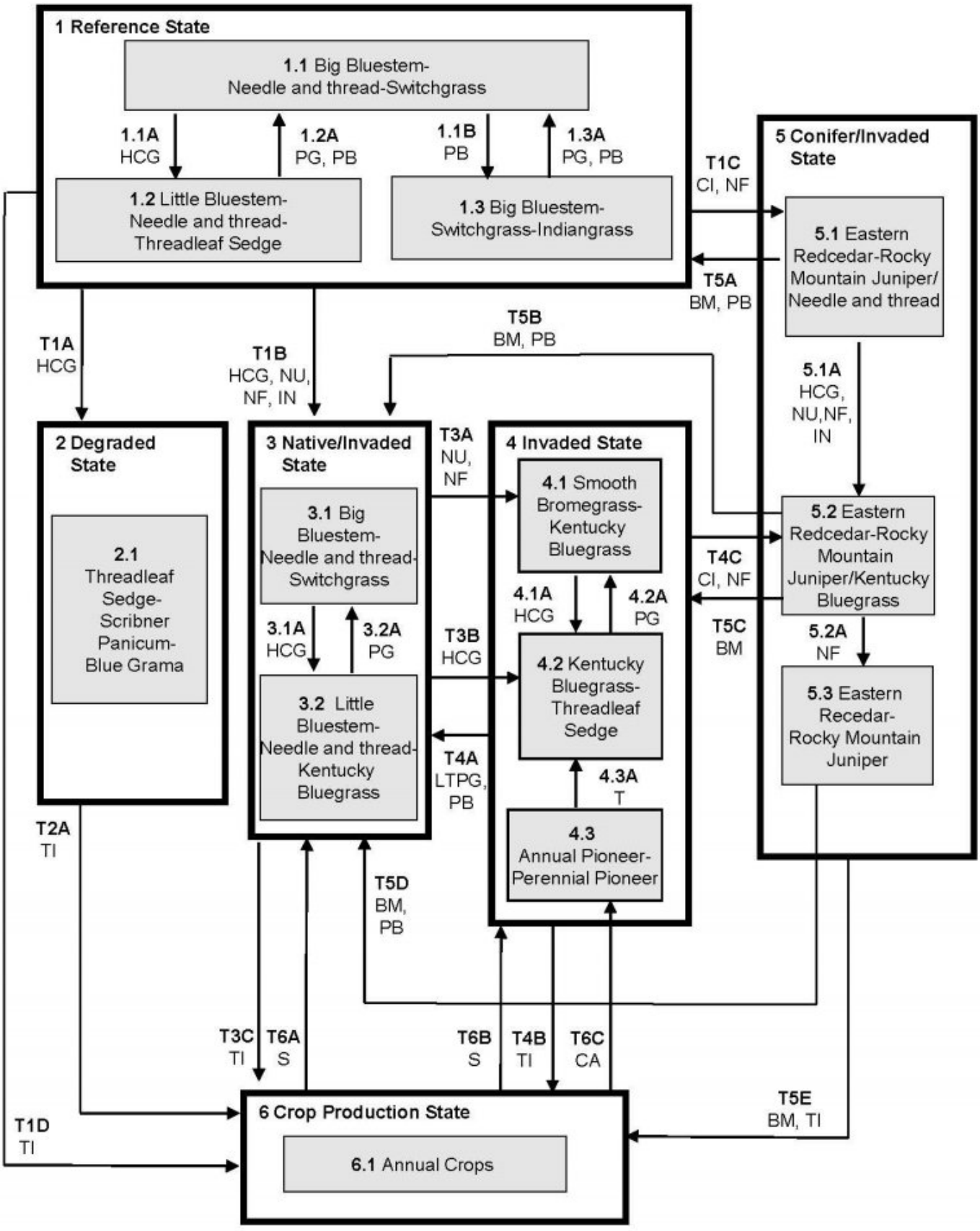

Figure 9. State-And-Transition Model for the Sandy site in MLRA 102B.

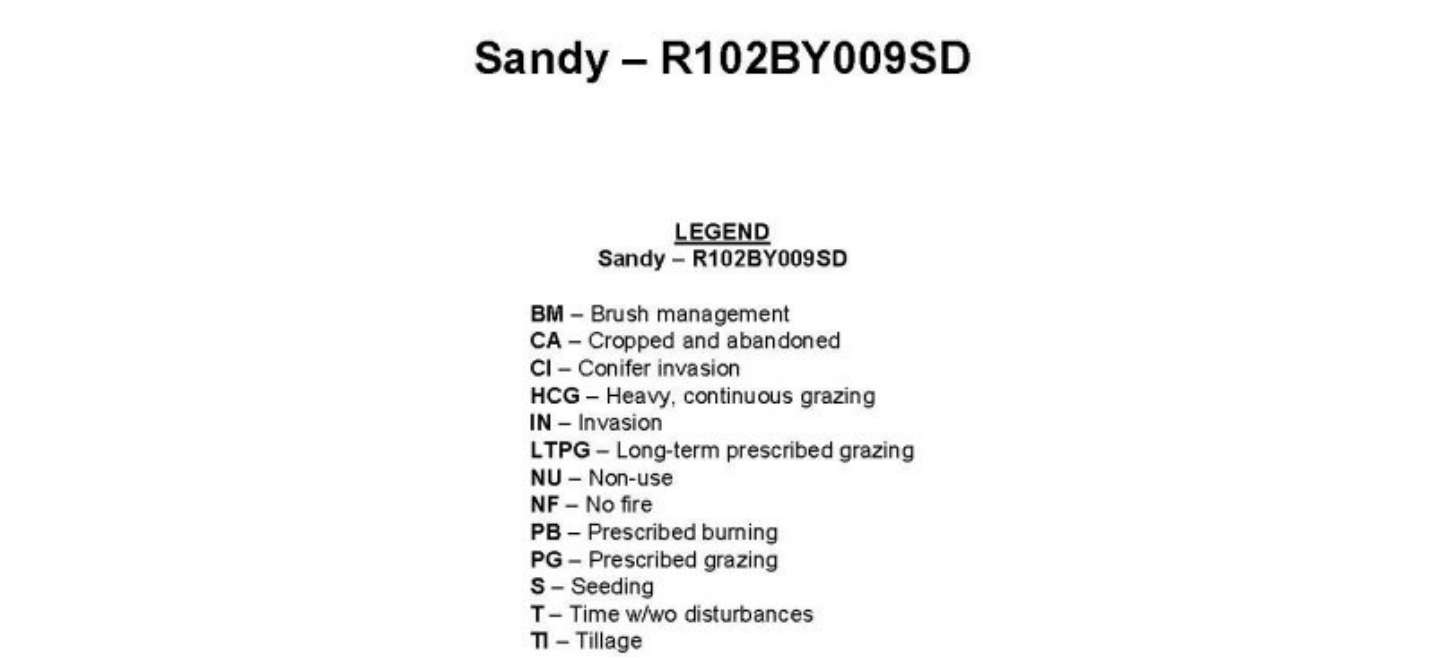

Figure 10. Legend for the Sandy site in MLRA 102B.

Code	Process
T1A	Heavy, continuous grazing
T1B	Heavy ,continuous grazing, non-use, no fire, invasion
T1C	Conifer invasion, no fire
T1D	Tillage
T2A	Tillage
T3A	Non-use, no fire
T3B	Heavy, continuous grazing
T3C	Tillage
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T4C	Conifer invasion, no fire
T5A	Brush management, prescribed burning
T5B	Brush management, prescribed burning
T5C	Brush management
T5D	Brush management, prescribed burning
T5E	Brush management, tillage
T6A	Seeding
T6B	Seeding
T6C	Cropped and abandoned
1.1A	Heavy, continuous grazing
1.1B	Prescribed burning
1.2A	Prescribed grazing with recovery periods, prescribed burning
1.3A	Prescribed grazing with recovery periods, prescribed burning
3.1A	Heavy, continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy, continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time w/wo disturbances
5.1A	Heavy, continuous grazing, non-use, no fire, invasion
5.2A	No fire

Figure 11. Matrix for the Sandy site in MLRA 102B.

State 1
Reference State

The Reference State represents the natural range of variability that influences the dynamics of this ecological site (ES). This state was dominated by warm-season grasses with cool-season grasses being subdominant. Before Europeans settled North America, the primary disturbance mechanisms for this site in the Reference condition included periodic fire, grazing by large herding ungulates, and fluctuations in the water table. Frequent surface fires (every 3 to 5 years), grazing, and weather events dictated the dynamics that occurred within the natural range of variability. Cool-season and taller warm-season grasses would have declined and a corresponding increase in short, warm-season grasses would have occurred. Today, a similar state 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-Needle and Thread-Switchgrass

Figure 12. Typical vegetation associated with the Reference Community.

Interpretations are based primarily on the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase. The potential vegetation was about 85 percent grasses or grass-like plants, 10 percent forbs, and five percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses included big bluestem, sand bluestem (*Andropogon hallii*), prairie sandreed (*Calamovilfa longifolia*), little bluestem, needle and thread, and porcupinegrass. Other grass or grass-like species included sideoats grama, blue grama, threadleaf sedge (*Carex filifolia*), and Indiangrass. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high tolerance to drought. This was a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2556	3490	4366
Forb	174	295	460
Shrub/Vine	73	138	219
Total	**2803**	**3923**	**5045**

Figure 14. Plant community growth curve (percent production by month). SD0214, Till Plains, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

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

Community 1.2
Little Bluestem-Needle and Thread-Threadleaf Sedge

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 80 percent grasses and grass-like species, 15 percent forbs, and five percent shrubs. Dominant grasses included needle and thread, prairie sandreed, little bluestem, threadleaf sedge, and blue grama. Grasses of secondary importance included sideoats grama, porcupinegrass, big bluestem, and sand dropseed (*Sporobolus cryptandrus*). Forbs commonly found in this plant community included cudweed sagewort (*Artemisia ludoviciana*), prairie coneflower (*Ratibida columnifera*), and western yarrow (*Achillea millefolium*). This plant community had similar plant composition to the 3.2 Little Bluestem-Needle and Thread-Kentucky Bluegrass Plant Community Phase. The main difference is that this plant community phase did not have the presence of non-native invasive species such as Kentucky bluegrass and smooth bromegrass. When compared to the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase, needle and thread, threadleaf sedge, and blue grama increased. Big bluestem and porcupinegrass decreased, and production of mid- and tall warm-season grasses was also reduced. This plant community was moderately resistant to change. The herbaceous species present were well adapted to grazing; however, species composition could be altered through long-term overgrazing. If the herbaceous component was intact, it tended to be resilient if the disturbance was not long-term.

Figure 15. Plant community growth curve (percent production by month). SD0213, Till Plains, cool-season/warm-season codominant.. Cool-season, warm-season codominant..

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

Community 1.3
Big Bluestem-Switchgrass-Indiangrass

This plant community was a result of fire occurring at relatively frequent intervals (every 3 to 5 years). This phase could have also resulted from a combination of grazing events immediately following early season fire (i.e., large ungulates attracted to highly nutritious vegetative growth following a fire). These events would have caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire and would have increased in vigor and production leading to a temporary shift to this phase. Needlegrasses would have decreased most significantly among the cool-season grasses. The potential vegetation was about 80 percent grasses or grass-like plants, 15 percent forbs, and five percent shrubs. The community was dominated by warm-season grasses. The major grasses included big bluestem, little bluestem, Indiangrass, switchgrass, prairie sandreed, and sideoats grama. Other grass or grass-like species included porcupinegrass, needle and thread, blue grama, and threadleaf sedge. This plant community was not resistant to change and would have readily shifted back to the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase with a return of more normal fire return intervals.

Figure 16. Plant community growth curve (percent production by month). SD0215, Till Plains, warm-season dominant.. Warm-season dominant..

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

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 will shift this community to the 1.2 Little Bluestem-Needle and Thread-Threadleaf Sedge Plant Community Phase.

Pathway 1.1B
Community 1.1 to 1.3

Prescribed burning occurring at relatively frequent intervals (every 3 to 5 years) and a return to normal disturbance regime levels, along with occasional grazing events immediately following early season fire caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of

shorter return intervals of fire, which would increase in vigor and production leading to a temporary shift to the 1.3 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

Pathway 1.2A
Community 1.2 to 1.1

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

Pathway 1.3A
Community 1.3 to 1.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest and/or prescribed burning occurring at relatively frequent intervals (every 3 to 5 years) and a return to normal disturbance regime levels may convert this plant community to the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase.

State 2
Degraded State

The Degraded State is the result of heavy, continuous grazing, and the absence of periodic fire due to fire suppression. This state is dominated by threadleaf sedge, scribner panicum, and blue grama. The blue grama can form a sod-like layer that effectively blocks introduction of other plants into the system. Taller warm-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 restore the degraded state.

Community 2.1
Threadleaf Sedge-Scribner Panicum-Blue Grama

This plant community evolved under heavy, continuous season grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and five percent shrubs. Dominant grasses typically included threadleaf sedge, Scribner panicum, and blue grama. Grasses of secondary importance included little bluestem and needle and thread. Forbs commonly found in this plant community included cudweed sagewort, green sagewort (*Artemisia campestris*), and western yarrow. This vegetation state was very resistant to change. The herbaceous species present were well adapted to grazing. This plant community was less productive than other phases. The thick sod prevented other species from getting established due to decreased infiltration and increased runoff.

Figure 17. Plant community growth curve (percent production by month). SD0213, Till Plains, cool-season/warm-season codominant.. Cool-season, warm-season codominant..

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

State 3
Native/Invaded State

This state represents the range of variability that exists with higher levels of grazing management, but in the absence of periodic fire due to fire suppression. The Native/Invaded State is dominated by cool- 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 cool-season species can decline and a corresponding increase in short statured grass will occur.

Community 3.1

Big Bluestem-Needle and Thread-Switchgrass

This plant community phase is similar to the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase, but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses include big bluestem, porcupinegrass, needleandthread, switchgrass, little bluestem, and prairie sandreed. Other grass or grass-like species include blue grama, threadleaf sedge, Indiangrass, sideoats grama, switchgrass, prairie dropseed, and Kentucky bluegrass. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Figure 18. Plant community growth curve (percent production by month). SD0214, Till Plains, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

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

Community 3.2
Little Bluestem-Needle and Thread-Kentucky Bluegrass

This plant community is a result of heavy, continuous grazing, continuous season-long grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 80 percent grasses and grass-like species, 15 percent forbs, and five percent shrubs. Dominant grasses include little bluestem, needle and thread, Kentucky bluegrass, prairie sandreed, threadleaf sedge, and blue grama. Grasses of secondary importance include sideoats grama, porcupinegrass, and sand dropseed. Forbs commonly found in this plant community include cudweed sagewort, prairie coneflower, and western yarrow. When compared to the 1.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase, threadleaf sedge, needle and thread, and blue grama have increased. Big bluestem, little bluestem, and porcupinegrass have decreased, and production of mid- and tall warm-season grasses has also been reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1833	2521	3021
Forb	129	291	516
Shrub/Vine	56	102	163
Total	**2018**	**2914**	**3700**

Figure 20. Plant community growth curve (percent production by month). SD0213, Till Plains, cool-season/warm-season codominant.. Cool-season, warm-season codominant..

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

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 will shift this community to the 3.2 Little Bluestem-Needle and Thread-Kentucky

Bluegrass Plant Community Phase.

Pathway 3.2A
Community 3.2 to 3.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing will convert this plant community to the 3.1 Big Bluestem-Needle and Thread-Switchgrass Plant Community Phase.

State 4
Invaded State

The Invaded State is the result of invasion and dominance by introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth bromegrass, and an increasing thatch layer that effectively blocks introduction of other plants into the system. Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is also impaired and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns, thereby shifting competitive advantage to shade tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift exploits the soil microclimate, encouraging growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies indicate this threshold exists when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the composition. Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch will not result in more than a very short term reduction of Kentucky bluegrass. These events may reduce the dominance of Kentucky bluegrass, but due to the large amount of rhizomes in the soil, there is no opportunity for the native species to establish before Kentucky bluegrass rebounds.

Community 4.1
Smooth Bromegrass-Kentucky Bluegrass

This plant community phase is a result of extended periods of nonuse and no fire. It is characterized by an abundance of smooth bromegrass and Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface and eventually a thatch-mat layer may develop at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. When dominated by smooth bromegrass, infiltration is moderately reduced and runoff is moderate. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short, as these cool-season species mature rapidly. Energy capture is also reduced.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2460	3192	3867
Forb	163	269	415
Shrub/Vine	67	126	202
Total	**2690**	**3587**	**4484**

Figure 22. Plant community growth curve (percent production by month). SD0211, Till Plains, cool-season dominant.. Cool-season dominant..

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

Community 4.2

Kentucky Bluegrass-Threadleaf Sedge

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, threadleaf sedge, and blue grama. The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and a thatch-mat layer often develops at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1222	1950	2628
Forb	106	224	387
Shrub/Vine	17	67	123
Total	**1345**	**2241**	**3138**

Figure 24. Plant community growth curve (percent production by month). SD0211, Till Plains, cool-season dominant.. Cool-season dominant..

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

Community 4.3
Annual Pioneer-Perennial Pioneer

This plant community developed under continuous, heavy grazing or other excessive disturbances (e.g., heavy use areas, defoliation by rodents, etc.). The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and zero to five percent shrubs. The species present in this phase are highly variable but often include non-native invasive and early seral species. Plant diversity is low (plant richness may be high but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites.

Pathway 4.1A
Community 4.1 to 4.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation will shift this community to the 4.2 Kentucky Bluegrass-Threadleaf Sedge Plant Community Phase.

Pathway 4.2A
Community 4.2 to 4.1

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

Conservation practices

Prescribed Grazing

Pathway 4.3A
Community 4.3 to 4.2

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

Conservation practices

Integrated Pest Management (IPM)

State 5
Conifer/Invaded State

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

Community 5.1
Eastern Red Cedar-Rocky Mountain Juniper/Needleandthread

This plant community evolved due to the invasion of conifers, such as eastern red cedar and Rocky Mountain juniper. This phase was a result of the absence of periodic fire. These events may cause a reduction in warm-season grasses and an increase in cool-season grasses and allow for the encroachment of conifers. The potential plant community is made up of approximately 50 percent grasses and grass-like species, 10 percent forbs, 10 percent shrubs, and 30 percent trees. Dominant grasses and grass-likes include big bluestem, needleandthread, prairie sandreed, and switchgrass. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses increase. Forbs will be diverse. Trees species will include eastern red cedar and Rocky Mountain juniper. When compared to the 1.1 Big Bluestem-Needleandthread-Switchgrass Plant Community, coniferous trees have increased significantly and herbaceous component has decreased. This plant community is susceptible to the encroachment of eastern red cedar and Rocky Mountain juniper.

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

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing or non-use and/or no surface fire for extended periods of time (typically for 10 or more years). When compared to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Needleandthread Plant Community, the amount of nonnative invasive cool-season grasses such as Kentucky bluegrass and smooth bromegrass have increased significantly. It is characterized by a dominance of Kentucky bluegrass, smooth bromegrass, threadleaf sedge, and blue grama. The dominance of Kentucky bluegrass is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and a thatch-mat layer often develops at the surface. Production is limited to the sod forming species. The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Infiltration continues to decrease and runoff increases, energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominate species. Biological activity in the soil is likely reduced significantly in this phase.

Community 5.3
Eastern Red Cedar-Rocky Mountain Juniper

This plant community phase is a result of no surface fire for extended periods of time (typically for 10 or more years). Coniferous trees have increased significantly, and the herbaceous component has decreased. With the dominance of the coniferous trees such as eastern red cedar and Rocky Mountain juniper, the canopy covers the area and grass species are unable to survive. Grass production for livestock is severely limited. Prescribed burning before the juniper species reach maturity and are still susceptible to fire (< 5 foot in height), or mechanical brush management can be used to maintain or recover 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

Pathway 5.1A
Community 5.1 to 5.2

Non-use 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 shift this plant community to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase.

Pathway 5.2A
Community 5.2 to 5.3

no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will shift this plant community to the 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase.

State 6
Crop Production State

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

Community 6.1
Annual crops

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

Transition T1A
State 1 to 2

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

Transition T1B
State 1 to 3

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

Transition T1C
State 1 to 5

No surface fire for extended periods of time (typically for 10 or more years causing litter levels to become high enough to reduce native grass vigor, diversity, and density) and invasion of conifer will move this state to the 5.1 Eastern Red Cedar-Rocky Mountain Juniper/Needle and Thread Plant Community Phase within the

Conifer/Invaded State (State 5).

Transition T1D
State 1 to 6

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

Transition T2A
State 2 to 6

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

Transition T3A and T3B
State 3 to 4

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years causing litter levels to become high enough to reduce native grass vigor, diversity, and density) will move this state over a threshold 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 move this state over a threshold to the 4.2 Kentucky Bluegrass-Threadleaf Sedge Community Phase within the Invaded State (State 4). Grazing repeatedly in the early growing season can expedite this shift by causing mechanical disturbance due to trampling.

Transition T3C
State 3 to 6

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

Restoration pathway T4A
State 4 to 3

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this plant community phase over a threshold to the Native/Invaded State (State 3).

Conservation practices

Prescribed Grazing

Transition T4C
State 4 to 5

No surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and invasion of conifer will likely lead this state over a threshold leading to the 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5).

Transition T4B
State 4 to 6

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

Restoration pathway T5A
State 5 to 1

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

Restoration pathway T5B and T5D
State 5 to 3

Brush management which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this 5.2 Eastern Red Cedar-Rocky Mountain Juniper/Kentucky Bluegrass Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Native/Invaded State (State 3). Brush management which would include the mechanical removal of the conifers, coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels may lead this 5.3 Eastern Red Cedar-Rocky Mountain Juniper Plant Community Phase within the Conifer/Invaded State (State 5) over a threshold to the Native/Invaded State (State 3).

Restoration pathway T5C
State 5 to 4

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

Transition T5E
State 5 to 6

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

Restoration pathway T6A
State 6 to 3

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

Restoration pathway T6B and T6C
State 6 to 4

Seeding may lead this Crop Production State (State 6) over a threshold to the Invaded State (State 4). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.3 Annual Pioneer-Perennial Pioneer Plant Community Phase.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-season Grasses**			785–2158	
	big bluestem	ANGE	*Andropogon gerardii*	392–1373	–
	sand bluestem	ANHA	*Andropogon hallii*	0–785	–

	prairie sandreed	CALO	*Calamovilfa longifolia*	118–588	–
	switchgrass	PAVI2	*Panicum virgatum*	196–588	–
	Indiangrass	SONU2	*Sorghastrum nutans*	39–392	–
2	**Mid Warm-season Grasses**			392–785	
	little bluestem	SCSC	*Schizachyrium scoparium*	196–785	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–196	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	39–196	–
3	**Cool-season Bunchgrasses**			196–588	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	78–588	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	78–588	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–118	–
4	**Short Warm-season Grasses**			78–196	
	blue grama	BOGR2	*Bouteloua gracilis*	39–196	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–118	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	39–78	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–39	–
	threeawn	ARIST	*Aristida*	0–39	–
5	**Other Native Grasses**			39–196	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–196	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–118	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–118	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	39–118	–
6	**Grass-likes**			39–196	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–196	–
	threadleaf sedge	CAFI	*Carex filifolia*	39–196	–
Forb					
7	**Forbs**			196–392	
	Forb, native	2FN	*Forb, native*	39–157	–
	field sagewort	ARCA12	*Artemisia campestris*	0–78	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	39–78	–
	purple prairie clover	DAPU5	*Dalea purpurea*	39–78	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	39–78	–
	blazing star	LIATR	*Liatris*	39–78	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	39–78	–
	western marbleseed	ONBEO	*Onosmodium bejariense var. occidentale*	0–78	–
	scurfpea	PSORA2	*Psoralidium*	39–78	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	39–78	–
	blackeyed Susan	RUHI2	*Rudbeckia hirta*	0–78	–
	goldenrod	SOLID	*Solidago*	39–78	–
	white heath aster	SYER	*Symphyotrichum ericoides*	39–78	–
	American vetch	VIAM	*Vicia americana*	39–78	–

	purple locoweed	OXLA3	*Oxytropis lambertii*	0–39	–
	beardtongue	PENST	*Penstemon*	0–39	–
	ticktrefoil	DESMO	*Desmodium*	0–39	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–39	–
	prairie fleabane	ERST3	*Erigeron strigosus*	0–39	–
	sand milkweed	ASAR	*Asclepias arenaria*	0–39	–
	milkvetch	ASTRA	*Astragalus*	0–39	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–39	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–39	–
	ragweed	AMBRO	*Ambrosia*	0–39	–
Shrub/Vine					
8	**Shrubs**			78–196	
	leadplant	AMCA6	*Amorpha canescens*	39–157	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–118	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–78	–
	rose	ROSA5	*Rosa*	39–78	–
	snowberry	SYMPH	*Symphoricarpos*	0–78	–

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-season Grasses**			58–437	
	big bluestem	ANGE	*Andropogon gerardii*	0–291	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–233	–
	sand bluestem	ANHA	*Andropogon hallii*	0–87	–
	switchgrass	PAVI2	*Panicum virgatum*	0–58	–
2	**Mid Warm-season Grasses**			146–729	
	little bluestem	SCSC	*Schizachyrium scoparium*	146–729	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–58	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–29	–
3	**Cool-season Bunchgrasses**			146–583	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	146–583	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–146	–
4	**Short Warm-season Grasses**			87–291	
	blue grama	BOGR2	*Bouteloua gracilis*	58–291	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–146	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	29–117	–
	threeawn	ARIST	*Aristida*	0–117	–
5	**Other Native Grasses**			29–146	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–146	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–117	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–117	–
	prairie junegrass	KOMA	*Koeleria macrantha*	29–58	

	prairie junegrass	KOMA	*Koeleria macrantha*	29–58	–
6	**Grass-likes**			58–291	
	threadleaf sedge	CAFI	*Carex filifolia*	58–233	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–146	–
7	**Non-Native Grasses**			146–437	
	Kentucky bluegrass	POPR	*Poa pratensis*	146–437	–
	smooth brome	BRIN2	*Bromus inermis*	0–175	–
Forb					
8	**Forbs**			146–437	
	field sagewort	ARCA12	*Artemisia campestris*	29–146	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	29–117	–
	goldenrod	SOLID	*Solidago*	29–117	–
	white heath aster	SYER	*Symphyotrichum ericoides*	29–117	–
	Forb, introduced	2FI	*Forb, introduced*	29–117	–
	Forb, native	2FN	*Forb, native*	0–87	–
	scurfpea	PSORA2	*Psoralidium*	29–87	–
	ragweed	AMBRO	*Ambrosia*	29–87	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	29–58	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–29	–
	American vetch	VIAM	*Vicia americana*	0–29	–
	milkvetch	ASTRA	*Astragalus*	0–29	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–29	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–29	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–29	–
	blazing star	LIATR	*Liatris*	0–29	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–29	–
	western marbleseed	ONBEO	*Onosmodium bejariense var. occidentale*	0–29	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–29	–
Shrub/Vine					
9	**Shrubs**			58–146	
	prairie sagewort	ARFR4	*Artemisia frigida*	29–117	–
	snowberry	SYMPH	*Symphoricarpos*	0–87	–
	rose	ROSA5	*Rosa*	29–58	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–58	–
	leadplant	AMCA6	*Amorpha canescens*	0–29	–

Table 11. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid Warm-season Grasses**			0–179	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–179	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–36	–
2	**Cool-season Bunchgrasses**			0–359	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–359	–
3	**Short Warm-season Grasses**			36–179	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	36–179	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–143	–
	threeawn	ARIST	*Aristida*	0–108	–
4	**Other Native Grasses**			0–179	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–143	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–72	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–72	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–72	–
5	**Grass-likes**			0–179	
	threadleaf sedge	CAFI	*Carex filifolia*	0–179	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
6	**Non-Native Grasses**			1076–2690	
	smooth brome	BRIN2	*Bromus inermis*	359–2152	–
	Kentucky bluegrass	POPR	*Poa pratensis*	359–1793	–
Forb					
7	**Forbs**			179–359	
	Forb, introduced	2FI	*Forb, introduced*	36–215	–
	ragweed	AMBRO	*Ambrosia*	36–143	–
	field sagewort	ARCA12	*Artemisia campestris*	0–108	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–108	–
	goldenrod	SOLID	*Solidago*	36–108	–
	white heath aster	SYER	*Symphyotrichum ericoides*	36–108	–
	Forb, native	2FN	*Forb, native*	0–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–72	–
	scurfpea	PSORA2	*Psoralidium*	0–72	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–36	–
Shrub/Vine					
8	**Shrubs**			72–179	
	snowberry	SYMPH	*Symphoricarpos*	36–179	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–72	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–72	–
	rose	ROSA5	*Rosa*	36–72	–

Table 12. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid Warm-season Grasses**			0–67	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–67	–
2	**Cool-season Bunchgrasses**			0–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–112	–
3	**Short Warm-season Grasses**			112–336	
	blue grama	BOGR2	*Bouteloua gracilis*	45–336	–
	threeawn	ARIST	*Aristida*	0–112	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	22–112	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–67	–
4	**Other Native Grasses**			45–157	
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	22–157	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–157	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–112	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
5	**Grass-likes**			112–448	
	threadleaf sedge	CAFI	*Carex filifolia*	112–448	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–179	–
6	**Non-Native Grasses**			448–1121	
	Kentucky bluegrass	POPR	*Poa pratensis*	336–1121	–
	smooth brome	BRIN2	*Bromus inermis*	0–179	–
Forb					
7	**Forbs**			112–336	
	Forb, introduced	2FI	*Forb, introduced*	22–179	–
	field sagewort	ARCA12	*Artemisia campestris*	22–157	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	22–112	–
	goldenrod	SOLID	*Solidago*	22–112	–
	ragweed	AMBRO	*Ambrosia*	22–112	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	22–67	–
	white heath aster	SYER	*Symphyotrichum ericoides*	22–67	–
	Forb, native	2FN	*Forb, native*	0–45	–
	scurfpea	PSORA2	*Psoralidium*	0–22	–
Shrub/Vine					
8	**Shrubs**			22–112	
	prairie sagewort	ARFR4	*Artemisia frigida*	22–112	–
	snowberry	SYMPH	*Symphoricarpos*	0–45	–
	rose	ROSA5	*Rosa*	0–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–22	–

Animal community

The following table lists annual, suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this ES description). Because of this, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity. Stocking rates are calculated using Animal-Unit-Month (AUM), which is the amount of air-dry forage required to feed a cow, with or without calf, for one month.

Bluestem/Needlegrass/Switchgrass (1.1 & 3.1)
Average Annual Production (lbs./acre, air-dry): 3,500
Stocking Rate* (AUM/acre): 0.96

Little Bluestem/Needleandthread/Kentucky Bluegrass (3.2)
Average Annual Production (lbs./acre, air-dry): 2,600
Stocking Rate* (AUM/acre): 0.71

Smooth Bromegrass/Kentucky Bluegrass (4.1)
Average Annual Production (lbs./acre, air-dry): 3,200
Stocking Rate* (AUM/acre): 0.88

Kentucky Bluegrass/Sedge (4.2)
Average Annual Production (lbs./acre, air-dry): 2,000
Stocking Rate* (AUM/acre): 0.55

Annual/Pioneer, Non-Native Perennial (4.3)
Average Annual Production (lbs./acre, air-dry): 1,000
Stocking Rate* (AUM/acre): 0.27

*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 B, with some soils in hydrologic group A. Infiltration and runoff potential for this site varies from moderate to 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 an area where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, bluegrass, 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 variety of plants

that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

Seed harvest of native plant species can provide additional income on this site.

Other information

Ecological Site Correlation Issues and Questions:

• Reference and alternative states within the state and transition model are may not be fully documented and may require additional field sampling for refinement.

Inventory data references

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.

Data Source Sample Period State County
None

Other references

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USDA, NRCS. National Soil Information System, Information Technology Center, Fort Collins, CO. http://nasis.nrcs.usda.gov

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

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	David Schmidt, Tim Nordquist, Stan Boltz
Contact for lead author	
Date	12/07/2004
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

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

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground less than 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 5-6. Typically high root content. 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.

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

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

    Dominant: Tall warm-season rhizomatous grass >>

    Sub-dominant: Mid warm-season grasses > mid and tall cool-season bunchgrasses >

    Other: Forbs > short warm-season grasses = short grass-like species = shrubs > 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):** 70-80%, roughly 0.5 inch thick or less. Litter cover is in contact with soil surface.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Production ranges from 2,500-4,500 lbs./acre (air-dry weight). Reference value production is 3,500 lbs./acre (air-dry weight).

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

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