USDA Natural Resources Conservation Service

Ecological site R102AY004SD
Wet Meadow

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General information

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

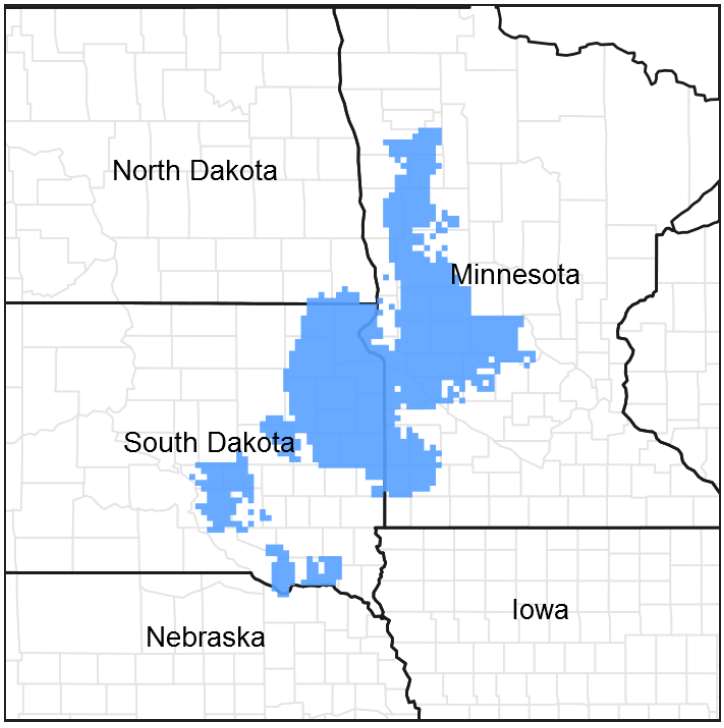


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 102A–Rolling Till Prairie

The Rolling Till Prairie (102A) is located within the Central Feed Grains and Livestock Land Resource Region. It spans 3 states (Minnesota 58 percent, South Dakota 42 percent,

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

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

Classification relationships

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

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

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

Ecological site concept

The Wet Meadow ecological site typically occurs in a basin or closed depression, and receives water directly from precipitation, surface overland flow, and groundwater discharge. Soils are poorly drained and formed in local alluvium. Permeability is very slow due to the clayey subsoil and the site will pond water 4 to 8 weeks in the spring of the year. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship. Vegetation in the Reference State is codominated by grass-likes, warm-season, and cool-season grasses including woolly sedge, reedgrasses, and prairie cordgrass as well as switchgrass, fowl bluegrass, and a variety of other sedges and rushes. Key forbs include Rydberg’s sunflower, Canada goldenrod, Indian hemp, and

cinquefoil. Non-native species such as reed canarygrass and creeping meadow foxtail may invade due to change in disturbance regime.

Associated sites

R102AY001SD	**Shallow Marsh** These sites occur in a basin or closed depression. Soils are very poorly drained and the site will pond water until early summer in most years. The central concept soil series is Parnell and Oldham, but other series are included.
R102AY003SD	**Subirrigated** These sites occur in drainageways. Soils are somewhat poorly drained which have a water table within 2 to 5 feet of the soil surface that persists longer than the wettest part of the growing season typically until the month of August. The central concept soil series is Badger, but other series are included.
R102AY006SD	**Limy Subirrigated** These sites occur along the edges of drainageways. Soils are somewhat poorly drained which have a water table within 2 to 5 feet of the soil surface that persists longer than the wettest part of the growing season typically until the month of August. Soils will effervesce with acid at or near the surface. The central concept soil series is Cubden, Hamerly, McKranz, but other series are included.
R102AY020SD	**Loamy Overflow** These sites occur in upland swales. Soils are moderately well drained which have water flow into and over/through the site. The central concept soil series is Aastad, Brookings, Svea, and Waubay but other series are included.

Similar sites

R102AY001SD	**Shallow Marsh** The Shallow Marsh site is in a similar landscape position, but the site ponds water until early summer in most years. A Shallow marsh site will have less prairie cordgrass and higher production than a wet meadow.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex pellita* (2) *Spartina pectinata*

Physiographic features

The Wet Meadow ecological site typically occurs in a basin or closed depression, and receives water directly from precipitation, surface overland flow, and groundwater

discharge.

Table 2. Representative physiographic features

Landforms	(1) Basin > Closed depression (2)
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	305–610 m
Slope	0–1%
Ponding depth	0–30 cm
Water table depth	23–76 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 102A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

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

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Greenup of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	117-129 days
Freeze-free period (characteristic range)	139-152 days
Precipitation total (characteristic range)	635-711 mm
Frost-free period (actual range)	109-132 days
Freeze-free period (actual range)	135-159 days
Precipitation total (actual range)	610-737 mm
Frost-free period (average)	122 days
Freeze-free period (average)	146 days
Precipitation total (average)	660 mm

Climate stations used

- (1) FOSSTON 1 E [USC00212916], Fosston, MN
- (2) MAHNOMEN [USC00215012], Mahnomen, MN
- (3) ROTHSAY [USC00217149], Rothsay, MN
- (4) WADENA 3 S [USC00218579], Deer Creek, MN
- (5) FERGUS FALLS [USC00212768], Fergus Falls, MN
- (6) ORWELL DAM [USC00216228], Fergus Falls, MN
- (7) DALTON 3S [USC00212015], Dalton, MN
- (8) ALEXANDRIA MUNI AP [USW00014910], Alexandria, MN
- (9) MELROSE [USC00215325], Melrose, MN
- (10) GLENWOOD 2 WNW [USC00213174], Glenwood, MN
- (11) MORRIS WC EXP STN [USC00215638], Hancock, MN
- (12) ARTICHOKE LAKE [USC00210287], Correll, MN
- (13) NEW LONDON [USC00215842], New London, MN
- (14) MONTEVIDEO 1 SW [USC00215563], Dawson, MN
- (15) SISSETON MUNI AP [USW00094993], Sisseton, SD
- (16) SISSETON [USC00397742], Sisseton, SD
- (17) BROWNS VALLEY [USC00211063], Beardsley, MN
- (18) WILMOT [USC00399337], Wilmot, SD
- (19) MILBANK 4 NW [USC00395536], Milbank, SD
- (20) BENSON [USC00210667], Benson, MN
- (21) MILAN 1 NW [USC00215400], Milan, MN

Influencing water features

Soil features

The Wet Meadow site typically occurs in a basin or closed depression, and receives water directly from precipitation, surface overland flow, and groundwater discharge. Soils are poorly drained and formed in local alluvium. Permeability is very slow and the site will

pond water 4 to 8 weeks in the spring of the year. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship. The central concept soil series is Tonka, but other series are included.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Poorly drained
Permeability class	Very slow
Soil depth	203 cm
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	17.78–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–2
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–8%
Subsurface fragment volume >3" (Depth not specified)	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 Woolly Sedge-Northern Reedgrass-Prairie Cordgrasss Plant Community Phase. This community phase and the Reference State have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily

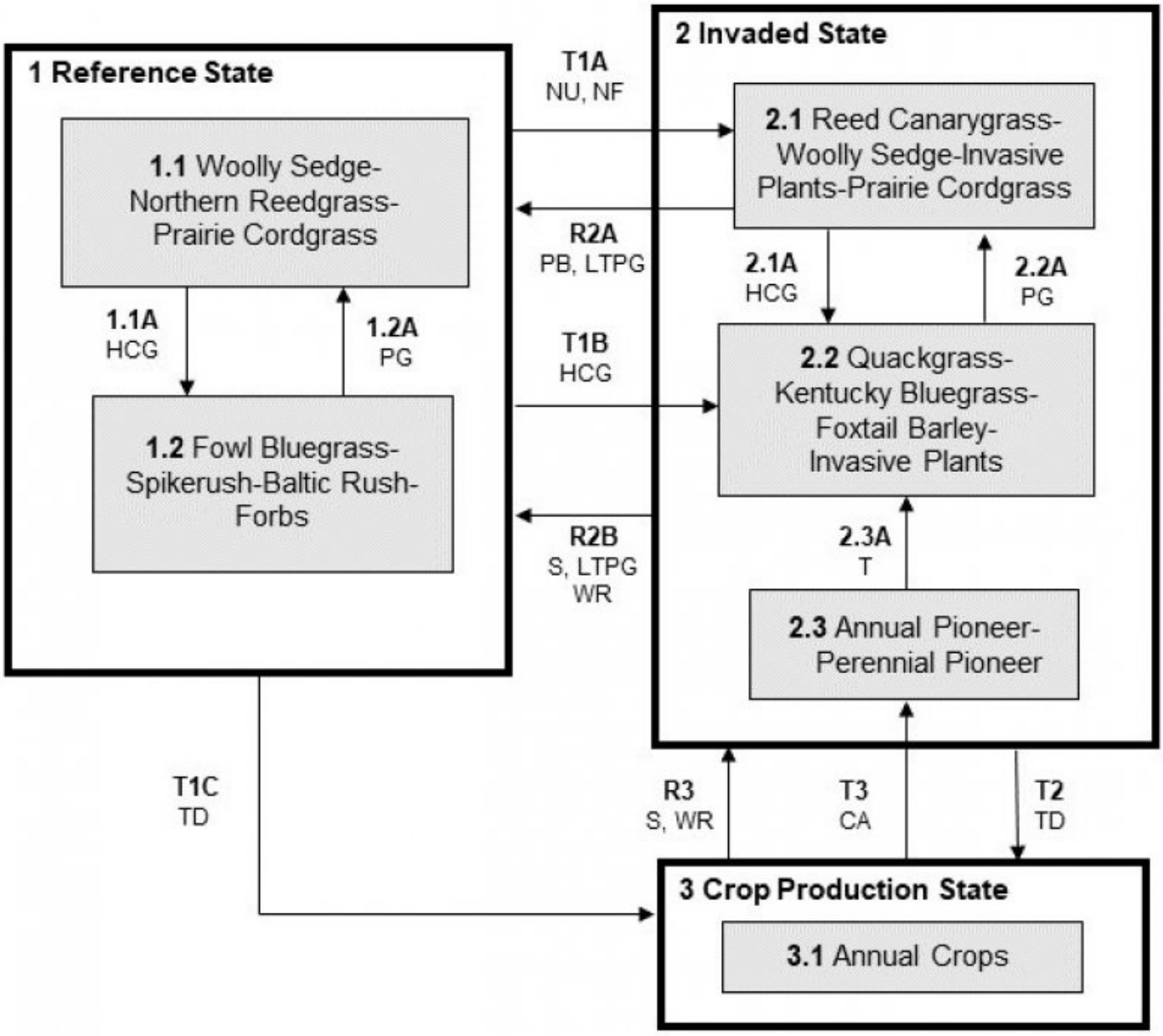
grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered.

This ecological site (ES) has been grazed by domestic livestock since introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have changed the disturbance regime of this site. Heavy continuous grazing without adequate recovery periods following each grazing occurrence causes this site to depart from the Reference State. Species such as fowl bluegrass (*Poa palustris*), spikerush (Eleocharis), and Baltic rush (Juncus balticus) will initially increase. Prairie cordgrass and northern reedgrass will decrease in frequency and production. Continued heavy grazing eventually causes quackgrass (*Elymus repens*), foxtail barley (*Hordeum jubatum*), Kentucky bluegrass (*Poa pratensis*), spikerush and unpalatable forbs such as curly dock (*Rumex crispus*) to increase and dominate.

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

Wet Meadow – R102AY004SD



LEGEND
Wet Meadow – R102AY004SD

CA – Cropped and abandoned
HCG – Heavy continuous grazing
LTPG – Long-term prescribed grazing
NU – Non-use
NF – No fire
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding
T – Time w/wo disturbances
TD – Tillage, Artificial drainage
WR – Wetland restoration

Code	Process
T1A	No use, no fire
T1B	Heavy continuous grazing
T1C	Tillage, artificial drainage (surface and subsurface)
T2	Tillage, artificial drainage (surface and subsurface)
T3	Abandonment of cropping
1.1A	Heavy continuous grazing
1.2A	Prescribed grazing with recovery periods
2.1A	Heavy continuous grazing
2.2A	Prescribed grazing with recovery periods
2.3A	Time w/wo disturbances
R2A	Long term prescribed grazing, prescribed burning
R2B	Long term prescribed grazing, seeding, wetland restoration
R3	Seeding, wetland restoration

State 1
Reference State

The Reference State represents the natural range of variability that dominates the dynamics of this ES. This state is typically dominated by cool-season grass and grass-like species. Before European settlement, 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 and ponding frequency and duration. Frequent surface fires (3 to 5 years) and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Today, the primary disturbance is from a lack of fire, concentrated livestock grazing, and weather fluctuations. Species that are desirable for livestock and wildlife can decline and a corresponding increase in less desirable species will occur.

Community 1.1
Woolly Sedge-Northern Reedgrass-Prairie Cordgrass

Interpretations are based primarily on the 1.1 Woolly Sedge-Northern Reedgrass-Prairie Cordgrass Plant Community Phase (this is also considered to be climax). This community evolved with grazing by large herbivores, occasional prairie fires, and relatively frequent ponding events and 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. The potential vegetation is about 50 percent grass-like species, 35 percent grasses, and 15 percent forbs by air-dry weight. Prairie cordgrass is the dominant tall warm-season grass occupying this plant community. Northern reedgrass is the dominant tall cool-season species. A variety of sedges and rushes occur throughout this community, as well as, switchgrass (*Panicum virgatum*) and fowl bluegrass (*Poa palustris*). Key forbs include Rydberg's sunflower (*Arnica rydbergii*), Canada goldenrod (Solidago canacensis), Indian hemp (*Apocynum cannabinum*), and cinquefoil (Potentilla). This plant community phase is diverse, stable, and productive, and is well adapted to the Northern Great Plains. The high water table supplies much of the moisture for plant growth. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly

distributed with very little movement offsite and natural plant mortality is very low. The diversity in plant species allows for the variability of both the fluctuations of water table and reoccurring ponding. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity. Transitions or pathways leading to other plant communities are as follows:

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	4242	4960	5531
Forb	241	560	1009
Shrub/Vine	–	84	185
Total	**4483**	**5604**	**6725**

Figure 9. Plant community growth curve (percent production by month). SD0208, Rolling Till Prairie, lowland cool-season/warm-season codominant.. Cool-season, warm-season codominant, lowland..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	11	19	23	20	12	6	5	0	0

Community 1.2
Fowl Bluegrass-Spikerush-Baltic Rush-Forbs

This community develops with periods of heavy continuous grazing with lack of adequate recovery periods during the growing season following periods of below normal precipitation. Lack of litter and reduced plant heights result in higher soil temperatures and reduced water infiltration rates. Recognition of this plant community will enable the land user to implement key management decisions before a significant ecological threshold is crossed. Prairie cordgrass has been reduced in this plant community but still persists. Fowl bluegrass, spikerush (Eleocharis), other grass-likes, and forbs are the dominant species. Spikerush and Baltic rush (Juncus balticus), as well as, other grass-likes have increased. Northern reedgrass has been significantly reduced. Switchgrass may be removed at this stage. Reed canarygrass (*Phalaris arundinacea*) may begin to increase significantly. Forb species would include asters (Asteraceae), goldenrod (Solidago) and cinquefoil, as well as, a possible invasion of Canada thistle (*Cirsium arvense*). Plant production and frequency have been reduced. The water cycle, nutrient cycle, and energy flow are slightly reduced but continue to function adequately.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	3166	4102	4977
Forb	196	336	532
Shrub/Vine	–	45	95
Total	**3362**	**4483**	**5604**

Figure 11. Plant community growth curve (percent production by month). SD0207, Rolling Till Prairie, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, lowland..

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

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 Fowl Bluegrass-Spikerush-Baltic Rush-Forbs Plant Community Phase.

Pathway 1.2A
Community 1.2 to 1.1

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 1.1 Woolly Sedge-Northern Reedgrass-Prairie Cordgrass Plant Community Phase. This pathway could also occur with a return to more normal precipitation levels and frequencies.

Conservation practices

Prescribed Grazing

State 2
Invaded State

This state is characterized by the dominance of invasive and/or nonnative species as a result of disturbance regimes outside the normal variability. Loss or reduction of native cool- and warm-season grasses and the forb component have negatively impacted energy flow and nutrient cycling. Infiltration is reduced and native plant mortality is increased. As

the disturbance level increases, native plant density decreases even more, giving way to annual species and invasive perennial species, as well as, an increase in bare ground.

Community 2.1
Reed Canarygrass-Woolly Sedge-Invasive Plants-Prairie Cordgrass

This plant community phase develops with a long-term lack of grazing and/or fire. Eventually litter levels become high enough to reduce native grass vigor, diversity, and density. Years of accumulated litter will tend to make this community wetter. Sedges, Baltic rush, spikerush, and bulrush (Scheonplectus) will increase. Hydrophytic forbs will also increase. Reed canarygrass often will increase to the point of dominance, while prairie cordgrass will diminish significantly. Other invasive plants such as creeping meadow foxtail (*Alopecurus arundinaceus*) may become prevalent if a seed source is present or nearby. Nutrient cycling will be greatly diminished and the energy flow will shift significantly and be reduced as well due to the increase in plant litter. Infiltration will be reduced somewhat compared to the Reference State. This plant community is somewhat resistant to change. The combination of both grazing and fire is most effective in moving this plant community towards the Reference State.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2729	3688	4584
Forb	73	235	460
Total	**2802**	**3923**	**5044**

Figure 13. Plant community growth curve (percent production by month). SD0206, Rolling Till Prairie, lowland cool-season dominant.. Cool-season dominant, lowland..

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

Community 2.2
Quackgrass-Kentucky Bluegrass-Foxtail Barley-Invasive Plants

This plant community phase occurs after prolonged heavy disturbance such as described above in the community pathway (i.e., heavy grazing pressure without adequate recovery). The prolonged nature of this disturbance will tend to increase soil temperatures and evaporation, causing this site to become drier than normal. This allows the increase/invasion of typically less hydrophytic vegetation such as quackgrass (*Elymus repens*) and Kentucky bluegrass (*Poa pratensis*). A significant amount of production and diversity has been lost when compared to the Reference State. Loss or reduction of native cool- and warm-season grasses, and the native forb component have negatively impacted

energy flow and nutrient cycling. It will take an extended period of time to restore this plant community back to the Reference State with improved management. Renovation is typically not practical but may be the only means to significantly restore the ecological processes on this site.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1670	2522	3312
Forb	123	280	499
Total	**1793**	**2802**	**3811**

Figure 15. Plant community growth curve (percent production by month). SD0206, Rolling Till Prairie, lowland cool-season dominant.. Cool-season dominant, lowland..

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

Community 2.3
Annual Pioneer-Perennial Pioneer

This plant community develops under severe disturbance, typically abandonment after cropping. The dominant vegetation includes pioneer annual or perennial grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include inland saltgrass (*Distichlis spicata*), foxtail barley (*Hordeum jubatum*), barnyardgrass (Echinochloa), quackgrass, fowl bluegrass, Kentucky bluegrass, Baltic rush, and sedges. The dominant forbs include curlycup gumweed (*Grindelia squarrosa*), Canada thistle, and other early successional species. The community is susceptible to invasion of nonnative species due to severe soil disturbances and relatively high percent of bare ground. This plant community is resistant to change, as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. Significant economic inputs, management, and time would be required to move this plant community toward a higher successional stage. Secondary succession is highly variable, depending upon availability and diversity of a viable reproductive source of higher successional species. This plant community may be renovated to improve the production capability but management changes would be needed to maintain the new plant community.

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 Quackgrass-Kentucky Bluegrass-Foxtail Barley-Invasive Plants 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 Reed Canarygrass-Woolly Sedge-Invasive Plants-Prairie Cordgrass Plant Community Phase. This pathway could also occur with a return to more normal precipitation levels and frequencies.

Pathway 2.3A
Community 2.3 to 2.2

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 2.2 Quackgrass-Kentucky Bluegrass-Foxtail Barley-Invasive Plants Plant Community Phase.

State 3
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 3.1
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 years or more) causing litter levels to become high enough to reduce native grass vigor, diversity will eventually cause a shift over a threshold leading to the 2.1 Reed Canarygrass-Woolly Sedge-Invasive Plants-Prairie cordgrass Plant Community Phase within the Invaded State (State 2). Grazing repeatedly in the early growing season can expedite this shift by

causing mechanical disturbance due to trampling. 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 eventually cause a shift over a threshold leading to the 2.2 Quackgrass-Kentucky Bluegrass-Foxtail Barley-Invasive Plants Plant Community Phase within the Invaded State (State 2). Grazing repeatedly in the early growing season can expedite this shift by causing mechanical disturbance due to trampling.

Transition T1C
State 1 to 3

Tillage, Artificial drainage (surface and subsurface) will cause a shift over a threshold leading to the 3.1 Annual Crops Plant Community Phase within the Crop Production State (State 3).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning may lead this 2.1 Reed Canarygrass-Wooly Sedge-Invasive Plants-Prairie Cordgrass Plant Community Phase within the Invaded State (State 2) over a threshold to the Reference State (State 1). Seeding followed by 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 plant community phase over a threshold to the Reference State (State 1). Wetland restoration techniques may be necessary to restore biotic integrity and plant diversity and productivity.

Transition T2
State 2 to 3

Tillage, Artificial drainage (surface and subsurface) will cause a shift over a threshold leading to the 3.1 Annual Crops Plant Community Phase within the Crop Production State (State 3).

Restoration pathway R3
State 3 to 2

Wetland restoration along with seeding of perennial species adapted to the site may lead this plant community phase over a threshold to the Invaded State (State 2). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 2) and more specifically to the 2.2 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	**Grass-likes**			1121–2802	
	woolly sedge	CAPE42	*Carex pellita*	280–2242	–
	wheat sedge	CAAT2	*Carex atherodes*	280–1401	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	112–841	–
	fox sedge	CAVU2	*Carex vulpinoidea*	56–280	–
	Bicknell's sedge	CABI3	*Carex bicknellii*	56–280	–
	shortbeak sedge	CABR10	*Carex brevior*	0–280	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	56–280	–
	water sedge	CAAQ	*Carex aquatilis*	0–280	–
	spikerush	ELEOC	*Eleocharis*	56–168	–
	rush	JUNCU	*Juncus*	56–168	–
	green bulrush	SCAT2	*Scirpus atrovirens*	0–56	–
	bulrush	SCHOE6	*Schoenoplectus*	0–56	–
2	**Cool-season Grasses**			560–1961	
	northern reedgrass	CASTI3	*Calamagrostis stricta ssp. inexpansa*	280–1681	–
	reed canarygrass	PHAR3	*Phalaris arundinacea*	56–280	–
	fowl bluegrass	POPA2	*Poa palustris*	56–280	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	56–280	–
	American sloughgrass	BESY	*Beckmannia syzigachne*	56–280	–
	prairie wedgescale	SPOB	*Sphenopholis obtusata*	0–168	–
3	**Warm-season Grasses**			112–560	
	prairie cordgrass	SPPE	*Spartina pectinata*	56–280	–
	switchgrass	PAVI2	*Panicum virgatum*	0–168	–
	spiked muhly	MUGL3	*Muhlenbergia glomerata*	56–168	–

	Mexican muhly	MUME2	*Muhlenbergia mexicana*	0–112	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–56	–
Forb					
4	**Forbs**			280–841	
	Forb (herbaceous, not grass nor grass-like)	2FORB	*Forb (herbaceous, not grass nor grass-like)*	56–224	–
	Indianhemp	APCA	*Apocynum cannabinum*	56–168	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–168	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	56–112	–
	swamp milkweed	ASIN	*Asclepias incarnata*	56–112	–
	Canadian anemone	ANCA8	*Anemone canadensis*	56–112	–
	mint	MENTH	*Mentha*	56–112	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	56–112	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	56–112	–
	cinquefoil	POTEN	*Potentilla*	56–112	–
	Macoun's buttercup	RAMA2	*Ranunculus macounii*	56–112	–
	western dock	RUAQ	*Rumex aquaticus*	0–112	–
	blackeyed Susan	RUHI2	*Rudbeckia hirta*	56–112	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	56–112	–
	Rydberg's sunflower	HENUR	*Helianthus nuttallii ssp. rydbergii*	56–112	–
	blazing star	LIATR	*Liatris*	0–112	–
	giant goldenrod	SOGI	*Solidago gigantea*	56–112	–
	goldenrod	SOLID	*Solidago*	56–112	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	56–112	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	56–112	–
	Canada germander	TECA3	*Teucrium canadense*	0–56	–
	broadleaf cattail	TYLA	*Typha latifolia*	0–56	–
	northern bog violet	VINE	*Viola nephrophylla*	0–56	–
	wood lily	LIPH	*Lilium philadelphicum*	0–56	–
	American water horehound	LYAM	*Lycopus americanus*	0–56	–

	horehound				
	golden dock	RUMA4	*Rumex maritimus*	0–56	–
	blue-eyed grass	SISYR	*Sisyrinchium*	0–56	–
	white doll's daisy	BOAS	*Boltonia asteroides*	0–56	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–56	–
	Virginia strawberry	FRVI	*Fragaria virginiana*	0–56	–
Shrub/Vine					
5	**Shrubs**			0–168	
	willow	SALIX	*Salix*	0–168	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–112	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass-likes**			1569–2018	
	spikerush	ELEOC	*Eleocharis*	448–897	–
	green bulrush	SCAT2	*Scirpus atrovirens*	45–538	–
	bulrush	SCHOE6	*Schoenoplectus*	45–538	–
	rush	JUNCU	*Juncus*	224–448	–
	wheat sedge	CAAT2	*Carex atherodes*	90–448	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	45–314	–
	woolly sedge	CAPE42	*Carex pellita*	90–224	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	45–224	–
	fox sedge	CAVU2	*Carex vulpinoidea*	0–179	–
	shortbeak sedge	CABR10	*Carex brevior*	0–179	–
	water sedge	CAAQ	*Carex aquatilis*	0–135	–
	Bicknell's sedge	CABI3	*Carex bicknellii*	0–45	–
2	**Cool-season Grasses**			224–1121	
	fowl bluegrass	POPA2	*Poa palustris*	224–1121	–
	reed canarygrass	PHAR3	*Phalaris arundinacea*	90–448	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–224	–
	northern reedgrass	CASTI3	*Calamagrostis stricta ssp. inexpansa*	0–224	–

	American mannagrass	GLGR	*Glyceria grandis*	0–179	–
	foxtail barley	HOJU	*Hordeum jubatum*	0–179	–
3	**Warm-season Grasses**			90–673	
	prairie cordgrass	SPPE	*Spartina pectinata*	224–673	–
	spiked muhly	MUGL3	*Muhlenbergia glomerata*	0–224	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	90–224	–
	switchgrass	PAVI2	*Panicum virgatum*	0–90	–
4	**Non-Native Grasses**			224–673	
	creeping meadow foxtail	ALAR	*Alopecurus arundinaceus*	0–448	–
	quackgrass	ELRE4	*Elymus repens*	0–448	–
	Kentucky bluegrass	POPR	*Poa pratensis*	90–448	–
Forb					
5	**Forbs**			224–448	
	giant goldenrod	SOGI	*Solidago gigantea*	0–135	–
	goldenrod	SOLID	*Solidago*	45–135	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	45–135	–
	Forb, native	2FN	*Forb, native*	45–135	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–135	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	45–135	–
	cinquefoil	POTEN	*Potentilla*	45–135	–
	Forb, introduced	2FI	*Forb, introduced*	0–90	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	45–90	–
	mint	MENTH	*Mentha*	0–90	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–90	–
	swamp milkweed	ASIN	*Asclepias incarnata*	0–90	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	45–90	–
	broadleaf cattail	TYLA	*Typha latifolia*	0–90	–
	western dock	RUAQ	*Rumex aquaticus*	0–90	–
	blackeyed Susan	RUHI2	*Rudbeckia hirta*	0–45	–
	golden dock	RUMA4	*Rumex maritimus*	0–45	–

	blue-eyed grass	SISYR	*Sisyrinchium*	0–45	–
	Canadian anemone	ANCA8	*Anemone canadensis*	0–45	–
	Rydberg's sunflower	HENUR	*Helianthus nuttallii ssp. rydbergii*	0–45	–
	blazing star	LIATR	*Liatris*	0–45	–
	wood lily	LIPH	*Lilium philadelphicum*	0–45	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	0–45	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	0–45	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–45	–
	Macoun's buttercup	RAMA2	*Ranunculus macounii*	0–45	–
Shrub/Vine					
6	**Shrubs**			0–90	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–90	–
	willow	SALIX	*Salix*	0–45	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass-likes**			785–1569	
	wheat sedge	CAAT2	*Carex atherodes*	78–392	–
	spikerush	ELEOC	*Eleocharis*	78–392	–
	woolly sedge	CAPE42	*Carex pellita*	78–392	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	78–392	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	39–196	–
	shortbeak sedge	CABR10	*Carex brevior*	39–196	–
	rush	JUNCU	*Juncus*	39–196	–
	green bulrush	SCAT2	*Scirpus atrovirens*	0–196	–
	bulrush	SCHOE6	*Schoenoplectus*	0–196	–
	fox sedge	CAVU2	*Carex vulpinoidea*	0–157	–
	Bicknell's sedge	CABI3	*Carex bicknellii*	0–39	–
2	**Cool-season Grasses**			588–1373	
	reed canarygrass	PHAR3	*Phalaris arundinacea*	588–1177	–
	fowl bluegrass	POPA2	*Poa palustris*	78–588	–

	foxtail barley	HOJU	*Hordeum jubatum*	0–235	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–196	–
	northern reedgrass	CASTI3	*Calamagrostis stricta ssp. inexpansa*	39–196	–
	American mannagrass	GLGR	*Glyceria grandis*	0–118	–
3	**Warm-season Grasses**			78–392	
	prairie cordgrass	SPPE	*Spartina pectinata*	78–392	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–157	–
4	**Non-Native Grasses**			392–1373	
	quackgrass	ELRE4	*Elymus repens*	0–1177	–
	creeping meadow foxtail	ALAR	*Alopecurus arundinaceus*	0–981	–
	Kentucky bluegrass	POPR	*Poa pratensis*	78–588	–
Forb					
5	**Forbs**			78–392	
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–78	–
	cinquefoil	POTEN	*Potentilla*	0–78	–
	giant goldenrod	SOGI	*Solidago gigantea*	0–78	–
	goldenrod	SOLID	*Solidago*	0–78	–
	Forb, introduced	2FI	*Forb, introduced*	0–78	–
	Forb, native	2FN	*Forb, native*	0–78	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–78	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–78	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–78	–
	mint	MENTH	*Mentha*	0–39	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–39	–
	swamp milkweed	ASIN	*Asclepias incarnata*	0–39	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	0–39	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–39	–
	broadleaf cattail	TYLA	*Typha latifolia*	0–39	–
	western dock	RUAQ	*Rumex aquaticus*	0–39	–

Table 12. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass-likes**			701–981	
	spikerush	ELEOC	*Eleocharis*	140–701	–
	rush	JUNCU	*Juncus*	280–560	–
	shortbeak sedge	CABR10	*Carex brevior*	28–140	–
	fox sedge	CAVU2	*Carex vulpinoidea*	0–84	–
	woolly sedge	CAPE42	*Carex pellita*	0–56	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	0–56	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–56	–
	green bulrush	SCAT2	*Scirpus atrovirens*	0–56	–
	bulrush	SCHOE6	*Schoenoplectus*	0–56	–
2	**Cool-season Grasses**			140–560	
	foxtail barley	HOJU	*Hordeum jubatum*	140–420	–
	reed canarygrass	PHAR3	*Phalaris arundinacea*	0–280	–
	fowl bluegrass	POPA2	*Poa palustris*	0–140	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–140	–
3	**Warm-season Grasses**			28–140	
	mat muhly	MURI	*Muhlenbergia richardsonis*	28–140	–
	prairie cordgrass	SPPE	*Spartina pectinata*	0–140	–
4	**Non-Native Grasses**			420–1261	
	creeping meadow foxtail	ALAR	*Alopecurus arundinaceus*	0–981	–
	quackgrass	ELRE4	*Elymus repens*	140–981	–
	Kentucky bluegrass	POPR	*Poa pratensis*	140–701	–
Forb					
5	**Forbs**			140–420	
	Forb, introduced	2FI	*Forb, introduced*	28–224	–
	Forb, native	2FN	*Forb, native*	28–112	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	28–112	–

	smartweed		*pensylvanicum*		
	goldenrod	SOLID	*Solidago*	28–112	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	28–84	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	28–84	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–84	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	28–84	–
	giant goldenrod	SOGI	*Solidago gigantea*	0–84	–
	cinquefoil	POTEN	*Potentilla*	0–56	–
	western dock	RUAQ	*Rumex aquaticus*	0–28	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–28	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–28	–

Table 13. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Animal community

Animal Community – Grazing Interpretations
The following table lists annual, suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this ES description). Because of this, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Prairie Cordgrass/Sedge/Northern Reedgrass (1.1)
Average Annual Production (lbs./acre, air-dry) :5000
Stocking Rate* (AUM/acre): 1.37

Fowl Bluegrass/Spikerush/Baltic Rush/Forbs (1.2)
Average Annual Production (lbs./acre, air-dry) :4000
Stocking Rate* (AUM/acre): 1.10

Reed Canarygrass/Sedge/Invasive Plants/Prairie Cordgrass (2.1)

Average Annual Production (lbs./acre, air-dry) :3500
Stocking Rate* (AUM/acre): 0.96

Quackgrass/Kentucky Bluegrass/Foxtail Barley/Invasive Plants (2.2)
Average Annual Production (lbs./acre, air-dry) :2500
Stocking Rate* (AUM/acre): 0.69

Annual/Pioneer, Non-Native Perennial (2.3)
Average Annual Production (lbs./acre, air-dry) :1200
Stocking Rate* (AUM/acre): 0.33

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

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

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic groups C and D. Infiltration is typically slow to very slow and runoff potential for this site is negligible due to the concave shape of the landform this site occupies.

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

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

Data Source Sample Period State County
SCS-Range-417 (0020746039) 1985 SD Clark
NP-ESC-1 (0020746039) 2007 SD Deuel
NP-ESC-1 (0110746039) 2007 SD Deuel
NP-ESC-1 (0020846039 2008 SD Deuel

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Rangeland health reference sheet

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

Author(s)/participant(s)	David Schmidt, Tim Nordquist, Stan Boltz
Contact for lead author	
Date	12/04/2007
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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10. **Effect of community phase composition (relative proportion of different functional**

groups) and spatial distribution on infiltration and runoff: Healthy, deep rooted native grasses enhance infiltration and reduce runoff.

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

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

    Dominant: Mid & tall cool-season grass-like >> tall warm-season rhizomatous grass

    Sub-dominant: > tall cool-season rhizomatous grass > mid cool-season rhizomatous grass > forb

    Other:

    Additional:

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

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14. **Average percent litter cover (%) and depth (in):** 85-90%, roughly 1-2 inches. Litter cover is in contact with soil surface.

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

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a**

dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site: Refer to State and Local Noxious Weed List, also reed canarygrass.

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