

United States Department of Agriculture Natural Resources Conservation Service

Ecological Site Description

Site Type: Rangeland

Site Name: Shallow Gravel

Site ID: R102AY014SD

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

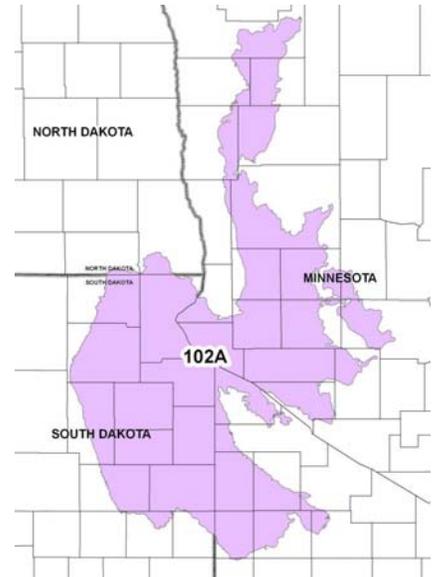
Physiographic Features

This site occurs on gently to somewhat steeply sloping uplands.

Landform: outwash plain, outwash terrace, moraine

Aspect: N/A

	<u>Minimum</u>	<u>Maximum</u>
Elevation (feet):	1,000	2,000
Slope (percent):	1	20
Water Table Depth (inches):	80	80
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):	None	None
Frequency:	None	None
Duration:	None	None
Runoff Class:	Negligible	Medium



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.

	<u>Minimum</u>	<u>Maximum</u>
Frost-free period (days):	121	152
Freeze-free period (days):	145	174
Mean Annual Precipitation (inches):	21	27

Average Monthly Precipitation (inches) and Temperature (°F):

	Precip. Min.	Precip. Max	Temp. Min.	Temp. Max.
January	0.50	0.78	-5.9	23.1
February	0.50	0.76	1.1	27.8
March	0.86	1.46	15.0	39.4
April	2.00	2.52	30.5	56.5
May	2.93	3.14	42.5	70.0
June	3.67	4.14	52.0	79.4
July	3.17	3.66	56.3	84.7
August	2.64	3.60	54.2	82.3
September	1.98	2.83	44.6	73.6
October	1.52	2.14	34.1	60.8
November	0.74	1.23	18.4	41.9
December	0.45	0.76	2.8	27.9

Climate Stations		Period	
Station ID	Location or Name	From	To
SD0281	Arlington 1 W, SD	1928	2009
MN0667	Benson, MN	1952	2009
SD1739	Clark, SD	1893	2009
MN5012	Mahnomen 1 W, MN	1927	1998
MN8323	Tracy, MN	1912	2009
SD8980	Waubay National Wildlife Refuge, SD	1952	2009

For local climate stations that may be more representative, refer to <http://www.wcc.nrcs.usda.gov>.

Riparian and Wetland Features

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

Representative Soil Features

These soils are very deep and well to somewhat excessively drained. Soil textures include moderately coarse and medium textured soils over sand or sand and gravel between the depths of 14 to 25 inches. Permeability is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate in the upper part and low to very low in the lower part. This site occurs on flats, rises, and side slopes on outwash plains and terraces. Slope ranges from 1 to 20 percent. Runoff as evidenced by patterns of rill, gully, or other water flow is negligible to low, in spite of the slopes, due to the very high intake rate of these soils. Some pedestalling of plants occurs but it is not very evident on casual observation and occurs on less than 5 percent of the plants.

These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about 15 percent. 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/or production.

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

Parent Material Kind: alluvium, outwash, glaciofluvial deposits

Parent Material Origin:

Surface Texture: loam, sandy loam

Surface Texture Modifier: none

Subsurface Texture Group: sandy

Surface Fragments ≤3" (% Cover): 5-10

Surface Fragments >3" (%Cover): 0-2

Subsurface Fragments ≤3" (% Volume): 5-40

Subsurface Fragments >3" (% Volume): 0-2

	<u>Minimum</u>	<u>Maximum</u>
Drainage Class:	somewhat excessively	somewhat excessively
Permeability Class:	moderate	moderate
Depth (inches):	80	80
Electrical Conductivity (mmhos/cm)*:	0	2
Sodium Absorption Ratio*:	0	0
Soil Reaction (1:1 Water)*:	6.1	8.4
Soil Reaction (0.1M CaCl₂)*:	NA	NA
Available Water Capacity (inches)*:	3	4
Calcium Carbonate Equivalent (percent)*:	0	15

*These attributes represent from 0-40 inches or to the first restrictive layer.

Plant Communities

Ecological Dynamics of the Site

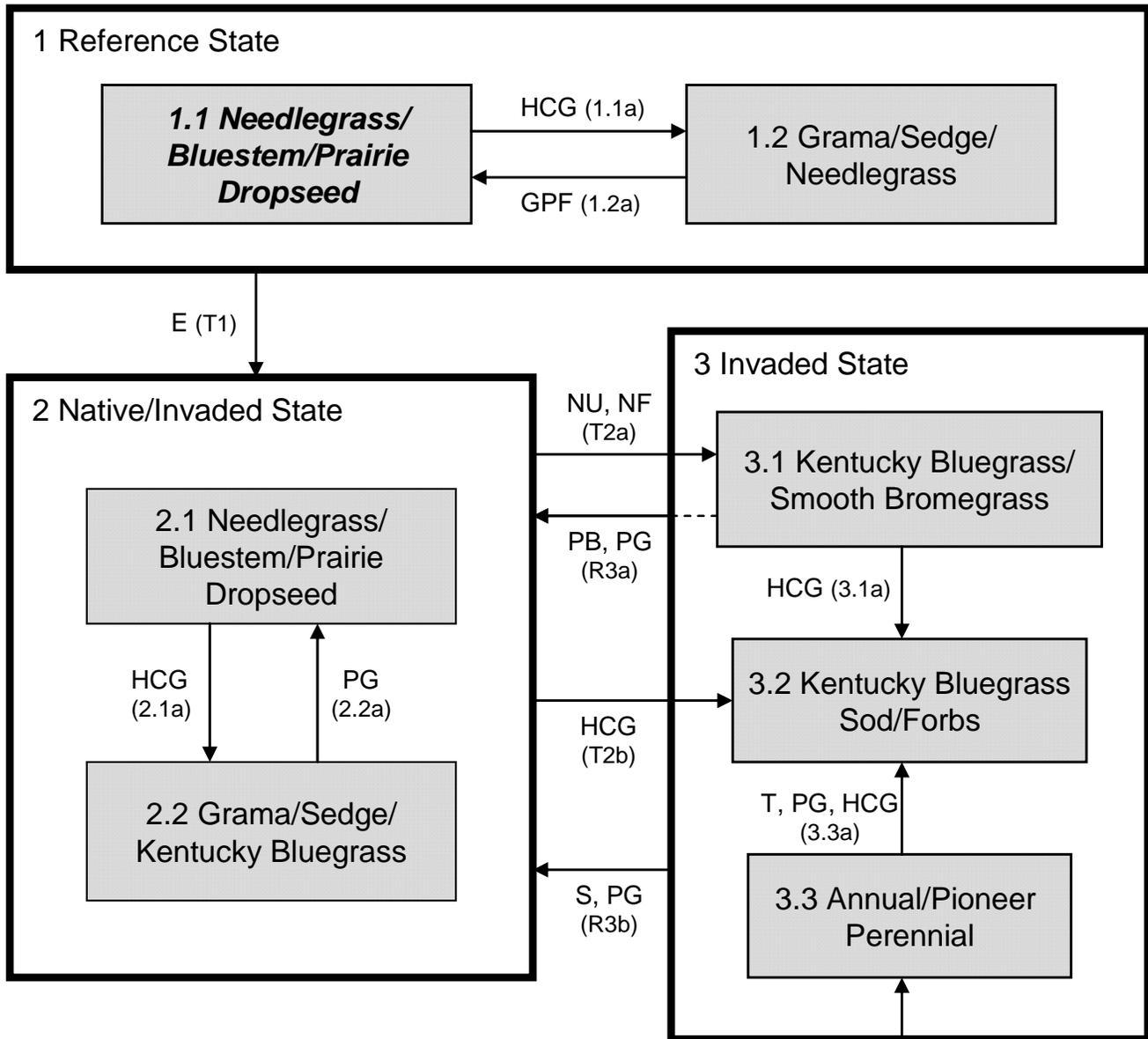
This site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire (often of light intensities), and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions describe more typical transitions that will occur, severe disturbances, such as periods of well below average precipitation, can cause significant shifts in plant communities and/or species composition.

Heavy continuous grazing (season-long grazing during the typical growing season of April through October and/or repeated seasonal grazing during the same time of year each year) without adequate recovery periods following grazing events causes departure from the Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase (2.1). Sedge and blue grama will increase and eventually develop into a sod. Little bluestem will increase initially and then begin to decrease. Needleandthread, porcupine grass, sideoats grama, big bluestem, and little bluestem will decrease in frequency and production. Extended periods of nonuse and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as Kentucky bluegrass and smooth brome grass.

Interpretations are primarily based on the 1.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase. It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

Plant Communities and Transitional Pathways



Refer to narrative for details on pathways: **CA** – Cropped, abandoned; **E** – Encroachment of introduced species; **GPF** – Grazing, precipitation, and/or fire returning to more normal disturbance regime levels and frequencies; **HCG** – Heavy continuous grazing; **NU, NF** – Non-use, no fire; **PB** – Prescribed burning; **PG** – Prescribed grazing; **S** – Seeding; **T** - Time.

Any Plant Community

Plant Community Composition and Group Annual Production

COMMON/GROUP NAME	SCIENTIFIC NAME	SYMBOL	1.1 Needlegrass/Bluestem/ Prairie Dropseed		
			Group	lbs./acre	% Comp
GRASSES & GRASS-LIKES				1800 - 2040	75 - 85
COOL-SEASON BUNCHGRASSES			1	240 - 720	10 - 30
needleandthread	Hesperostipa comata ssp. comata	HECOC8	1	120 - 720	5 - 30
porcupine grass	Hesperostipa spartea	HESP11	1	120 - 720	5 - 30
Canada wildrye	Elymus canadensis	ELCA4	1	0 - 72	0 - 3
green needlegrass	Nassella viridula	NAV14	1	0 - 72	0 - 3
MID WARM-SEASON GRASSES			2	240 - 720	10 - 30
little bluestem	Schizachyrium scoparium	SCSC	2	120 - 480	5 - 20
prairie dropseed	Sporobolus heterolepis	SPHE	2	48 - 360	2 - 15
plains muhly	Muhlenbergia cuspidata	MUCU3	2	24 - 120	1 - 5
sideoats grama	Bouteloua curtipendula	BOCU	2	24 - 120	1 - 5
TALL WARM-SEASON GRASSES			3	48 - 360	2 - 15
big bluestem	Andropogon gerardii	ANGE	3	48 - 360	2 - 15
switchgrass	Panicum virgatum	PAVI2	3	0 - 120	0 - 5
prairie sandreed	Calamovilfa longifolia	CALO	3	0 - 120	0 - 5
SHORT WARM-SEASON GRASSES			4	48 - 240	2 - 10
blue grama	Bouteloua gracilis	BOGR2	4	24 - 240	1 - 10
hairy grama	Bouteloua hirsuta	BOHI2	4	24 - 240	1 - 10
sand dropseed	Sporobolus cryptandrus	SPCR	4	0 - 72	0 - 3
threeawn	Aristida spp.	ARIST	4	0 - 48	0 - 2
GRASS-LIKES			5	48 - 240	2 - 10
threadleaf sedge	Carex filifolia	CAFI	5	48 - 168	2 - 7
other grass-likes		2GL	5	0 - 120	0 - 5
WHEATGRASS			6	0 - 120	0 - 5
slender wheatgrass	Elymus trachycaulus	ELTR7	6	0 - 120	0 - 5
western wheatgrass	Pascopyrum smithii	PASM	6	0 - 120	0 - 5
OTHER NATIVE GRASSES			7	48 - 120	2 - 5
prairie junegrass	Koeleria macrantha	KOMA	7	24 - 72	1 - 3
Wilcox panicum	Dichanthelium wilcoxianum	DIWI5	7	24 - 48	1 - 2
other grasses		2GRAM	7	0 - 72	0 - 3
FORBS			9	120 - 360	5 - 15
American pasqueflower	Pulsatilla patens ssp. multifida	PUPAM	9	0 - 48	0 - 2
American vetch	Vicia americana	VIAM	9	24 - 48	1 - 2
anemone	Anemone spp.	ANEMO	9	0 - 48	0 - 2
aromatic aster	Symphyotrichum oblongifolium	SYOB	9	0 - 48	0 - 2
cudweed sagewort	Artemisia ludoviciana	ARLU	9	24 - 48	1 - 2
cutleaf ironplant	Machaeranthera pinnatifida	MAPI	9	0 - 24	0 - 1
false boneset	Brickellia eupatorioides	BREU	9	0 - 48	0 - 2
gayfeather	Liatris spp.	LIATR	9	24 - 72	1 - 3
goldenrod	Solidago spp.	SOLID	9	24 - 48	1 - 2
green sagewort	Artemisia campestris	ARCA12	9	24 - 48	1 - 2
heath aster	Symphyotrichum ericoides	SYER	9	24 - 48	1 - 2
Lambert crazyweed	Oxytropis lambertii	OXLA3	9	0 - 24	0 - 1
milkvetch	Astragalus spp.	ASTRA	9	0 - 24	0 - 1
northern bedstraw	Galium boreale	GABO2	9	0 - 48	0 - 2
prairie coneflower	Ratibida columnifera	RACO3	9	24 - 48	1 - 2
purple coneflower	Echinacea angustifolia	ECAN2	9	24 - 72	1 - 3
purple prairie clover	Dalea purpurea	DAPU5	9	24 - 48	1 - 2
pussytoes	Antennaria spp.	ANTEN	9	0 - 24	0 - 1
scarlet gaura	Gaura coccinea	GACO5	9	24 - 48	1 - 2
scurfpea	Psoralidium spp.	PSORA2	9	24 - 48	1 - 2
stiff sunflower	Helianthus pauciflorus	HEPA19	9	24 - 48	1 - 2
western ragweed	Ambrosia psilostachya	AMPS	9	0 - 24	0 - 1
western yarrow	Achillea millefolium var. occidentalis	ACMIO	9	0 - 24	0 - 1
wild bergamot	Monarda fistulosa	MOFI	9	0 - 48	0 - 2
woolly verbena	Verbena stricta	VEST	9	0 - 48	0 - 2
native forbs		2FN	9	24 - 120	1 - 5
SHRUBS			10	48 - 240	2 - 10
cactus	Opuntia spp.	OPUNT	10	0 - 48	0 - 2
fringed sagewort	Artemisia frigida	ARFR4	10	0 - 48	0 - 2
leadplant	Amorpha canescens	AMCA6	10	24 - 120	1 - 5
rose	Rosa spp.	ROSA5	10	24 - 48	1 - 2
snowberry	Symphoricarpos spp.	SYMPH	10	0 - 72	0 - 3
other shrubs		2SHRUB	10	0 - 72	0 - 3

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1450	2016	2505
FORBS	105	240	420
SHRUBS	45	144	275
TOTAL	1600	2400	3200

This list of plants and their relative proportions are based on near normal years. Fluctuations in species composition and relative production may change from year to year dependent upon precipitation or other climatic factors. RV = Representative value.

Plant Community Composition and Group Annual Production

COMMON/GROUP NAME	SYMBOL	1.1 Needlegrass/Bluestem/ Prairie Dropseed			2.2 Grama/Sedge/ Kentucky Bluegrass			3.1 Kentucky Bluegrass/ Smooth Bromegrass			3.2 Kentucky Bluegrass Sod/Forbs		
		Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp
GRASSES & GRASS-LIKES													
1800 - 2040 75 - 85 1350 - 1530 75 - 85 1650 - 1980 75 - 90 980 - 1120 70 - 80													
COOL-SEASON BUNCHGRASSES													
needleandthread	HECOC8	1	120 - 720	5 - 30	1	36 - 270	2 - 15	1	0 - 110	0 - 5			
porcupine grass	HESP11	1	120 - 720	5 - 30	1	0 - 90	0 - 5						
Canada wildrye	ELCA4	1	0 - 72	0 - 3									
green needlegrass	NAVI4	1	0 - 72	0 - 3									
MID WARM-SEASON GRASSES													
little bluestem	SCSC	2	120 - 480	5 - 20	2	18 - 180	1 - 10	2	0 - 44	0 - 2			
prairie dropseed	SPHE	2	48 - 360	2 - 15	2	0 - 90	0 - 5						
plains muhly	MUCU3	2	24 - 120	1 - 5	2	0 - 54	0 - 3						
sideoats grama	BOCU	2	24 - 120	1 - 5	2	0 - 90	0 - 5	2	0 - 66	0 - 3	2	0 - 70	
TALL WARM-SEASON GRASSES													
big bluestem	ANGE	3	48 - 360	2 - 15	3	0 - 36	0 - 2						
switchgrass	PAV12	3	0 - 120	0 - 5	3	0 - 18	0 - 1						
prairie sandreed	CALO	3	0 - 120	0 - 5	3	0 - 36	0 - 2						
SHORT WARM-SEASON GRASSES													
blue grama	BOGR2	4	24 - 240	1 - 10	4	90 - 450	5 - 25	4	22 - 154	1 - 7	4	0 - 210	
hairy grama	BOHI2	4	24 - 240	1 - 10	4	18 - 450	1 - 25	4	0 - 88	0 - 4	4	0 - 112	
sand dropseed	SPCR	4	0 - 72	0 - 3	4	0 - 90	0 - 5	4	0 - 88	0 - 4	4	0 - 84	
threeawn	ARIST	4	0 - 48	0 - 2	4	0 - 72	0 - 4	4	0 - 22	0 - 1	4	14 - 70	
GRASS-LIKES													
threadleaf sedge	CAFI	5	48 - 168	2 - 7	5	90 - 324	5 - 18	5	44 - 220	2 - 10	5	70 - 182	
other grass-likes	2GL	5	0 - 120	0 - 5	5	0 - 126	0 - 7	5	0 - 110	0 - 5	5	0 - 70	
WHEATGRASS													
slender wheatgrass	ELTR7	6	0 - 120	0 - 5									
western wheatgrass	PASM	6	0 - 120	0 - 5	6	0 - 36	0 - 2	6	0 - 44	0 - 2			
OTHER NATIVE GRASSES													
prairie junegrass	KOMA	7	24 - 72	1 - 3	7	18 - 36	1 - 2	7	0 - 22	0 - 1	7	0 - 14	
Wilcox panicum	DIW15	7	24 - 48	1 - 2	7	18 - 36	1 - 2	7	22 - 44	1 - 2	7	0 - 14	
other grasses	2GRAM	7	0 - 72	0 - 3	7	0 - 54	0 - 3	7	0 - 66	0 - 3	7	0 - 28	
NON-NATIVE GRASSES													
Kentucky bluegrass	POPR				8	90 - 360	5 - 20	8	330 - 1210	15 - 55	8	420 - 980	
smooth bromegrass	BRIN2				8	0 - 90	0 - 5	8	330 - 1210	15 - 55	8	0 - 140	
FORBS													
American pasqueflower	PUPAM	9	0 - 48	0 - 2									
American vetch	VIAM	9	24 - 48	1 - 2	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
anemone	ANEMO	9	0 - 48	0 - 2									
aromatic aster	SYOB	9	0 - 48	0 - 2	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
cudweed sagewort	ARLU	9	24 - 48	1 - 2	9	18 - 72	1 - 4	9	22 - 66	1 - 3	9	14 - 70	
cutleaf ironplant	MAPI	9	0 - 24	0 - 1									
false boneset	BREU	9	0 - 48	0 - 2									
gayfeather	LIATR	9	24 - 72	1 - 3	9	18 - 54	1 - 3	9	22 - 44	1 - 2	9	0 - 28	
goldenrod	SOLID	9	24 - 48	1 - 2	9	18 - 54	1 - 3	9	22 - 44	1 - 2	9	14 - 70	
green sagewort	ARCA12	9	24 - 48	1 - 2	9	18 - 72	1 - 4	9	22 - 44	1 - 2	9	14 - 70	
heath aster	SYER	9	24 - 48	1 - 2	9	18 - 54	1 - 3	9	22 - 44	1 - 2	9	14 - 70	
Lambert crazyweed	OXL3	9	0 - 24	0 - 1	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
milkvetch	ASTRA	9	0 - 24	0 - 1									
northern bedstraw	GABO2	9	0 - 48	0 - 2									
prairie coneflower	RACO3	9	24 - 48	1 - 2	9	0 - 18	0 - 1	9	0 - 22	0 - 1	9	0 - 14	
purple coneflower	ECAN2	9	24 - 72	1 - 3	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
purple prairie clover	DAPU5	9	24 - 48	1 - 2	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
pussytoes	ANTEN	9	0 - 24	0 - 1	9	0 - 18	0 - 1				9	0 - 14	
scarlet gaura	GACO5	9	24 - 48	1 - 2	9	0 - 18	0 - 1	9	0 - 22	0 - 1			
scurfpea	PSORA2	9	24 - 48	1 - 2	9	18 - 54	1 - 3	9	22 - 44	1 - 2	9	0 - 42	
stiff sunflower	HEPA19	9	24 - 48	1 - 2	9	0 - 18	0 - 1						
western ragweed	AMPS	9	0 - 24	0 - 1	9	0 - 36	0 - 2	9	22 - 44	1 - 2	9	14 - 42	
western yarrow	ACMIO	9	0 - 24	0 - 1	9	0 - 36	0 - 2	9	0 - 22	0 - 1	9	14 - 42	
wild bergamot	MOFI	9	0 - 48	0 - 2	9	0 - 18	0 - 1	9	22 - 44	1 - 2			
woolly verbena	VEST	9	0 - 48	0 - 2	9	0 - 36	0 - 2	9	0 - 22	0 - 1	9	0 - 28	
native forbs	2FN	9	24 - 120	1 - 5	9	0 - 72	0 - 4	9	0 - 44	0 - 2	9	0 - 14	
introduced forbs	2FI				9	18 - 54	1 - 3	9	22 - 66	1 - 3	9	14 - 98	
SHRUBS													
cactus	OPUNT	10	0 - 48	0 - 2	10	18 - 54	1 - 3	10	0 - 44	0 - 2	10	14 - 70	
fringed sagewort	ARFR4	10	0 - 48	0 - 2	10	18 - 72	1 - 4	10	22 - 66	1 - 3	10	14 - 84	
leadplant	AMCA6	10	24 - 120	1 - 5	10	0 - 36	0 - 2	10	0 - 66	0 - 3			
rose	ROSA5	10	24 - 48	1 - 2	10	18 - 36	1 - 2	10	22 - 88	1 - 4	10	14 - 28	
snowberry	SYMPH	10	0 - 72	0 - 3	10	0 - 54	0 - 3	10	22 - 220	1 - 10	10	0 - 42	
other shrubs	2SHRUB	10	0 - 72	0 - 3	10	0 - 36	0 - 2	10	0 - 66	0 - 3			
Annual Production lbs./acre													
GRASSES & GRASS-LIKES													
1450 - 2016 - 2505 965 - 1503 - 1990 1200 - 1815 - 2365 710 - 1085 - 1525													
FORBS													
105 - 240 - 420 85 - 180 - 310 100 - 165 - 250 125 - 210 - 320													
SHRUBS													
45 - 144 - 275 50 - 117 - 200 100 - 220 - 385 65 - 105 - 155													
TOTAL													
1600 - 2400 - 3200 1100 - 1800 - 2500 1400 - 2200 - 3000 900 - 1400 - 2000													

This list of plants and their relative proportions are based on near normal years. Fluctuations in species composition and relative production may change from year to year dependent upon precipitation or other climatic factors. RV = Representative value. Refer to PLANTS database for scientific names and codes: <http://plants.usda.gov>

Plant Community and Vegetation State Narratives

Reference State (State 1)

This state represents the natural range of variability that dominated the dynamics of this ecological site (ES). This state was codominated by warm- and cool-season grasses. The primary disturbance mechanisms for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Mid- and tall-stature grass species can decline and a corresponding increase in short-stature warm-season grasses and cool-season grass-like species will occur.

1.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase

Interpretations are based primarily on the 1.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase (this is also considered to be climax). This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favored the development of this community phase dominated by mid- and tall cool- and warm-season grasses such as needleandthread, little bluestem, prairie dropseed, and blue grama. Other grass and grass-like species occurring include big bluestem, threadleaf sedge, porcupine grass, plains muhly, western wheatgrass, prairie Junegrass, and sand dropseed. The vegetation consisted of about 75 percent grass and grass-like species, 15 percent forbs, and 10 percent shrubs. A variety of leguminous and nonleguminous perennial forbs are present in minor amounts. This is a naturally nitrogen deficient plant community.

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

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD0204

Growth curve name: Rolling Till Prairie, warm-season dominant, cool-season subdominant.

Growth curve description: 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

Transitions or pathways leading to other plant communities were as follows:

- 1.1a – Heavy continuous grazing which included herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods or a combination of disturbances such as extended periods of below average precipitation coupled with periodic or chronic heavy grazing would have shifted this community to the *1.2 Grama/Sedge/Needlegrass Plant Community Phase*.

1.2 Grama/Sedge/Needlegrass Plant Community Phase

This plant community evolved under heavy continuous grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 75 percent grasses and grass-like species, 15 percent forbs, and 10 percent shrubs. Dominant grass and grass-like species included blue grama, sideoats grama, sedge, and needleandthread. Grasses of secondary importance included porcupine grass, sand dropseed, little bluestem, western wheatgrass,

hairy grama, and threeawn. Forbs commonly found in this plant community included cudweed sagewort, prairie coneflower, and western ragweed.

This plant community had similar plant composition to the 2.2 Grama/Sedge/Kentucky Bluegrass Plant Community Phase (refer to the plant composition tables). The main difference is that this plant community phase did not have the presence of nonnative invasive species such as Kentucky bluegrass and smooth brome grass.

When compared to the Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase (1.1), sedge, and blue grama increased. Big bluestem and needlegrasses 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.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD0203

Growth curve name: Rolling Till Prairie, cool-season/warm-season codominant.

Growth curve description: 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

Transitions or pathways leading to other plant communities are as follows:

- 1.2a – Grazing, precipitation, and/or fire returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the *1.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase*.

Transition from Reference State (State 1) to the Native/Invaded State (State 2)

- T1 – Encroachment of non-native grasses such as Kentucky bluegrass and smooth brome grass, and disruption of natural disturbance regimes (typically as a result of fire suppression following settlement) led this state over a threshold to the *Native/Invaded State (State 2)*.

Native/Invaded State (State2)

This state is very similar to the Reference State. The invasion of introduced cool-season sod grasses has altered the natural range of variability for this ecological site (ES). This state still has strong components of both warm- and cool-season grass species, but invasive introduced cool-season sod grasses are now present in all community phases of this state. The primary disturbance mechanisms for this state include grazing by domestic livestock and a lack of fire. Timing of fires and grazing coupled with weather events dictate the dynamics that occur within this state. The mid- and tall warm- and cool-season native grasses can decline and an increase in introduced sod grasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing.

2.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase

This community phase most closely resembles the Reference State in appearance and ecological functions (e.g., hydrologic, biotic, and soil/site stability). The warm- and cool-season codominated community is maintained with grazing systems that allow for adequate recovery periods following grazing events and potentially the combination of grazing and prescribed burning which closely mimics the natural disturbance regime.

This community phase closely resembles the 1.1 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase (refer to plant composition table and the narrative for the 1.1 plant community phase). The basic difference is the presence of minor amounts of introduced cool-season grasses and forbs. This is likely a naturally nitrogen deficient plant community. A change in the nutrient cycle on this ES possibly due to the introduction of nonnative species may be a causative factor leading to the eventual dominance of cool-season introduced grasses in the Invaded State.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during a normal year.

Growth curve number: SD0204

Growth curve name: Rolling Till Prairie, warm-season dominant, cool-season subdominant.

Growth curve description: 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

Transitions or pathways leading to other plant communities are as follows:

- 2.1a – Heavy continuous grazing which included herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic or chronic heavy grazing will shift this community to the *2.2 Grama/Sedge/Kentucky Bluegrass Plant Community Phase*.

2.2 Grama/Sedge/Kentucky Bluegrass Plant Community Phase

Grazing pressure reduces the mid/tall, less grazing tolerant species, while the shorter more grazing tolerant species increase. Litter amounts are reduced and energy capture shifts to slightly earlier in the growing season due to a decline in the later maturing native grass component and an increase in the earlier maturing grass-like and nonnative grasses. Kentucky bluegrass increases and may approach dominance in this community. Vegetation consists of about 75 percent grass and grass-like species, 15 percent forbs, and 10 percent shrubs. Blue grama, sedge, Kentucky bluegrass, and fringed sagewort are the dominant species in the early stages of this community phase. Significant grass species include Kentucky bluegrass, needleandthread, threeawn, and sand dropseed. Other grasses present include western wheatgrass, porcupine grass, and prairie Junegrass. The common forbs include cudweed sagewort, goldenrod, green sagewort, heath aster, and scurfpea. Fringed sagewort, cactus, and rose are the principal shrubs.

This community phase is often dispersed throughout the pasture, in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some areas (overgrazed) will exhibit the impacts of heavy use, while other areas (undergrazed) will have a build-up of litter and a high amount of plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. In the undergrazed patches, litter buildup reduces plant vigor and density and native seedling recruitment declines. Due to a lack of tiller stimulation and sunlight, native bunchgrasses typically develop dead centers and native rhizomatous grasses are limited to small colonies. In the overgrazed patches,

plant vigor is reduced and the competitive advantage goes towards the grazing tolerant short-statured species such as Kentucky bluegrass and sedge.

This community phase is approaching the threshold which would readily lead to the Invaded State. If management is significantly altered, this community phase can still be reverted back to the 2.1 Needlegrass/Bluestem/Prairie Dropseed community. Grazing management that allows for adequate recovery periods will tend to restore the ecological functions of this site.

Fire can play a role in reducing the introduced cool-season species. The combination of grazing and fire may be the most effective in moving this community phase towards a community resembling the interpretive plant community. Soil erosion is low. Infiltration is reduced, while runoff is increased compared to the interpretive plant community.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during a normal year.

Growth curve number: SD0203

Growth curve name: Rolling Till Prairie, cool-season/warm-season codominant.

Growth curve description: 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

Transitions or pathways leading to other plant communities are as follows:

- 2.2a – 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 Needlegrass/Bluestem/Prairie Dropseed Plant Community Phase*.

Transitions from Native/Invaded State (State 2) to the Invaded State (State 3)

- T2a – Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this state over a threshold resulting in the *3.1 Kentucky Bluegrass/Smooth Bromegrass Plant Community Phase* within the *Invaded State (State 3)*.
- T2b – Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year) will cause a shift across a threshold leading to the *3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase* within the *Invaded State (State 3)*.

Invaded State (State 3)

This state is the result of invasion and dominance of introduced cool-season sod grasses. This state is characterized by the dominance of Kentucky bluegrass and/or smooth bromegrass and an increasing thatch layer that effectively blocks introduction of other plants into the system. 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 these two species. These events may reduce the dominance of the sod grasses, but due to the large amount of rhizomes in the soil, there is no opportunity for the native species to establish and dominate before the sod grasses rebound and again dominate 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 apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in sodgrass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition.

3.1 Kentucky Bluegrass/Smooth Bromegrass Plant Community Phase

This plant community phase is a result of extended periods of non-use and no fire. It is characterized by a dominance 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. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. When dominated by smooth bromegrass, infiltration is moderately reduced and runoff is moderate. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short, as these cool-season species mature rapidly. Energy capture is also reduced.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD0201

Growth curve name: Rolling Till Prairie, cool-season dominant.

Growth curve description: 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

Transitions or pathways leading to other plant communities are as follows:

- 3.1a – Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season and at the same time of year each year) will convert this plant community to the *3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase*.

3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase

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, 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. 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.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD0201

Growth curve name: Rolling Till Prairie, cool-season dominant.

Growth curve description: 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

Transition Pathway from Any Plant Community to the 3.3 Annual/Pioneer Perennial Plant Community Phase within the Invaded State (State 3)

- T4 – Cropping followed by abandonment may lead this plant community phase over a threshold to the *Invaded State (State 3)* and more specifically to the *3.3 Annual/Pioneer Perennial Plant Community Phase*.

3.3 Annual/Pioneer Perennial Plant Community Phase

This plant community developed under continuous heavy grazing or other excessive disturbances (e.g., heavy use areas, defoliation by rodents, etc.). The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable but often include nonnative invasive and/or early seral species. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites.

Transitions or pathways leading to other states are as follows:

- 3.3a – 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 likely occur with either prescribed grazing or heavy continuous grazing and lead to the *3.2 Kentucky Bluegrass Sod/Forbs Plant Community Phase*.

Restoration Pathways from the Invaded State (State 3) to the Native/Invaded State (State 2)

- R3a – Prescribed burning, combined with high levels of prescribed grazing management (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 *Native/Invaded State (State 2)*. Pest management (i.e., herbicide) may also be needed to suppress cool-season invasive grasses. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Success depends on whether native reproductive propagules remain intact on the site.
- R3b – Seeding of native species followed by 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 *Native/Invaded State (State 2)*. Pest management (i.e., herbicide) may also be needed to suppress cool-season invasive grasses. After establishment of the native grasses, management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of the introduced sod grasses.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

-- Under Development --

Needlegrass/Bluestem/Prairie Dropseed Plant Community Phases (1.1 & 2.1):

Grass/Sedge/Kentucky Bluegrass Plant Community Phase (2.2):

Kentucky Bluegrass/Smooth Bromegrass Plant Community Phase (3.1):

Kentucky Bluegrass Sod/Forbs Plant Community Phase (3.2):

Annual/Pioneer, Non-native Perennial Plant Community Phase (3.3):

Animal Preferences (Quarterly – 1,2,3,4†)

Common Name	Cattle	Sheep	Horses	Deer	Antelope	Bison	Elk
Grasses and Grass-likes							
big bluestem	U D P D	U D U U	U D P D	U D U U	U D U U	U D P D	U D P D
blue grama	U D P U	D P P D	U D P U	D P P D	D P P D	U D P U	U D P U
Canada wildrye	U D U U	N U N N	U D U U	N U N N	N U N N	U D U U	U D U U
green needlegrass	U P U D	N P N P	U P U D	N P N P	N P N P	U P U D	U P U D
hairy grama	U D P U	D P P D	U D P U	D P P D	D P P D	U D P U	U D P U
little bluestem	U D D U	N D N N	U D D U	N D N N	N D N N	U D D U	U D D U
needleandthread	U D U D	N D N U	U D U D	N D N U	N D N U	U D U D	U D U D
plains muhly	U U D U	U U D U	U U D U	N N N N	N N N N	U U D U	U U D U
porcupine grass	U P U D	N D N U	U P U D	N D N U	N D N U	U P U D	U P U D
prairie dropseed	N U P U	N U D U	N U P U	N U D U	N U D U	N U P U	N U P U
prairie junegrass	U D U D	N D N U	U D U D	N D N U	N D N U	U D U D	U D U D
prairie sandreed	U D D U	U D U U	U D D U	U U D U	U U D U	U D D U	U D D U
sand dropseed	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N
sideoats grama	U D P U	U P D U	U D P U	U P D U	U P D U	U D P U	U D P U
slender wheatgrass	U P U U	N D U N	U P U U	N D U N	N D U N	U P U U	U P U U
switchgrass	U D D U	U D U U	U D D U	N N N N	N N N N	U D D U	U D D U
threadleaf sedge	U D U D	U P N D	U D U D	U D U D	U D U D	U D U D	U D U D
threeawn	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N
western wheatgrass	U P D U	N D N N	U P D U	N D N N	N D N N	U P D U	U P D U
Wilcox panicum	U U U U	N U N N	U U U U	N U N N	N U N N	U U U U	U U U U
Forbs							
American pasqueflower	N N N N	N U N N	N N N N	N U N N	N U N N	N N N N	N N N N
American vetch	U D P U	U P P U	U D P U	U P P U	U P P U	U D P U	U P P U
anemone	N N U N	N N U N	N N U N	N N U N	N N U N	N N U N	N N U N
aromatic aster	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
cudweed sagewort	U U U U	U U D U	U U U U	U U D U	U U D U	U U U U	U U D U
cutleaf ironplant	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
false boneset	U U D U	N D U N	U U D U	N D U N	N D U N	U U D U	N D U N
gayfeather	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
goldenrod	U U D U	N U U N	U U D U	N U U N	N U U N	U U D U	N U U N
green sagewort	U U U U	U U U U	U U U U	U U U U	U U U U	U U U U	U U U U
heath aster	U U D U	U U P U	U U D U	U U P U	U U P U	U U D U	U U P U
Lambert crazyweed	T T T T	T T T T	T T T T	T T T T	T T T T	T T T T	T T T T
milkvetch	U U U U	U D U U	U U U U	U D U U	U D U U	U U U U	U D U U
northern bedstraw	N N N N	N U D N	N N N N	N U D N	N U D N	N N N N	N N N N
prairie coneflower	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
purple coneflower	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
purple prairie clover	U D P U	U P P U	U D P U	U P P U	U P P U	U D P U	U P P U
pussytoes	U U U U	U U U U	U U U U	U U U U	U U U U	U U U U	U U U U
scarlet gaura	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
scurfpea	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
stiff sunflower	U D P U	U D P U	U D P U	U D P U	U D P U	U D P U	U D P U
western ragweed	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
western yarrow	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
wild bergamot	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
woolly verbena	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
Shrubs							
cactus	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N
fringed sagewort	U U U U	U U U U	U U U U	U D D U	U P P D	U U U U	U U U D
leadplant	U P D U	U P D U	U P D U	U P D U	U P D U	U P D U	U P D U
rose	U D D U	U D D U	U D D U	U D D U	U D D U	U D D U	U D D U
snowberry	U U U U	U U U U	U U U U	D U D D	U U U U	U U U U	D U U U

N = not used; **U** = undesirable; **D** = desirable; **P** = preferred; **T** = toxic

† Quarters: 1 – Jan., Feb., Mar.; 2 – Apr., May, Jun.; 3 – Jul., Aug., Sep.; 4 – Oct., Nov., Dec.

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.

Plant Community	Average Annual Production (lbs./acre, air-dry)	Stocking Rate* (AUM/acre)
Needlegrass/Bluestem/Prairie Dropseed (1.1 & 2.1)	2,400	0.66
Gramma/Sedge/Kentucky Bluegrass (2.2)	1,800	0.49
Kentucky Bluegrass/Smooth Bromegrass (3.1)	2,200	0.60
Kentucky Bluegrass Sod/Forbs (3.2)	1,400	0.38
Annual/Pioneer, Non-Native Perennial (3.3)	900	0.25

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

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

Hydrology Functions

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

Recreational Uses

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

Wood Products

No appreciable wood products are typically present on this site.

Other Products

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

Supporting Information

Associated Sites

Loamy (R102AY010SD), Thin Loamy (R102AY012SD), Sandy (R102AY009SD)

Similar Sites

(R102AY009SD) – Sandy [more big bluestem; higher production]

(R102AY010SD) – Loamy [more big bluestem, less needleandthread; higher production]

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.

<u>Data Source</u>	<u>Number of Records</u>	<u>Sample Period</u>	<u>State</u>	<u>County</u>
SCS-RANGE-417	5	1986 – 2006	SD	Day, Roberts

State Correlation

This site has been correlated in MN, North Dakota (ND), and South Dakota (SD) in MLRA 102A.

Field Offices/Counties

Ada, MN/Norman	Forman, ND/Sargent	Olivia, MN/Renville
Alexandria, MN/Douglas	Glenwood, MN/Pope	Ortonville, MN/Big Stone
Benson, MN/Swift	Hayti, SD/Hamlin	Pipestone, MN/Pipestone
Breckenridge, MN/Wilkin	Ivanhoe, MN/Lincoln	Redwood Falls, MN/Redwood
Britton, SD/Marshall	Long Prairie, MN/Todd	Sisseton, SD/Roberts
Brookings, SD/Brookings	Madison, MN/Lac Qui Parle	Slayton, MN/Murray
Clark, SD/Clark	Madison, SD/Lake	Wahpeton, ND/Richland
Clarkfield, MN/Yellow Medicine	Mahnomen, MN/Mahnomen	Waite Park, MN/Stearns
Clear Lake, SD/Deuel	Marshall, MN/Lyon	Watertown, SD/Codington
De Smet, SD/Kingsbury	McIntosh, MN/Polk	Webster, SD/Day
Detroit Lakes, MN/Becker	Milbank, SD/Grant	Wheaton, MN/Traverse
Elbow Lake, MN/Grant	Montevideo, MN/Chippewa	Willmar, MN/Kandiyohi
Fergus Falls, MN/Otter Tail	Moorhead, MN/Clay	Windom, MN/Cottonwood
Flandreau, SD/Moody	Morris, MN/Stevens	

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 46e – Tewaukon Dead Ice Moraine, 46k – Prairie Coteau, 46l – Prairie Coteau Escarpment, 46m – Big Sioux Basin, 46o – Minnesota River Prairie, 47b – Des Moines Lobe, 48d – Lake Agassiz Plain, 51j – Alexandria Moraines and Detroit Lakes Outwash Plain.

Other References

High Plains Regional Climate Center, University of Nebraska, 830728 Chase Hall, Lincoln, NE 68583-0728. (<http://www.hprcc.unl.edu/>)

USDA, NRCS. National Water and Climate Center, 101 SW Main, Suite 1600, Portland, OR 97204-3224. (<http://www.wcc.nrcs.usda.gov>)

USDA, NRCS. National Range and Pasture Handbook, September 1997

