

United States Department of Agriculture Natural Resources Conservation Service

Ecological Site Description

Site Type: Rangeland

Site Name: Sands

Site ID: R102AY008SD

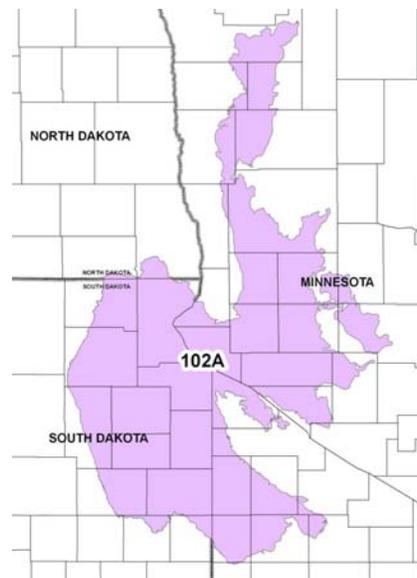
Major Land Resource Area (MLRA): 102A – Rolling Till Prairie

Physiographic Features

This site occurs on gently to moderately steeply sloping uplands.

Landform: moraine, delta plain, lake plain

Aspect: N/A



	<u>Minimum</u>	<u>Maximum</u>
Elevation (feet):	1,000	2,000
Slope (percent):	3	16
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	Low

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

The soils in this site are well to somewhat excessively well-drained and formed in eolian deposits. The surface layer is 7 to 14 inches thick. The surface texture is typically loamy fine sand or loam, while the texture of the subsurface ranges from loamy fine sand to sand. Slopes range from 3 to 16 percent. This site should show slight to no evidence of rills, wind scoured areas, or pedestalled plants. Water flow paths will typically not be present. The soil surface is stable and intact. These soils are mainly susceptible to wind erosion. The hazard of erosion increases where vegetative cover is low or in poor condition. Occasional erosion may occur with flooding events. Low available water capacity influences the soil-water-plant relationship. Loss of the soil surface layer 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: eolian deposits

Parent Material Origin:

Surface Texture: loamy fine sand, loam

Surface Texture Modifier: none

Subsurface Texture Group: sandy

Surface Fragments ≤3” (% Cover): 0

Surface Fragments >3” (%Cover): 0

Subsurface Fragments ≤3” (% Volume): 0-4

Subsurface Fragments >3” (% Volume): 0

	<u>Minimum</u>	<u>Maximum</u>
Drainage Class:	well	somewhat excessively
Permeability Class:	moderately rapid	rapid
Depth (inches):	80	80
Electrical Conductivity (mmhos/cm)*:	0	2
Sodium Absorption Ratio*:	0	0
Soil Reaction (1:1 Water)*:	6.6	8.4
Soil Reaction (0.1M CaCl₂)*:	NA	NA
Available Water Capacity (inches)*:	4	5
Calcium Carbonate Equivalent (percent)*:	0	10

*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.

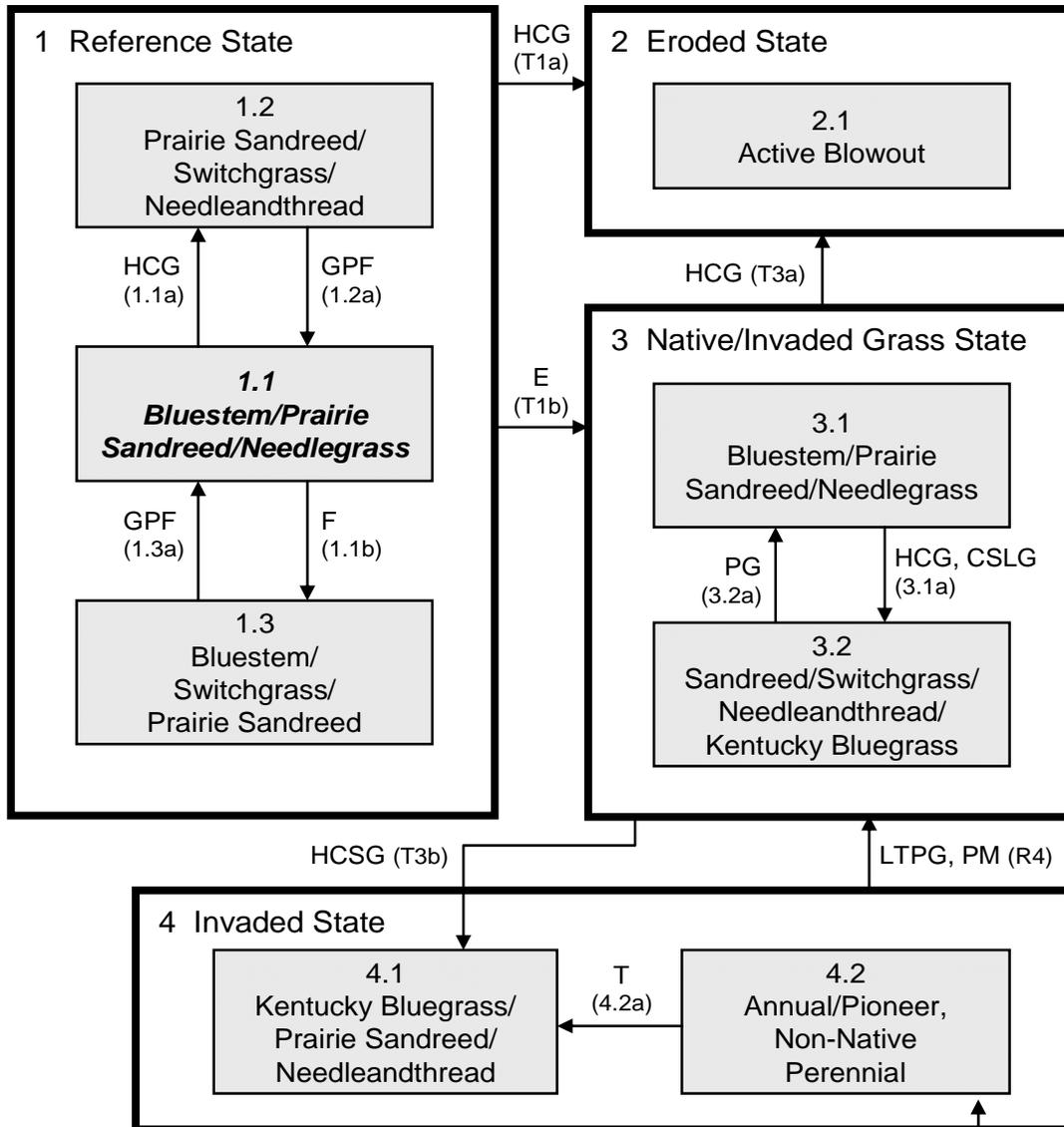
Heavy continuous grazing (season-long grazing during the typical growing season of April through October and/or repeated seasonal grazing during the same time of year each year) without adequate recovery periods following grazing events causes departure from the Bluestem/Needlegrass/Prairie Sandreed Plant Community Phase (3.1). Sedge and blue grama will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Needleandthread, porcupine grass, sideoats grama, sand 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, smooth brome grass, and cheatgrass.

Interpretations are primarily based on the 1.1 Bluestem/Needlegrass/Prairie Sandreed 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: **C** – Cropped, abandoned; **CSLG** – Continuous season-long grazing; **E** – Encroachment of introduced species; **F** – Fire; **GPF** – Grazing, precipitation, and/or fire returning to more normal disturbance regime levels and frequencies; **HCG** – Heavy continuous grazing; **HCSG** – Heavy continuous seasonal grazing; **LTPG** – Long-term prescribed grazing; **PG** – Prescribed grazing; **T** – Time, w/wo disturbances; **S** – Seeding.

Any Plant Community

Plant Community Composition and Group Annual Production

COMMON/GROUP NAME	SCIENTIFIC NAME	SYMBOL	1.1 Bluestem/Prairie Sandreed/ Needlegrass		
			Group	lbs./acre	% Comp
GRASSES & GRASS-LIKES				2805 - 3135	85 - 95
TALL WARM-SEASON GRASSES			1	825 - 1815	25 - 55
sand bluestem	Andropogon hallii	ANHA	1	495 - 1320	15 - 40
prairie sandreed	Calamovilfa longifolia	CALO	1	330 - 990	10 - 30
big bluestem	Andropogon gerardii	ANGE	1	0 - 495	0 - 15
switchgrass	Panicum virgatum	PAV12	1	165 - 660	5 - 20
Indiangrass	Sorghastrum nutans	SONU2	1	0 - 165	0 - 5
MID WARM-SEASON GRASSES			2	330 - 660	10 - 20
little bluestem	Schizachyrium scoparium	SCSC	2	330 - 660	10 - 20
sideoats grama	Bouteloua curtipendula	BOCU	2	0 - 99	0 - 3
NEEDLEGRASS			3	330 - 495	10 - 15
porcupine grass	Hesperostipa spartea	HESP11	3	165 - 495	5 - 15
needleandthread	Hesperostipa comata ssp. comata	HECOC8	3	165 - 495	5 - 15
SHORT WARM-SEASON GRASSES			4	99 - 330	3 - 10
blue grama	Bouteloua gracilis	BOGR2	4	33 - 165	1 - 5
hairy grama	Bouteloua hirsuta	BOH12	4	33 - 165	1 - 5
sand dropseed	Sporobolus cryptandrus	SPCR	4	33 - 165	1 - 5
sand paspalum	Paspalum setaceum	PASE5	4	0 - 99	0 - 3
OTHER NATIVE GRASSES			5	66 - 165	2 - 5
prairie junegrass	Koeleria macrantha	KOMA	5	33 - 99	1 - 3
Scribner panicum	Dichanthelium oligosanthos var. scribnerianum	DIOLS	5	33 - 99	1 - 3
Wilcox panicum	Dichanthelium wilcoxianum	DIW15	5	0 - 66	0 - 2
other grasses		2GRAM	5	0 - 165	0 - 5
GRASS-LIKES			6	33 - 165	1 - 5
threadleaf sedge	Carex filifolia	CAFI	6	33 - 165	1 - 5
other grass-likes		2GL	6	0 - 99	0 - 3
FORBS			8	165 - 330	5 - 10
bracted spiderwort	Tradescantia bracteata	TRBR	8	33 - 66	1 - 2
Carolina puccoon	Lithospermum carolinense	LICA13	8	0 - 66	0 - 2
cutweed sagewort	Artemisia ludoviciana	ARLU	8	33 - 66	1 - 2
cutleaf ironplant	Machaeranthera pinnatifida	MAPI	8	0 - 33	0 - 1
erigonum	Eriogonum spp.	ERIOG	8	0 - 66	0 - 2
false boneset	Brickellia eupatorioides	BREU	8	33 - 66	1 - 2
Flodman's thistle	Cirsium flodmanii	CIFL	8	0 - 33	0 - 1
gayfeather	Liatris spp.	LIATR	8	33 - 66	1 - 2
goldenrod	Solidago spp.	SOLID	8	33 - 66	1 - 2
green sagewort	Artemisia campestris	ARCA12	8	33 - 66	1 - 2
groundplum milkvetch	Astragalus crassicaarpus	ASCR2	8	0 - 33	0 - 1
heath aster	Symphotrichum ericoides	SYER	8	33 - 66	1 - 2
hoary puccoon	Lithospermum canescens	LICA12	8	33 - 66	1 - 2
horsetail	Equisetum laevigatum	EQLA	8	0 - 33	0 - 1
penstemon	Penstemon spp.	PENST	8	33 - 66	1 - 2
plains larkspur	Delphinium carolinianum ssp. virescens	DECAV2	8	0 - 33	0 - 1
prairie coneflower	Ratibida columnifera	RACO3	8	33 - 66	1 - 2
prairie groundsel	Packera plattensis	PAPL12	8	0 - 33	0 - 1
purple prairie clover	Dalea purpurea	DAPU5	8	33 - 66	1 - 2
scurfpea	Psoraleidum spp.	PSORA2	8	33 - 66	1 - 2
serrateleaf eveningprimrose	Calylophus serrulatus	CASE12	8	0 - 33	0 - 1
stiff sunflower	Helianthus pauciflorus	HEPA19	8	33 - 66	1 - 2
western ragweed	Ambrosia psilostachya	AMPS	8	0 - 33	0 - 1
woolly verbena	Verbena stricta	VEST	8	0 - 33	0 - 1
native forbs		2FN	8	28 - 84	1 - 3
SHRUBS			9	56 - 140	2 - 5
leadplant	Amorpha canescens	AMCA6	9	28 - 84	1 - 3
rose	Rosa spp.	ROSA5	9	28 - 56	1 - 2
snowberry	Symphoricarpos spp.	SYMPH	9	0 - 28	0 - 1
western sandcherry	Prunus pumila var. besseyi	PRPUB	9	0 - 28	0 - 1
other shrubs		2SHRUB	9	0 - 56	0 - 2

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	2100 -	2955	-3560
FORBS	145 -	248	-385
SHRUBS	55 -	98	-155
TOTAL	2300 -	3300	-4100

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 Bluestem/Prairie Sandreed/ Needlegrass			3.2 Sandreed/Switchgrass/Needle- andthread/Kentucky Bluegrass			4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread		
		Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp
GRASSES & GRASS-LIKES			2805 - 3135	85 - 95		2125 - 2375	85 - 95		1785 - 1995	85 - 95
TALL WARM-SEASON GRASSES		1	825 - 1815	25 - 55	1	500 - 1125	20 - 45	1	105 - 420	5 - 20
sand bluestem	ANHA	1	495 - 1320	15 - 40	1	0 - 75	0 - 3			
prairie sandreed	CALO	1	330 - 990	10 - 30	1	375 - 1000	15 - 40	1	42 - 420	2 - 20
big bluestem	ANGE	1	0 - 495	0 - 15	1	0 - 75	0 - 3			
switchgrass	PAVI2	1	165 - 660	5 - 20	1	125 - 500	5 - 20	1	0 - 210	0 - 10
Indiangrass	SONU2	1	0 - 165	0 - 5						
MID WARM-SEASON GRASSES		2	330 - 660	10 - 20	2	0 - 125	0 - 5	2		
little bluestem	SCSC	2	330 - 660	10 - 20	2	0 - 125	0 - 5			
sideoats grama	BOCU	2	0 - 99	0 - 3						
NEEDLEGRASS		3	330 - 495	10 - 15	3	250 - 500	10 - 20	3	0 - 315	0 - 15
porcupine grass	HESP11	3	165 - 495	5 - 15	3	0 - 75	0 - 3			
needleandthread	HECOC8	3	165 - 495	5 - 15	3	250 - 500	10 - 20	3	0 - 315	0 - 15
SHORT WARM-SEASON GRASSES		4	99 - 330	3 - 10	4	125 - 375	5 - 15	4	42 - 210	2 - 10
blue grama	BOGR2	4	33 - 165	1 - 5	4	50 - 250	2 - 10	4	0 - 105	0 - 5
hairy grama	BOHI2	4	33 - 165	1 - 5	4	0 - 200	0 - 8	4	0 - 42	0 - 2
sand dropseed	SPCR	4	33 - 165	1 - 5	4	50 - 250	2 - 10	4	21 - 168	1 - 8
sand paspalum	PASE5	4	0 - 99	0 - 3						
OTHER NATIVE GRASSES		5	66 - 165	2 - 5	5	25 - 200	1 - 8	5	0 - 105	0 - 5
prairie junegrass	KOMA	5	33 - 99	1 - 3	5	25 - 50	1 - 2	5	0 - 21	0 - 1
Scribner panicum	DIOLS	5	33 - 99	1 - 3	5	0 - 50	0 - 2	5	0 - 21	0 - 1
Wilcox panicum	DIWI5	5	0 - 66	0 - 2	5	0 - 25	0 - 1	5	0 - 42	0 - 2
other grasses	2GRAM	5	0 - 165	0 - 5	5	0 - 125	0 - 5	5	0 - 84	0 - 4
GRASS-LIKES		6	33 - 165	1 - 5	6	50 - 250	2 - 10	6	21 - 147	1 - 7
threadleaf sedge	CAFI	6	33 - 165	1 - 5	6	50 - 250	2 - 10	6	21 - 147	1 - 7
other grass-likes	2GL	6	0 - 99	0 - 3	6	0 - 75	0 - 3	6	0 - 42	0 - 2
NON-NATIVE GRASSES		7			7	75 - 300	3 - 12	7	525 - 1155	25 - 55
annual bromegrass	2BROMU				7	25 - 200	1 - 8	7	21 - 210	1 - 10
Kentucky bluegrass	POPR				7	50 - 300	2 - 12	7	420 - 1050	20 - 50
FORBS		8	165 - 330	5 - 10	8	125 - 250	5 - 10	8	105 - 210	5 - 10
bracted spiderwort	TRBR	8	33 - 66	1 - 2						
Carolina puccoon	LICA13	8	0 - 66	0 - 2						
cudweed sagewort	ARLU	8	33 - 66	1 - 2	8	25 - 75	1 - 3	8	21 - 105	1 - 5
cutleaf ironplant	MAPI	8	0 - 33	0 - 1						
erigonum	ERIOG	8	0 - 66	0 - 2	8	0 - 50	0 - 2	8	0 - 63	0 - 3
false boneset	BREU	8	33 - 66	1 - 2						
Flodman's thistle	CIFL	8	0 - 33	0 - 1	8	0 - 25	0 - 1			
gayfeather	LIATR	8	33 - 66	1 - 2	8	0 - 25	0 - 1			
goldenrod	SOLID	8	33 - 66	1 - 2	8	25 - 75	1 - 3	8	0 - 63	0 - 3
green sagewort	ARCA12	8	33 - 66	1 - 2	8	25 - 75	1 - 3	8	21 - 84	1 - 4
groundplum milkvetch	ASCR2	8	0 - 33	0 - 1						
heath aster	SYER	8	33 - 66	1 - 2	8	25 - 50	1 - 2	8	0 - 42	0 - 2
hoary puccoon	LICA12	8	33 - 66	1 - 2						
horsetail	EQLA	8	0 - 33	0 - 1	8	0 - 75	0 - 3	8	0 - 63	0 - 3
penstemon	PENST	8	33 - 66	1 - 2	8	0 - 25	0 - 1			
plains larkspur	DECAV2	8	0 - 33	0 - 1						
prairie coneflower	RACO3	8	33 - 66	1 - 2	8	0 - 25	0 - 1			
prairie groundsel	PAPL12	8	0 - 33	0 - 1	8	0 - 25	0 - 1			
purple prairie clover	DAPU5	8	33 - 66	1 - 2	8	0 - 25	0 - 1			
scurfpea	PSORA2	8	33 - 66	1 - 2	8	25 - 50	1 - 2	8	21 - 63	1 - 3
serrateleaf eveningprimrose	CASE12	8	0 - 33	0 - 1						
stiff sunflower	HEPA19	8	33 - 66	1 - 2						
western ragweed	AMPS	8	0 - 33	0 - 1	8	25 - 100	1 - 4	8	21 - 105	1 - 5
woolly verbena	VEST	8	0 - 33	0 - 1	8	0 - 50	0 - 2	8	0 - 42	0 - 2
native forbs	2FN	8	33 - 99	1 - 3	8	0 - 50	0 - 2	8	0 - 63	0 - 3
introduced forbs	2FI				8	0 - 75	0 - 3	8	21 - 105	1 - 5
SHRUBS		9	66 - 165	2 - 5	9	25 - 125	1 - 5	9	0 - 63	0 - 3
leadplant	AMCA6	9	33 - 99	1 - 3	9	0 - 25	0 - 1			
rose	ROSA5	9	33 - 66	1 - 2	9	0 - 25	0 - 1			
snowberry	SYMPH	9	0 - 33	0 - 1	9	0 - 50	0 - 2			
western sandcherry	PRPUB	9	0 - 33	0 - 1						
other shrubs	2SHRUB	9	0 - 66	0 - 2	9	0 - 50	0 - 2	9	0 - 21	0 - 1
Annual Production lbs./acre			LOW RV HIGH		LOW RV HIGH		LOW RV HIGH		LOW RV HIGH	
GRASSES & GRASS-LIKES			2090 - 2937 - 3530		1570 - 2238 - 2875		1305 - 1911 - 2295			
FORBS			145 - 248 - 385		110 - 188 - 285		95 - 158 - 240			
SHRUBS			65 - 116 - 185		20 - 75 - 140		0 - 32 - 65			
TOTAL			2300 - 3300 - 4100		1700 - 2500 - 3300		1400 - 2100 - 2600			

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 dominated by warm-season grasses with cool-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included periods of below and/or above average precipitation, sporadic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. The less grazing tolerant tall warm-season grasses and cool-season grasses would have declined. Prairie sandreed would have increased with ongoing disturbance. With severe, prolonged disturbance plant vigor can rapidly decline and this state can move towards an active blowout. Today, a similar state can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest.

1.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase

Interpretations are based primarily on the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (this is also considered to be climax). The potential vegetation was about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses included sand and/or big bluestem, prairie sandreed, switchgrass, little bluestem, needleandthread, and porcupine grass. Other grass or grass-like species included sideoats grama, western wheatgrass, blue grama, hairy grama, threadleaf sedge, Indiangrass, and sand dropseed. 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 will shift this community to the *1.2 Prairie Sandreed/Switchgrass/Needleandthread Plant Community Phase*.
- 1.1b – Fire occurring at relatively frequent intervals, and occasional grazing events immediately following early season fire caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire, and would increase in vigor and production leading to a temporary shift to the *1.3 Big Bluestem/Switchgrass/Prairie Sandreed Plant Community Phase*.

1.2 Prairie Sandreed/Switchgrass/Needleandthread 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 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses included prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary importance included little bluestem, purple lovegrass, hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community included cudweed sagewort, green sagewort, western ragweed, and scurfpea. This plant community had similar plant composition to the 3.2 Sandreed/Switchgrass/Needleandthread/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.

When compared to the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (1.1), prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increased. Bluestems and porcupine grass decreased and production was reduced. This plant community was moderately resistant to change. The herbaceous species present were well adapted to grazing; however, species composition could be altered through long-term overgrazing. If the herbaceous component was intact, it tended to be resilient if the disturbance was not long-term.

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 are as follows:

- T1a – 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 cause a shift over a threshold and convert this plant community to the *2.1 Active Blowout Plant Community Phase* and the *Eroded State (State 2)*.
- 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 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase*.

2.1 Active Blowout Plant Community Phase

This plant community evolved under heavy continuous season grazing or from over utilization during extended drought periods. The potential plant community is variable, sometimes nearly devoid of vegetation and other times having a considerable cover of grasses. The grasses that make up this plant community phase are those that have developed adaptations to withstand or avoid damage due to blowing sand and can withstand being buried. Typical species may include species such as sand bluestem, prairie sandreed, blowout grass, and other early pioneer species. This plant community phase is susceptible to wind erosion and the blowing and shifting sand may keep this community in an early seral 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: SD0205

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

Growth curve description: Warm-season dominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	2	5	15	25	30	15	7	1	0	0

1.3 Bluestem/Switchgrass/Prairie Sandreed Plant Community Phase

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

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: SD0205

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

Growth curve description: Warm-season dominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	2	5	15	25	30	15	7	1	0	0

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

- 1.3a – 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 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase*.

Transition from Reference State (State 1) to the Native/Invaded Grass State (State 3)

- T1b – Encroachment of non-native grasses such as Kentucky bluegrass, 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 Grass State (State 3)*.

Native/Invaded Grass State (State 3)

This state represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by warm-season grasses with cool-season grasses being subdominant. It can be found on areas that

are properly managed with grazing and/or prescribed burning and sometimes on areas receiving occasional short periods of rest. Grazing tolerant will increase with disturbance.

3.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase

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

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 are as follows:

- 3.1a – 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), or continuous season-long grazing, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the *3.2 Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community Phase*.

3.2 Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community

This plant community is a result of heavy continuous grazing, continuous season-long grazing, or from over utilization during extended drought periods. The potential plant community is made up of approximately 85 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grasses include prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary importance include little bluestem, purple lovegrass, hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community include cudweed sagewort, green sagewort, western ragweed, and scurfpea.

When compared to the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (1.1), prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increase. Bluestems and porcupine grass decrease and production is reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

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 are as follows:

- T3b – Heavy continuous seasonal 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 *4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase* within the *Invaded State (State 4)*.
- 3.2a – 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 *3.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase*.

Invaded State (State 4)

This state is a result of encroachment mainly by invasive introduced cool-season grasses. The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. The opportunity for high intensity spring burns is severely reduced by early greenup and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease and runoff increases, energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominate species.

4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread 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, prairie sandreed, needleandthread, sedge, and blue grama. The dominance of Kentucky bluegrass is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface. 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: SD0202

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

Growth curve description: Cool-season dominant, warm-season subdominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	3	10	23	34	15	6	5	4	0	0

Transition Pathway from Any Plant Community to the 4.2 Annual/Pioneer, Non-Native Perennial Plant Community Phase within the Invaded State (State 4)

- T5 – Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the *Invaded State (State 4)* and more specifically to the *4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase*. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

4.2 Annual/Pioneer, Non-Native 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. This community can be renovated to improve the production capability; however, if management changes are not made the vegetation could revert back invasive or early seral species.

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

- 4.2a – This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the *4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase*.

Transition Pathway from the Native/Invaded State (State 3) to the Eroded State (State 2)

- T3a – 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 cause a shift over a threshold and convert this plant community to the *2.1 Active Blowout Plant Community Phase* and the *Eroded State (State 2)*.

Restoration Pathway from the Invaded State (State 4) to the Native/Invaded Grass State (State 3)

- R4 - 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 *Native/Invaded Grass State (State 3)*. 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.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

-- Under Development --

Bluestem/Prairie Sandreed/Needlegrass Plant Community Phases (1.1 & 3.1):

Prairie Sandreed/Switchgrass/Needleandthread Plant Community Phases (1.2):

Bluestem/Switchgrass/Prairie Sandreed Plant Community Phase (1.3):

Active Blowout Plant Community Phase (2.1):

Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community Phase (3.2):

Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase (4.1):

Annual/Pioneer, Non-native Perennial Plant Community Phase (4.2):

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
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
Indiangrass	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
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
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 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 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
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
sand paspalum	N U U N	N U N N	N U U N	N U N N	N U N N	N U U N	N U U N
Scribner panicum	U U D U	N U N N	U U D U	N U N N	N U N N	U U D U	U U D U
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
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
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							
bracted spiderwort	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
Carolina puccoon	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
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
erigonum	U U D U	U U U U	U U D U	U U U U	U U U U	U U D U	U U U U
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
Flodman's thistle	N U U N	N U U N	N U U N	N U U N	N U U N	N U U N	N U 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
groundplum milkvetch	U D U U	U D D U	U D U U	U D D U	U D D U	U D U U	U D D 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
hoary puccoon	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
horsetail	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
penstemon	U U U U	U P P U	U U U U	U P P U	U P P U	U U U U	U P P U
plains larkspur	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
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
prairie groundsel	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
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
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
serrateleaf eveningprimrose	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
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							
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
western sandcherry	D P P D	D U U D	D P P D	P U D P	D U U D	D P P D	P U U P

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)
Bluestem/Prairie Sandreed/Needlegrass (1.1 & 3.1)	3,300	0.90
Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass (3.2)	2,500	0.69
Kentucky Bluegrass/Prairie Sandreed/Needleandthread (4.1)	2,100	0.58
Annual/Pioneer, Non-Native Perennial (4.2)	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 A. Infiltration is typically moderate to rapid and runoff potential for this site varies from negligible to low 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 and/or bluegrass 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 Upland (R102AY012SD), Sandy (R102AY009SD)

Similar Sites

(R102AY009SD) – Sandy [more needlegrass and less prairie sandreed; 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.

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

USDA, NRCS. National Soil Information System, Information Technology Center, 2150 Centre Avenue, Building A, Fort Collins, CO 80526. (<http://soils.usda.gov/technical/nasis/>)

USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Site Description Approval

MN, State Grazing Lands Specialist

Date

ND, State Range Management Specialist

Date

SD, State Range Management Specialist

Date