United States Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Site stage: Provisional

Provisional: An Ecological Site Description (ESD) at the provisional status represents the lowest tier of documentation that is releasable to the public. It contains a grouping of soil units that respond similarly to ecological processes. The ESD contains: 1) enough information to distinguish it from similar and associated ecological sites and, 2) a draft state-and-transition model capturing the ecological processes, vegetative states, and community phases as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. It is expected that the provisional ESD will continue refinement towards an approved status.

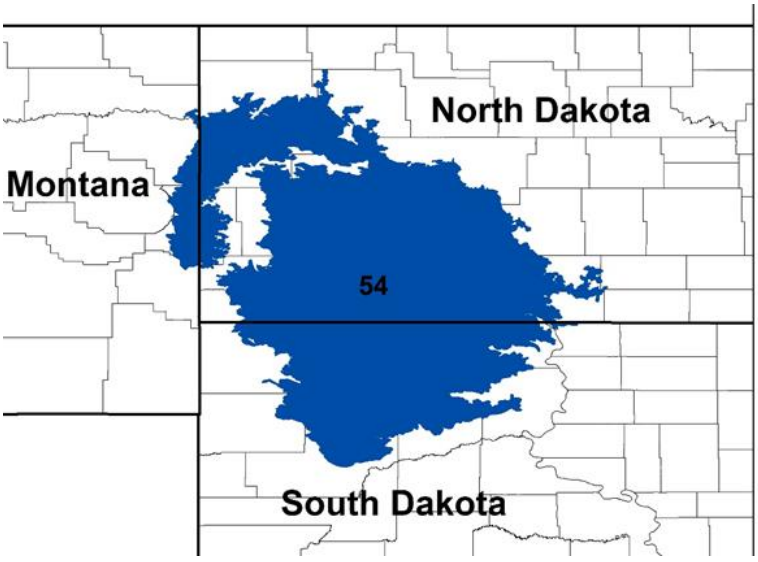
Site Name: Claypan

Site Type: Rangeland

Site ID: RO54XY021ND

Major Land Resource Area 54: Rolling Soft Shale Plain

For more information on MLRA's, refer to the following web site:
http://www.essc.psu.edu/soil_info/soil_lrr/



Location of MLRA 54, Rolling Soft Shale Plain in North Dakota, South Dakota and Montana

MLRA 54 covers 29,280 square miles and encompasses approximately 18.7 million acres. MLRA 54 spans three states with 64 percent of it in North Dakota, 33 percent in South Dakota, and 3 percent in Montana. Most of MLRA 54 is underlain by soft, calcareous shale, siltstone, and sandstone of the Tertiary Fort Union Group and the Cretaceous Fox Hills and Hell Creek Formations. Most of the soils in MLRA 54 developed from residuum weathered in place. Along the eastern and northern edges of

the MLRA where MLRA 54 transitions into the glaciated Missouri plateau, remnants of glacial till parent materials still remain on the high areas of the landscape. The MLRA 54 landscape is characterized by old, moderately dissected rolling plains with areas of local badlands, hills, and isolated buttes. Elevation is 1,650 feet (505 meters) on the eastern side of the MLRA with a gradual rise to 3,600 feet (1,100 meters) on the western side. The Missouri River runs along the north and east side of MLRA 54. Most of the Standing Rock Indian Reservation, the northwest third of the Cheyenne River Indian Reservation, and the Grand River National Grasslands are in the southern part of the MLRA

Ecological Site Concept

The Claypan ecological site occurs on backslopes and erosional footslopes of hillslope landforms in MLRA 54. Soils are moderately deep to very deep with soft, sedimentary bedrock parent material below 20 inches. Surface textures range from fine sandy loam to silty clay loam, and form a ribbon less than 2 inches long. The dense, root-limiting subsoil (claypan) ranges from heavy silty clay loam to clay, and forms a ribbon greater than 2 inches long. The heavy-textured, sodium-affected claypan is below 6 inches from the soil surface, and has columnar structure with visible salts and gypsum crystals below 16 inches. The slopes range from 0 to 25 percent. This site occurs on well drained or moderately well drained uplands in conjunction with Thin Claypan and Clayey ecological sites. Saline Lowland sites occur in the shallow drainageways that crisscross these landforms. Vegetation in the Reference site consists primarily of mid-statured, cool-season grasses (e.g., western wheatgrass and needlegrasses) and short-statured, warm-season bunchgrass (e.g., blue grama).

Revision Notes

This ESD was developed in 2001 from the existing North Dakota and South Dakota Range Site Descriptions, expert opinions, and available data. The Rangeland Health Reference Worksheet was last updated in 2011. The site concept for this ecological site has remained constant. In 2011, this ESD was revised with the current knowledge, expertise, and data. In 2016, Tammy DeCock added MLRA Notes, Site Concept, Revision Notes, Ground Cover tables, a Site Development and Testing Plan, and made minor revisions with input from key resource professionals representing several agencies in North Dakota and South Dakota.

Physiographic Features

This site occurs on level to moderately steep sedimentary uplands in MLRA 54.

Landform: (1) Hillslopes

	Minimum	Maximum
Elevation (feet):	1650	3600
Slope (percent):	0	25
Water table depth (inches):	48	None
Flooding		
Frequency:	None	None
Ponding		
Frequency:	None	None
Runoff class:	Low	High
Aspect:	No influence on this site	

Climatic Features

MLRA 54 is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of MLRA 54. The continental climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains, so air masses move unobstructed across the plains and account for rapid changes in temperature.

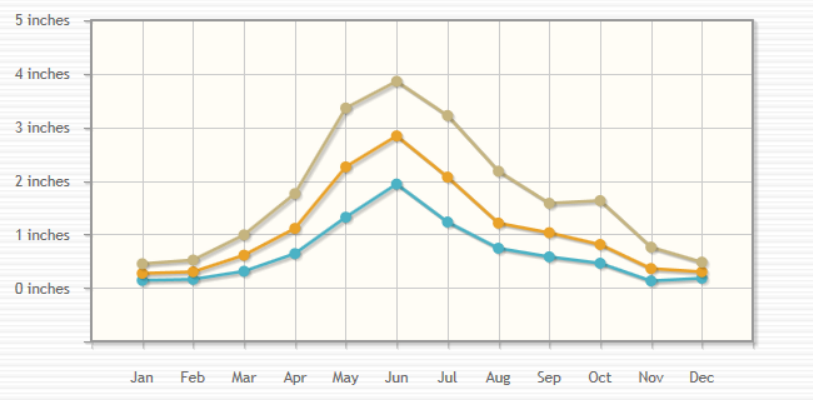
Annual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42° F. January is the coldest month with average temperatures ranging from about 13° F (Beach, ND) to about 16° F (Bison, SD). July is the warmest month with temperatures averaging from about 69° F (Beach, ND) to about 72° F (Timber Lake, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57° F. This large temperature range attests to the continental nature of MLRA 54's climate. Wind speeds average about 11 miles per hour, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime wind speeds are generally stronger than nighttime wind speeds, and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins in late March and continues through early to mid-July. Native warm-season plants begin growth in mid-May and continue to the end of August. Greening-up of cool-season plants can occur again in September and October when adequate soil moisture is present.

	Averaged
Frost-free period (days):	128
Freeze-free period (days):	148
Mean annual precipitation (inches):	16.

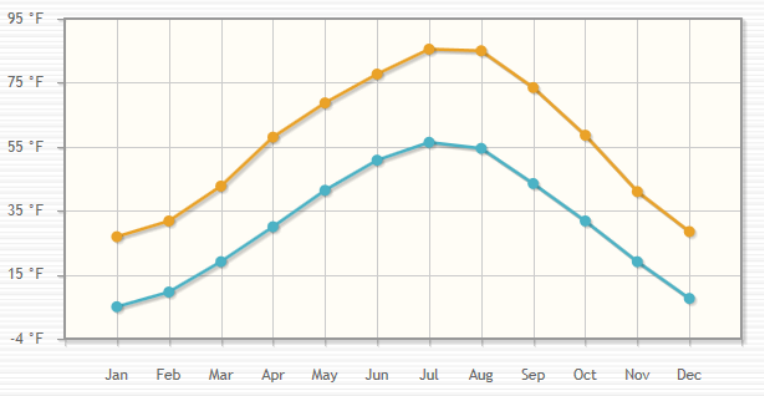
Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	0.45	0.52	0.99	1.76	3.36	3.86	3.22	2.18	1.58	1.63	0.76	0.48
Medium	0.27	0.30	0.61	1.11	2.26	2.84	2.07	1.21	1.03	0.81	0.36	0.30
Low	0.14	0.16	0.31	0.64	1.32	1.94	1.23	0.74	0.58	0.46	0.13	0.18



Monthly Temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	27.7	32.6	43.5	58.8	69.5	78.5	86.3	85.8	74.3	59.4	41.8	29.3
Low	5.8	10.4	19.9	30.8	42.2	51.6	57.2	55.3	44.3	32.6	19.9	8.4

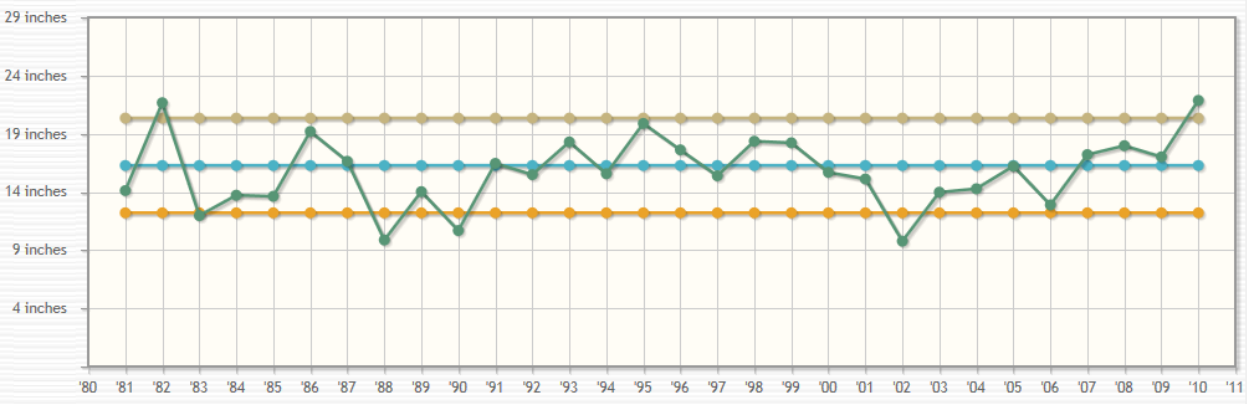


30 Year Annual Rainfall (inches):

1981 N	1982 H	1983 D	1984 N	1985 N	1986 N	1987 N	1988 D	1989 N	1990 D	1991 N	1992 N	1993 N	1994 N	1995 N
14.12	21.67	11.97	13.72	13.63	19.2	16.64	9.87	14.03	10.69	16.46	15.49	18.3	15.57	19.89

1996 N	1997 N	1998 N	1999 N	2000 N	2001 N	2002 D	2003 N	2004 N	2005 N	2006 N	2007 N	2008 N	2009 N	2010 H
17.62	15.39	18.36	18.23	15.69	15.12	9.77	13.98	14.28	16.22	12.89	17.21	17.98	17.02	21.87

D-Drought N-Normal H-Heavy



Climate stations:
(1) SIDNEY [USC00247560], Richland County MT 59270. Period of record 1981-2010
(2) FT YATES 4 SW [USC00323207], Sioux County ND 58538. Period of record 1981-2010
(3) HETTINGER [USC00324178], Adams County ND 58639. Period of record 1981-2010
(4) DUPREE [USC00392429], Ziebach County SD 57623. Period of record 1981-2010

Influencing Water Features

No significant water features influence this site.

Representative Soil Features

The Claypan ESD in MLRA 54 is represented by moderately deep to very deep, fine-textured sodium-affected soils. Representative soils in MLRA 54 include the deep or very deep Daglum series and the moderately deep Janesburg series. Slopes range from 0 to 25 percent. The soils in this ecological site are well or moderately well drained, and developed in soft sedimentary shale and siltstone parent materials, or from alluvium derived from soft shale and siltstone residuum.

The surface layer is generally 4 to 10 inches thick, and textures range from fine sandy loam to silty clay loam. In native rangeland, the upper horizons have not been mixed by tillage operations, and so a light-colored subsurface layer immediately below the surface horizon may be visible. This layer is lighter-textured than the surface layer and ranges from 1 inch to 5 inches thick with thin platy structure. Permeability is moderate or moderately slow in the surface horizons, and slow or very slow in the subsoil. Cryptobiotic crusts are present, but their function is not well understood. Some pedestalling of plants may occur, but it is not very evident on casual observation and occurs on less than 5 percent of the plants. Water flow paths are broken and irregular in appearance or are discontinuous with numerous debris dams or vegetative barriers. There is a risk of rills and eventually gullies if vegetative cover is not adequate.

Claypan and Thin Claypan ecological sites typically occur in conjunction with one another on the rolling, complex residual and alluvial landforms in MLRA 54. Claypan sites are on micro-

highs and Thin Claypan sites are in the micro-lows, resulting in the pock-marked appearance of the ground surface that is characteristic of sodium-affected landscapes in MLRA 54.

The following soil properties listed in the following table represent the soil profile above the sedimentary beds.

Major soil series correlated to this ecological site can be found in Section II of the Natural Resources Conservation Service (NRCS) Field Office Technical Guide or the following web sites:

http://www.nrcs.usda.gov/technical/efotg/
http://soildatamart.nrcs.usda.gov/
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Parent materials
Kind: Residuum, slope alluvium
Origin: Shale, siltstone
Surface texture:
(1) Clay loam
(2) Silty clay loam
(3) Silt loam
Subsurface texture group: Clayey

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	0
Surface fragments >3" (% cover):	0	0
Subsurface fragments <=3" (% volume):	0	0
Subsurface fragments >3" (% volume):	0	0
Drainage class: Moderately well or Well		
Permeability class: Slow to Very slow		

	Minimum	Maximum
Depth (inches):	20	80
Available water capacity (inches):	3.00	8.00
Electrical conductivity (mmhos/cm):	0	16
Sodium adsorption ratio:	0	25
Calcium carbonate equivalent (percent):	0	25
Soil reaction (1:1 water):	5.6	9.0

Plant Communities

Ecological Dynamics of the Site:
The site developed under Northern Great Plains climatic conditions, and included the natural influences of large herbivores and occasional fire. Changes will occur in the plant communities due to climatic conditions and/or management actions. Due to the nature of the soils, the site is considered moderately resilient. Under continued adverse impacts, a slow decline in vegetative vigor and composition will occur. If the existing plant community is in Reference State, implementing favorable vegetative management treatments may return to the Reference Plant Community. However, if

existing plant community is outside the Reference State, returning to the Reference State is not feasible.

The natural disturbance regime consisted of frequent fires caused both by natural and Native American ignition sources. These fires occurred during any season of the year, but were concentrated in the spring and late summer or early fall. Lightning fires occurred most frequently in July and August, while fires started by Native Americans occurred in April, September, and October. Large ungulate grazing was heavy and occurred often, but usually for short durations. Grazing may have been severe when occurring after a fire event, or in association with reliable water sources. The grazing and fire interaction, especially when coupled with drought events, set up the dynamics discussed and displayed in the following state–and-transition diagram and descriptions.

The plant community upon which interpretations are primarily based is the Reference Plant Community. The Reference Plant Community 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 considered. Subclimax plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

This ecological site has been grazed by domestic livestock since they were introduced into the area. The introduction of domestic livestock and the use of fencing and reliable water sources have radically changed the disturbance regime of this site. Heavy continuous grazing and/or continuous seasonal (spring) grazing, without adequate recovery periods following each grazing occurrence, causes this site to depart from the Reference State. Production of blue grama and buffalograss will begin to increase. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass will decrease in frequency and production.

In time, heavy continuous grazing will likely cause blue grama and buffalograss to dominate and pioneer perennials, annuals, and club moss (when present) to increase. This plant community is relatively stable, and the competitive advantage prevents other species from establishing. This plant community is less productive than the Reference State. Runoff increases, and infiltration will decrease. Soil erosion will be minimal. Extended periods of non-use and/or lack of fire will result in a plant community with high litter levels, which favors an increase in exotic cool-season species (Kentucky bluegrass, crested wheatgrass, and/or smooth bromegrass).

Due to a general invasion of exotic cool-season species and alterations in historic disturbance regimes (i.e., reduced fire frequency) across the MLRA, returning to the Western Wheatgrass-Blue Grama-Needlegrasses Plant Community Phase 1.1 is not possible. Today, the 2.1 Western Wheatgrass-Blue Grama-Needlegrasses Plant Community Phase most resembles the 1.1 Reference Plant Community Phase in appearance and function.

Within the natural disturbance regime, droughts of varying length and severity are common. Long-term drought reduced plant vigor and seed production, and increased bare ground.

Extended periods of non-use and/or lack of fire results in a plant community with high litter levels, favoring an increase in exotic cool-season grasses such as Kentucky bluegrass, crested wheatgrass, and/or smooth bromegrass

Due to a general invasion of exotic cool-season species and alterations in historic disturbance regimes (i.e. reduced fire frequency) across the MLRA, returning to the Western Wheatgrass-Needlegrasses-Blue Grama Plant Community Phase 1.1, is not possible. Today, the Western

Wheatgrass-Needlegrasses-Blue Grama Plant Community Phase 2.1 most resembles the 1.1 Reference Plant Community Phase in appearance and function.

State and Transition Models (STM) are ecological process-driven models. The ecological dynamics characterized by the STM reflect the functional changes in ecological drivers and feedback mechanisms (pathways), and the resulting changes in plant community composition (phases or states). The application of various management actions coupled with weather variables impact the ecological processes/drivers/feedback mechanisms drive plant community composition changes. The pathway narratives describing the ecological dynamics of the site reference various management inputs (i.e., prescribed grazing, prescribed fire), it is the manager's responsibility to understand how these various management actions impact the ecological processes/drivers/feedback mechanisms.

Plant Community and Vegetation State Narratives

Following are the narratives for each of the described plant communities. These plant communities may not represent every possibility, but they are the most prevalent and repeatable plant communities. The plant composition tables shown above have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these plant communities may be revised or removed, and new ones may be added. None of these plant communities should necessarily be thought of as "Desired Plant Communities." According to the U.S. Department of Agriculture (USDA) NRCS National Range and Pasture Handbook, Desired Plant Communities (DPCs) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including any description of a plant community here is to capture the current knowledge and experience at the time of this revision.

Plant Communities and Transitional Pathways

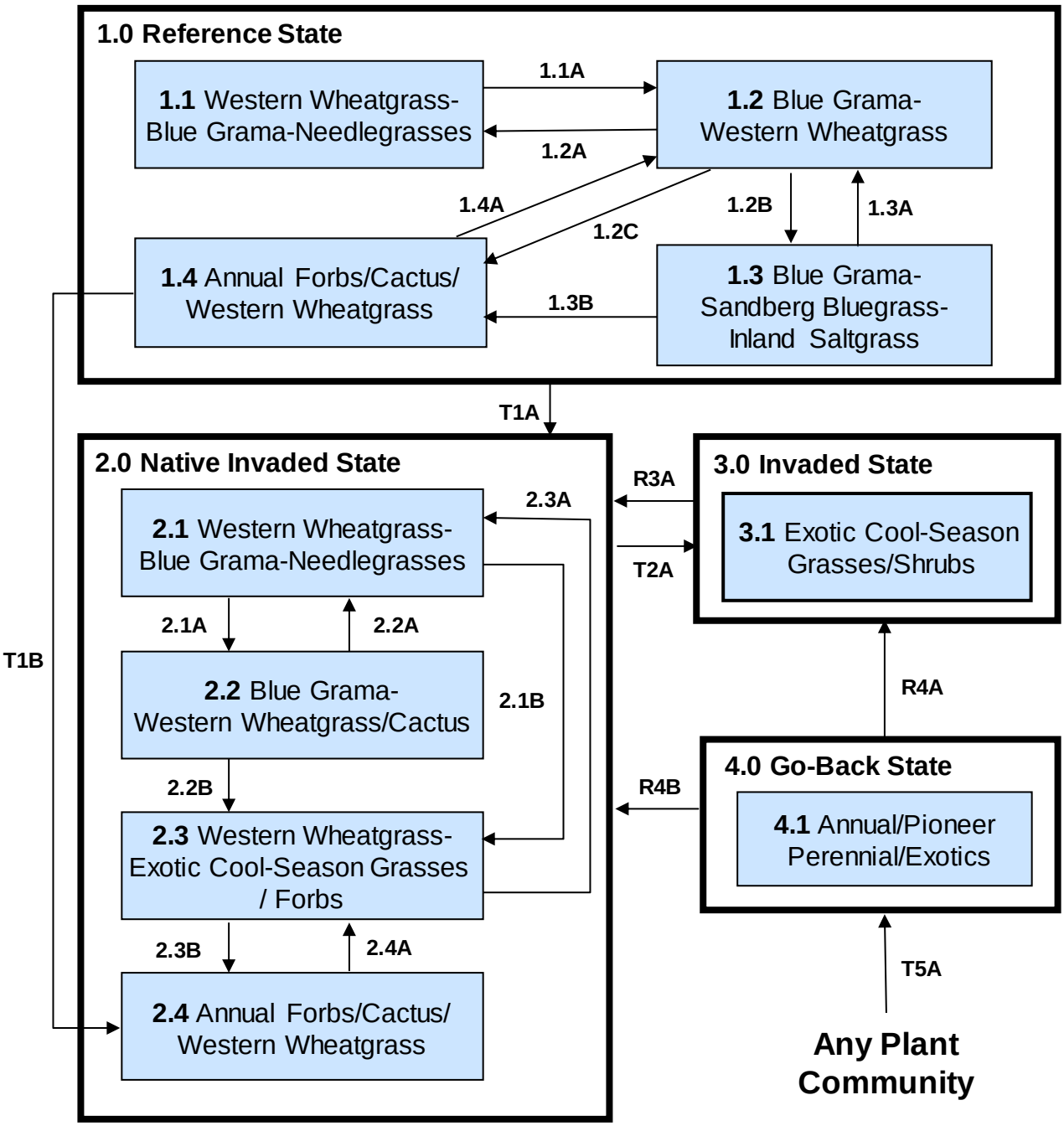


Diagram Legend - MLRA 54 Claypan	
T1A	Introducation of exotic cool-season grasses
T1B	Long-term prairie dog occupation coupled with introduction of exotic grasses and forbs
T2A	Extended periods of non-use or very light grazing, no fire
T5A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed fire with possible reseeding
R4A	Cropped go-back with continuous grazing; failed native seeding
R4B	Native seeding with prescribed grazing and prescribed fire
CP 1.1 - 1.2 (1.1A)	Long-term drought with/without heavy, long-term grazing
CP 1.2 - 1.1 (1.2A)	Return to average growing conditions and reduced grazing pressure
CP 1.2 - 1.3 (1.2B)	Long-term occupation by prairie dogs
CP 1.2 - 1.4 (1.2c)	Long-term occupation by prairie dogs with long-term drought
CP 1.3 - 1.2 (1.3A)	Removal of prairie dogs
CP 1.3 - 1.4 (1.3B)	Continued occupation by prairie dogs with long-term drought
CP 1.4 - 1.2 (1.4A)	Removal of prairie dogs, return to normal precipitation
CP 2.1 - 2.2 (2.1A)	Heavy continuous grazing with or without drought
CP 2.1 - 2.3 (2.1B)	Light (<20%) or no grazing; no fire
CP 2.2 - 2.1 (2.2A)	Reduced grazing pressure and return to average precipitation
CP 2.2 - 2.3 (2.2B)	Heavy continuous grazing coupled with long-term drought
CP 2.3 - 2.1 (2.3A)	Prescribed grazing and possibly prescribed burning
CP 2.3 - 2.4 (2.3B)	Long-term prairie dog occupation
CP 2.4 - 2.1 (2.4A)	Removal of prairie dogs

State 1: Reference State

The Reference State represented the natural range of variability that dominated the dynamics of this ecological site. This state was dominated by 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. Cool-season species decline and a corresponding increase in warm-season grasses will occur. To maintain this State, the proper application of prescribed grazing with appropriate utilization levels, coupled with fire at historic return intervals, will be required.

Community Phase 1.1: Western Wheatgrass-Blue Grama-Needlegrass

Community Phase 1.1 is considered to be the Reference Plant Community upon which most interpretations are based. This community evolved with grazing by large herbivores and occasional prairie fire. The potential vegetation consists of about 82 percent grasses or grass-like plants, 12 percent forbs, 5 percent shrubs, and 1 percent cryptograms. Cool-season grasses dominate the site, but warm-season shortgrasses are also prevalent. Western wheatgrass is the dominant grass. Other grasses and grass-like plants occurring on the site include blue grama, needle and thread, buffalograss, green needlegrass, Sandberg bluegrass, inland saltgrass, and

sedges. Significant forbs include silverleaf scurfpea, cudweed sagewort, and white prairie aster. Shrubs may include silver sagebrush, winterfat, and fringed sagewort.

This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species vary greatly in production, depending upon growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle, and energy flow functioned properly. Plant litter is properly distributed with very little movement off-site. Natural plant mortality is very low. The diversity in plant species allows for high tolerance to drought. Good vegetative cover coupled with moderate available water capacity provides for a favorable soil-water-plant relationship.

Plant Community Composition and Group Annual Production

			1.1 Western Wheagrass- Blue Grama-Needlegrasses		
COMMON/GROUP NAME	**SCIENTIFIC NAME**	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES				*1275 - 1425*	*85 95*
MID-STATURED COOL-SEASON GRASSES				300 - 450	20 - 30
western wheatgrass	Pascopyrum smithii	PASM	1	300 - 450	20 - 30
needle and thread	Hesperostipa comata ssp comata	HECOC8	1	75 - 225	5 - 15
green needlegrass	Nassella viridula	NAVI4	1	75 - 150	5 - 10
SHORT-STATURED COOL-SEASON GRASSES				75 - 150	5 - 10
prairie Junegrass	Koeleria macrantha	KOMA	2	30 - 75	2 - 5
plains reedgrass	Calamagrostis montanensis	CAMO	2	0 - 75	0 - 5
WARM-SEASON GRASSES				150 - 225	10 - 15
blue grama	Bouteloua gracilis	BOGR2	3	150 - 300	10 - 20
inland saltgrass	Distichlis spicata	DISP	3	15 - 45	1 - 3
OTHER NATIVE GRASSES				15 - 75	1 - 5
buffalograss	Buchloe dactyloides	BUDA	4	15 - 75	1 - 5
thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	ELLAL	4	0 - 150	0 - 10
prairie sandreed	Calamovilfa longifolia	CALO	4	15 - 45	1 - 3
other native grasses		2GN	4	15 - 30	1 - 2
GRASS-LIKES				30 - 105	2 - 7
needleleaf sedge	Carex duriuscula	CADU6	5	15 - 75	1 - 5
threadleaf sedge	Carex filifolia	CAFI	5	15 - 75	1 - 5
FORBS			*6*	*75 - 225*	*5 - 15*
common yarrow	Achillea millefolium	ACMI2	6	15 - 30	1 - 2
onion	Allium spp.	ALLIU	6	0 - 15	0 - 1
rosy pussytoes	Antennaria rosea ssp. arida	ANROA	6	0 - 15	0 - 1
white sagebrush	Artemisia ludoviciana ssp. albula	ARLUA	6	0 - 15	0 - 1
wavyleaf thistle	Cirsium undulatum	CIUN	6	15 - 30	1 - 2
blanketflower	Gaillardia spp.	GAILL	6	15 - 30	1 - 2
prairie smoke	Geum triflorum	GETR	6	0 - 15	0 - 1
rush skeletonweed	Lygodesmia juncea	LYJU	6	0 - 15	0 - 1
leafy wild parsley	Musineon divaricatum var. divaricatum	MUDID	6	0 - 15	0 - 1
purple locoweed	Oxytropis lambertii var. articulata	OXLAA2	6	15 - 30	1 - 2
silverleaf scurfpea	Pediomelum argophyllum	PEAR6	6	15 - 30	1 - 2
woolly Indianwheat	Plantago patagonica	PLPA2	6	0 - 15	0 - 1
sticky cinquefoil	Potentilla glandulosa	POGL9	6	0 - 15	0 - 1
prairie coneflower	Ratibida columnifera	RACO3	6	15 - 30	1 - 2
Missouri goldenrod	Solidago missouriensis	SOMI2	6	0 - 15	0 - 1
scarlet globemallow	Sphaeralcea coccinea	SPCO	6	0 - 15	0 - 1
heath aster	Symphyotrichum ericoides	SYER	6	15 - 30	1 - 2
Nuttall's violet	Viola nuttallii	VINU2	6	0 - 15	0 - 1
other native forbs		2FN	6	0 - 15	0 - 1
SHRUBS			*7*	*15 - 75*	*1 - 5*
silver sagebrush	Artemisia cana	ARCA13	7	0 - 30	0 - 2
fringed sagewort	Artemisia frigida	ARFR4	7	15 - 30	1 - 2
Nuttall's saltbush	Atriplex nuttallii	ATNU2	7	15 - 30	1 - 2
rubber rabbitbrush	Ericameria nauseosa	ERNA10	7	0 - 30	0 - 2
purple pincushion	Escobaria vivipara var. vivipara	ESVIV	7	0 - 15	0 - 1
broom snakeweed	Gutierrezia sarothrae	GUSA2	7	0 - 15	0 - 1
winterfat	Krascheninnikovia lanata	KRLA2	7	15 - 30	1 - 2
brittle cactus	Opuntia fragilis	OPFR	7	0 - 15	0 - 1
other shrubs		2S	7	0 - 15	0 - 1

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	920 -	1305	- 1690
FORBS	70 -	150	- 230
SHRUBS	10 -	45	- 80
TOTAL	1000 -	1500	- 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 depending upon precipitation or other climatic factors

Community Phase Pathway 1.1A

Heavy, continuous grazing associated with proximity to perennial water sources or a combination of disturbances such as extended periods of below average precipitation coupled with periodic

heavy grazing would shift this community to the 1.2 Blue Grama-Western Wheatgrass Plant Community Phase.

Community Phase 1.2: Blue Grama-Western Wheatgrass

This plant community is the result of continuous seasonal grazing or overutilization during extended drought periods, possibly due to proximity to permanent or seasonal water sources. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 10 percent forbs, and 15 percent shrubs. Dominant grass and grass-like species include blue grama, western wheatgrass, sedges, and buffalograss. Grasses of secondary importance include green needlegrass, needle and thread, inland saltgrass, and sideoats grama. Forbs commonly found in this plant community include cudweed sagewort, goldenrod, heath aster, scurfpea, and western yarrow. Dominant shrubs include brittle cactus, plains pricklypear, broom snakeweed, and fringed sagewort.

Community Phase Pathway 1.2A

A reduction in grazing and fire frequency coupled with a return to normal precipitation initiates this pathway. Cool-season mid-statured grasses regain vigor, and the plant community resembles the 1.1 Plant Community Phase.

Community Phase Pathway 1.2B

Continued heavy grazing, repeated drought, short-term prairie dog occupation, or a combination of these disturbances will continue to shift the plant community away from the Reference Plant Community Phase. Perennial grasses and forbs are reduced in stature and abundance. Annual forbs increase.

Community Phase 1.3: Blue Grama-Sandberg Bluegrass-Inland Saltgrass

This plant community phase is characterized by disturbance (i.e., grazing, drought) tolerant grasses and forbs.

Community Phase Pathway 1.2C

Long-term heavy utilization by livestock and/or prairie dogs, coupled with drought, will initiate this pathway.

Community Phase Pathway 1.3A

Prescribed grazing, removal of prairie dogs, and return to normal precipitation initiates this pathway.

Community Phase Pathway 1.3B

Long-term continued heavy utilization, like that associated with a more permanent water site or long-term prairie dog occupation, with or without drought, would have continued to shift the plant community from the one described in Phase 1.1 to one characterized by annual forbs, cactus, and western wheatgrass.

Community Phase 1.4: Annual Forbs/Cactus/Western Wheatgrass

This plant community phase is characterized by grazing-tolerant species and annual forbs. This phase was approximately 30 percent less productive than Phase 1.1. Bare ground increased dramatically, litter amounts declined, and soil surface temperatures increased. Infiltration rates declined. Less grazing-tolerant species were still present but in greatly reduced amounts, so this phase still had adequate resilience to return to Phase 1.1.

Community Phase Pathway 1.4A
Removal of the excessive grazing disturbance permitted this plant community to recover the native grass component and shift towards Phase 1.1. This pathway may have resulted from the natural movement of prairie dogs, elimination of the prairie dogs (e.g., plague), or a change in grazing patterns relative to the proximity to water.

Transition T1A

This is the transition from the native grass-dominated reference state to a state that has been invaded by exotic cool-season grass species. When propagules of exotic cool-season grasses such as Kentucky bluegrass, smooth bromegrass and/or crested wheatgrass are present, this transition occurs as natural and/or management actions favor a decline in the composition of warm- and cool-season native bunch grasses and an increase in exotic cool-season grasses. This transition is compounded by a change in the historic grazing and fire regime where native herbivores would follow periodic fires with grazing. This historic grazing/fire sequence has largely been replaced by chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire can also lead to this transition. The threshold between states is crossed when exotic cool-season grasses become established on the site. These species typically are part of functional/structural groups that were not present in the Reference State.

Transition T1B

This is the transition from the native grass state (Reference State 1) to the Native/Invaded State as a result of long-term prairie dog occupation coupled with the introduction of exotic cool-season grasses (i.e. crested wheatgrass, Kentucky bluegrass, annual brome) and forbs (i.e. Canada thistle, leafy spurge). The presence of these non-native species alters ecological processes, preventing return to the reference state.

State 2: Native/Invaded State

The Native/Invaded State is very similar to the Reference State. The invasion of exotic cool-season grasses has altered the natural range of variability for this ecological site. This state is still dominated by native cool-season grasses, but exotic cool-season grasses are now present in all community phases of this state. The primary disturbance mechanisms for this State include grazing by domestic livestock and infrequent fires. Timing and duration of grazing coupled with weather events dictate the dynamics that occur within this state. The cool-season native grasses can decline and an increase in exotic grasses will occur. Often this state appears as a mosaic of community phases caused primarily by continuous season-long grazing.

Community Phase 2.1: Western Wheatgrass-Blue grama-Needlegrasses

Community Phase 2.1 most closely resembles the Reference State in appearance and ecological functions (e.g., hydrologic, biotic, and soil/site stability). The cool-season plant-dominated 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 Reference State Community Phase 1.1 (see narrative for 1.1 Western Wheatgrass-Blue grama-Needlegrass). The vegetation consists of about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs (by weight), with western wheatgrass constituting about 30 percent and green needlegrass about 18 percent of the canopy cover.

The basic difference between this community phase and Community Phase 1.1 of the Reference State is the presence of minor amounts of exotic cool-season grasses and forbs. This is likely a naturally nitrogen-limited plant community, but perhaps less so than the Reference State. A change in the nutrient cycle on this Claypan ecological site is possibly due to the introduction of non-native species, and may be a causative factor leading to the eventual dominance of cool-season exotic grasses in the Invaded State.

Community Phase Pathway 2.1A
Several combinations of events can occur to initiate Pathway 2.1A. Continuous, heavy season-long grazing or heavy seasonal grazing will favor the shift to short-statured warm-season grasses such as blue grama and sedges. Along this pathway, the timing of energy capture shifts from spring and early summer to early spring and mid-summer. The change in plant community composition and distribution of the vegetation causes a decrease in production and an increase in runoff, with a corresponding decrease in infiltration. Nutrient cycling is restricted as the rooting depth of the vegetation decreases with the change in plant community composition. Plant community diversity is reduced with a loss of leguminous forbs and minor grass components.

Community Phase Pathway 2.1B
Pathway 2.1B is initiated with any management action that allows the introduced exotic cool-season grasses to increase. Heavy late season or season-long grazing will favor this change. Total rest or light utilization (<20 percent) grazing and no fire events will also initiate this pathway. The change in plant community composition and distribution of the vegetation causes an increase in runoff, with a corresponding decrease in infiltration. Nutrient cycling in restricted as the rooting depth of the vegetation decreases with the change in plant community composition. Available nitrogen increases due to invasive legumes (i.e. black medic and sweetclover) altering the carbon to nitrogen ratio, favoring non-native, nitrogen–dependent, exotic cool-season grasses.

Community Phase 2.2: Blue Grama-Western Wheatgrass/Cactus

Community Phase 2.2 occurs when natural or management actions favor the development of a sodgrass community. It is dominated by blue grama, western wheatgrass, upland sedges, and fringed sagewort. Western wheatgrass would make up

approximately 25-30 percent of the canopy cover, blue grama 20-25 percent, needle and thread 15-20 percent, and threadleaf sedge 5-10 percent.

Both tap-rooted and fibrous-rooted perennial forbs increase in this phase, but remain a minor component. Nutrient cycling declines due to a lack of deep-root grasses, higher soil surface temperatures due to lack of plant cover, and a lack of leguminous forbs. Water cycling also declines due to a decrease in the rooting depth of the plant community, an increase in the percentage of bare ground, and increased soil surface temperatures. These changes result in a plant community producing approximately 60-80 percent of the biomass produced by Phase 1.1.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2A is initiated by implementation of prescribed grazing management which includes adequate recovery periods following each grazing event, and utilization levels which match the available resources. If properly implemented, this will shift the competitive advantage from the exotic cool-season species to the native cool-season grasses. The addition of prescribed burning may expedite this shift. As this pathway continues, the change in composition and distribution of the plant community will increase infiltration and reduce runoff.

Community Phase Pathway 2.2B
Complete rest or light utilization (<20 percent) grazing and no fire events will initiate this pathway. As plant litter accumulates, the competitive advantage is shifted from the native species to the exotic cool-season grasses. Shrubs will also begin to increase within this phase. Infiltration rates will begin to decline as deeper-rooted native species are replaced by the shallow-rooted exotic cool-season grasses.

Community Phase 2.3: Western Wheatgrass-Exotic Cool-Season Grasses / Forbs

This community phase is characterized by an increase in the exotic cool-season grasses. Western wheatgrass, needlegrasses, and perennial and annual forbs are secondary species. Warm- season grasses are present in minor amounts and have decreased. Production and infiltration both decrease, and this community phase is at risk of transitioning across a State threshold. With natural or management actions that decrease the composition of the native cool-season grasses and increase the composition of exotic cool-season grasses, Transition T2A will be initiated.

Community Phase Pathway 2.3A
Implementation of a prescribed grazing system which incorporates adequate recovery periods between grazing events and shift the competitive advantage to the remaining native species will initiate this pathway. The addition of prescribed burning may facilitate this shift.

Community Phase Pathway 2.3B

Long-term prairie dog occupation, with or without drought initiates this pathway.

Community Phase 2.4: Annual Forbs/Cactus/Western Wheatgrass

This plant community phase is characterized by grazing-tolerant species and annual forbs. Bare ground increases, litter amounts decline and soil surface temperatures increase. Infiltration rates decline. Less grazing-tolerant species are still present but in greatly reduced amounts so this phase still had adequate resilience to return to Phase 2.1.

Community Phase Pathway 2.4A
Removal of prairie dogs and existing management continues without the benefit of prescribed grazing practices will allow the exotic cool-season grasses to increase and dominate the site.

Transition T2A

Complete rest or light grazing (<20 percent utilization) and elimination of fire are the two major contributors to this transition. Preliminary studies indicate this threshold may exist when exotic cool-season grasses exceed 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 reduced by early green-up and increased moisture and humidity at the soil surface. Grazing pressure cannot cause a reduction in exotic grass 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 structure and depth of the dominant species.

State 3: Invaded Grass State

This state is the result of invasion and dominance of exotic cool-season grasses. This state is characterized by exotic cool-season species and, when Kentucky bluegrass is present, an increasing thatch layer that effectively blocks introduction of other plants into the system. Once the state is well established, single disturbance events, such as high intensity fires or severe grazing, will not result in more than a very short-term reduction of these species. These events may reduce the dominance of exotic cool-season 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 exotic grasses rebound and again dominate the system.

Community Phase 3.1: Exotic Cool-Season Grasses/Shrubs

This plant community develops after an extended period of 10 or more years of non-use by herbivores and exclusion of fire. Non-native grasses, such as Kentucky bluegrass, crested wheatgrass, and smooth brome tend to invade and may dominate this plant community. Other grasses present in greatly reduced amounts include western wheatgrass, green needlegrass, and bearded wheatgrass. Blue grama is greatly reduced

due to the competition and shading by the exotic cool-season grasses. The common forbs include sweetclover, green sagewort, cudweed sagewort, and American vetch. Western snowberry is the principal shrub and tends to increase in density and cover.

This plant community can occur in grazed pastures, and is most commonly found in areas most distant from water. This is a typical pattern found in properly stocked pastures grazed season-long.

Restoration Pathway R3A

This restoration pathway will be initiated with the combination of prescribed burning applied to recreate the historic fire regime followed by a high level of prescribed grazing management. The success of this restoration pathway depends on the presence of a remnant population of native grasses in Community Phase 3.1. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be needed at relatively short intervals in the early phases of this restoration process. Some previous efforts have shown promise with early season prescribed burning; however, summer or fall burning may also be effective under certain circumstances depending on exotic grass species.

State 4: Go-Back State

This state is the result of severe soil disturbance such as cropping, recreational activity or concentrated livestock activity for a prolonged time period. Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. The composition and production of this state is highly variable.

Community Phase 4.1: Annual/Pioneer Perennial/Exotics

This plant community is characterized by a dominance of early pioneer annual and perennial plant species. Plant species composition and production is highly variable.

Restoration Pathway R4A

This restoration pathway may be initiated when attempts to reseed abandoned cropland fails and exotic cool-season species or other introduced species dominate the system.

Restoration Pathway R4B

This restoration pathway may be initiated when reseeding that results in the successful establishment of the native species. Prescribed grazing, burning, or haying will be necessary to achieve desired results and potentially noxious weed control.

Transition T5A

This pathway is most commonly associated with the cessation of cropping without the benefit of range or pasture seeding resulting in a “go-back” situation. This may be compounded with improper grazing which further inhibits the establishment of perennial grasses and forbs. This transition can originate from any state/plant community phase in this ecological site.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

Landscape

The MLRA 54 landscape is characterized by old, moderately dissected rolling plains with areas of local badlands, buttes, and isolated hills. MLRA 54 is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of MLRA 54. This area supports natural mixed-grass prairie vegetation with prairie rose, leadplant, and patches of western snowberry interspersed throughout the area. Green ash, chokecherry, and buffaloberry occur in draws and narrow valleys creating woody riparian corridors. Complex, intermingled ecological sites create diverse grass/shrub land habitats interspersed with varying densities linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries to the Missouri River. These habitats provide critical life-cycle components for many wildlife species.

Historic Communities/Conditions within MLRA:

The northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary ecological drivers either singly or often in combination. Many species of grassland birds, small mammals, insects, reptiles, amphibians, and large herds of roaming American bison, elk, and pronghorn were historically among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators such as the wolf, mountain lion, and grizzly bear and smaller carnivores such as the coyote, bobcat, red fox, and raptors. The black-tailed prairie dog was once abundant and provided ecological services by manipulating the plant and soil community, thus providing habitat for the black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, swift fox, small mammals, and amphibians and reptiles. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, and peregrine falcon (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Agriculture, transportation corridors, and energy development are the main factors contributing to habitat fragmentation, reducing habitat quality for area-sensitive species. These influences fragmented the landscape, reduced or eliminated ecological drivers (fire) and introduced exotic species including, smooth brome, crested wheatgrass, Kentucky bluegrass, and leafy spurge further impacting plant and animal communities. The loss of the bison, black-tailed prairie dogs, and fire, as primary ecological drivers, greatly influenced the character of the remaining native plant communities and the associated wildlife moving towards a less diverse and more homogeneous landscape.

Included in this MLRA are the isolated Killdeer Mountains containing bur oak, quaking aspen, green ash, paper birch, river birch, and American elm. Except for floodplain forests

within the MRLA, the Killdeer Mountains contains the largest deciduous forest in southwestern North Dakota.

Some wildlife species in this area are: mule deer, white-tailed deer, elk, pronghorn, coyote, red fox, bobcat, prairie rattlesnake, American badger, raccoon, North American porcupine, beaver, striped skunk, American mink, white-tailed jackrabbit, black-tailed prairie dog, Eastern and Merriam's turkey, golden eagle, ferruginous hawks, sharp-tailed grouse, greater prairie chicken, black-billed magpie, and numerous species of grassland-nesting birds and pollinating insects.

Presence of wildlife species is often determined by ecological site characteristics including grass and forb species, hydrology, aspect, and other associated ecological sites. The home ranges of a majority species are larger than one ecological site or are dependent on more than one ecological site for annual life requisites. Ecological sites offer different habitat elements as the annual life requisites change. Habitat improvement and creation must be conducted within the mobility limits of a known population for the species.

Insects play an important role providing ecological services for plant community development. Insects that are scavengers or aid in decomposition provide the food chain baseline sustaining the carnivorous insects feeding upon them. Many insects provide the ecological services necessary for pollination, keeping plant communities healthy and productive. Insects provide a protein food source for numerous species including grassland-nesting birds and their young.

Species unique to the MLRA:

Bald Eagle: Bald Eagles prefer large rivers, lakes, reservoirs, or wetlands that are bordered by mature stands of trees or a single large tree. Bald eagles use the Missouri River system, including Lakes Sakakawea and Oahe, and associated tributaries. Mature trees, including cottonwoods, provide nesting sites adjacent to aquatic and upland foraging sites.

Dakota skipper: The extreme northern portion of this MLRA provides limited Dakota skipper habitat. Dakota skipper habitat within MLRA 54 is considered Type B habitat. Type B habitat is described as rolling native-prairie terrain over gravelly glacial moraine deposits dominated by bluestems and needlegrasses with the likely presence of bluebell bellflower, wood lily, purple coneflower, upright prairie coneflower, and blanket flower. The United States Fish and Wildlife Service lists two critical habitat units within the MLRA in McKenzie County, North Dakota.

Golden eagle: The Lake Sakakawea breaks, bluffs, and rock outcroppings within the northwest portion of the MRLA 54 are key areas for golden eagle nesting. Grasslands, shrublands, and black-tailed prairie dog towns are used for foraging.

Black-footed ferret: Black-footed ferrets have been reintroduced as an experimental population in the southern portion of the MLRA located on the Cheyenne Sioux Indian Reservation. Since reintroduction between1991 and 1996, black-footed ferrets have been documented on the Standing Rock Sioux Indian Reservation approximately 20 miles north of the reintroduction site. Black-footed ferrets rely exclusively on prairie dog towns for shelter, breeding, and food sources (prairie dogs and other species within the town).

Least tern (Interior): Least terns are found on the Missouri River system in MLRA 54. Sparsely vegetated sandbars within the free-flowing portions of the Missouri River or shorelines of Lake Oahe and Sakakawea are used for nesting and foraging.

Species of Concern within the MLRA:

The following is a list of species considered "species of conservation priority" in the North Dakota State Wildlife Action Plan (2015); "species of greatest conservation need" in the Montana State Wildlife Action Plan (2015) and the South Dakota State Wildlife Action Plan (2014); and "species listed as threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 54 at the time this section was developed:

Invertebrates: Dakota skipper, little white tiger beetle, monarch butterfly, Ottoe skipper, regal fritillary, yellow-banded bumble bee, and western bumble bee.

Birds: American Kestrel, Baird's sparrow, bald eagle, black-billed cuckoo, black tern, bobolink, Brewer's sparrow, burrowing owl, chestnut-collared longspur, ferruginous hawk, golden eagle, grasshopper sparrow, greater sage-grouse, greater prairie-chicken, lark bunting, loggerhead shrike, least tern, long-billed curlew, marbled godwit, McCown's longspur, mountain plover, northern goshawk, northern harrier, northern pintail, peregrine falcon (migration), piping plover, prairie falcon, red knot (migration), red-headed woodpecker, sharp-tailed grouse, short-eared owl, Sprague's pipit, Swainson's hawk, trumpeter swan, upland sandpiper, western meadowlark, willet, Wilson's phalarope, and whooping crane (migration).

Mammals: Big and little brown bats, long-eared bat, long-legged bat, northern long-eared bat, Townsend's big-eared bat, western small-footed bat, black-footed ferret, black-tailed prairie dog, dwarf shrew, gray wolf, hispid pocket mouse, Merriam's shrew, northwestern moose, sagebrush vole, silver-haired bat, and swift fox.

Amphibians/Reptiles: Common snapping turtle, Great Plains toad, false map turtle, greater short-horned lizard, milk snake, northern leopard frog, plains hognose snake, plains spadefoot, sagebrush lizard, smooth green snake, and smooth softshell and spiny softshell turtle.

Fish and Mussels: Blue sucker, burbot, flathead chub, fragile papershell, northern redbelly dace, paddlefish, pallid sturgeon, pearl dace, pink papershell, shortnose gar, sickle-fin chub, sturgeon chub, and sauger.

Grassland Management for Wildlife in the MLRA

Management activities within the community phase pathways impact wildlife. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Significant inputs must occur to cross the threshold between States (e.g. State 3.0 to 2.0) requiring substantial economic inputs and management (mechanical, reseeding, prescribed fire, woody vegetation removal, grazing intensity, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on local wildlife species. Ranchers and other land managers must always consider the long-term beneficial

effects of management on the habitat in comparison to potential short-term negative effects to individuals.

Ecological sites occur as intermingled complexes on the landscape with gradual or sometimes abrupt transitions. Rarely do ecological sites exist in large enough acreage to manage independently. Ecological sites, supporting a dominance of herbaceous vegetation (loamy/limy residual), can be located adjacent to ecological sites that support medium to tall shrubs (loamy overflow or shallow). Conversely, ecological sites that are dominated by short to mid-statured grasses (Claypan) can be adjacent to sites with bare soil only supporting a minor amount of short grasses and forbs (Thin Claypan).

Management of these complex ecological sites can provide a heterogeneous or a homogenous landscape. Grassland bird use reduces as the plant community transitions to a homogenous state. Managers need to recognize ecological sites and the complexes they occur in to properly manage the landscape as a whole. A management regime for one ecological site may negatively impact an adjacent site: e.g., alteration of a grazing regime within a Flat Bottom Wooded Draw ecological site to encourage understory growth may encourage exotic cool-season grasses to increase or dominate an adjacent ecological site.

Life requisites and habitat deficiencies are determined for targeted species. Deficiencies need to be addressed along community phase, transitional, and restoration pathways as presented in specific state-and-transition models. Ecological sites should be managed and restored within the site's capabilities to provide sustainable habitat. Managers also must consider habitat provided by adjacent/intermingled ecological sites for species with home ranges or life requests that cannot be provided by one ecological site.

With populations of many grassland-nesting birds in decline, it is important to maintain these ecological sites in a 1.0 Reference State or the 2.0 Native/Invaded. plant communities, optimal for a guild of grassland species, serve as a population source where the birth rate exceeds mortality. Species may use marginal plant communities, however, these sites may function as a population sink where mortality exceeds the birth rate.

Understanding preferred vegetative stature and sensitivity to woody encroachment is necessary to manage for the specific grassland species. Various grass heights may be used for breeding, nesting, foraging, or winter habitat. While most species use varying heights, many have a preferred vegetative stature height. The following chart provides preferred vegetative stature heights and sensitivity to woody vegetation encroachment.

Grassland-nesting Bird Species	Preferred Vegetative Stature			Avoids woody vegetation*
	Short < 6 inches	Medium 6 - 12 inches	Tall >12 inches	
Baird's sparrow	x	x		x

Bobolink		x	x	x
Brewer's sparrow	x	x		
Burrowing owl	x			x
Chestnut-collared longspur	x	x		x
Common yellowthroat			x	
Dickcissel		x	x	
Ferruginous hawk	x	x		
Grasshopper sparrow	x	x		x
Horned lark	x			x
Killdeer	x			x
Lark bunting	x	x		
Lark sparrow	x			
Le Conte's sparrow			x	x
Long-bill curlew	x			x
Marbled godwit	x	x		x
McCown's longspur	x	x		x
Mountain plover	x			x
Nelson's sparrow			x	x
Nesting waterfowl		x	x	
Northern harrier		x	x	x
Savannah sparrow		x	x	x
Short-eared owl		x	x	x
Sprague's pipit	x	x		x
Upland sandpiper	x	x		x
Western meadowlark	x	x		
Willet	x	x		x
*Many of the listed species avoid nesting in grassland areas with large amounts of woody vegetation within a grassland or avoid nesting near woody vegetation in adjacent habitats. Although these species avoid areas with woody vegetation, most can tolerate a small amount of woody vegetation within areas dominated by grassland habitat, including short-statured shrubs (e.g., sagebrush, western snowberry) in this MLRA.				

Claypan Wildlife Habitat Interpretation:

Claypan ecological sites are identified by the presence of a claypan within 6” to 14” within the soil surface, making the site droughty. Claypan sites are less productive and less diverse than loamy, and loamy overflow, sites in similar landscape positions. Limitations within claypan sites support shorter stature and lower diversity of grasses and forbs for wildlife. Associated ecological sites include clayey, closed depression, sandy claypan, shallow claypan, shallow loamy, loamy, and thin

claypan. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species.

Claypan habitat features and components commonly support grassland-nesting birds, notably sharp-tailed grouse and greater prairie chicken leks. Insects rely on associated forbs and grasses for survival and serve as food sources for birds and their young, and forage for small and large herbivores.

Claypan ecological sites may be found in four plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, and 4.0 Go-back State) within a local landscape. Multiple plant community phases exist within each state. Today, these states occur primarily in response to grazing and drought. Secondary influences include anthropogenic disturbances, black-tailed prairie dogs, and fire.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in State 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along either the T1A Transitional Pathway to Native/Invaded State 2.0, or the T2A Transitional Pathway to Invaded State 3.0 thresholds. Native wildlife generally benefits from the heterogeneous grasslands found in Community Phases 1.1, 1.2, 2.1, and 2.2 that include diverse grass and forb species of varying stature and density. As plant communities degrade within State 2.0, warm-season grasses increase, particularly short-statured grasses, while native forbs are reduced. This transition results in reduced stature and increased plant community homogeneity. When adjacent and/or intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape.

Success along Restoration Pathway R3A from State 3.0 to State 2.0 is very difficult and is dependent upon presence of a remnant native grass population. This concept also applies to wildlife, as the target species must either be present on adjacent State 1.0 or State 2.0 plant communities or ecological sites within the mobility limits of the species. Species with limited mobility, such as Dakota skippers, must exist near the plant community in order to utilize restored sites. Mobile species such as grassland-nesting birds can easily locate isolated, restored plant communities.

Plant Community Phase 3.1 shows dramatic increased homogeneity of cool-season exotic cool-season grasses, and further reduction in native forbs. Reduced forb diversity limits insect populations, negatively affecting foraging opportunities for grassland-nesting birds. Increased exotic grass litter can limit access to bare ground by nesting insects and can limit mobility by small chicks. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species are not able to meet life requisites.

Management along community phase, transition, or restoration pathways should focus upon attainable changes. Short- and long-term monetary costs must be evaluated against short- and long-term ecological services in creating and maintaining habitat of sufficient quality to support a sustainable population density.

Community Phase 1.1: "Western Wheatgrass-Blue Grama-Needlegrass": This plant community offers good wildlife habitat, and every effort should be made to maintain this Claypan ecological site within this community phase. This phase retains high functionality through continued maintenance, including prescribed grazing with adequate recovery period as well as prescribed fire. Predominance of grass species in this community favors grazers and mixed-feeders (animals that select grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. Ecological services, historically provided by bison, are mirrored by domestic livestock. These services include putting plant material and dung in contact with mineral soil to be used by low trophic-level consumers such as invertebrate shredders, predators, herbivores, dung beetles, and fungal-feeders.

Dakota skippers do not prefer this site due to limited host plants, such as little bluestem and prairie dropseed. Regal fritillary habitat is limited because Nuttall's violet and prairie violets are uncommon. Monarch butterfly may use flowering forbs on this site, however, few milkweed species are found on this site to support breeding. The ecological site does not provide habitat for the little white tiger beetles that prefer large, active choppy sands ecological sites or sandy beaches. This plant community provides limited habitat for the Ottoe Skipper, which prefers mid- to tall-statured grasses. Bumblebees and other native bees utilize forbs as a nectar source and bare ground for nesting sites in bunchgrasses. Prescribed grazing with adequate recovery periods, as well as prescribed fire, to maintain the 1.1 Phase, has little effect on nests of ground-dwelling insects.

Birds: This plant community provides quality nesting, foraging and escape habitats favored by short- to mid- grass-nesting birds. Plant stature may be too dense or tall for burrowing owl and McCown’s longspur, however, it may be used during periods of drought or management such as rotational grazing or fire, resulting in defoliation, along Community Phase Pathway 1.1A.

Several species of grassland birds preferring mid-grass stature will use this site. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community provides suitable areas for sharp-tailed grouse and greater prairie chicken leks, nesting, and brood-rearing habitat. Limited stature and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, rodents, jackrabbits, pronghorn, white-tailed and mule deer. Short to moderate stature provides suitable food and thermal, protective, and escape cover for small herbivores such as the hispid pocket mouse.

Amphibians/Reptiles: This ecological site and associated plant communities provides habitat for smooth green snakes. This ecological site can provide habitat for the northern

leopard frog and Great Plains toad if freshwater habitat such as stock water ponds are located in or adjacent to the site.

Fish and Mussels: This ecological site is not directly associated with streams, rivers, or water bodies. Associated ecological sites, such as loamy overflow, can receive run-on hydrology from claypan sites. Management on these interconnected sites will have limited, secondary effects on aquatic species.

Community Phase 1.2 "Blue Grama-Western Wheatgrass": Blue grama and western wheatgrass will dominate after heavy, continuous seasonal grazing or overutilization during extended drought periods. This plant community consists of 75 percent grasses and grass-likes with 15 percent forbs and 15 percent shrubs. The dominant forbs include cudweed sagewort, goldenrod, heath aster, silver-leaf scurfpea, and western yarrow. The dominant shrubs are brittle cactus, plains pricklypear, broom snakeweed, and fringed sagewort.

Invertebrates: This phase provides similar life requisites as Community Phase 1.1, however, heavy, continuous seasonal grazing may negatively impact ground-nesting sites for bumble bees, other native bees and other ground-nesting insects due to reduction of forbs, timing of forb flowering, or increased soil compaction.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short- to midgrass-nesting birds. A shift to shorter herbaceous plant stature with a short shrub component along Community Phase Pathway 1.1A begins to benefit McCown's longspur, chestnut-collared longspur, horned lark, and burrowing owl. Species that prefer mid-grass stature will be generally successful with normal to above normal precipitation and a change in management along the 1.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing, nesting recruitment may be compromised for midgrass-nesting species. This plant community provides areas suitable for sharp-tailed grouse and greater prairie chicken leks. Limited cover and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.1.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 1.3 "Blue grama-Sandberg Bluegrass-Inland Saltgrass": Short-statured grasses will dominate with continued heavy grazing, repeated drought, short-term prairie dog occupation, or a combination of these disturbances. Perennial grasses and forbs are reduced in stature and abundance.

Invertebrates: Reduction in forbs (stature and abundance) will reduce nectar availability for foraging insect populations. Continued heavy grazing may negatively impact ground-nesting sites for bumble bees, other native bees, and other ground-nesting insects due to reduction of forbs, timing of forb flowering, or increased soil compaction. However, prairie dog burrows will provide nesting sites for bumble bees.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by shortgrass-nesting birds. A shift to shorter plant stature, along Community Phase Pathway 1.2B, benefits McCown's longspur, chestnut-collared longspur, horned lark, and burrowing owl. Species preferring mid-grass stature may be successful with normal to above normal precipitation and a change in management along the 1.3A Community Phase Pathway. In years with reduced precipitation or heavy grazing, nesting recruitment will be compromised for midgrass-nesting species Limited cover and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.1.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 1.4 "Annual Forbs/Cactus/Western Wheatgrass": This plant community phase is characterized by grazing-tolerant species and annual forbs (e.g., fetid marigold). Continued heavy grazing, repeated drought, short-term prairie dog occupation, or a combination of these disturbances will shift to increased annual forbs with a reduction in perennial grasses. Moderate perennial forbs stature and abundance are being replaced by short-statured annual forbs. Bare ground increases, litter amounts and infiltration rates decline, while soil surface temperatures increase. This plant community is resilient, retaining sufficient grazing-sensitive native species to return to the 1.2 community phases via Community Phase Pathway 1.4A.

Invertebrates: A switch to annual forbs from perennial forbs will not have a significant impact to invertebrates, but may reduce season-long nectar-producing plants for pollinators. Season-long nectar sources may be found on adjacent plant communities or ecological sites for mobile species. Increased bare ground provides increased nesting sites for bumble bees and other ground-nesting insects.

Birds: This very short statured phase, driven by short-term prairie dog occupation, is favored by burrowing owls, chestnut-collared longspur, and McCown's longspur. Prairie dog towns provide abundant prey populations for grassland raptors. The lack of grass and forb stature limits use by many bird species. Long-term prairie dog occupation following Transitional Phase Pathway T1B leads to the 2.0 State with no known return pathway due to the presence of exotic cool-season grasses. Managing this phase along Community Phase Pathway 1.4A can be an economical and successful method to restore habitat for many grassland-nesting birds.

Mammals: Suitable food, thermal, shelter, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including rodents, white-tailed jackrabbits, and deer. Grazers such as pronghorn and bison use prairie dog towns for foraging and loafing. Long-term prairie dog occupation following Community Phase Pathway T1B leads to the 2.0 State, with no known return pathway due to the presence of exotic, cool-season

grasses. Managing this phase along Community Phase Pathway 1.4A can be an economical and successful method to restore habitat.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

2.0 Native Invaded State

Community Phase 2.1 "Western Wheatgrass-Blue Grama-Needlegrasses": This plant community develops through Transition Pathway T1A, due to changes in management (chronic season-long or heavy late season grazing or complete rest) and the presence of exotic, cool-season grasses. The threshold between states 1.0 and 2.0 is crossed when Kentucky bluegrass, crested wheatgrass, smooth brome grass, or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except that it has a minor amount of cool-season exotic grasses and forbs. This phase functions at a high level for native wildlife; therefore, managers should consider the 2.0 Community Phase pathways to avoid transitioning to State 3.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 2.2 "Blue Grama-Western Wheatgrass/Cactus": Continuous, heavy season-long grazing or heavy seasonal grazing, along Community Phase Pathway 2.1A, leads to shorter-statured grasses, such as blue grama and sedges. Dominated by shorter-stature grasses and a loss of nitrogen-fixing or leguminous native forbs, the diversity of this plant community is reduced. Both tap-rooted and fibrous-rooted perennial forbs increase in this phase, but still remain a minor component. Prescribed grazing with adequate recovery periods along Community Phase Pathway 2.2A is an efficient, effective method to regain the cool-season grass and forb diversity components in Community Phase 2.1.

Invertebrates: The loss of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators. Continuous, heavy season-long grazing or heavy seasonal grazing may reduce ground-nesting site availability. Homogeneity of forb species may limit season long nectar availability.

Birds: Continuous, heavy season-long grazing or heavy seasonal grazing will reduce nesting sites, forage (invertebrates), and cover. A reduced forb component may limit foraging opportunities. Stature is generally short, serving both mid- and shortgrass-

nesting birds. Shortgrass-nesting birds favor this phase. Species that prefer mid-grass stature will be generally successful with normal to above normal precipitation and a change in management along the 2.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing during the nesting season, nesting recruitment may be compromised for mid-grass nesting species. This plant community provides areas suitable for sharp-tailed grouse and greater prairie chicken lek site development. Limited stature and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: Suitable food and thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including voles, mice, rodents, jack rabbits, pronghorn, and white-tailed and mule deer.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 2.3 "Western Wheatgrass-Exotic Cool-Season Grasses": Community Phase Pathway 2.2B is characterized by complete rest or light utilization (<20 percent) grazing and elimination of fire when exotic cool-season grasses are present, as in Community Phase 2.2. Plant community diversity is reduced with a decline of deeper-rooted native species being replaced by shallow-rooted exotic cool-season grasses. This plant community is on the cusp of crossing the threshold to the 3.0 Invaded State. Prescribed grazing with adequate recovery periods between grazing will shift the competitive edge to native species along Community Phase Pathway 2.3A is the most effective method to regain diverse cool-season grass and forb components in Community Phase 2.1. Every effort should be used to manage within Community Phase Pathway 2.3A to avoid crossing the threshold into State 3.0. Restoration Pathway R3A requires intensive management and economic inputs to successfully cross back to State 2.0.

Insects: Provides similar life requisites as Community Phase 2.2. However, the loss of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators. Homogeneity of forb species may limit season long nectar availability. Litter build-up, resulting from complete rest or light utilization, may reduce ground-nesting site availability.

Birds: An increase in cool-exotic cool-season grasses, moves this plant community towards homogeneity. Native grasses are still present in the plant community, however, the increase in cool-season exotic grasses reduces plant stature. With reduced amount of native grasses and forbs, reduced plant stature and increased litter, bird species shift from mid- to short-grass species. Sharp-tailed grouse and greater prairie chicken may still use this plant community for leks and brood rearing, however winter cover will need to be provided by adjacent ecological sites or plant communities. Management for bird species preferring mid-statured grasses should follow Community Phase Pathway 2.3A

Mammals: Provides similar life requisites as Community Phase 2.2.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

Community Phase 2.4 "Annual Forbs/Cactus/Western Wheatgrass": This plant community is a result of ecological services provided by long-term black-tailed prairie dog occupation, coupled with the introduction of exotic cool-season grasses and annual forbs along Transitional Pathway T1B. Utilizing one or more tools in Community Phase Pathway 2.4A (e.g., removal of black-tailed prairie dogs, control of exotic perennial forbs, implementation of prescribed grazing) can move this community back to Phase 2.1, but this may require significant management and economic inputs. Black-tailed prairie dogs provide primary ecological services to transition to and maintain Plant Community Phase 2.4.

Invertebrates: The loss of native forb diversity limits use by all pollinators. However, annual and invasive forbs will provide limited seasonal use dependent upon bloom period. Bare ground, burrows, and short plant stature provide nest sites for bumblebees and other ground-nesting insects. Burrowing owls place dung around their burrow entrance, attracting dung beetles and other insects, as a food source.

Birds: Burrowing owl and McCown's longspur rely on the stature and composition that this plant community provides. Presence of black-tailed prairie dogs provided diverse prey populations for grassland raptors, including burrowing owls, prairie falcons, and ferruginous hawks. Burrowing owls nest in abandoned prairie dog burrows.

Mammals: Suitable food and thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of grass and forb diversity reduces nutrition levels for small and large herbivores including voles, mice, rodents, white-tailed jackrabbits, cottontail rabbits, and deer. Except for black-tailed prairie dog, this plant community provides little habitat for mid-sized or small herbivores. Nonetheless, black-tailed prairie dog towns provide important habitat for many mammal species, including small rodents. Grazers such as pronghorn and bison use prairie dog towns for foraging and loafing.

Amphibians/Reptiles: Prairie dog towns provide habitat for both amphibians and reptiles. Tiger salamanders, prairie rattlesnakes, and other snake species will use the burrow systems of prairie dogs for shelter and denning.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1

3.0 Invaded State

Community Phase 3.1 "Exotic Cool-Season Grasses/Shrubs": Community Phase Pathway T2A is characterized by non-use (10 or more years) or low-intensity (<20 percent utilization) grazing and elimination of fire when exotic cool-season grasses are present, as in Community Phase 2.0. This plant community phase is characterized by a partial (>30 percent) to a complete dominance of exotic cool-season grasses such as Kentucky bluegrass, crested wheatgrass, and smooth bromegrass. Western snowberry

becomes a dominant shrub and tends to increase in density and cover. Restoration Pathway R3A requires remnant amounts of native warm- (i.e. blue grama) and cool-season grasses (i.e. needlegrasses, western wheatgrass, prairie Junegrass) and forbs (i.e. silverleaf scurfpea and prairie coneflower). These remnant populations can only be expressed through frequent prescribed burns and high levels of prescribed grazing management targeting the exotic cool-season grasses. Intensified management along the R3A pathway will have significant short-term negative impacts on wildlife habitat, however this is necessary to restore long-term native habitat functions.

Invertebrates: Non-use or low intensity (<20 percent utilization) grazing, limits use by beneficial insects provided in States 1.0 and 2.0. Increased litter and lack of grazing leads to limited contact between plant material and mineral soil resulting in a cooler microclimate, which is unfavorable to most insects. Lack of bare soil limits ground-nesting sites for native bees and other ground-nesting insects. The lack of nectar-producing plants limits forage opportunities for bumblebees, regal fritillary, monarch butterfly, and other pollinating species.

Birds: This homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of stature and plant diversity, along with increased litter and the tendency of Kentucky bluegrass and smooth bromegrass to lay down, limits use by many grassland-nesting birds. Litter accumulations reduce use by chestnut-collared and McCown's longspurs. Western snowberry reduces use of this site by species that avoid areas with woody vegetation. Sharp-tailed grouse and greater prairie chicken may use these sites for brood rearing and winter cover; however, the reduction in forbs may limit foraging opportunities for chicks.

Mammals: Black-tailed prairie dog expansion is possible in this plant community phase. This community phase provides foraging habitat for pronghorn and deer. Litter accumulation favors thermal, protective, and escape cover for small rodents. However, reduced availability of native grass seed may reduce food availability for species such as the hispid pocket mouse.

Amphibians/Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1.

4.0 Go-Back State

Community Phase 4.1 "Annual/Pioneer Perennial/Exotic": These plant communities are the result of severe soil disturbance such as cropping, recreational activity, or concentrated livestock activity for a prolonged time period. Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production is highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals, birds and their young. Dense weed cover can keep soils moist, increasing insect presence. Tall stature provided by some weeds such as marsh elder and ragweed offer thermal cover and seeds throughout winter.

Successful restoration of native species along transition pathway R4B results in a native grass and forb community in State 2.0. Failed restoration to native species through Restoration pathway R4A results in Invaded State 3.0. Wildlife species response will be dependent upon plant community composition, vegetative stature, patch size, and management activities, such as prescribed grazing, burning, interseeding, haying, or noxious weed control.

Animal Community – Grazing Interpretations

This site is well adapted to managed grazing by domestic livestock. The predominance of herbaceous plants across all plant community phases best lends these sites to grazing by cattle, but other domestic grazers with differing diet preferences may also be a consideration, depending upon management objectives. Often, the current plant community does not entirely match any particular plant community (as described in the ecological site description). Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of this inventory data will permit the establishment of a safe, initial stocking rate for the type and class of animals and level of grazing management. More accurate stocking rate estimates should eventually be calculated using actual stocking rate information and monitoring data.

Grazing levels are noted within the plant community narratives and pathways in reference to grazing prescribed grazing management. “Degree of utilization” is defined as the proportion of the current years forage production that is consumed and/or destroyed by grazing animals (may refer to a single plant species or a portion or all the vegetation). “Grazing utilization” is classified as slight, moderate, full, close, and severe (see the following table for description of each grazing use category). The following utilization levels are also described in the Ranchers Guide to Grassland Management IV. Utilization levels are determined by using the landscape appearance method as outlined in the Interagency Technical Reference “Utilization Studies and Residual Measurements” 1734-3.

Utilization Level	%	Use Description
Slight (Light)	0-20	Appears practically undisturbed when viewed obliquely. Only choice areas and forage utilized.
Moderate	20-40	Almost all of accessable range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing.
Full	40-60	All fully accessable ares are grazed. The major sites have key forage species properly utilized (about half taken, half left). Points of concentration with overuse limited to 5 to 10 percent of accessible area.
Close (Heavy)	60-80	All accessible range plainly shows use and major sections closely cropped. Livestock forced to use less desirable forage, considering seasonal preference.
Severe	> 80	Key forage species completely used. Low-value forages are dominant.

Hydrology Functions

This section is under development.

Recreational Uses

This section is under development.

Wood Products

No appreciable wood products are present on the site.

Other Products

This section is under development

Site Development and Testing Plan

This ESD contains the best available knowledge at this time. The site concept and species composition table has been used in the field and tested for more than five years. It is expected that revisions may be needed as additional information becomes available.

Supporting Information

Associated Sites

Clayey	*R054XY020ND*	These are heavy-textured, well drained or moderately well drained soils on upland landforms that do not receive additional moisture from runoff. Soils on Clayey ecological sites are often adjacent to soils on Claypan sites. Clayey sites are upslope from Claypan, and Thin Claypan ecological sites and are downslope from Shallow Loamy and Shallow Clayey sites. Clayey ecological sites are on similar landscape positions as Claypan ecological sites. Soils on Clayey sites will form a ribbon greater than 2 inches long due to high clay content in these soils. Clayey sites are influenced by the hydrology and parent materials that formed the soils on adjacent ecological sites. Clayey sites may exhibit some of the characteristics of sodium-affected soils found on Claypan sites. Indicator species are dominated by western wheatgrass and green needlegrass. Clayey sites produce better than Claypan sites, with more green needlegrass and western wheatgrass, and less blue grama.
Thin Claypan	*R054XY033ND*	These are heavy-textured, well drained or moderately well drained soils on upland landforms that do not receive additional moisture from runoff. Soils on Thin Claypan ecological sites are severely sodium-affected. Soils on Thin Claypan sites have a dense, root-limiting subsoil (claypan) layer that ranges from heavy silty clay loam to clay, and will form a ribbon greater than 2 inches long. The heavy-textured, sodium-affected claypan is within 6 inches of the soil surface and has columnar structure with visible salts and gypsum crystals above 16 inches. Sodium-affected landscapes in MLRA 54 exhibit the shallow micro-relief that is evident in the pock-marked appearance of the ground surface. Both Thin Claypan and Claypan ecological sites occur together on the same landform positions with the Thin Claypan sites in the micro-lows and Claypan sites on micro-highs. Indicator species are western wheatgrass and Sandberg bluegrass with an understory of blue grama and buffalograss.

		Also present are heath aster, cudweed sagewort, and western yarrow, along with a few shrubs of fringed sagewort, cactus, and Gardner's saltbush. Species are similar between the two sites, but Thin Claypan sites have less total production with more blue grama and less needle and thread and green needlegrass than Claypan sites.
Saline Lowland	*R054XY024ND*	Soils on Saline Lowland ecological sites are poorly drained, saline soils that are often high in sodium. The Saline Lowland site typically is found in the shallow drainageways that cut through sodium-affected uplands in MLRA 54. The Saline Lowland site is downslope from Claypan, Thin Claypan, and Clayey sites. Saline Lowland ecological sites are on slightly higher landscape positions than the very poorly drained Wet Meadow and Wetland ecological sites. The poorly drained soils on Saline Lowland sites have visible salts, gypsum crystals, and redoximorphic features at or near the surface. Soils on the Saline Lowland site are very deep, and developed in concave drainageways that accumulate sediments eroded from the surrounding landforms. The Saline Lowland ecological site receives additional moisture from runoff and a seasonal high water table. Indicator species include inland saltgrass, Nuttall's alkaligrass, Sandberg bluegrass, western wheatgrass, and slender wheatgrass.
Loamy	*R054XY031ND*	Loamy ecological sites are medium-textured, well drained soils on upland hillslope landforms that do not receive additional moisture from runoff. Loamy sites are on similar landscape positions as Clayey sites. Soils on Loamy sites have carbonates below 8 inches from the soil surface and do not have a dense, root-limiting subsoil (hardpan) layer. Loamy sites are upslope from Claypan and Thin Claypan ecological sites and downslope from Shallow Loamy sites. Soils on Loamy sites will form a ribbon greater than 1 inch and less than 2 inches long. Indicator species: western wheatgrass, green needlegrass, and blue grama. Fringed sagewort, western snowberry, and silver sagebrush are the dominant shrubs. This site has more production than the Claypan site, with more green needlegrass and shrubs and less blue grama.

Shallow Loamy	*R054XY030ND*	The Shallow Loamy ecological site is upslope from the Claypan site on hillslope landforms and downslope from Very Shallow sites. These are medium-textured, well drained soils with soft, unweathered mudstone or siltstone bedrock between 10-20 inches below the soil surface. The unweathered mudstone and siltstone beds are a root-restrictive layer. The soils on Shallow Loamy sites will form a ribbon longer than 1 inch but less than 2 inches long before breaking. This site has slightly less production than the Claypan site due to its position on shoulder slopes of steep upland landforms and the presence of a restrictive layer above twenty inches. Indicator species: little bluestem, plains muhly, needlegrasses and sideoats grama, with dotted gayfeather, pasqueflower, purple coneflower, and purple prairie clover, and shrubs like broom snakeweed. The Claypan ecological site has little bluestem, plains muhly, sideoats grama, western wheatgrass, and needle and thread.

Inventory Data References

Information presented here has been derived from NRCS clipping and other inventory data. Also, field knowledge of range-trained personnel was used. All descriptions were peer reviewed and/or field tested by various private, state, and Federal agency specialists. Data Source Number of Records Sample Period State County SCS-RANGE-417 18 1971 – 2007 SD Perkins, Corson, Harding, Meade, Ziebach ND-CONS-20 1 2001 ND Dunn. NRCS National Resource Inventory (NRI) On-Site Grazing Lands Study Data 2003-2015. US Forest Service/North Dakota State University/North Dakota Grazing Associations Cooperative Monitoring Data (2009-2012).

State Correlation

This site has been correlated with the following states: ND MT SD

Relationship to Other Established Classifications

Level IV Eco-regions of the Conterminous United States: 43a – Missouri Plateau.

Developers

Those involved in developing the revised site description include: NRCS: Steve Sieler, Jody Forman, John Kempenich, Jeanne Heilig, Mike Gerbig, Jeff Printz, Rick Peterson, Mark Hayek, Tammy DeCock, Ryan Foster, David Dewald, Curtis Bradbury; USFS: Jack Dahl, Chad Prosser, Lauren Klempel; and NPS: Chad Sexton. Those involved in developing the original site description included: Dennis Froemke, NRCS Range Management Specialist;

Jeff Printz, NRCS State Range Management Specialist; L. Michael Stirling, NRCS Range Management Specialist; Stan Boltz, NRCS Range Management Specialist; Josh Saunders, NRCS Range Management Specialist; Darrell Vanderbusch, NRCS Resource Soil Scientist; Michael D. Brand, State Land Dept. Director Surface Management; David Dewald, NRCS State Biologist; and Brad Podoll, NRCS Biologist.

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Site Description Approval

MARK HAYEK Digitally signed by MARK HAYEK Date: 2018.05.08 13:42:40 -05'00'

ND, State Range Management Specialist Date SD, State Range Management Specialist Date

Ecological Reference Worksheet

Author(s)/participant(s): **J. Printz, S. Boltz,** R. Kilian**, D. Froemke,** M. Rasmusson
Contact for lead author: jeff.printz@nd.usda.gov **Reference site used? Yes/No:** No
Date: 5-05-08 **Revised** 5-9-11 **MLRA:** 54 **Ecological Site:** Claypan. This ***must*** be verified based on soils and climate (see Ecological Site Description). Current plant community ***cannot*** be used to identify the ecological site.

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community within the reference state, when appropriate & (3) cite data. Continue descriptions on separate sheet.
1. Number and extent of rills: Rills should not be present**.**
2. Presence of water flow patterns: Barely observable.
3. Number and height of erosional pedestals or terracettes: Not evident on slopes < 8%. Erosional pedestals may be present with small terracettes present at debris dams on slopes 9%.
4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are *not* bare ground): Bare ground is 25 to 45%.
5. Number of gullies and erosion associated with gullies: Active gullies should not be present.
6. Extent of wind scoured, blowouts and/or depositional areas: None.
7. Amount of litter movement (describe size and distance expected to travel): Little to no plant litter movement. If litter movement occurs, it is only for a short distance.
8. Soil surface (top few mm) resistance to erosion (stability values are averages – most sites will show a range of values for both plant canopy and interspaces, if different): Plant cover and litter is at 45% or greater of soil surface and maintains soil surface integrity. Stability class anticipated to be 5 or greater.
9. Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness for both plant canopy and interspaces, if different): Use soil series description for depth, color and structure of A-horizon.
10. Effect of plant community composition (relative proportion of different functional groups) & spatial distribution on infiltration & runoff: Moderate plant canopy (50 to 70% maximum), deeper surface layer and a healthy plant community contribute to reduced runoff. Infiltration rates are very slow to slow.
11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site): No compaction layer would be expected except for the naturally occurring claypan within 6 to 14 inches of the soil surface which restricts root penetration.
12. Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to): Mid stature cool-season rhizomatous grass > mid stature, cool-season bunch grasses > short stature, warm-season rhizomatous grass > forbs > grass-likes > shrubs.

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): Some plant mortality and decadence (less than 5%) is expected on this site.
14. Average percent litter cover (40 to 50 %) and depth (0.25 to 0.5 inches). Litter cover is in contact with soil surface.
15. Expected annual production (this is TOTAL above-ground production, not just forage production): Representative value of 1500 lbs/ac with a range of 1000 lbs/ac to 2000 lbs/ac (air dry weight) depending upon growing conditions
16. Potential invasive (including noxious) species (native and non-native). List species which characterize degraded states and which, after a threshold is crossed, "can, and often do, continue to increase regardless of the management of the site and may eventually dominate the site": State/and local noxious, Kentucky bluegrass, smooth bromegrass,
17. Perennial plant reproductive capability: No limitations.