United States Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Site Stage: Provisional

Provisional: an 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 and 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.

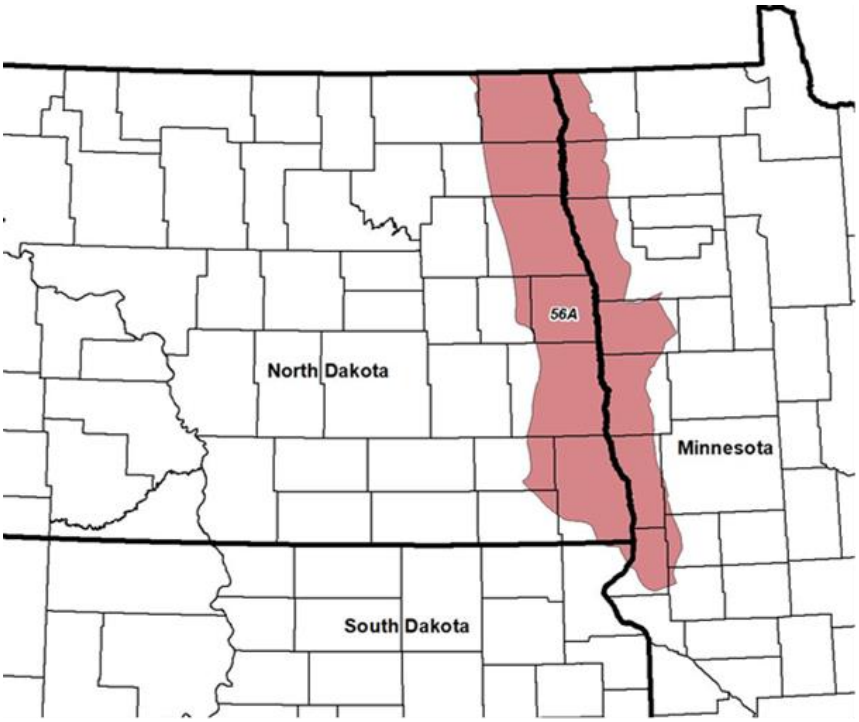
Site Name: Loamy

Site Type: Rangeland

Site ID: R056AY094ND

Major Land Resource Area: 56A – Red River Valley of the North

For more information on MLRAs, refer to the following web site:
https://www.nrcs.usda.gov/resources/data-and-reports/major-land-resource-area-mlra



Location of MLRA 56A within Minnesota, North Dakota, and South Dakota

The Red River Valley of the North MLRA is an expansive and agriculturally important region consisting of 10,400,000 acres and including a portion of 25 counties in eastern North Dakota and northwestern Minnesota along with a small portion of the northeast corner (Roberts County) of South Dakota.

Although MLRA 56A is currently called the Red River Valley of the North, the landscape does not fit the common understanding of "valley" as the transition out of the Valley is very gradual in most places. The extent of the MLRA corresponds to the area covered by Glacial Lake Agassiz including lacustrine sediments, beach ridges, and deltas where rivers flowed into the glacial lake. Also included are island areas of glacial till which were surrounded by the lake waters. Some of the lacustrine deposits are very deep and some have glacial till within a few feet of the surface. The glaciolacustrine materials range from clayey to sandy.

The primary river in the MLRA is the Red River of the North flowing northward into Canada where it empties into Lake Winnipeg. The river is formed by the confluence of the Bois de Sioux River (flowing from northeastern South Dakota) and the Ottertail River flowing from west-central Minnesota. Numerous tributaries in MLRA 56A contribute additional water to the Red River. In Minnesota these include the Two Rivers, Snake, Marsh, Middle, Red Lake, Wild Rice, and Buffalo. In North Dakota, the Pembina, Tongue, Park, Forest, Turtle, Goose, Elm, Rush, Maple, Sheyenne, and Wild Rice are tributaries to the Red River. There are also smaller streams and coulees along with many legal drains.

The relative flatness of much of the MLRA contributes to a flooding hazard for large areas of agricultural land in the spring months. Soil salinity, while variable, also impacts land management on many areas within the MLRA. Extensive surface and subsurface (tile) drainage systems have been constructed/installed to manage excess water and/or salinity on cropland. This extensive drainage has apparently reduced ground water recharge regionally, thus impacting seasonal water table level/fluctuation and its influence on plant communities. Soils that were poorly drained prior to wide-spread drainage may now function as somewhat poorly drained or even moderately well drained soils. For example, undrained Fargo soils are Wet Meadow ecological sites; with surface drainage they may function as Subirrigated sites; and with tile drainage, they commonly function as Clayey sites. Because of the extensive alteration of the hydrology, restoration to the natural conditions of the reference state dynamics would not be possible.

MLRA 56A is an ecotone between grassland dominated MLRAs 55A and 55B to the west and forest dominated MLRAs 56B and 102A to the east. This region is utilized mostly by farms; about 80 percent is non-irrigated cropland, but some irrigated fields exist on the beach areas. Cash-grain, bean, sugar beets, potatoes, and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. Currently about 6 percent of this area is forested, mostly in areas along rivers that are difficult to access with farm equipment. Another 6 percent is grassland used for ranching and/or wildlife habitat. Grazing lands occur primarily in the Sand Hills area of the Sheyenne River delta, on beach areas, and on other areas too wet, saline, sodic, steep, or inaccessible to be productive cropland.

Ecological Site Concept

The Loamy ecological site is located on flats and rises on lake plains, till-floored lake plains, delta plains, and isolated areas of till plain and on flats on glacial lake beaches. It also occurs on high terraces and side slopes above streams and rivers; these landforms are no longer impacted by frequent flooding. The soils are very deep; however, some have layers of sand and gravel in the substratum (>20 inches deep). The dark-colored surface soil is more than 7 inches thick. Surface textures typically are loam, silt loam, or silty clay loam but clay loam, very fine sandy loam, fine sandy loam, sandy loam also occur. Where fine sandy loam or sandy loam occurs, these textures are <10 inches thick. The subsoil typically is loam, clay loam, silt loam, or silty clay loam, but very fine sandy loam also occurs; the subsoil forms a ribbon 1 to 2 inches long to a depth >20 inches. Soil on this site is moderately well drained or well drained. Very slight to slight effervescence is allowed. Generally, the depth to effervescence exceeds 12 inches; however, very slight effervescence is allowable where the depth to a layer of accumulated carbonate (strong or violent effervescence) is >20 inches.

Soil salinity, typically, is none to very slight in the upper 20 inches, but below that depth may increase to moderate in some soils. Slopes range from 0 to 25 percent. On the landscape, this site is below the Thin Loamy ecological site and above the Loamy Overflow, Limy Subirrigated, Wet Meadow, and Subirrigated sites. The Clayey and Sandy ecological sites occur on similar landscape positions; the subsoil of the Clayey site forms a ribbon >2 inches long while the subsoil of the Sandy site forms a ribbon <1 inch long. The transition between Loamy and Thin Loamy sites is determined by depth to accumulated carbonates. Soils with strong or violent effervescence within a depth of 8 inches are included in Thin Loamy - even where a thin, non-calcareous subsoil layer occurs above the calcic layer.

Physiographic Features

This site typically occurs on flats and rises on lake plains, delta plains, and isolated areas of till plain and on flats on glacial lake beaches. It also occurs on high terraces and side slopes above streams and rivers; these landforms are no longer impacted by frequent flooding. Parent materials include fine-silty, coarse-silty, fine-loamy, and coarse-loamy glaciolacustrine sediments and deltaic deposits; loamy or silty stream alluvium; till; and loamy (>20 inches thick) over sandy beach deposits. Slopes range from 0 to 25 percent.

Landform: lake plain, delta plain, isolated till plain, high terrace, beaches

	Minimum	**Maximum**
Elevation (feet):	750	1475
Slope (percent):	0	25
Water Table Depth (inches):	36	>80
Flooding:		
Frequency:	None	Occasional
Duration:	None	Long
Ponding:		
Frequency:	None	None
Runoff Class:	Low	High
Aspect:	No influence on this site	

Climatic Features

MLRA 56A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 18 to 23 inches per year. The average annual temperature is about 40°F. January is the coldest month with average temperatures ranging from about 1°F (Pembina, North Dakota (ND) to about 11°F (Wheaton, Minnesota (MN). July is the warmest month with temperatures averaging from about 68°F (Pembina, ND) to about 73°F (Wheaton, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 65°F. This large annual range attests to the continental nature of this area's climate. Winds are estimated to average about 13 miles per hour annually, ranging from about 15 miles per hour during the spring to about 11 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

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

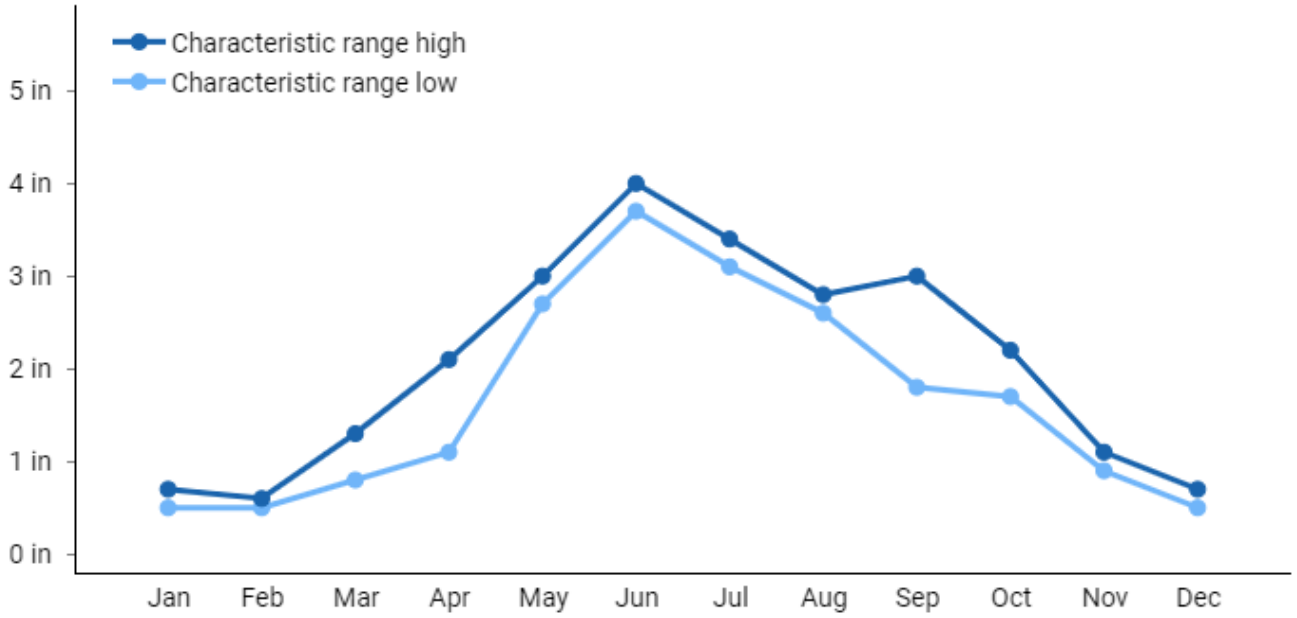
Climate normals

	Representative High	Representative Low	Actual High	Actual Low	Average
Mean annual precipitation (in):	24	21	25	20	22
Frost free period (days):	126	102	131	87	112
Freeze free period (days):	145	132	150	126	138

Normal monthly precipitation (in)

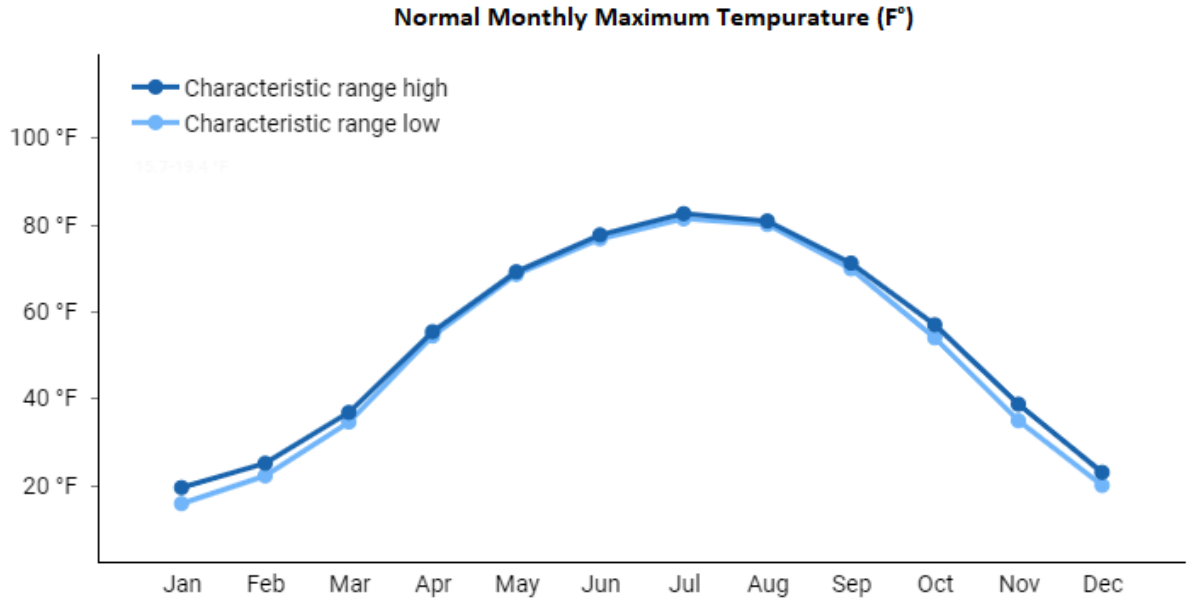
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.7	0.6	1.3	2.1	3	4	3.4	2.8	3	2.2	1.1	0.7
Representative low:	0.5	0.5	0.8	1.1	2.7	3.7	3.1	2.6	1.8	1.7	0.9	0.5
Actual high:	0.8	0.7	1.5	2.2	3.2	4.1	3.4	3	3.1	2.3	1.2	0.8
Actual low:	0.5	0.4	0.8	1	2.7	3.6	3	2.5	1.8	1.6	0.8	0.5

Normal Monthly Precipitation (in)



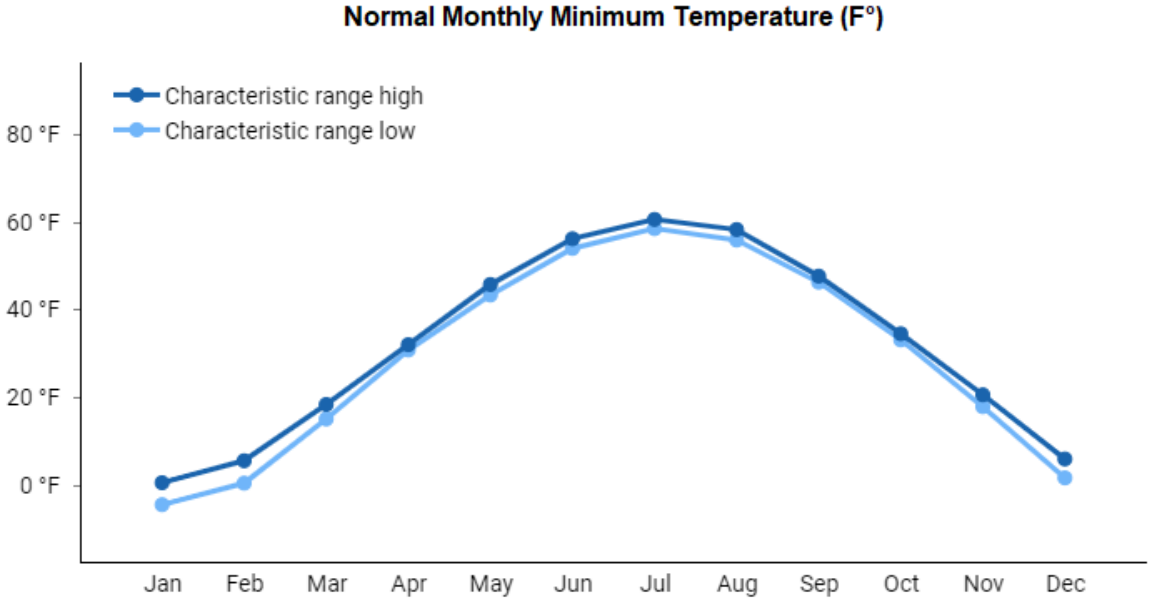
Normal monthly maximum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	19.4	25	36.7	55.3	69.1	77.6	82.5	80.8	71.1	56.9	38.6	22.9
Representative low:	15.7	22.1	34.5	54.3	68.5	76.7	81.3	80	69.8	53.9	34.8	19.9
Actual high:	19.9	25.1	36.8	55.9	69.7	77.7	82.7	80.8	71.4	57	38.6	23.9
Actual low:	13.4	19.3	32	51.8	65.8	74.5	79.1	78.4	67.9	52.3	33.1	18.1
Average:	17	23	35.2	54.5	68.3	76.7	81.5	80.1	70.2	55.1	36.1	21.1



Normal monthly minimum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.6	5.6	18.4	32	45.7	56.1	60.5	58.2	47.6	34.5	20.6	6
Representative low:	-4.4	0.5	15.1	30.8	43.3	53.9	58.4	55.8	46.2	33.1	17.9	1.7
Actual high:	0.6	5.7	18.9	33.3	46.1	56.2	60.7	58.4	48.4	35.6	20.7	6.3
Actual low:	-5.4	-0.5	13.9	29.7	41.9	52.4	56.6	53.8	43.8	31.5	16.9	1.2
Average:	-1.5	3.6	16.9	31.5	44.2	54.5	58.9	56.3	46.5	33.9	19.4	4.3



Climate stations used

(1) VICTOR 4 NNE [USC00398652], Rosholt, SD
(2) PARK RIVER [USC00326857], Park River, ND
(3) GRAFTON [USC00323594], Grafton, ND
(4) WHEATON [USC00218907], Wheaton, MN
(5) AGASSIZ REFUGE [USC00210050], Grygla, MN
(6) PEMBINA [USW00014924], Pembina, ND

Influencing Water Features

This site does not receive significant additional water either as runoff from adjacent slopes (it is commonly in a run-off landscape position) or from stream overflow. Neither does it receive significant additional water from a seasonal high-water table. Depth to the water table typically exceeds 3 feet in the spring; however, in a few soils it may be as shallow as 2 feet early in the growing season. During the summer months, the depth is generally from 4 feet to more than 6 feet. Surface infiltration is moderately slow to moderately rapid. Permeability through the profile, typically, is moderately slow to moderate; however, in soils with contrasting substratum materials, it is very rapid where it is gravelly. Water loss is through evapotranspiration and percolation below the root zone. Where this site occurs on terraces, flooding frequency is none to occasional.

Representative Soil Features

Soils associated with Loamy ES are typically in the Mollisol order. The Mollisols are classified further as Aquic Argiudolls, Calcic Argiudolls, Oxyaquic Argiudolls, Calcic Hapludolls, Cumulic Hapludolls (>6% slope on uplands or on terraces), Oxyaquic Hapludolls, Pachic Hapludolls, or Typic Hapludolls. These soils were developed under prairie vegetation. The soils in this site commonly formed in glaciolacustrine sediments, deltaic deposits, beach deposits, till, or alluvium.

The common feature of soils in this site are the medium and moderately fine textures through most of the root zone; the soil forms a ribbon 1 to 2 inches long between depths of 10 and 20 inches. Surface textures typically are loam, silt loam, or silty clay loam but clay loam, very fine sandy loam, fine sandy loam, sandy loam also occur. Where fine sandy loam or sandy loam occurs, these textures are <10 inches thick. The subsoil typically is loam, clay loam, silt loam, or silty clay loam, but very fine sandy loam also occurs; the subsoil forms a ribbon 1 to 2 inches long to a depth >20 inches. Some soils have clayey substrata and others have sand and/or gravel substrata; a few soils in the northwest part of the MLRA have substrata material which is very high in shale content. Where these contrasting materials occur, they are at a depth >20 inches. Soils in this site are well drained or moderately well drained; where present, redoximorphic features are deeper than 30 inches.

Soil salinity is none to very slight (E.C. <4 dS/m). Typically, sodicity is none to low (SAR <2) to a depth >30 inches. Soil reaction is slightly acid to slightly alkaline (pH 6.1 to 7.8) in the surface layer and upper part of the subsoil. It commonly increases to moderately alkaline (pH 7.9 to 8.4) in the lower subsoil due to a layer of calcium carbonate accumulation. Where present, this layer is typically below a depth of 10 inches and the layers above do not effervesce. In the layer of accumulation, $CaCO_3$ can be as much as 30 percent.

The soil surface is stable and intact. These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to the Loamy site are Aastad, Aazdahl, Barnes, Beotia, Croke, Darnen, Eckman, Fairdale, Fordville, Forman, Gardena, Great Bend, Heimdal, Lankin, La Prairie, LaDelle, Overly, Svea, Vang, and Walsh.

Access Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) for specific local soils information.

Parent Material Kind: glaciolacustrine deposits, deltaic deposits, beach deposits, till, alluvium
Parent Material Origin: glacial till, lacustrine
Surface Texture: loam, silt loam, or silty clay loam but clay loam, very fine sandy loam
Surface Texture Modifier: None, very stony, very cobbly
Subsurface Texture Group: loamy
Surface Fragments <3" (% Cover): 0-15
Surface Fragments ≥3" (% Cover): 0-20
Subsurface Fragments <3" (% Volume): 0-15
Subsurface Fragments >3" (% Volume): 0-5

	Minimum	**Maximum**
Drainage Class:	moderately well	well
Permeability Class*:	moderately slow	moderate
Soil Depth to first restrictive layer (inches):	20	>80
Electrical Conductivity (dS/m):**	0	4
Sodium Absorption Ratio:**	0	2
Soil Reaction (1:1 water):**	6.1	8.4
Soil Reaction (.01 M CaCl2):	N/A	N/A
Available Water Capacity (inches)*:	5	12
Calcium Carbonate Equivalent (percent)*:	0	30

*These attributes represent from 0-40 inches or to the first restrictive layer.
**These attributes represent from 0-20 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will likely have E.C. values ≤2.

Plant Communities

Ecological Dynamics of the Site:

This ecological site description is based on nonequilibrium ecology and resilience theory and utilizes a State-and-Transition Model (STM) diagram to organize and communicate information about ecosystem change as a basis for management. The ecological dynamics characterized by the STM diagram reflect how changes in ecological drivers, feedback mechanisms, and controlling variables can maintain or induce changes in plant community composition (phases and/or states). The application of various management actions, combined with weather variables, impact the ecological processes which influence the competitive interactions, thereby maintaining or alter plant community structure.

Prior to European influence, the historical disturbance regime for MLRA 56A included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months except perhaps January. These fires occurred in two peak periods, one from March-May with the peak in April and another from July-November with the peak occurring in October. Most of these fires were scattered and of small extent and duration. The grazing history would have involved grazing and browsing by large herbivores (such as American bison, elk, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

Following European influence, this ecological site generally has had a history of grazing by domestic livestock, particularly cattle, which along with other related activities (e.g., fencing, water development, fire suppression) has changed the disturbance regime of the site. Changes will occur in the plant communities due to these and other factors.

Weather fluctuations, coupled with managerial factors, may lead to changes in the plant communities and, under adverse impacts, may result in a slow decline in vegetative vigor and composition. However, under favorable conditions the botanical composition may resemble that prior to European influence.

Five vegetative states have been identified for the site (Reference, Native/Invaded, Invaded, Go-Back, and Wooded). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant and visually conspicuous species; they have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. Transitional pathways and thresholds have been determined through similar methods.

State 1: Reference State represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. Dynamics of the state were largely determined by variations in climate and weather (e.g., drought), as well as that of fire (e.g., timing, frequency) and grazing by native herbivores (e.g., frequency, intensity, selectivity). Due to those variations, the Reference State is thought to have shifted temporally and spatially between three plant community phases.

Presently, the primary disturbances include widespread introduction of exotic plants, concentrated livestock grazing, lack of fire, and perhaps long-term non-use or very light grazing and no fire. Because of these changes, particularly the widespread occurrence of exotic species, as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic plants on the site precludes it from being placed in the Reference State. It must then be placed in one of the other states, commonly State 2: Native/Invaded State. This state may transition to State 2: Native/Invaded State with the colonization of exotic cool-season grasses (T1A). It may also transition to State 5: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T1B).

State 2: Native/Invaded State. Colonization of the site by exotic plants will cause a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was inevitable; it often resulted from colonization by exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, and/or quackgrass) which have been particularly and consistently invasive under long-term non-use or very light grazing, and no fire. Other exotic plants (e.g., Canada thistle, leafy spurge) are also known to invade the site.

Three community phases have been identified for this state; they are similar to the community phases in the Reference State but have now been invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, a decline in forb diversity can be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient cycling, and biological activity near the soil surface. As a result, these factors, coupled with shading, cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A). This state may also transition to State 5: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T2B).

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (e.g., Kentucky bluegrass, quackgrass, smooth brome) exceed 30% of the plant community and native grasses represent less than 40% of the community. One plant community phase has been identified for this state.

The exotic cool-season grasses can be quite invasive and often form monotypic stands. As they increase, both forage quantity and quality of the annual production becomes increasingly restricted to late spring and early summer, even though annual production may increase. Forb diversity often declines. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This may also alter infiltration, nutrient cycling, and biological activity near the soil surface. As such, desirable native plants become increasingly displaced.

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to respond to treatments, a restoration pathway to State 2: Native/Invaded State (R3A) may be accomplished with the implementation of long-term prescribed grazing in conjunction with prescribed burning. This state may also transition to State 5: Invaded Wooded State during long-term non-use or very light grazing, and no fire (T3A).

State 4: Go-Back State often results following cropland abandonment and consists of only one plant community phase. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) will likely predominate. Initially, due to extensive bare ground and a preponderance of shallow rooted annual plants, infiltration is low and the potential for soil erosion is high. Plant species richness may be high, but overall diversity (i.e., equitability) is typically low with the site dominated by a relatively small assemblage of species. Due to the lack of native perennials and other factors, restoring the site with the associated ecological processes is difficult. However, a successful range planting may result in something approaching State 2: Native/Invaded State (R4A). Following planting, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 3: Invaded State (R4B). This state may also transition to State 5: Invaded Wooded State during long-term non-use and no fire (T4A).

State 5: Invaded Wooded State. This state historically existed as small patches of trees and/or shrubs scattered across the site when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of patches of woody vegetation interspersed within the grass-dominated vegetation. Marked increases in non-use management and active fire suppression since European influence have enabled this state to expand and become more widespread. One community phase has been identified and often results from long-term non-use or very light grazing, and no fire (T2B, T3A, T4A).

Prescribed burning and/or chemical/mechanical brush management followed by a successful range planting may lead to State 2: Native/Invaded State (R5A). Failure of the range planting followed by secondary succession, however, will lead to State 3: Invaded State (R5B).

The following state and transition model diagram illustrates the common states, community phases, community pathways, and transition and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience; changes may be made as more data are collected. Pathway narratives describing the site's ecological dynamics reference various management practices (e.g., prescribed grazing, prescribed burning, brush management, herbaceous weed treatment) which, if properly designed and implemented, will positively influence plant community competitive interactions. The design of these management practices will be site specific and should be developed by

knowledgeable individuals; based upon management goals and a resource inventory; and supported by an ongoing monitoring protocol.

When the management goal is to maintain an existing plant community phase or restore to another phase within the same state, modification of existing management to ensure native species have the competitive advantage may be required. To restore a previous state, the application of two or more management practices in an ongoing manner will be required. Whether using prescribed grazing, prescribed burning, or a combination of both with or without additional practices (e.g., brush management), the timing and method of application needs to favor the native species over the exotic species. Adjustments to account for variations in annual growing conditions and implementing an ongoing monitoring protocol to track changes and adjust management inputs to ensure desired outcome will be necessary.

The plant community phase composition table(s) has been developed from the best available knowledge including research, historical records, clipping studies, and inventory records. As more data are collected, plant community species composition and production information may be revised.

Plant Communities and Transitional Pathways

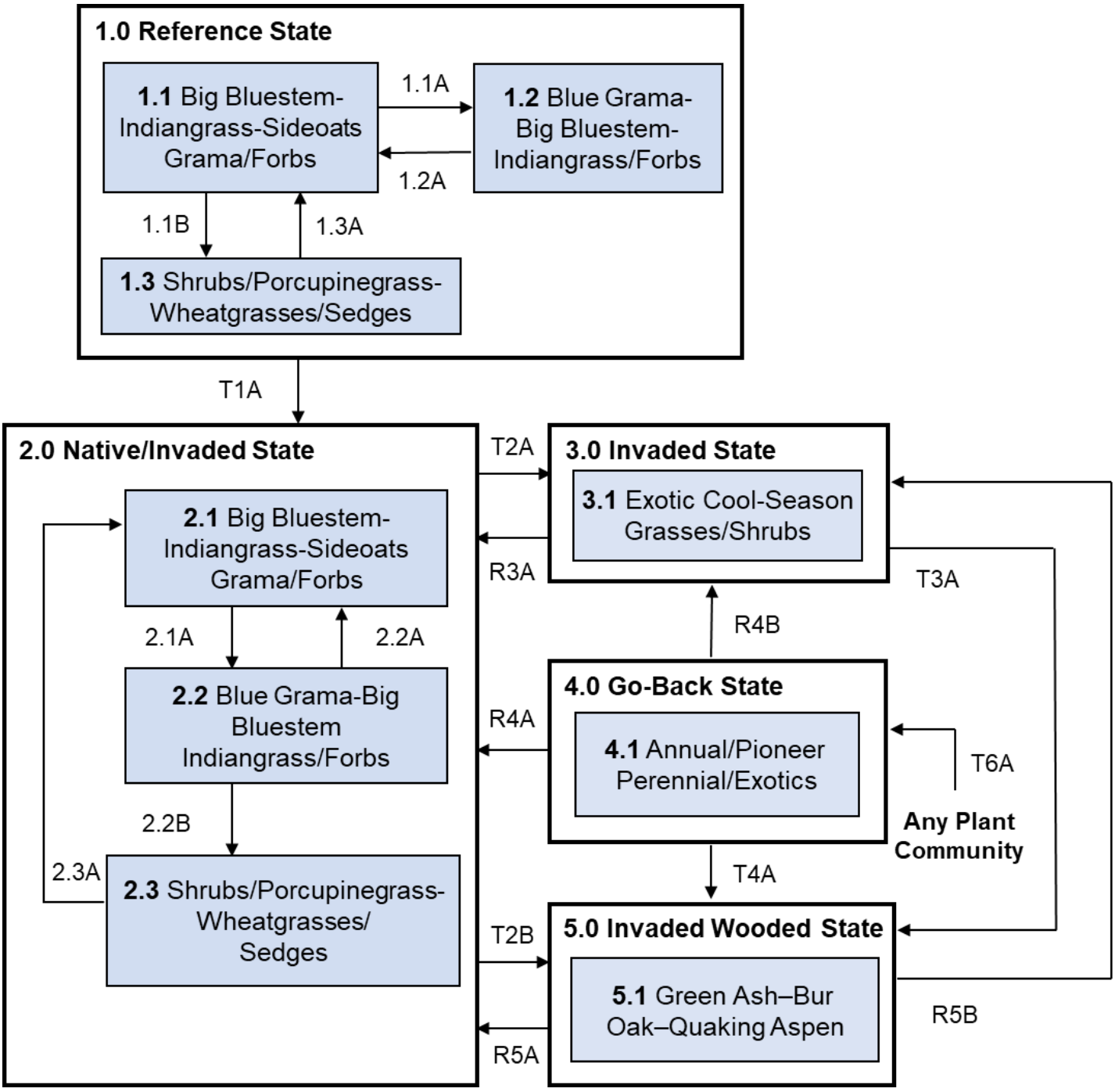

1.0 Reference State
1.1 Big Bluestem-Indiangrass-Sideoats Grama/Forbs
1.2 Blue Grama-Big Bluestem-Indiangrass/Forbs
1.3 Shrubs/Porcupinegrass-Wheatgrasses/Sedges
1.1A
1.2A
1.1B
1.3A
T1A
2.0 Native/Invaded State
2.1 Big Bluestem-Indiangrass-Sideoats Grama/Forbs
2.2 Blue Grama-Big Bluestem Indiangrass/Forbs
2.3 Shrubs/Porcupinegrass-Wheatgrasses/ Sedges
2.1A
2.2A
2.2B
2.3A
T2A
R3A
3.0 Invaded State
3.1 Exotic Cool-Season Grasses/Shrubs
T3A
R4B
4.0 Go-Back State
4.1 Annual/Pioneer Perennial/Exotics
R4A
T6A
Any Plant Community
T4A
T2B
5.0 Invaded Wooded State
5.1 Green Ash–Bur Oak–Quaking Aspen
R5B
R5A

Diagram Legend - MLRA 56A Loamy

T1A	Introduction of exotic cool-season grasses
T1B	Long-term non-use or very light grazing, no fire
T2A	Long-term non-use or very light grazing, no fire
T2B	Long-term non-use or very light grazing, no fire
T3A	Long-term non-use or very light grazing, no fire
T4A	Long term non-use or very light grazing, no fire
T6A	Cessation of annual cropping
R3A	Long-term prescribed grazing and prescribed burning
R4A	Successful range planting
R4B	Failed range planting and/or secondary succession
R5A	Prescribed burning and/or chemical/mechanical brush management followed by successful range planting
R5B	Prescribed burning and/or chemical/mechanical brush management followed by failed range planting
CP 1.1 - 1.2 (1.1A)	Multiyear drought with/without heavy, long-term grazing
CP 1.1 - 1.3 (1.1B)	Above average precipitation and/or reduced grazing or fire frequency
CP 1.2 - 1.1 (1.2A)	Return to average precipitation and reduced grazing
CP 1.3 - 1.1 (1.3A)	Return to average precipitation and fire frequency with/without reduced grazing
CP 2.1 - 2.2 (2.1A)	Heavy grazing with or without drought
CP 2.2 - 2.1 (2.2A)	Long-term prescribed burning and prescribed grazing, return to average precipitation
CP 2.2 - 2.3 (2.2B)	Long-term non-use or very light grazing, no fire
CP 2.3 - 2.1 (2.3A)	Long-term prescribed grazing and prescribed burning

State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. 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. These factors likely caused the community to shift both spatially and temporally between three community phases.

Characteristics and indicators (i.e., characteristics and indicators that can be used to distinguish this state from others). Because of changes in disturbances and other environmental factors (particularly the widespread occurrence of exotic species), the Reference State is considered to no longer exist.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). If intact, the reference state should probably be managed with current disturbance regimes which have permitted the site to remain in reference condition, as well as maintaining the quality and integrity of associated ecological sites. Maintenance of the reference condition is contingent upon a monitoring protocol to guide management.

Community Phase 1.1: Big Bluestem-Indiangrass-Sideoats Grama/Forbs (*Andropogon gerardii-Sorghastrum nutans-Bouteloua curtipendula*/Forbs)

This community phase was historically the most dominant both temporally and spatially, with warm-season grasses dominating the community. The major grasses and sedges included big bluestem, Indiangrass, switchgrass, sideoats grama, little bluestem, prairie dropseed, porcupinegrass, and green needlegrass. Other

associated grasses included needle and thread, western wheatgrass, slender wheatgrass, bearded wheatgrass, blue grama, and upland sedges.

Blazing star, common yarrow, purple prairie clover, blacksamson echinacea, silverleaf Indian breadroot, upright prairie coneflower, stiff sunflower, and stiff goldenrod were among the more common forbs. Common shrubs likely included leadplant, prairie rose, western snowberry, and prairie sagewort.

Annual production likely varied between about 1900-3900 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 85%, 10% and 5%, respectively. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

		1.1 Big Bluestem-Indiangrass-Sideoats Grama/Forbs		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*2030 - 2465*	*70 - 85*
TALL WARM-SEASON GRASSES		**1**	**290 - 725**	**10 - 25**
big bluestem	ANGE	1	290 - 580	10 - 20
Indiangrass	SONU2	1	145 - 290	5 - 10
switchgrass	PAVI2	1	145 - 290	5 - 10
NEEDLEGRASSES		**2**	**435 - 870**	**15 - 30**
green needlegrass	NAVI4	2	145 - 290	5 - 10
porcupinegrass	HESP11	2	145 - 580	5 - 20
needle and thread	HECO26	2	0 - 145	0 - 5
MID WARM-SEASON GRASSES		**3**	**290 - 725**	**10 - 25**
little bluestem	SCSC	3	145 - 290	5 - 10
sideoats grama	BOCU	3	58 - 290	2 - 10
prairie dropseed	SPHE	3	58 - 290	2 - 10
WHEATGRASS		**4**	**145 - 290**	**5 - 10**
western wheatgrass	PASM	4	0 - 145	0 - 5
slender wheatgrass	ELTR7	4	29 - 145	1 - 5
bearded wheatgrass	ELCA11	4	29 - 145	1 - 5
OTHER NATIVE GRASSES		**5**	**29 - 145**	**1 - 5**
blue grama	BOGR	5	29 - 87	1 - 3
prairie Junegrass	KOMA	5	0 - 29	0 - 1
mat muhly	MURI	5	0 - 87	0 - 3
Leiberg's panicum	DILE2	5	0 - 87	0 - 3
other grasses	2GRAM	5	29 - 145	1 - 5
GRASS-LIKES		**6**	**29 - 145**	**1 - 5**
needleleaf sedge	CADU6	6	29 - 145	1 - 5
long-stolon sedge	CAIN9	6	29 - 145	1 - 5
other grass-likes	2GL	6	0 - 145	0 - 5
FORBS		*7*	*145 - 290*	*5 - 10*
blazing star	LIATR	7	29 - 87	1 - 3
common yarrow	ACMI2	7	29 - 58	1 - 2
Cuman ragweed	AMPS	7	29 - 58	1 - 2
field ragwort	ARCA12	7	29 - 58	1 - 2
white sagebrush	ARLU	7	29 - 58	1 - 2
false boneset	BREU	7	0 - 58	0 - 2
wavyleaf thistle	CIUN	7	0 - 58	0 - 2
purple prairie clover	DAPU5	7	29 - 58	1 - 2
blacksamson echinacea	ECAN2	7	29 - 58	1 - 2
stiff sunflower	HEPA19	7	29 - 58	1 - 2
stiff goldenrod	OLRI	7	29 - 58	1 - 2
soft-hair marbleseed	ONBEB	7	29 - 58	1 - 2
silverleaf Indian breadroot	PEAR6	7	29 - 58	1 - 2
upright prairie coneflower	RACO3	7	29 - 58	1 - 2
compassplant	SILA3	7	0 - 58	0 - 2
Canada goldenrod	SOCA6	7	29 - 58	1 - 2
white heath aster	SYER	7	29 - 58	1 - 2
aromatic aster	SYOB	7	0 - 58	0 - 2
American vetch	VIAM	7	29 - 58	1 - 2
rush skeletonplant	LYJU	7	0 - 29	0 - 1
Nuttall's sensitive-briar	MINU6	7	0 - 29	0 - 1
cutleaf anemone	PUPAM	7	0 - 29	0 - 1
Missouri goldenrod	SOMI2	7	0 - 29	0 - 1
hoary verbena	VEST	7	0 - 29	0 - 1
other native forbs	2FORB	7	29 - 145	1 - 5
SHRUBS		*8*	*29 - 145*	*1 - 5*
leadplant	AMCA6	8	29 - 116	1 - 4
prairie rose	ROAR3	8	29 - 87	1 - 3
western snowberry	SYOC	8	29 - 87	1 - 3
prairie sagewort	ARFR4	8	0 - 29	0 - 1
other shrubs	2SHRUB	8	0 - 58	0 - 2

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1615 -	2465	- 3315
FORBS	190 -	290	- 390
SHRUBS	95 -	145	- 195
TOTAL	1900 -	2900	- 3900

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

Community Phase Pathway 1.1A
Community Phase Pathway 1.1 to 1.2 occurred during multiyear drought with or without heavy-long term grazing or other conditions that resulted in an increase in blue grama with corresponding decreases in big bluestem, Indiangrass, and sideoats grama.

Community Phase Pathway 1.1B
Community Phase Pathway 1.1 to 1.3 occurred with above average precipitation and/or reduced grazing or fire frequency resulting in marked increases in shrubs (e.g., western snowberry), porcupinegrass, wheatgrass, and sedges with corresponding decreases in big bluestem, Indiangrass, and sideoats grama.

Community Phase 1.2: Blue Grama-Big Bluestem-Indiangrass/Forbs (*Bouteloua gracilis-Andropogon gerardii-Sorghastrum nutans*/Forbs)
This community phase occurred with multiyear drought with or without heavy long-term grazing. This resulted in an increase in blue grama with corresponding decreases in big bluestem, Indiangrass, and sideoats grama. The forb and shrub component of this community was similar to that of Community Phase 1.1 but some species (e.g., prairie sagewort) may have markedly increased.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 occurred with the return to average precipitation and reduced grazing which led to a decrease in blue grama with corresponding increases in big bluestem, Indiangrass, and sideoats grama.

Community Phase 1.3: Shrubs/Porcupinegrass-Wheatgrasses/Sedges (Shrubs/*Hesperostipa spartea-Elymus caninus, Elymus trachycaulus*/*Carex* spp.)
This community phase occurred during periods of above average precipitation and/or reduced grazing or fire frequency. It may be characterized as a shrub dominated community consisting of a mixture of species (e.g., western snowberry, prairie rose, leadplant, American plum, chokecherry). Associated grasses often included porcupinegrass, bearded wheatgrass, and slender wheatgrass, along with upland sedges. Canada goldenrod, white heath aster, wavyleaf thistle, and common yarrow were likely among the common forbs.

Community Phase Pathway 1.3A
Community Phase Pathway 1.3 to 1.1 occurred upon return to average precipitation and fire frequency with/without reduced grazing. This would have resulted in decreases in shrubs, porcupinegrass, wheatgrasses, and sedges with corresponding increases in big bluestem, Indiangrass, and sideoats grama.

Transition T1A
This is the transition from the State 1: Reference State to the State 2: Native/Invaded State due to the introduction and establishment of exotic cool-season grasses (typically Kentucky bluegrass, smooth brome, and/or quackgrass). This transition was inevitable and corresponded to a decline in native warm-season and cool-season grasses; it may have been exacerbated by chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire could also have hastened the transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, quackgrass, or other exotic plants became established on the site.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). Current knowledge and technology will not facilitate a successful restoration to Reference State.

State 2: Native/Invaded State
This state is similar to State 1: Reference State but has now been colonized by the exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass) which are now present in small amounts. Although the state is still dominated by native grasses, an increase in these exotic cool-season grasses can be expected.

These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State.

These exotic cool-season grasses have been particularly and consistently invasive under extended periods of non-use and no fire. To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected.

Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. Annual production may range from 1800-3800 pounds per acre.

Characteristics and indicators (i.e., characteristics that can be used to distinguish this state from others). The presence of trace amounts of exotic cool-season grasses indicates a transition from State 1 to State 2. The presence of exotic biennial or perennial leguminous forbs (i.e., sweet clover, black medic) may not, on their own, indicate a transition from State 1 to State 2 but may facilitate that transition.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). To slow or limit the invasion of these exotic grasses, it is imperative that managerial techniques (e.g., prescribed grazing, prescribed burning) be carefully constructed, monitored, and evaluated with respect to that objective.

Grazing management should be applied that enhances the competitive advantage of native grass and forb species. This may include: (1) grazing when exotic cool-season grasses are actively growing and native cool-season grasses are dormant; (2) applying proper deferment periods allowing native grasses to recover and maintain or improve vigor; (3) adjusting overall grazing intensity to reduce excessive plant litter (above that needed for rangeland health indicator #14 – see Rangeland Health Reference Worksheet); (4) incorporating early heavy spring utilization which focuses grazing pressure on exotic cool-season grasses and reduces plant litter, provided that livestock are moved when grazing selection shifts from exotic cool-season grasses to native grasses.

Prescribed burning should be applied in a manner that maintains or enhances the competitive advantage of native grass and forb species. Prescribed burns should be applied as needed to adequately reduce/remove excessive plant litter and maintain the competitive advantage for native species. Timing of prescribed burns (spring vs. summer vs. fall) should be adjusted to account for differences in annual growing conditions and applied during windows of opportunity to best shift the competitive advantage to the native species.

Community Phase 2.1: Big Bluestem-Indiangrass-Sideoats Grama/Forbs (*Andropogon gerardii-Sorghastrum nutans-Bouteloua curtipendula*/Forbs)

This community phase is very similar to Community Phase 1.1, but now has been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass).

Figure 1. Community Phase 2.1: Big Bluestem-Indiangrass-Sideoats Grama/Forbs.

Community Phase Pathway 2.1A

Community Pathway 2.1 to 2.2 occurs with heavy grazing with or without drought. Blue grama increases with corresponding decreases in big bluestem, Indiangrass, and sideoats grama.

Community Phase 2.2: Blue Grama-Big Bluestem-Indiangrass/Forbs (*Bouteloua gracilis-Andropogon gerardii-Sorghastrum nutans*/Forbs)

This community phase is similar to Community Phase 1.2 but has now been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass). These exotic plants, however, are present in smaller amounts with the community still dominated by native grasses.

This community phase is often dispersed throughout a pasture in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some overgrazed areas will exhibit the impacts of heavy use, while the ungrazed areas will have a build-up of litter and increased plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. As a result, Kentucky bluegrass tends to increase more in the undergrazed areas while the more grazing tolerant short statured species, such as blue grama and sedges, increase in the heavily grazed areas. If present, Kentucky bluegrass may increase under heavy grazing.

This community phase is approaching the threshold leading to a transition to State 3: Invaded State. As a result, it is an “at risk” community. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected.

Community Phase Pathway 2.2A

Community Phase Pathway 2.2 to 2.1 occurs with the implementation of long-term prescribed grazing and prescribed burning, and a return to average precipitation. This results in increases in big bluestem, Indiangrass, and sideoats grama with a corresponding decrease in blue grama.

Community Phase Pathway 2.2B

Community Phase Pathway 2.2 to 2.3 occurs during long-term non-use or very light grazing, and no fire, resulting in an increase in mulch accumulation along with marked increases in shrubs, forbs, and exotic cool-season grasses.

Community Phase 2.3: Shrubs/Porcupinegrass-Wheatgrasses/Sedges (Shrubs/*Hesperostipa spartea-Elymus caninus, Elymus trachycaulus*/*Carex* spp.)

This community phase is similar to Community Phase 1.3 but has now been colonized by exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass). These exotic grasses, however, are present in smaller amounts with the community still dominated by native grasses.

Community Phase Pathway 2.3A

Community Phase Pathway 2.3 to 2.2 occurs with the implementation of long-term prescribed grazing and prescribed burning. Prescribed grazing incorporates heavy early spring and/or late fall grazing of cool-season exotic grasses when cool-season exotic grass is most vulnerable, shifting the competitive advantage to the remaining native species. Prescribed burning will likely require repeated treatments to complete the pathway to target exotic cool-season grass invasion and because many of the shrubs (e.g., western snowberry) sprout profusely following one burn.

Transition T2A

This transition from State 2: Native/Invaded State to State 3: Invaded State generally occurs with long-term non-use or very light grazing, and no fire. Exotic cool-season grasses (e.g., quackgrass, Kentucky bluegrass, smooth brome) become the dominant graminoids.

Studies indicate that a threshold may exist in this transition when both the exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the plant community composition. This transition may occur under other management including heavy season-long grazing (primarily Kentucky bluegrass).

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). Variations in growing conditions (e.g., cool, wet spring) will influence the effects of various management activities on exotic cool-season grass populations.

Transition T2B

This transition from the State 2: Native/Invaded to State 5: Invaded Wooded State generally occurs with long-term non-use or very light grazing, and no fire. It frequently occurs when the site is in close proximity to wooded areas where the woodland vegetation may encroach vegetatively and/or serve as a seed source for these species to colonize the site. The Invaded Wooded State has become more frequent following European settlement since the historic fire regime has been markedly reduced.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

Constraints to recovery include reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. are some of the

constraints to recovery. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

State 3: Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or quackgrass). These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State. Common forbs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as western snowberry and prairie rose, may increase. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful.

Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses. However, annual production may be in the range of 1300-3700 pounds per acre.

Characteristics and indicators (i.e., characteristics that can be used to distinguish this state from others). This site is characterized by exotic cool-season grasses constituting greater than 30 percent of the annual production and native grasses constituting less than 40 percent of the annual production.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). Light or moderately stocked continuous, season-long grazing or a prescribed grazing system which incorporates adequate deferment periods between grazing events and proper stocking rate levels will maintain this State. Application of herbaceous weed treatment, occasional prescribed burning and/or brush management may be needed to manage noxious weeds and increasing shrub (e.g., western snowberry) populations.

Community Phase 3.1 – Exotic Grasses/Shrubs

This Community Phase is dominated by exotic, cool-season sodgrasses (such as Kentucky bluegrass, smooth brome, and/or quackgrass), often with a reduced forb component. Excessive accumulation of mulch may also be present, particularly when dominated by Kentucky bluegrass. Common forbs and shrubs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as western snowberry and prairie rose, may increase.

Total production may be in the range of 3,000 pounds per acre with over 60% of total production attributable to the exotic cool-season grasses. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass or smooth brome are typically short-lived.

Transition T3A

This transition pathway from State 3: Invaded State to State 5: Invaded Wooded State may be initiated by extended periods of non-use or very light grazing, and no fire. This frequently occurs when the site is in close proximity to wooded areas where the woodland vegetation may encroach vegetatively and/or serve as a seed source for these species to colonize the site. It has also become more frequent following European settlement since the historic fire regime has been markedly reduced.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

Constraints to recovery include the reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

Restoration R3A

This restoration pathway from the State 3: Invaded State 2: Native/Invaded State may be initiated with the implementation of long-term prescribed burning with prescribed grazing, assuming there is an adequate component of native grasses to respond to the treatments.

Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 3.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g., western snowberry) sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique.

Common forb and shrub associates include northern bedstraw, common dandelion, Canada goldenrod, common yarrow, Canada thistle, western snowberry, and prairie rose. If the site is adjacent to woodlands, sprouts and seeds from the woodland species may begin to encroach and colonize the site.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Grazing management should be applied in a manner that enhances/maximizes the competitive advantage of native grass and forb species over the exotic species. This may include the use of prescribed grazing to reduce excessive plant litter accumulations above that needed for rangeland health indicator #14 (see Rangeland Health Reference Worksheet). Increasing livestock densities may facilitate the reduction in plant litter provided length and timing of grazing periods are adjusted to favor native species.

Grazing prescriptions designed to address exotic grass invasion and favor native species may involve earlier, short, intense grazing periods with proper deferment to improve native species health and vigor. Fall (e.g., September, October) prescribed burning followed by an intensive, early spring graze period with adequate deferment for native grass recovery may shift the competitive advantage to the native species, facilitating the restoration to State 2: Native/Invaded.

Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime, or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fine fuel orientation (e.g., “flopped” Kentucky bluegrass); (2) fire intensity and duration by adjusting ignition pattern (e.g., backing fires vs head fires); (3) account for plant phenological stages to maximize stress on exotic species while favoring native species (both cool- and warm-season grasses).

State 4: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds needing control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) will likely predominate.

Characteristics and indicators (i.e., characteristics that can be used to distinguish this state from others). Tillage has destroyed the native plant community, altered soil structure and biology, reduced soil organic matter, and resulted in the formation of a tillage induced compacted layer which is restrictive to root growth. Removal of perennial grasses and forbs results in decreased infiltration and increased runoff.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). Continued tillage will maintain the state. Control of noxious weeds will be required.

Community Phase 4.1: Annual/Pioneer Perennial /Exotics

This Community Phase is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, including noxious weeds (e.g., Canada thistle) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) will likely predominate.

Transition T4A

The transition from State 4: Go-Back State to State 5: Invaded Wooded State may occur with long-term non-use and no disturbances. This frequently occurs when the site is in close proximity to wooded areas where the woodland vegetation may encroach vegetatively and/or serve as a seed source for these species to colonize the site. It has also become more frequent following European settlement since the historic fire regime has been markedly reduced.

Constraints to recovery (i.e., variables or processes that preclude recovery of the former state). The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Continued recruitment of tree seeds from adjacent sites will hamper site restoration.

Constraints to recovery include reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. Managers wanting to manage the site for deer, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

Restoration R4A

The restoration pathway from State 4: Go-Back State to State 2: Native/Invaded State may result from a successful range planting with prescribed grazing and prescribed burning. Following planting, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds.

It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources; management objectives

must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion.

The method or methods of herbaceous weed treatment will be site specific to each situation; but generally, the goal would be to apply the pesticide, mechanical control, or biological control (either singularly or in combination) in a manner that shifts the competitive advantage from the targeted species to the native grasses and forbs. The control method(s) should be as specific to the targeted species as possible to minimize impacts to non-target species.

Restoration R4B

A failed range planting and/or secondary succession will lead to State 3: Invaded State.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Failed range plantings can result from many causes (both singularly and in combination) including drought, poor seedbed preparation, improper seeding methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

State 5: Invaded Wooded State

This state historically existed as small patches of trees and/or shrubs scattered across the site, where trees and shrubs could have encroached onto the site vegetatively (e.g., rhizomes, root sprouts) or provided a seed source for colonization of the site. Variations in fire frequency enabled woody plant species in some areas (i.e., period of infrequent fire) to grow large enough to escape the next fire event. As trees increased in size, canopy cover increased which altered micro-climate and reduced fine fuel amounts resulting in reduced fire intensity and frequency. This would have been the primary pathway under the historic disturbance regime and would have resulted in a mosaic pattern of small, wooded patches interspersed within herbaceous plant community phases. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

Common woody species often include bur oak, green ash, and small patches of quaking aspen clones with an understory of smaller trees and shrubs (often including western snowberry, prairie rose, and chokecherry). Buckthorn is increasing in MLRA 56A and can become invasive in this plant community. An herbaceous component of smooth brome, wildrye, and/or Kentucky bluegrass is often present, particularly when the canopy is more open. Under more closed canopies, the herbaceous understory is predominantly shade-tolerant sedges (e.g., Sprengel's sedge).

Characteristics and indicators (i.e., characteristics and indicators that can be used to distinguish this state from others). The dominance of woody species (by cover and production) distinguishes this state from other herbaceously dominated states.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). This state is resistant to change in the long-term absence of fire. Restoration efforts would require the use of prescribed fire, mechanical treatment, and prescribed grazing. Considerable time and effort will be required to restore to other states.

Community Phase 5.1: Green Ash-Bur Oak-Quaking Aspen (*Fraxinus pennsylvanica-Quercus macrocarpa-Populus tremuloides*)

This plant community phase is often characterized by a dominance of green ash, bur oak, and quaking aspen with lesser amounts of American plum, boxelder, and perhaps ironwood. Shrubs include chokecherry, prairie rose, and western snowberry. An herbaceous understory of sedges, wildrye, and assorted forbs may also be present. Regardless of how this community phase originated, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) will generally be prominent components. As the trees mature and canopy cover increases, herbaceous production declines and shrubs/vines associated with mature woodlands may begin to occupy the understory.

Restoration R5A

Restoration Pathway from State 5: Invaded Wooded State to State 2: Native/Invaded State occurs with the implementation of prescribed burning and/or chemical/mechanical brush management followed by successful range planting.

A combination of mechanical brush management, chemical treatment, and prescribed burning is necessary to remove the woody vegetation and prepare the seedbed for a successful range planting. It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. Following the establishment of the native plant species, prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources; management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fuel type (herbaceous vs. shrub vs. tree), fine fuel amount and orientation (e.g., “flopped” Kentucky bluegrass); (2) fire intensity and duration by adjusting ignition pattern (e.g., backing fires vs head fires); (3) account for plant phenological stages to maximize stress on exotic species while favoring native species (both cool- and warm-season grasses).

The method of brush management will be site specific, but generally the goal would be to apply the pesticide, mechanical control, or biological control (either singularly or in combination) in a manner that shifts the competitive advantage from the targeted species to the native grasses and forbs. The control method(s) should be as specific to the targeted species as possible to minimize impacts to non-target species.

A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As

a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion.

Restoration R5B

Restoration Pathway from State 5: Invaded Wooded State to State 3: Invaded State occurs with the implementation of prescribed burning and/or chemical/mechanical brush management followed by a failed range planting.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Failed range plantings can result from many causes (both singularly and in combination) including drought, poor seedbed preparation, improper seeding methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

Transition T6A

This is the Transition from any plant community to State 4: Go-Back State. It is most commonly associated with the cessation of cropping without the benefit of range planting, resulting in a "go-back" situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g., development of tillage induced compaction, erosion, fertility, and/or herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

Landscape

The MLRA 56A landscape is characterized by a nearly level glacial lake plain bordered on the east and west by outwash plains, till plains, gravelly beaches, and dunes. MLRA 56A 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 the MLRA. This area supports natural tall-grass prairie vegetation with bur oak, green ash, and willow growing in drainageways. This area is formed in silty and clayey lacustrine sediments from the former Glacial Lake Agassiz. Complex intermingled ecological sites create diverse grass/shrub land habitats interspersed with varying densities of linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries to the Red River of the North. MLRA 56A is located within the boundaries of the Prairie Pothole Region and is an ecotone between the humid east and the sub-humid west regions. The primary land use is annual cropland (~80%). The Red River Valley is known for its exceptional fertility with major crops including corn, soybeans, small grains, and sugar beets.

By the mid-19th century, the majority of the Red River Valley had been converted from tall-grass prairie to annual crop production. To alleviate crop production loss from wetlands and overland flow, a system of shallow surface ditches, judicial ditches, and road ditches removes surface water in spring and during high rainfall events. The major soils are poorly drained with extensive areas of saline soils. Tile drainage systems have been or are being extensively installed throughout MLRA 56A for sub-surface field drainage to enhance annual crop production.

The east and west side of the Red River Valley formed in a complex pattern of sandy beach material, stratified inter-beach material, lacustrine silts, and lake washed glacial till. The soils vary from excessively drained on ridges to very poorly drained organic basins. Surface ditches serve to drain some of the area, although much of the area lacks adequate drainage for maximum crop production.

Calcareous fens and saline seeps can occur at the base of beach ridges and result in rare plant communities. Native vegetation was mixed- and tall-grass prairie with scattered woodland and brush.

Historic Communities/Conditions within MLRA 56A:

The northern tall- and 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). Frequent and expansive flooding along the Red River and its tributaries provided abundant opportunities for Native Americans to harvest wild rice. American bison roamed MLRA 56A wintering along the Red River and migrating west into MLRA 55A and 55B for parts of the season. 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 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 and American black bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). Extirpated species include free-ranging American bison and gray wolf (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 56A:

MLRA 56A has the most conversion to cropland of any MLRA within Region F-Northern Great Plains. European influence has impacted remaining grassland and shrubland by domestic livestock grazing, elimination of fire, removal of surface and subsurface hydrology via artificial drainage, and other anthropogenic factors influencing plant community composition and abundance.

Extensive drainage has taken place. Streams have been straightened, removing sinuosity, and riparian zones have been converted to annual crop production. These anthropogenic impacts have reduced flood water detention and retention on the landscape, increasing storm water runoff, sediment, and nutrient loading to the Red River and its tributaries. The installation of instream structures has reduced aquatic species movement within the MLRA.

Annual cropping is the main factor 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, Kentucky bluegrass, and leafy spurge which further impacted plant and animal communities. The loss of the bison 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 approximately 70,000 acres of the United States Forest Service, Sheyenne National Grassland (southern portion of MLRA) with an additional 65,000 acres of intermingled privately owned land of sandy soils providing a large tract of intact tall grass prairie within the MLRA. United Fish and Wildlife Service refuges and waterfowl production areas, along with and state wildlife management areas cover approximately 67,000 acres within the MLRA. Two of three largest cities in North Dakota are located within the MLRA.

USDA conservation programs have seeded thousands of cropland acres in riparian zones to native herbaceous vegetation. Natural succession is replacing the planted native herbaceous vegetation to native woody vegetation re-establishing native wooded riparian areas on previously cropland. Most of the plantings have been along the Red River and its tributaries in the northern portions of the MLRA within the United States. These areas are privately owned and protected from annual agricultural production with perpetual conservation easements.

Some characteristic wildlife species in this area are:

Birds: Mallard, blue-winged teal, red-tailed hawk, American kestrel, ring-necked pheasant, western meadowlark, killdeer, eastern and western kingbird, American crow, common yellowthroat, downy and hairy woodpecker, clay-colored sparrow, vesper sparrow, Savannah sparrow, and brown-headed cowbird.

Mammals: Northern short-tailed shrew, white-tailed jackrabbit, snowshoe hare, Franklin's ground squirrel, thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher, western harvest mouse, deer mouse, meadow vole, meadow jumping mouse, western jumping mouse, coyote, red fox, raccoon, American badger, striped skunk, white-tailed deer, North American beaver, and moose.

Reptiles/Amphibians: American toad, Great Plains toad, northern leopard frog, chorus frog, tree frog, tiger salamander, plains garter snake, and common garter snake.

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 most species are usually larger than one ecological site or are dependent upon 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. Extensive use of insecticides for specialty crops (such as potatoes, sugar beets, and other crops) has greatly reduced insects within this MLRA.

Species of Concern within MLRA 56A:

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 Minnesota State Wildlife Action Plan, Conservation Focus Areas, Target Species (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 56A at the time this section was developed:

Invertebrates: Arogos skipper, Assiniboia skipper, Dakota skipper, dusted skipper, Leonard's skipper, monarch butterfly, Poweshiek skippering, red-tailed leafhopper, regal fritillary, and Uhler's Arctic.

Birds: American kestrel, American bittern, bobolink, American white pelican, bald eagle, black-billed cuckoo, chestnut-collared longspur, Dickcissel, grasshopper sparrow, greater prairie-chicken, Henslow's sparrow, LeConte's sparrow, loggerhead shrike, marbled godwit, Nelson's sparrow, northern harrier, northern pintail, red-headed woodpecker, sharp-tailed grouse, short-eared owl, Swainson's hawk, upland sandpiper, western meadowlark, willet, Wilson's phalarope, and yellow rail.

Mammals: Arctic shrew, big brown bat, eastern spotted skunk, gray fox, little brown bat, northern grasshopper mouse, plains pocket mouse, prairie vole, pygmy shrew, Richardson's ground squirrel, and river otter.

Amphibians/Reptiles: Canadian toad, common snapping turtle, northern prairie skink, and plains hognose snake.

Fish: Blacknose shiner, blue sucker, burbot, chestnut lamprey, finescale dace, hornyhead chub, largescale stoneroller, logperch, northern pearl dace, northern redbelly dace, pearl dace, shortnose gar, sickle-fin chub, sliver chub, silver lamprey, trout-perch, and yellow bullhead.

Mussels: Black sandshell, creek heelsplitter, creeper, mapleleaf, pink heelsplitter, pink papershell, threeridge, and Wabash pigtoe.

Grassland Management for Wildlife in MLRA 56A:

Management activities within the community phase pathways have both short and long term positive and negative impacts on 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 (grazing intensity, reseeding, prescribed fire, woody vegetation removal, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on vegetative structure impacting local wildlife species' habitats. 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 individual species.

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 (Wet Meadow, Subirrigated Sands) can be located adjacent to ecological sites that support trees (Choppy Sands and Loamy Overflow).

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 or increases in woody vegetation. Managers need to recognize ecological sites and the complexes they occur in to properly manage the landscape. A management regime for one ecological site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Choppy Sands 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 requisites 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 State. 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, or foraging 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., western snowberry) in this MLRA.

Loamy Wildlife Habitat Interpretation:

Loamy ecological sites have no restrictions in the soil profile. This complex of ecological sites provides habitat for many edge-sensitive, grassland bird species. Loamy habitat features support nesting and foraging grassland birds but may be too dense and tall for sharp-tailed grouse leks.

Associated ecological sites include Clayey, Limy Subirrigated, Loamy Overflow, Subirrigated, Thin Loamy, Sandy, and Wet Meadow.

Loamy ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, 4.0 Go-Back State, and 5.0 Invaded Wooded State). Multiple plant community phases exist within States 1.0 and 2.0. These states occur primarily in response to grazing, drought, and non-use. Secondary influences include fire and anthropogenic disturbances.

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 2.0 Community Phase pathways to prevent further plant community degradation along the Transitional Pathway T2A to Invaded State 2.0 or Transitional Pathway T2B to State 5.0 Invaded Wooded State. Conversion to a woody state along transitional pathway T2B, T3A, or T4A generally benefit wildlife species that can tolerate or require woody habitat within plant community State 5.0.

As plant communities degrade within State 2.0, warm-season grasses (particularly short-statured and cool-season exotic grasses) increase while native forbs are reduced. This transition results in reduced structure, increased plant community homogeneity, and reduced insect populations resulting in a reduction of breeding, nesting, foraging, or winter habitat for grassland birds. When adjacent/intermingled ecological sites undergo the same transition, the result can be an expansive, homogenous landscape. Success along restoration pathway R3A, R4A, and R5A to State 2.0 is very difficult and is dependent upon presence of remnant native grass populations, successful native range planting, and/or successful woody vegetation removal.

Invaded Wooded State 5.0 provides habitat features and components which support woodland edge and interior birds and other wildlife species dependent upon trees and shrubs to meet their life requisites. Grassland-nesting birds that commonly avoid woody vegetation will not have their habitat needs met and may even avoid adjacent ecological sites dominated by grassland vegetation. A reduction in nesting success by grassland nesting birds on adjacent herbaceous sites is likely due to an increase in avian predation. These wooded sites provide quality loafing, escape, and winter cover for small and large herbivores and quality year-round habitat for American martin, snowshoe hare, elk, moose, and white-tailed deer. These sites provide habitat for many migratory passerines, year-round habitat for ruffed grouse, and quality winter cover for eastern screech owl, great horned owl, wild turkey, and non-migrating passerine birds (such as black-capped chickadee and white-breasted nuthatch).

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 enough quality to support a sustainable population.

1.0 Reference State

Community Phase 1.1 Big Bluestem-Indiangrass-Sideoats Grama/Forbs: This plant community offers quality wildlife habitat; every effort should be made to maintain this 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 burning. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting 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 American bison, are simulated 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 decomposers, scavengers, shredders, predators, herbivores, dung beetles and fungal feeders).

Dakota skippers do not prefer this site due to limited host plants (such as woody lily, harebell, and smooth camas). Regal fritillary habitat is limited due to Nuttall's violet and prairie violets being uncommon. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding and larvae development. Bumblebees and other native bees utilize forbs for nectar and pollen and bare ground for nesting amongst bunchgrasses (such as sideoats grama, green needlegrass, porcupinegrass, and little bluestem). Prescribed grazing with adequate recovery periods, as well as prescribed burning, to maintain the 1.1 phase will have long-term positive effects on ground dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tall-grass nesting birds. Grassland birds preferring mid- to tall-grass structure 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 nesting, brood-rearing, and winter habitat. Limited structure and diverse prey populations provide good hunting opportunity for grassland raptors. Many passerine species utilize MLRA 56A as a major migratory travel corridor. The low scattered shrubs present in the plant community phase should not impact woody vegetation sensitive bird species.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores. Mid- to tall-stature vegetation provides suitable food, thermal, protective, and escape cover for small and large herbivores.

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 wetlands, streams, or lakes) is adjacent or near the site.

Fish and Mussels: This ecological site can be near or adjacent to wetlands (Wet Meadow ecological site), streams, rivers, or water bodies. Associated ecological sites, such as Loamy Overflow, can receive run-on hydrology from Loamy sites (out-letting into receiving waters). Management on these interconnected sites can have direct effects on aquatic species.

Community Phase 1.2 Blue Grama-Big Bluestem-Indiangrass/Forbs: Multiyear drought with or without heavy long-term grazing favors an increase blue grama (a shorter, warm-season grass) and corresponding decreases in big bluestem, Indiangrass, and sideoats grama.

Invertebrates: Provides similar life requisites as Community Phase 1.1 since the forb component remains similar. However, an increase in warm-season, sod-forming grasses with the corresponding reduction in sideoats grama may negatively impact ground nesting pollinator species.

Birds: Long-term drought with or without heavy long-term grazing favors grassland-nesting birds species preferring short- to mid-statured vegetation. Winter cover for resident bird species, such as sharp-tailed grouse, is somewhat compromised due to the increase in blue grama and heavy-long-term grazing.

Mammals: Even though tall warm season grasses are still present in this plant community phase, heavy long-term grazing and long-term drought creates shorter statured vegetation, reducing cover for large mammals such as white-tailed deer.

Amphibians and 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 Shrubs/Porcupinegrass-Wheatgrasses/Sedges: With above average precipitation and a reduction in fire frequency or reduced grazing, native shrubs become prominent and begin to dominate. Western snowberry, American plum, chokecherry, Saskatoon serviceberry, leadplant, and wild rose may spread across the entire site.

Invertebrates: Provides similar life requisites as Community Phase 1.1. However, increased shrub component will provide early- and mid- season nectar and pollen sources for pollinating insects. Depending on the number of forbs still present, late season pollen and nectar may not be available. These woody species are not considered nectar sources for regal fritillary or monarch butterfly.

Birds: Western snowberry-dominated sites provide brood and winter cover for sharp-tailed grouse and ring-necked pheasant. Western snowberry, chokecherry, and American plum provide winter cover and food (berries) for grassland-nesting bird species that use woody vegetation (or can tolerate a small amount) within areas dominated by grassland habitat. Woody vegetation may not reach enough density to provide habitat for woodland edge species but may reach density for grassland nesting birds sensitive to woody vegetation to avoid this site. Brown-headed cowbird use will increase with an increase in the woody cover component of this ecological site.

Mammals: Increase in woody habitat provides winter and escape cover, birthing sites, browse, etc. for white-tailed deer. The increase in woody cover may not benefit bat species found in MLRA 56A since necessary maternity or roost trees are limited.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1; however, the increase in woody vegetation will decrease habitat quality for the smooth green snake.

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

2.0 Native/Invaded State

Community Phase 2.1 Big Bluestem-Indiangrass-Sideoats Grams/Forbs: This plant community occurs with the introduction of exotic cool-season grasses. The transition can be facilitated by chronic or heavy late-season grazing, as well as long-term non-use and no fire events (via Transitional Pathway T1A). The threshold between the states is crossed when exotic grasses, such as Kentucky bluegrass and smooth brome, become established on the site. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except 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 the Invaded State 3.0. There is no known Community Phase Pathway back to State 1.0 from State 2.0.

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 and 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-Big Bluestem-Indiangrass/Forbs: Heavy grazing, with or without drought along Community Phase Pathway 2.1A leads to shorter-statured warm-season grasses dominating this plant community. As grama grasses begin to dominate, stature is reduced. This community can appear in a mosaic of overgrazed/undergrazed dispersed throughout the pasture with undergrazed areas having a litter build-up and other areas lacking cover. 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. This plant community is considered an "at-risk" plant community and can transition to State 3.0 if management regimes are not incorporated to control or reduce cool-season exotic grasses.

Invertebrates: Provides similar life requisites as Community Phase 1.2; however, heavy season-long grazing may reduce forb richness and production. Undergrazed areas will have an increase in litter, reducing ground-nesting site availability. The reduction of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators.

Birds: Provides similar life requisites as Community Phase 1.2; however, heavy season-long grazing will reduce grassland-nesting birds nest sites, forage (invertebrates), and cover. A mosaic of undergrazed/overgrazed areas favor both grassland-nesting bird species that favor short- to mid-statured vegetation. A reduced forb component may limit foraging opportunities. Species that prefer mid-grass stature generally will be 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, use by mid-grass nesting species may be compromised. This plant community provides areas suitable for sharp-tailed grouse lek site development in overgrazed areas with nesting, brood, and winter cover in undergrazed areas. Limited stature and diverse prey populations provide good hunting opportunities for grassland raptors.

Mammals: Provides similar life requisites as Community Phase 1.2. Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals become limited in overgrazed areas while undergrazed areas provide thermal, protective, and escape cover.

Amphibians and 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 Shrubs/Porcupinegrass-Wheatgrasses/Sedges: Long-term non-use or very light grazing, with no fire, enables native shrubs to become dominant. Kentucky bluegrass, smooth brome, and/or quackgrass may be found alone or as a mosaic across the site. Shrubs are dominated by shorter statured shrubs, but chokecherry and American plum may be found in this plant community phase. Continued extended periods of non-use or very light season-long grazing, with no fire, enables native trees to begin dominating the site (via Transitional Phase T2B). While implementation of prescribed grazing or prescribed burning results in a reduction of the shrub component moving this plant community back to Community Phase 2.2.

Invertebrates: The invasion of woody vegetation and reduction or entire loss of big bluestem reduces or eliminates habitats for all invertebrate species of concern within MLRA 56A. Season-long pollen and nectar availability becomes limited on this site. The woody shrub component will provide early- to mid-season bloom period. Hairy false goldenaster provide mid- to late-season bloom times. Forbs, such a goldenrod and white heath aster, provide late season pollen and nectar opportunities. Overall, pollinator plant diversity is high providing season-long nectar and pollen production.

Birds: Grassland nesting birds sensitive to woody vegetation encroachment may discontinue use of this community phase dependent upon the density of western snowberry, Saskatoon serviceberry, chokecherry, and silver buffaloberry. Tall shrub density will also have a negative impact on grassland nesting birds not tolerant to woody species. Woody vegetation typically does not reach enough density or height to provide habitat for bird species favoring woodland edge. Brown-headed cowbird use will increase with an increase in the woody cover component of this ecological site. Increase in woody component will provide winter cover for pheasant and sharp-tailed grouse.

Mammals: Increase in woody habitat provides winter and escape cover, birthing sites, browse, etc. for large and small mammals.

Amphibians and Reptiles: This site no longer provides life requisites for the northern prairie skink and plains hog-nosed snake due to the dominance of western snowberry and other shrubs.

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 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 dominance (>30%) of exotic cool-season grasses, such as smooth brome; native grasses represent less than 40% of the plant community. Restoration Pathway R3A, through prescribed burning and high levels of grazing management, requires remnant amounts of native warm- and cool-season grasses and forbs to be successful. The remnant native community needs frequent prescribed burns and high levels of grazing management targeting the exotic cool-season grasses to improve competitiveness and increase vigor and density. Without intensive management, the remnant native plants will not increase adequately to transition back to State 2.0. Managers need to evaluate impacts to wildlife while implementing these management practices. 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: Exotic grasses limit use by beneficial insects provided in States 1.0 and 2.0. However, western snowberry and prairie rose may provide early season pollen and nectar sources. Increased litter and lack of grazing leads to limited contact between plant material and mineral soil, resulting in a cooler micro-climate which is unfavorable to most insects. Lack of bare soil limits ground-nesting sites for native bees and other ground-nesting insects. Western snowberry and prairie rose provides early season pollen and nectar. Mid-season pollen and nectar is limited due to lack of forb diversity, while goldenrods provide last season pollen and nectar sources.

Birds: The homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of plant diversity and stature, along with increased litter and the tendency of Kentucky bluegrass and smooth brome to lay down or flop, limits use by many grassland-nesting birds. Depending on the density of western snowberry, sharp-tailed grouse may use this plant community for lek sites and nesting cover; western snowberry may provide winter cover, depending on density.

Mammals: Litter accumulation and exotic grass cover favors thermal, protective, and escape cover for small rodents. Western snowberry may provide escape, parturition, and thermal cover dependent on density.

Amphibians and 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/Exotics: Following cropland abandonment, these plant communities are dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and 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 for deer, small mammals, and over-wintering birds. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, inter-seeding, haying, or noxious weed control).

Successful restoration of native species along Restoration Pathway R4A can result in a native grass and forb community in State 2.0. Over time, with no management, the exotic cool-season perennial grasses (Kentucky bluegrass, smooth brome, and/or quackgrass) generally become established and dominate the community. Failed range planting, via Restoration Pathway R4B, can result in an invaded plant community Invaded State 3.0.

5.0 Invaded Wooded State

Loamy ecological sites did not historically support a woody plant community. The Invaded Wooded State usually exists on the east or north aspect slopes or as a linear woody feature on a concave landscape commonly referred to as “woody draws”. The invaded wooded state occurs when the Loamy ecological site is located near a seed source for woody vegetation (such as a wooded Loamy Overflow ecological site or near a wooded riparian corridor). The removal of all disturbance through Transition Pathways T2B or T3A are the major contributors to this community phase crossing the threshold from an herbaceous plant community to a community dominated by hardwoods and shrubs. The composition of this woody plant community will be dependent upon shading (tree canopy density), management (grazing), and the amount of invasive grass and shrub species.

Successful restoration along Restoration Pathway R5A, can result in a native grass and forb community in State 2.0. Implementation of prescribed burning and/or chemical/mechanical brush management followed by a failed range planting, via Restoration Pathway R5B, can result in an invaded plant community Invaded State 3.0.

Invaded Wooded State 5.1 Green Ash-Bur Oak-Quaking Aspen: Loamy ecological sites supported small patches of trees and shrubs (including chokecherry, prairie rose, and western snowberry). This wooded phase can be scattered or across the entire site; however, the longer the site has been removed from active fire management or other management tools, the more this plant community is enabled to expand. North-facing slopes, river valleys, and concave landscape positions are particularly prone to woody encroachment. The Invaded Wooded State occurs when the Loamy ecological site is located near a seed source for woody vegetation (such as a wooded Loamy Overflow ecological site, forested ecological sites, or a wooded riparian corridor). The removal of all disturbance through Transition Pathways, T2B or T3A are the major contributors to this community phase crossing the threshold from an herbaceous plant community to a community dominated by hardwoods and shrubs. The composition of this woody plant community will be dependent upon shading (tree canopy density), management (grazing), and the amount of invasive grass and shrub species.

The Invaded Wooded State is an important vegetative type used by many large herbivorous mammals and woodland bird species. Multi-level canopy, high edge-to-area ratio, and prevalence of preferred forage provides high quality wildlife habitat. Within MLRA 56A, the Invaded Wooded State provides important travel corridors, security cover, foraging, loafing, winter cover, and parturition (birthing) areas.

Invertebrates: Early season flowering shrubs provide pollen and nectar. However, pollinating insects will need adjacent herbaceous- and forb-dominated ecological sites for mid- to late-season pollen sources. Lower trophic-level consumers (such as invertebrate decomposers, scavengers, shredders, predators, herbivores, dung beetles and fungal-feeders) will use woody plant material, leaves, and limited amounts of grasses in contact with mineral soil. The woody component of this site is not conducive to use by the Dakota skipper, monarch butterfly, and regal fritillary. Woody plant material is available for wood-nesting bees. These wind-protected, moist plant communities provide favorable habitat for flying insects (flies, mosquitoes, moths, etc.). Favorable climatic conditions can lead to large hatches of insects.

Birds: This site no longer provides habitat for grassland-nesting bird species due to the dominance of woody vegetation. Bird species that use and benefit from woodland edge (such as wild turkey, black-billed cuckoo, black-capped chickadee, gray catbird, and Swainson's hawk) can be found in this community phase. These sites provide nesting habitat for many migratory passerines and quality habitat for ruffed grouse, eastern screech owl, great horned owl, wild turkey, red-headed woodpecker, and non-migrating birds such as woodpeckers (downy, hairy, and pileated), black-capped chickadee and white-breasted nuthatch. Berry producing shrubs provide late summer, fall, and winter forage for many bird species. Wildlife use increases as the depth of snow increases during the winter, thereby becoming critical to the sustainment of winter resident bird populations. The presence of woody plant species may increase mammalian and avian predation and increase brood parasitism by brown-headed cowbirds on adjacent grassland ecological sites.

Mammals: Dead and mature trees provide cavities and loose bark for big brown bat, northern long-eared bat, and little brown bat. Small herbivores that can use or tolerate woodland (such as arctic shrew, pygmy shrew, river otter, American porcupine, cotton-tail rabbit, and snowshoe hare) will benefit from this plant community phase. Shrubs and trees provide security and thermal cover used by white-tailed deer and elk for foraging, loafing, and rearing young-of-the-year. Multi-layer shrub/tree communities provide concealment protection from predators during parturition. Plant species provide highly nutritious forage during peak lactation, one of the most energetic demanding time periods of the year for female ungulates. Winter white-tailed deer diets are dominated by chokecherry, western snowberry, Saskatoon serviceberry, rose, and various species of gooseberry.

Amphibians and Reptiles: This Invaded Wooded State does not provide habitat for species of conservation priority.

Fish and Mussels: Provides similar life requisites as Community Phase 1.1; however, the Invaded Wooded State can occur near or on side slopes above drainageways in close proximity to receiving water bodies. The bare soil found under the tree and shrub canopy may reduce infiltration and nutrient cycling. Run-off, sediment yield, and nutrient load increase from the site which negatively impacts receiving water bodies.

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.

NRCS defines prescribed grazing as “managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives”. As used in this site description, the term ‘prescribed grazing’ is intended to include multiple grazing management systems (e.g., rotational grazing, twice-over grazing, conservation grazing, targeted grazing, etc.) provided that, whatever management system is implemented, it meets the intent of prescribed grazing definition.

The basic grazing prescription addresses balancing forage demand (quality and quantity) with available forage, varying grazing and deferment periods from year-to-year, matching recovery/deferment periods to growing conditions when pastures are grazed more than once in a growing season, implementation of a contingency (e.g., drought) plan, and a monitoring plan. When the management goal is to facilitate change from one plant community phase or state to another, then the prescription needs to be designed to shift the competitive advantage to favor the native grass and forb species.

Grazing levels are noted within the plant community narratives and pathways in reference to 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 areas 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

Available water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B, but includes some soils in group C. Infiltration varies from moderately slow to moderately rapid; runoff potential varies from low to high depending upon soil hydrologic group, surface texture, slope, and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where short grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational Uses

Hunting and Bird Watching: The United States Fish and Wildlife Service manages approximately 4,000 acres of National Wildlife Refuges for hiking and bird watching and approximately 24,000 acres of Waterfowl Production Areas for public hunting, hiking, and bird watching. States within MLRA 56A manage approximately 39,000 acres of wildlife management areas for multiple use including hunting, fishing, hiking, birdwatching, berry picking, and other non-motorized uses. Of the 39,000 acres, approximately 21,400 are in Minnesota with approximately 16,000 acres in North Dakota and approximately 1,700 acres in South Dakota.

In North Dakota, the United States Forest Service manages 70,000 acres on the Sheyenne National Grassland for multiple uses including camping, hunting, photography, backpacking birdwatching, biking, horseback riding, and other non-motorized recreation. The Sheyenne National Grassland is also managed for livestock grazing. The Choppy Sands and Sands ecological sites dominate the Grassland. It is the only National Grassland in the tallgrass prairie region of the United States. The grassland provides habitat for greater prairie chicken, as

well as several other sensitive species (such as the Dakota skipper and regal fritillary). It also contains one of largest populations of the western prairie fringed orchid which is listed as a threatened species by the U.S. Fish and Wildlife Service.

Fishing: Approximately 20 lakes are managed for public fishing MLRA 56A. Most of these lakes offer boat docks and ramps. These lakes contain various sport fish including walleye, northern pike, yellow perch, crappie, and bluegill. The Red River runs from south to north through the center of the MLRA. The Red River is best known for channel catfish but also has walleye, sauger, northern pike, and smallmouth bass. The Red River is 550 miles long from its source in the southern end of the MLRA near Breckenridge, Minnesota to Lake Winnipeg in Manitoba, Canada. Between North Dakota and Minnesota, there are 32 public access points along the Red River with 18 having boat ramps.

Camping: Four state parks or recreation areas provide of modern and primitive camping facilities. Minnesota hosts the Buffalo River State Park and Red River State Park. North Dakota hosts the Icelandic State Park and Turtle River State Park. These Parks provide hiking, biking, birding, canoeing, and wildlife viewing opportunities. Many local parks and private parks provide modern and primitive camping opportunities. Limited primitive camping is also available on North Dakota Game and Fish Department Wildlife Management Areas.

Hiking/Biking/Horseback Riding: Hiking is permitted on most state and federally owned lands. Developed hiking and biking trails can be found the four state parks. The Grand Forks Greenway has over 22 miles of trails while municipalities along the Red River have extensive walking and hiking trails. A 30-mile segment of the North Country National Scenic Trail leads hikers through the Sheyenne National Grassland's unique landforms and plant communities. This trail has three trailheads along its route; it is a graveled, marked trail. The entire North Country National Scenic Trail stretches from Crown Point, New York to Lake Sakakawea near Garrison, North Dakota.

Canoeing/Kayaking: The Red River has six designated canoe/kayaking trails. Public access, with limited rentals, is available at these segments. Sheyenne River Water Trail has a segment within the MLRA Sheyenne National Grasslands. Canoe/kayak rentals are available at Icelandic State Park.

Wood Products

No appreciable wood products are present on the site.

Other Products

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

Site Development and Testing Plan

- Further documentation may be needed for plant communities in all states. This site currently includes soils on low terraces of flood plains; a unique, provisional site (Loamy Floodplain) has been proposed to separate these areas from Loamy Overflow soils which occur in upland swales. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review to determine which sampling sites occur in upland swales and which sampling sites occur on floodplains. The data also needs review to determine if geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are available; if not, representative sites will be selected for further investigation. Soils of primary interest are La Prairie and LaDelle.
- Further investigation may be needed areas of this site on beaches. The available water capacity in these areas is lower than on other areas where this site occurs. This may impact the plant community during extended, drier than normal periods.

- Further evaluation and refinement of the State-and-Transition model may be needed to identify disturbance driven dynamics. Additional states and/or phases may be required to address grazing response.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
- Site concepts will be refined as the above noted investigations are completed.
- The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.
- NASIS revisions needed:
    - Six components (2 major) of Aastad need to be relinked from Loamy to Loamy Overflow.
    - Three minor components of Bottineau and 1 minor component of Waukon need to be relinked from Loamy to 55A Loamy Savannah.
    - Three components (1 major) of Kelvin and 2 components (3 major) of Olga need to be relinked from Loamy to 55A Upland Hardwood Forest.
    - Numerous Gardena components that are currently linked to Loamy Overflow need review. Where they are in complex only with soils that are lower on the landscape, they should be linked to Loamy instead.
    - Eleven Kittson components are somewhat poorly drained taxadjuncts. Most occur in map units in the Minnesota part of MLRA 56A. Currently, these components are linked to Loamy, but should be relinked to Subirrigated.
    - One major component of Wolverton Aquic Caldiudolls (moderately well drained) should be relinked from Loamy to Thin Loamy. It is a coarse-loamy, lacustrine version of Balaton.
    - Two major components of Walsh soils exceed 6 percent slopes; they need to be relinked from Loamy Overflow to Loamy.

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

Supporting Information

Associated Sites

Ecological Site Name	Site ID	Narrative
Clayey	R056AY084ND	This site typically occurs somewhat lower on the landscape. The subsoil layer forms a ribbon >2 inches long.
Limy Subirrigated	R056AY087ND	This site occurs lower on the landscape. It is highly calcareous in the upper part of the subsoil and has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Loamy Overflow	R056AY088ND	This site occurs on lower, concave slopes on lake plains – a run-on position; it also occurs on floodplain steps. The surface and subsoil layers form a ribbon 1 to 2 inches long.
Subirrigated	R056AY095ND	This site occurs on concave flats and in shallow depressions which have occasional, brief ponding early in the growing season. It has redoximorphic features at a depth of 18 to 30 inches. It is >16 inches to a

		highly calcareous subsoil. All textures are included in this site.
Thin Loamy	R056AY099ND	This site occurs on higher, convex slopes on lake plains. It is effervescent within a depth of 5 inches and is highly calcareous (strong or violent effervescence) immediately below the surface layer. The surface and subsoil layers form a ribbon 1 to 2 inches long.
Sandy	R056AY091ND	This site occurs on lake plains. The surface and subsoil layers from a ribbon <1 inch long.
Wet Meadow	R056AY102ND	This poorly drained site occurs in depressions and flats on uplands; it also occurs on floodplains. A seasonal highwater table is typically within a depth of 1.5 feet during the months of April through June; in depressions, it is frequently ponded (typically ≤1.5 feet) in April and May. It typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. E.C. is <8 dS/m in the surface and subsoil layers. All textures are included in this site.

Similar Sites

Ecological Site Name	Site ID	Narrative
Clayey	R056AY084ND	This site typically occurs somewhat lower on the landscape. The subsoil layer forms a ribbon >2 inches long.
Loamy Overflow	R056AY088ND	This site occurs on lower, concave slopes on lake plains – a run-on position; it also occurs on floodplain steps. The surface and subsoil layers form a ribbon 1 to 2 inches long.
Sandy	R056AY091ND	This site occurs on lake plains. The surface and subsoil layers from a ribbon <1 inch long.

Acknowledgements

Developers

ND NRCS: Keith Anderson, Fred Aziz, Stan Boltz, David Dewald, Jonathan Fettig, Alan Gulsvig, Mark Hayek, Chuck Lura, Jeff Printz, Steve Sieler, Lee Voigt, and Hal Weiser.

Inventory Data References

Information presented here has been derived from NRCS and other federal/state agency clipping and 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.

State Correlation

This site has been correlated with Minnesota, North Dakota, and South Dakota.

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48b Beach Ridges and Sand Deltas; 48c Saline Area; and 48d Lake Agassiz Plains.

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Site Description Approval

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

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: _Loamy_ Ecological site code: _RO56AY094ND_____
Author(s)/participant(s): _USDA-NRCS North Dakota_____
Contact for lead author: __NRCS State Rangeland Management Specialist___
Date: _Dec. 2021__ **MLRA:** __56_____ **LRU:** _____
Composition based on (check one): ☐ Cover ☒ Annual Production

Indicators. For each indicator, describe the potential for the site using the reference sheet checklist. Where possible, (1) use quantitative measurements; (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community phase within the reference state, when appropriate; and (3) cite data sources used. Continue descriptions on separate sheet.
1. Rills: Rills are not expected on this site.
2. Water flow patterns: Water flow patterns are not visible.
3. Pedestals and/or terracettes: Neither pedestals nor terracettes are expected on this site.
4. Bare ground: Bare ground is 5% or less. Bare ground patches should be small (less than 2 inches in diameter) and not connected. Animal activity (burrows and ant mounds) may occasionally result in isolated bare patches of up to 24 inches in diameter.
5. Gullies: Active gullies are not present under normal precipitation regime. If present, existing gullies are fully vegetated with no active erosion visible.
6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas expected on this site.
7. Litter movement: Litter movement is not expected when slopes are less than 15%. When slopes exceed 15%, slight movement (less than 12 inches) of fine/small class litter may be visible.
8. Soil surface resistance to erosion: Stability class averages 6.
9. Soil surface loss and degradation: Use soil series description for depth, color, and structure of A-horizon.
10. Effects of plant community composition and distribution on infiltration: Mid- and short-statured bunch grasses and tall rhizomatous grasses are dominant and well distributed across the site. Mid- and short-statured rhizomatous grasses and forbs are subdominant.
11. Compaction layer: No compaction layers occur naturally on this site.
12. Functional/structural groups: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), **not expected for this site**.

Dominance Category[1]	**Relative dominance of F/S groups for community phases in the *Reference State*** *Minimum expected number of species for dominant and subdominant groups is included in parentheses.*

	Dominance based on[1]: Annual Production _X_ or Foliar Cover __		
	Phase 1.1_	**Phase 1. __**	**Phase 1. __**
Dominant	Mid & short C3 bunch grasses (4); Tall C4 rhizomatous grasses (3)		
Subdominant	Mid & short C4 bunch grasses (3); Mid & short C4 rhizomatous grasses (1); Forbs (15)		
Minor	Mid & short C3 rhizomatous grasses; Grass-likes; Shrub		
Trace			

[1]Biological soil crust dominance is determined based on cover, rather than production. If biological soil crusts are an expected dominant or subdominant group, the number of expected life forms (e.g., lichen, moss) is listed, rather than number of individual species.

13. Dead or dying plants or plant parts: Rare to not occurring on this site.

14. Litter cover and depth: Plant litter cover is 70 to 80% with a depth of 0.25 to 0.75 inches. Litter is in contact with soil surface.

15. Annual production: Annual air-dry production is 2900 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 1900 to 3900 lbs./ac, respectively.

16. Invasive plants: State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, quackgrass, Russian olive, Siberian elm, and Eastern red cedar/juniper.

17. Vigor with an emphasis on reproductive capability of perennial plants: Noninvasive species in all functional/structural groups are vigorous and capable of reproducing annually under normal weather conditions.

October 2024

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Loamy **Ecol. site code** RO56AY094ND

Observers _____ **Date** _____

Evaluation site ID and/or name: _____
Dominance in ESD based on: Foliar Cover Annual Production Biomass

Species list of functional/structural groups in the **Reference State**	
Functional/Structural Group	Species List
Mid & short C3 bunch grasses	green needlegrass, porcupinegrass, needle and thread*, slender wheatgrass, bearded
.	wheatgrass, prairie Junegrass*
Tall C4 rhizomatous grasses	big bluestem, Indiangrass, switchgrass
Mid & short C4 bunch grasses	little bluestem, prairie dropseed, blue grama, Leiberg's panicum*
Mid & short C4 rhizomatous grasses	sideoats grama, mat muhly*
Forbs	please see plant community table 1.1
Mid & short C3 rhizomatous grasses	western wheatgrass*
Grass-likes	needleleaf sedge, long-stolon sedge
Shrub	leadplant, prairie rose, western snowberry, prairie sagewort*
.	
Biological soil crust[1]	

Reference State - Relative dominance of functional/structural groups for each community phase

Relative dominance annotations: *Use the following annotations in the narrow columns to describe the relative dominance of the listed functional/structural groups: = "equal"; > "greater than"; >> "much greater than"*

Phase	Dominant **	>> > =	Subdominant **	>> > =	Minor **	>> > =	Trace **
1.1	Mid & short C3 bunch grasses > Tall C4 rhizomatous grasses	>>	Mid & short C4 bunch grasses >> Mid & short C4 rhizomatous grasses > Forbs	>	Mid & short C3 rhizomatous grasses = Grass-likes = Shrub	.	
		.		.		.	
		.		.		.	

* Indicates species that may or may not be present on the site. Absence of these species may not constitute a departure.
** See IIRH Version 5 page 70.

Circle the community phase that most closely matches the evaluation area. *Revise functional/structural groups relative dominance for the community phase circled to represent changes in dominance given the time since disturbance(s) (see page 1 of site evaluation sheet).

Species list of functional/structural groups in the **Evaluation Area**	
Functional/Structural Group	Species List
Mid & short C3 bunch grasses	
Tall C4 rhizomatous grasses	
Mid & short C4 bunch grasses	
Mid & short C4 rhizomatous grasses	
Forbs	
Mid & short C3 rhizomatous grasses	
Grass-likes	
Shrub	
Groups not expected:	
Mid & short early C3 grasses	
Biological soil crust[1]	

Evaluation Area - Relative dominance of functional/structural groups						
Dominant **	>> > =	Subdominant **	>> > =	Minor **	>> > =	Trace **

Biological soil crust [1] - dominance is evaluated solely on cover, not composition by weight

** See IIRH Version 5 page 70.

Notes: