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: Wet Meadow

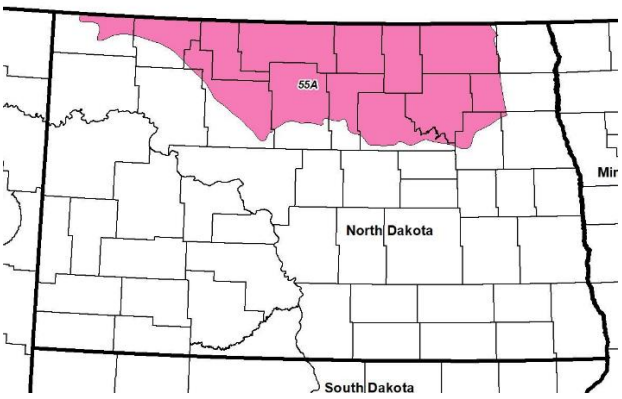
Site Type: Rangeland

Site ID: R055AY055ND

Major Land Resource Area: 55A – Northern Black Glaciated Plains

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 55A - Northern Black Glaciated Plains within North Dakota

The Northern Black Glaciated Plains MLRA is an expansive and agriculturally important region consisting of 8,200,000 acres and including all or a portion of 16 counties in north-central and northeast North Dakota.

Nearly all MLRA 55A is covered by till: material that was moved and redeposited by the glaciers. Pre-glaciated bedrock (shale) is exposed in some of the deeper valleys and at the edges of some hills; but what covers the bedrock is glacial sediment, known as drift. These areas have the Late Wisconsin age till plain integrated drainage system in contrast to the closed drainage of much of the till plain and moraines. The Drift Prairie Region consists of nearly level to gently rolling glacial till plains dissected

by glacial outwash channels. Five rivers flow through parts of the MLRA. The Souris (also known as Mouse) River meanders across the Canadian border through Renville and Ward counties; it then loops east through McHenry County and north through Bottineau County returning to Canada. The Des Lacs River flows southward from Canada through Burke, southwest Renville, and Ward counties where it joins the Souris River. Along the eastern edge of the MLRA the Pembina River, Park River, and Forest River flow eastward to join the Red River. Some soils along these rivers have weathered shale beds in the substratum.

This region is utilized mostly by farms and ranches; about 80 percent is cropland that is dry-farmed. Cash-grain, bean and oil production crops are the principal enterprise on many farms, but other feed grains and hay are also grown. The vegetation on the steeper slopes and thinner (or sandy) soils is still native rangeland. About 3 percent of this area is forested. The most extensive areas of forest are in the Turtle Mountains, Pembina Gorge, White Horse Hill, and on the moraines in proximity to Devils Lake.

Ecological Site Concept

The Wet Meadow ecological site is generally located in depressions and on low-lying flats on uplands – till plains, lake plains, outwash plains, and eolian sand plains; however, it also occurs in drainageways, on concave areas of flood plains, and on lake beaches. The soil is very deep. It is poorly drained - a seasonal high-water 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. Generally, redox features are within a depth of 18 inches. Very slight to slight salinity (E.C. <8 dS/m) is allowable on this site. Effervescence ranges from none to violent. Hydrology (surface and sub-surface) is the primary factor used in identifying this site. All textures are included in the site. Slope is less than 3 percent. On the landscape, this site is below the Loamy, Limy Subirrigated, and Subirrigated Sands ecological sites and above the Shallow Marsh ecological site. The Subirrigated ecological site occurs in shallow depressions and concave areas on flats; it has redoximorphic features at a depth of 18 to 30 inches. The Saline Lowland is on similar landscape positions. It has moderate or strong soil salinity (E.C. >8 dS/m). The Sodic Subirrigated site occurs on similar landscape positions on some sand plains; it has a sodic claypan layer. **Note: Some frequently flooded soils may be included in this site. The Riparian Complex ecological site should be considered for such soils.**

Physiographic Features

This site typically occurs in depressions and on low-lying flats on uplands – till plains, lake plains, outwash plains, and eolian sand plains; it also occurs in drainageways, on concave areas of flood plains, and on lake beaches. The parent materials vary widely. Slope is less than 3 percent.

Landform: pothole, depression, flat, drainageway, floodplain, lake beach

	Minimum	**Maximum**
Elevation (feet):	950	2525
Slope (percent):	0	3
Water Table Depth (inches):	0	42
Flooding:		
Frequency:	None	Frequent
Duration:	None	Long
Ponding:		
Depth (inches):	0	18
Frequency	Rare	Frequent
Duration:	Brief	Very long

Runoff Class: Negligible Low
Aspect: No influence on this site

Climatic Features

MLRA 55A 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. The continental climate is the result of the location of this MLRA in the geographic center of North America. There are few natural barriers on the northern Great Plains, so air masses move unobstructed across the plains and account for rapid changes in temperature.

The average annual precipitation is 17 to 19 inches (432 to 483 millimeters). The normal average annual temperature is 36º to 41º F (2º to 5º C). January is the coldest month with an average low temperature of about ¯ 3º F (¯19º C). July is the warmest month with an average high temperature of about 80º F (27º C).

About 75 percent of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Winter precipitation is typically snow. The annual snowfall is 25 to 50 inches (635 to 1,270 millimeters). The frost-free period averages 101 days and ranges from 108 days to 92 days. The freeze-free period averages 124 days and ranges from 128 to 119 days.

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

Long-term climate data is lacking for Turtle Mountain; however, annual precipitation for the International Peace Garden averaged 27.7 inches (704 millimeters) from 1967-1970 while that for Boissevain, Manitoba averaged 17.1 inches (434 millimeters). Turtle Mountain likely has greater precipitation, cooler temperatures, and less evapotranspiration than the adjacent plains.

Climate Station(s) 1981-2010

Station	Name	Location	Elevation	Lat	Long
USC00323963	HANSBORO 4 NNE	Hansboro	1540	48.9989	-99.3464
USC00324958	LANGDON EXP FARM	Langdon	1615.2	48.7622	-98.3447
USC00328913	UPHAM 3 N	Upham	1424.9	48.6147	-100.7264
USC00328990	VELVA 3NE	Velva	1535.1	48.0797	-100.875
USC00329333	WESTHOPE	Westhope	1502	48.9097	-101.0192
USW00024013	MINOT INTL AP	Minot	1665	48.2553	-101.2733
USC00322304	DRAKE 9 NE	Drake	1529.9	48.0475	-100.31
USC00322525	EDMORE 1NW	Edmore	1535.1	48.4267	-98.47
USC00325993	MINOT EXP STN	Minot	1769	48.1803	-101.2964
USC00326025	MOHALL	Mohall	1641.1	48.7603	-101.5089
USC00327704	RUGBY	Rugby	1549.9	48.3542	-99.9925
USC00328792	TOWNER 2 NE	Towner	1480	48.3706	-100.3908
USC00329445	WILLOW CITY	Willow City	1473.1	48.6061	-100.2911
USW00014912	DEVILS LAKE KDLR	Devils Lake	1463.9	48.1069	-98.8681
USC00320941	BOTTINEAU	Bottineau	1619.1	48.8217	-100.4525
USC00323686	GRANVILLE	Granville	1509.8	48.2675	-100.8439
USC00325078	LEEDS	Leeds	1529.9	48.2881	-99.4317
USC00327664	ROLLA 1NE	Rolla	1833	48.8811	-99.5861
USC00321871	CROSBY	Crosby	1952.1	48.9075	-103.2944
USC00320961	BOWBELLS	Bowbells	1961	48.7994	-102.2464

Climate Normals

	Representative		Actual		
	High	Low	High	Low	Average
Mean annual precipitation (in):	19	17	20	17	18
Frost free period (days):	109	92	112	88	101
Freeze free period (days):	128	119	132	116	124

Normal Monthly Precipitation (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.6	0.5	0.8	1.2	2.6	3.6	3.1	2.5	1.8	1.5	1.0	0.7
Representative low:	0.5	0.4	0.7	1.0	2.4	3.3	2.7	2.0	1.4	1.2	0.7	0.5
Actual high:	0.6	0.5	1.0	1.3	2.7	3.9	3.4	2.6	1.8	1.6	1.1	0.7
Actual low:	0.4	0.4	0.7	0.9	2.2	3.2	2.5	1.9	1.4	1.2	0.6	0.5

Normal monthly minimum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	0.1	4.0	17.1	30.3	42.0	52.2	56.6	54.3	44.0	31.7	17.7	3.9
Representative low:	-4.9	0.2	13.3	27.3	39.4	49.6	54.0	51.8	41.4	28.9	14.6	-0.1
Actual high:	1.8	7.9	19.2	31.8	43.6	53.3	58.0	55.8	46.0	33.9	18.6	6.4
Actual low:	-6.2	-1.6	11.8	26.2	38.1	48.7	53.2	51.0	40.8	27.9	14.1	-0.6
Average:	-2.6	2.3	14.9	28.8	40.6	50.7	55.3	53.1	42.8	30.2	16.0	2.0

Normal monthly maximum temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Representative high:	18.9	24.1	35.7	55.3	67.6	76.0	81.7	81.2	70.3	55.5	35.9	21.6
Representative low:	15.9	21.1	33.5	53.1	65.6	74.2	79.8	79.3	68.1	53.1	34.4	19.4
Actual high:	20.9	25.7	37.7	56.6	68.3	76.8	82.3	82.1	71.1	56.4	37.9	24.0
Actual low:	13.2	18.7	30.4	49.6	63.5	72.0	76.6	76.5	66.4	51.0	32.2	17.1
Average:	17.4	22.5	34.5	53.9	66.4	74.8	80.4	80.2	69.1	54.2	35.1	20.7

30 Year Annual Rainfall (inches): D-Dry; N-Normal; W-Wet

1981 D	1982 W	1983 D	1984 D	1985 N	1986 N	1987 N	1988 D	1989 D	1990 D	1991 W	1992 D	1993 W	1994 W	1995 N
15.5	22.9	16.1	16.2	18.5	18.8	17.4	11.6	13.5	16.5	22.7	11.5	21.7	22.1	17.9

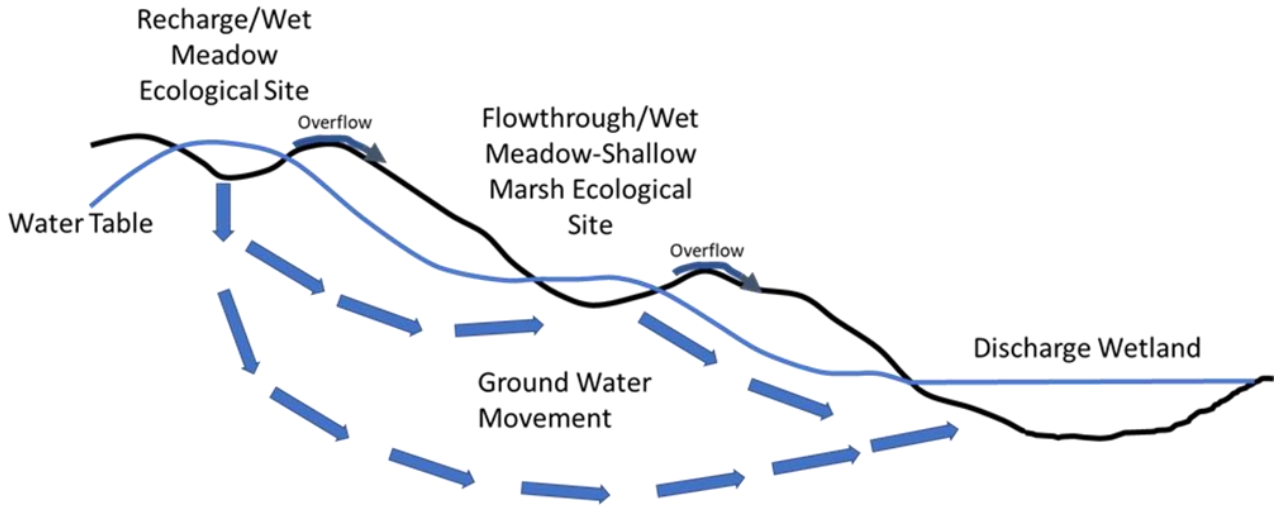
1996 W	1997 D	1998 W	1999 W	2000 W	2001 D	2002 N	2003 D	2004 W	2005 W	2006 D	2007 D	2008 W	2009 N	2010 W
19.6	16.2	22.8	21.9	22.9	16.3	17.0	15.0	20.8	22.7	13.4	16.8	21.5	18.4	26.7

Influencing Water Features

This site is poorly drained. Many areas of this site receive additional water as surface runoff from adjacent uplands. Under normal climatic conditions, the soils in depressions are frequently ponded in April and May and occasionally ponded in June. Depth of ponding typically is less than 1.5 feet during these months. In mid and late summer, ponded water commonly is not evident except after heavy rains. Ponding is commonly rare on flats; but, if adjacent to depressions, it may be occasional. Where present, ponding is less than 1 foot deep and of brief duration. Soils in this site occurring on flood plains have rare, brief to frequent, long flooding. On lake beaches, periodic inundation occurs with fluctuating lake levels.

When not ponded, a seasonal high-water table typically fluctuates with precipitation events between the surface and a depth of 1.5 feet during the months of April through June and it is typically within a depth 3.5 feet through the remainder of the growing season. Some of the soils in this site have endosaturation (apparent water table) and some have episaturation (perched water table above a subsoil layer with slow permeability).

Surface infiltration ranges from slow to rapid. Permeability typically ranges from slow to rapid; some soils have a coarser-textured substratum with very rapid permeability. Water loss is primarily through evapotranspiration.



Surface/Subsurface Water Flow Diagram (Adapted from Seelig and DeKeyser 2006)

Wetlands receive water from different sources including ground water movement. Recharge wetlands (Wet Meadow) have groundwater flow predominantly away from the wetland moving toward or into a discharge wetland basin. Flowthrough wetlands have groundwater flowing away from the wetland basin but is balanced with water flowing into the basin.

Due to the potential high rate of surface evaporation, areas of this site without frequent ponding are at risk of becoming saline (Saline Lowland) if vegetative cover is reduced or removed.

Water loss is primarily through evapotranspiration and lateral movement into (and evaporation from) adjacent soils. During periods of drought or extreme wetness, water table fluctuations will also have an impact on depth of ponding, especially in sandy soils. During periods of drawdown (e.g., prolonged drought), soil and water chemistry may significantly impact the soil/water/vegetation dynamics of the site (see **Site Development and Testing Plan**).

Fluctuations in specific conductance are less pronounced during average or normal water conditions than during periods of excessive water depth or extreme drought. The approximate normal and extreme range in specific conductance (micromhos/cm3) of surface water in plant communities that are indicators of differences in average salinity are as follows:

Plant Community	Normal Range (micromhos/cm^3)	Electroconductivity (dS/m)
Fresh	<40 - 500	< 0.5
Slightly brackish	500 - 2,000	0.5 to 2.0
Moderately brackish	2,000 - 5,000	2.1 to 5.0
Brackish	5,000 - 15,000	5.1 to 15.0
Sub-saline	15,000 - 45,000	15.1 to 45.0
Saline	45,000 -100,000	> 45.0

Wetlands in these depressions are considered temporary wetlands; however, during wetter than normal climate cycles, these soils may have seasonal ponding.

Representative Soil Features

Soils associated with Wet Meadow ES are in the Mollisol, Entisol, and Vertisol orders. The Mollisols are classified further as Argiaquic Argialbolls, Typic Argiaquolls, Typic Calciaquolls, Cumulic Endoaquolls, and Typic Endoaquolls. The Entisols are classified further as Typic Psammaquents and Vertic Fluvaquents. The Vertisols are further classified as Typic Calciaquerts, Typic Endoaquerts, and Typic Epiaquerts. These soils were developed under wetland vegetation. They formed in till, glaciolacustrine sediments, glaciofluvial deposits, eolian deposits, local alluvium from till, and in flood plain alluvium; some formed in beach deposits.

The common feature of soils in this site are ponding or near-surface saturation in the early part of the growing season. The soils are very deep and poorly drained. Some are in depressions and potholes that are ponded from April and May, some are on low-flying flats which have prolonged saturation in the spring, and some are on flood plains with frequent, brief, or long flooding. Since hydrology (surface and sub-surface) is the primary factor used in identifying this site, all textures are included. Therefore, soil physical properties associated with texture vary widely.

Soil salinity is none to slight (E.C. <8 dS/m) to a depth of >20 inches; in some soils it increases to moderate (E.C. 8-16 dS/m) in the lower subsoil and substratum. Sodicity is none or slight in the upper part of the soil; it is none to moderate in the substratum. Soil reaction typically is moderately acid to moderately alkaline (pH 5.6 to 8.4); but a few soils may be strongly alkaline (pH 8.5 to 9.0) in the substratum. The calcium carbonate content is none to high.

This site should show no evidence of rills, wind-scoured areas, or pedestaled plants. The soil surface is stable and intact. In some soils, sub-surface layers are non-restrictive to water movement; in other soils a layer of clay accumulation slows water movement and prolongs surface ponding. The soil/water/plant relationship is strongly influenced by ponded/and or saturated conditions.

Major soil series correlated to the Wet Meadow site are Arveson, Borup, Colvin, Fargo, Fossum, Hamar, Hegne, Kratka, Lallie, Lamoure, Lindaas, Lowe, Ludden, Marysland, Minnewaukan, Perella, Tiffany, Tonka, Vallers, and Verendrye.

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

Parent Material Kind: till, glaciolacustrine deposits, glaciofluvial deposits, alluvium, eolian deposits
Parent Material Origin: till, lacustrine
Surface Texture: silt loam, silty clay loam, loam, clay loam, silty clay, fine sandy loam
Surface Texture Modifier: none
Subsurface Texture Group: loamy, clayey, sandy
Surface Fragments <3" (% Cover): 0-8
Surface Fragments ≥3" (%Cover): 0-1
Subsurface Fragments <3" (% Volume): 0-32
Subsurface Fragments ≥3" (% Volume): 0-2

	Minimum	Maximum
Drainage Class:	poorly	poorly
Permeability Class:**	slow	rapid
Depth to first restrictive layer (inches):	80	>80
Electrical Conductivity (dS/m)*:	0	8
Sodium Absorption Ratio:**	0	8
Soil Reaction (1:1 Water):**	5.6	8.4
Soil Reaction (0.1M CaCl2):	NA	NA
Available Water Capacity (inches):**	1.5	12
Calcium Carbonate Equivalent (percent):**	0	35

*This attribute represents from 0-20 inches. Electrical Conductivity (E.C.) values are based on Saturated Paste method; the commonly used 1:1 field method will have E.C. values <4.
**These attributes represent from 0-40 inches.

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 altering plant community structure.

Prior to European influence, the historical disturbance regime for MLRA 55A 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.

This ecological site generally has a history of grazing by domestic livestock (particularly cattle) which, along with related activities (e.g., fencing, water development), has changed the disturbance regime of the site. Changes will occur in the plant communities due to weather fluctuations and/or

management actions; under adverse impacts, a slow decline in vegetative vigor and composition will result. However, under favorable conditions the site has the potential to resemble the reference state.

Although grazing and fire are significant ecological drivers for this site, equally important drivers are hydrology and water chemistry. Hydrology is mainly a factor of landscape position including the size of the contributing watershed, connectivity to other basins, and whether the basin has an outlet. Water chemistry is influenced by soil chemistry and whether the site is a recharge, flow-through, or discharge site. Grazing and fire interaction, particularly when coupled with drought events, set up the dynamics discussed and displayed in the following state and transition diagram and descriptions.

Several years of above or below average precipitation can have a dramatic impact on this ecological site. During periods of above average precipitation, the site has been observed to support vegetative communities associated with the Shallow Marsh ecological site. During drought periods, the vegetation of the site may be similar to that of Subirrigated ecological site.

When soils are saturated, particularly in the spring and early summer, Wet Meadow sites are susceptible to pugging damage (or hummocking of the soil by livestock walking on the site). Pugging is a form of soil compaction due to livestock which damages the soil structure. It can seal the soil surface which reduces infiltration and exacerbates waterlogging of the topsoil. The microtopography created by pugging generally supports plants of more well drained conditions; it is often associated with an increase in weedy species. This can lead to a significant reduction in plant production and utilization.

Seven vegetative states have been identified for the site (Reference, Native/Invaded, Wooded, Invaded/Saline, Invaded/Fresh Water, Invaded/Eutrophic, and Go-Back). 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 two plant community phases.

State 2: Native/Invaded State. Colonization of the site by exotic plants results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition is probably inevitable; it often results from colonization by exotic grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, red top, barnyard grass and/or exotic strains or hybrids of reed canarygrass) which have been particularly and consistently invasive under extended periods of non-use and no fire. Other exotic plants (e.g., hybrid cattail, Russian olive) may also 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 grasses. These exotic grasses can be expected to increase, particularly under extended periods of non-use and no fire. As that increase occurs, plants more desirable to wildlife and livestock decline. A decline in forb diversity can also be expected. Under long-term 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. Depending upon variations in water chemistry, heavy season-long grazing and below average precipitation can lead to a transition to either State 4: Invaded/Saline State via (T2B), or State 5: Invaded/Fresh Water State via (T2C). Both states are dominated by exotic grasses. Eutrophication and sedimentation may cause a transition to State 6: Invaded/Eutrophication State which is dominated by hybrid cattails or reed exotic strains/hybrids of canarygrass (via T2D). This state may also transition to State 3: Wooded State if willows are allowed to increase in size and extent during extended periods of infrequent fire (T2A).

State 3: Wooded State. This state may form during extended periods of infrequent fire and consists of one community phase. Bebb willow and perhaps other willows become dominant. Over time, the willows may form rather extensive stands or thickets. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. Mechanical treatment and prescribed burning may lead to State 2: Native/Invaded State (R3A).

State 4: Invaded/Saline State. This state (characterized by foxtail barley, exotic grasses, and exotic forbs) forms from State 2: Native/Invaded State (via T2B) during periods of heavy season-long grazing during times of below average precipitation leading to a decrease in water depth and brackish (alkalinity/salinity) conditions (discharge site). It may also form during long-term periods of non-use, no fire, no planting, saline conditions, and a successful hydrological restoration from State 7: Go-Back State (via R7B). Extended periods of above average precipitation will lead to State 2: Native/Invaded State (R4A).

State 5: Invaded/Fresh Water State. This state is characterized by exotic grasses, exotic forbs, sedges, and rushes and forms from State 2: Native/Invaded Site (via T2C) during periods heavy season-long grazing, below average precipitation, and no salinity (recharge site). It may also form during periods of long-term non-use, no fire, and no planting with freshwater conditions and a successful hydrological restoration from State 7: Go-Back State (via R7C). Extended periods of above average precipitation will lead to State 2: Native/Invaded State (R5A).

State 6: Invaded/Eutrophication State. This state, characterized by hybrid cattail or exotic strains/hybrids of reed canarygrass, forms from State 2: Native/Invaded State (via T2D) due to eutrophication and sedimentation of the site, often due to tillage on or adjacent to the site. A rise in water levels, particularly when in association with Shallow Marsh ecological sites, may also lead to dominance by cattails. It may also form during long-term non-use and no fire under conditions of eutrophication and sedimentation with a successful hydrological restoration from State 7: Go-Back State (via R7D). Extended periods of above average precipitation will lead to State 2: Native/Invaded State (R6A).

State 7: Go-Back State. This 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 grasses (e.g., Kentucky bluegrass, smooth brome, quackgrass, red top, barnyard grass, and/or exotic strains/hybrids of reed canarygrass) will likely predominate.

Initially, due to extensive bare ground and a preponderance of shallow-rooted annual plants, 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 hydrological restoration and planting may result in something approaching State 2: Native/Invaded State (R7A). 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 successful hydrological restoration followed by long-term non-use, no fire, and no planting will lead to one of the three invaded states depending upon variations in hydrology and water chemistry (e.g., R7B, R7C, R7D).

Drainage/Hydrological Manipulation: Hydrological manipulation (surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site. For more detailed information on drainage/hydrological manipulation of the site, see the "Hydrology Functions" section of this document.

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 fire, 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 plants. 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

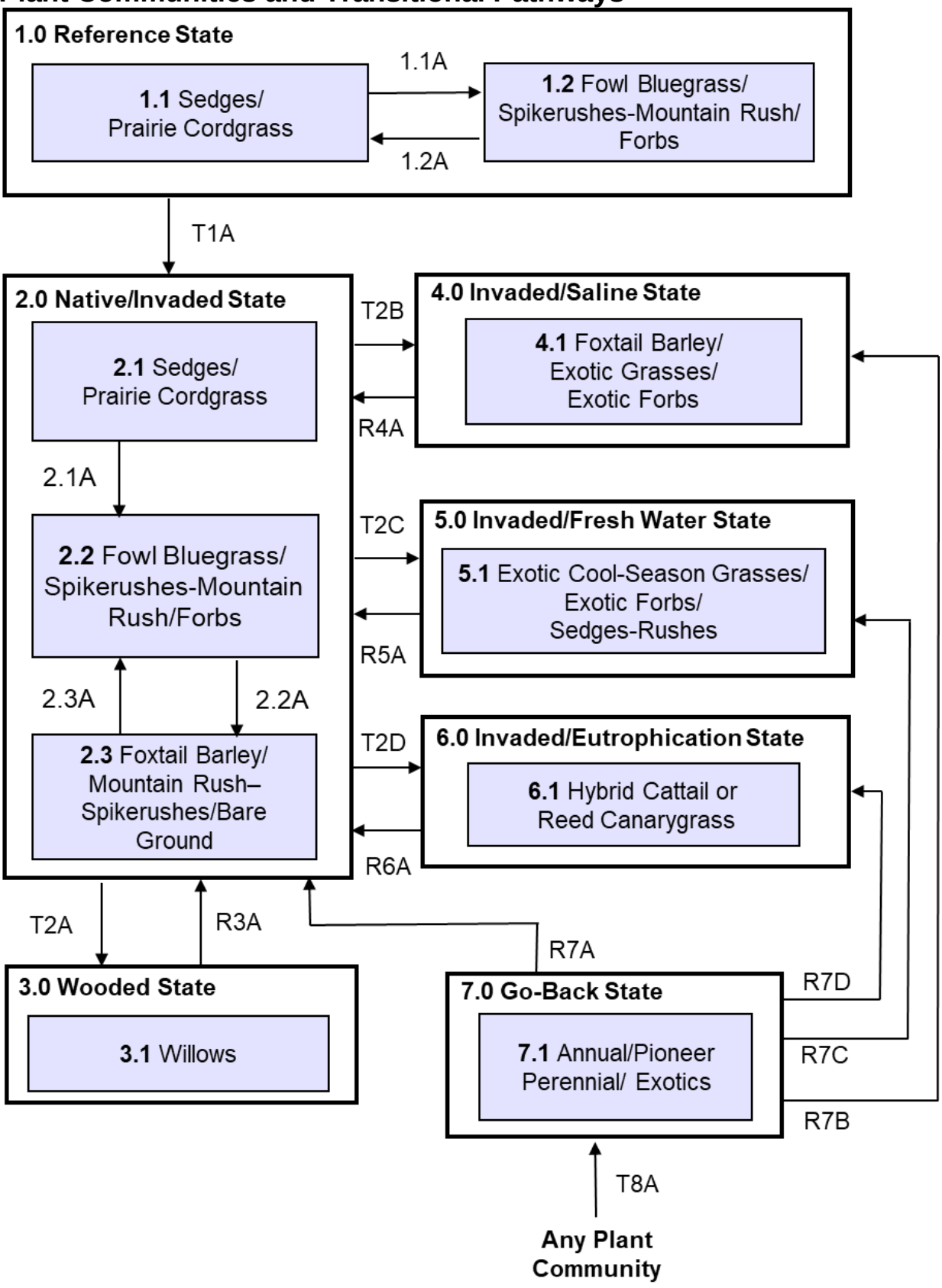


Diagram Legend - MLRA 55A Wet Meadow

T1A	Invasion by exotic grasses and forbs, no-use no fire, or heavy grazing
T2A	Extended periods of infrequent fire
T2B	Heavy season-long grazing, below average precipitation, salinity (discharge site)
T2C	Heavy season-long grazing, below average precipitation, no salinity (recharge site)
T2D	Eutrophication, sedimentation
T8A	Cessation of annual cropping
R3A	Mechanical treatment and prescribed burning
R4A	Extended periods above average precipitation
R5A	Extended periods above average precipitation
R6A	Extended periods above average precipitation
R7A	Successful hydrological restoration and seeding
R7B	Long-term no use, no fire, no planting, salinity, successful hydrological restoration
R7C	Long-term no use, no fire, no planting, fresh water, successful hydrological restoration
R7D	Long-term no use, eutrophication, sedimentation, successful hydrological restoration
CP 1.1 - 1.2 (1.1A)	Below average precipitation, heavy grazing
CP 1.2 - 1.1 (1.2A)	Return to average precipitation with reduced grazing
CP 2.1 - 2.2 (2.1A)	Heavy season-long grazing, below average precipitation
CP 2.2 - 2.3 (2.2A)	Heavy season-long grazing, below average precipitation (discharge site)
CP 2.3 - 2.2 (2.3A)	Return to average precipitation with prescribed grazing

State 1: Reference State

This site developed under Northern Great Plains climatic conditions which included frequent droughts and wide fluctuations in temperature and precipitation which can result in both short-term and long-term changes in water levels and water chemistry (e.g., alkalinity/salinity). Hydrology, water chemistry, grazing, and fire can all serve as important drivers of this site. Hydrology is mainly a factor of landscape position which includes the size of the contributing watershed, connectivity to other basins, and whether the basin has an outlet. Water chemistry is influenced by soil chemistry and whether the site is a recharge, flow-through, or discharge site.

This state is typically co-dominated by a mixture of cool-season and warm-season graminoids (mainly woolly sedge, wheat sedge, and Sartwell's sedge) along with prairie cordgrass and northern reedgrass. Prior to European influence the primary disturbance mechanisms for this site in the reference condition included water level fluctuations, periodic fire, and grazing by large herding ungulates. Spring snowmelt runoff and rainfall events, coupled with timing of fires and grazing events, dictated the dynamics that occurred within the natural range of variability. Along with water level fluctuations and water chemistry, present day primary disturbances are from concentrated livestock grazing and a lack of fire. Under these conditions, vegetation for livestock and wildlife can be expected to decline along with a corresponding increase in less desirable vegetation.

Wet Meadow ecological sites are highly influenced by water levels (including saturated soil), water movement, and water chemistry (i.e., discharge and recharge hydrology). Water levels influence fire effectiveness and livestock use. Water levels also influence exotic plant invasion. As Wet Meadow sites draw down, drying and losing soil moisture, they transition to functioning as an upland ecological site and can increase in salinity/alkalinity. Exotic cool-season grasses and forbs begin to invade starting from the upland edge of the Wet Meadow ecological site moving toward the deeper portion of the wetland. Many factors will dictate the speed of exotic plant invasion including duration of draw-down phase, management of the sites during the draw-down phase, changes in soil chemistry, and availability of exotic plant seed or plants parts (e.g., propagules). During extended periods of draw-down, presence of exotic plants adjacent to the site and lack of fire or heavy season-long livestock

grazing can speed up the invasion of cool-season exotic grasses or forbs, such as Canada thistle or sow thistle.

Once the site is invaded, increased water depth can begin to reverse the invasion of exotic plants. However, the increase in salt accumulation will be difficult to reverse back to levels prior to extended periods of draw-down. In addition, exotic grasses (such as quackgrass and foxtail barley) can tolerate extended periods of inundation or saturation and never totally drown out along the outer margins of the Wet Meadow site. The continued presence of cool-season exotic grasses prevents the site from transitioning back to State 1: Reference State.

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 plants), 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 has 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: Sedges/Prairie Cordgrass (*Carex* spp./*Spartina pectinata*)

This community phase evolved with grazing by large herbivores, occasional prairie fires, and relatively frequent shallow ponding or saturation events. It may be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Woolly sedge is typically the dominant graminoid while prairie cordgrass is the dominant warm-season grass and northern reedgrass the dominant cool-season species. A variety of sedges and rushes also occur throughout this community (such as wheat sedge, mountain rush, and spikerush). Switchgrass and fowl bluegrass are also common. Common forbs often include Canada germander, goldenrods, Flodman's thistle, Indianhemp, white doll's aster, and white panicle aster. Shrubs such as willow (e.g., Bebb willow), rose (e.g., prairie rose), and redosier dogwood are often minor components.

Annual production can vary from roughly 3600-5600 pounds per acre, consisting of about 70 percent grass-like species, 20 percent grasses, 7 percent forbs, and 3 percent shrubs. The community is further described in the "Plant Community Composition and Group Annual Production" portion of this ecological site description.

This plant community phase is diverse, stable, productive, and well adapted to the Northern Great Plains. Temporary ponding or a high-water table supplies much of the moisture for plant growth, and the plant composition and diversity will shift with these changes. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity.

Plant Community Composition and Group Annual Production

		1.1 Sedge/Prairie Cordgrass		
COMMON/GROUP NAME	**SYMBOL**	**Group**	**lbs./acre**	**% Comp**
GRASSES & GRASS-LIKES			*3220 - 4140*	*70 - 90*
GRASS-LIKES		**1**	**1840 - 3220**	**40 - 70**
woolly sedge	CAPE42	1	460 - 1380	10 - 30
clustered field sedge	CAPR5	1	460 - 1380	10 - 30
wheat sedge	CAAT2	1	92 - 690	2 - 15
Sartwell's sedge	CASA8	1	92 - 690	2 - 15
Bicknell's sedge	CABI3	1	46 - 230	1 - 5
fox sedge	CAVU2	1	46 - 230	1 - 5
shortbeak sedge	CABR10	1	0 - 230	0 - 5
water sedge	CAAQ	1	0 - 230	0 - 5
mountain rush	JUARL	1	46 - 138	1 - 3
spikerush	ELEOC	1	46 - 138	1 - 3
green bulrush	SCAT2	1	0 - 46	0 - 1
river bulrush	SCFL11	1	0 - 46	0 - 1
bulrush	SCHOE6	1	0 - 46	0 - 1
other grass-likes	2GL	1	46 - 230	1 - 5
WARM-SEASON GRASSES		**2**	**92 - 690**	**2 - 15**
prairie cordgrass	SPPE	2	230 - 1150	5 - 25
spiked muhly	MUGL3	2	46 - 138	1 - 3
switchgrass	PAVI2	2	0 - 138	0 - 3
Mexican muhly	MUME2	2	0 - 92	0 - 2
mat muhly	MURI	2	0 - 46	0 - 1
COOL-SEASON GRASSES		**3**	**92 - 460**	**2 - 10**
northern reedgrass	CASTI3	3	230 - 920	5 - 20
American sloughgrass	BESY	3	0 - 230	0 - 5
reed canarygrass	PHAR3	3	0 - 230	0 - 5
fowl bluegrass	POPA2	3	0 - 230	0 - 5
prairie wedgescale	SPOB	3	0 - 230	0 - 5
OTHER NATIVE GRASSES		**4**	**0 - 230**	**0 - 5**
rough bentgrass	AGSC5	4	0 - 230	0 - 5
slender wheatgrass	ELTR7	4	0 - 230	0 - 5
other perennial grasses	2PG	4	0 - 230	0 - 5
FORBS		***5***	***230 - 322***	***5 - 7***
Flodman's thistle	CIFL	5	46 - 138	1 - 3
Canada germander	TECA3	5	46 - 138	1 - 3
Canadian anemone	ANCA8	5	46 - 92	1 - 2
Indianhemp	APCA	5	46 - 92	1 - 2
swamp milkweed	ASIN	5	46 - 92	1 - 2
white doll's aster	BOAS	5	46 - 92	1 - 2
Illinois bundleflower	DEIL	5	46 - 92	1 - 2
smooth horsetail	EQLA	5	46 - 92	1 - 2
American licorice	GLLE3	5	46 - 92	1 - 2
American water horehound	LYAM	5	46 - 92	1 - 2
mint	MENTH	5	46 - 92	1 - 2
swamp smartweed	POHY2	5	46 - 92	1 - 2
cinquefoil	POTEN	5	46 - 92	1 - 2
Macoun's buttercup	RAMA2	5	46 - 92	1 - 2
western dock	RUAQ	5	46 - 92	1 - 2
black-eyed Susan	RUHI2	5	46 - 92	1 - 2
blue-eyed grass	SISYR	5	46 - 92	1 - 2
white panicle aster	SYLA6	5	46 - 92	1 - 2
New England aster	SYNO2	5	46 - 92	1 - 2
broadleaf cattail	TYLA	5	46 - 92	1 - 2
northern bog violet	VINE	5	46 - 92	1 - 2
Rydberg's sunflower	HENUR	5	0 - 92	0 - 2
gayfeather	LIATR	5	0 - 92	0 - 2
Pennsylvania smartweed	POPE2	5	0 - 92	0 - 2
wild strawberry	FRVI	5	0 - 46	0 - 1
wood lily	LIPH	5	0 - 46	0 - 1
golden dock	RUMA4	5	0 - 46	0 - 1
giant goldenrod	SOGI	5	0 - 46	0 - 1
goldenrod	SOLID	5	0 - 46	0 - 1
other forbs	2FORB	5	46 - 230	1 - 5
SHRUBS		***6***	***0 - 138***	***0 - 3***
willow	SALIX	6	0 - 138	0 - 3
other shrubs	2SHRUB	6	0 - 138	0 - 3

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	3240 -	4140	- 5040
FORBS	252 -	322	- 392
SHRUBS	108 -	138	- 168
TOTAL	3600 -	4600	- 5600

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 occurs with below average precipitation and heavy grazing. This is associated with a drop in water level and an increased frequency and intensity of grazing due to limited forage availability on the adjacent upland sites.

Community Phase 1.2: Fowl Bluegrass/Spikerushes-Mountain Rush/Forbs (*Poa palustris/Eleocharis* spp.-*Juncus arcticus/Forbs*)
This community develops during periods of heavy grazing, particularly during decreasing or low water conditions when grazing pressure on the site is disproportionately high. Compared to Community Phase 1.1, prairie cordgrass, northern reedgrass, and switchgrass have declined with noticeable increases in fowl bluegrass, spikerush, mountain rush, and forbs. Common forbs include asters, goldenrods, and cinquefoil.

Community Phase Pathway 1.2A
Community Phase Pathway 1.2 to 1.1 results from the return to average precipitation and reduced grazing. This results in noticeable increases in prairie cordgrass, northern reedgrass, and switchgrass.

Transition T1A
This is the transition from the State 1: Reference State to State 2: Native/Invaded State. Exotic cool-season grasses (such as Kentucky bluegrass, quackgrass, smooth brome, or exotic strains/hybrids of reed canarygrass) invade the site. This transition often occurs over several years of non-use and no fire or heavy season-long grazing. Canada thistle is also a frequent exotic on the state.

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 may be characterized as consisting of similar community phases as found in the Reference State (i.e., Community Phase 1.1 and 1.2), but the site has now been colonized by exotic plants - mainly cool-season grasses (such as Kentucky bluegrass, quackgrass, smooth brome, or exotic strains/hybrids of reed canarygrass). Canada thistle is also a frequent exotic on the state. Although the state is still dominated by native cool-season grasses and graminoids, an increase in the exotic cool-season grasses can be expected.

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, other) 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.

Willows (e.g., Bebb willow) may be present in this state. They may markedly increase, particularly during periods of infrequent fire (i.e., +/- 5-10 year intervals), leading to the transition to State 3: Wooded State (T2A).

Restoration of State 2: Native/Invaded State back to State 1: Reference State is not considered to be achievable. However, it should be noted that if the major invader is reed canarygrass, prescribed grazing techniques that target reed canarygrass may be a good choice for restoration efforts because the species is not very tolerant of heavy grazing.

Characteristics and indicators (i.e., characteristics and indicators that can be used to distinguish this state from others). The presence of trace amounts of exotic grasses indicates a transition from State 1 to State 2. The presence of exotic biennial leguminous forbs (e.g., sweet clover) 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 options (e.g., prescribed grazing, prescribed burning) be carefully constructed 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 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 grasses and reduces plant litter, provided that livestock are moved when grazing selection shifts from exotic 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: Sedges/Prairie Cordgrass (*Carex* spp./*Spartina pectinata*)

This plant community phase is similar in composition and production to that of Plant Community Phase 1.1 but has been colonized by exotic plants. It often develops under conditions of non-use and no fire which can result in excessive litter accumulates which exacerbates the invasion by exotic plants (such as reed canarygrass, Canada thistle, and perhaps red top). It can also develop under heavy season-long grazing.

Community Phase Pathway 2.1A

Community Phase Pathway 2.1 to 2.2 occurs during times of below average precipitation leading to a decreasing water depth in conjunction with heavy season-long grazing.

Community Phase 2.2: Fowl Bluegrass/Spikerushes-Mountain Rush/Forbs (*Poa palustris/Eleocharis* spp.-*Juncus arcticus/Forbs*)

This plant community phase develops with heavy season-long grazing during periods of below average precipitation leading to decreasing water levels. Sedge, mountain rush, spikerushes and bulrushes will increase noticeably. Prairie cordgrass and sedges will decline, while grazing tolerant invasive plants (e.g., creeping meadow foxtail) may become prevalent if a seed source is present or nearby. This plant community is somewhat resistant to change. A combination of both prescribed grazing and prescribed burning is most effective in moving this plant community towards the Reference State.

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.

Community Phase Pathway 2.2A
Community Phase Pathway 2.2 to 2.3 occurs with heavy season-long grazing along with a decrease in water depth and increased salinity (discharge site).

Community Phase 2.3: Foxtail Barley/Mountain Rush-Spikerushes/Bare Ground (*Hordeum jubatum/Juncus arcticus-Eleocharis* spp./Bare Ground)
This plant community phase develops under prolonged conditions of disturbance (e.g., heavy season-long grazing) particularly during periods of below average precipitation when water depths lower and salinity increases (discharge site).

The prolonged nature of this disturbance will tend to increase soil temperatures and evaporation, causing this site to become drier. Foxtail barley often becomes a prominent component of the community, largely resulting from an increase in soil salinity/sodicity and lack of utilization by livestock once awns begin to appear.

Production and diversity are much reduced compared to that of the Reference State. Production may be in the range of 4150 pounds per acre with the foxtail barley, mountain rush, and spikerushes accounting for over one-half of the total production and forbs contributing less than one percent.

Community Phase Pathway 2.3A
Community Phase Pathway 2.3 to 2.2 occurs with prescribed grazing in conjunction with increased precipitation leading to an increase in ponding depth above plant height leading to plant mortality.

Transition T2A
This is the transition from State 2: Native/Invaded State to State 3: Wooded State. It often results from extended periods of infrequent fire. This transition appears to cross a threshold after 5-10 years +/- of no fire. Bebb willow and many other willows resprout following burns. A vigorous sprouting response, in combination with increased growth (e.g., size, canopy cover), and reduced fine fuel loads beneath the canopy often enables the willows to survive subsequent fires, and perhaps even expand coverage.

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.

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.

Transition T2B

This is the transition from State 2: Native/Invaded State to State 4: Invaded/Saline State due to heavy season-long grazing during times of below average precipitation leading to a lower water depth and brackish (alkalinity/salinity) conditions (discharge site).

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 effects of various management activities on exotic cool-season grass populations.

Transition T2C

This is the transition from State 2: Native/Invaded State to State 5: Invaded/Fresh Water State during times of a lowering of water depth and decrease in freshwater conditions on conjunction with heavy season-long grazing.

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 effects of various management activities on exotic cool-season grass populations.

Transition T2D

This is the transition from State 2: Native/Invaded State to State 6: Invaded/Eutrophication State resulting from eutrophication and sedimentation of the site, often due to tillage on or adjacent to the site. Hybrid cattail or exotic strains/hybrids of reed canarygrass become dominant. A rise in water levels, particularly when in association with Shallow Marsh ecological sites, may also lead to dominance by cattails.

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 effects of various management activities on exotic cool-season grass populations.

State 3: Wooded State

This state occurs throughout the MLRA and often results from extended periods of infrequent fire. A threshold leading to this state appears to occur over 5-10 years +/- of no fire. Bebb willow and many other willows resprout following burns. A vigorous sprouting response, in combination with increased growth (i.e., size, canopy cover), and reduced fine fuel loads beneath the canopy often enables the willows to increase with infrequent fires. Older, larger plants survive the fires while smaller and younger plants resprout following a burn. Over time, the willows may form rather extensive stands or thickets. Marked increases in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread.

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 3.1: Willows (*Salix* spp.)

This plant community phase is dominated by willows (e.g., Bebb). Associated shrubs may include redosier dogwood and, perhaps, white meadowsweet. Sedges and rushes generally dominate the herbaceous understory.

Once established, this plant community is very resilient and resistant to change. The lack of fine fuels in the understory and high degree of shading makes the application of prescribed burning very difficult without a mechanical pretreatment a year to two prior to the burn.

Restoration R3A

This is the restoration pathway from State 3: Wooded State to State 2: Native/Invaded State due to high willow mortality resulting from mechanical treatment followed by prescribed burning. The prescribed burning will likely require repeated treatments because many of the willows will resprout following one burn.

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 plants. 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; (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 woody and exotic plants 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.

State 4: Invaded/Saline State

This state is similar to Community Phase 2.1, but exotic plants now dominate the site. Foxtail barley is a conspicuous component of the community; however, the exotic grasses make up the bulk of the vegetation. Several exotic grasses may be present (alone or in combination) and include barnyard grass, quackgrass, smooth brome, redtop, and/or exotic strains or hybrids of reed canarygrass. Common exotic forbs include Canada thistle, kochia, lambsquarters, and field sowthistle. Marsh fleabane (aka swamp ragwort) is also occasionally abundant on the site during draw-downs.

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 and grass-likes constituting less than 40 percent of the annual production.

Resilience management (i.e., management strategies that will sustain a state and prevent a transition). Salinity levels need to be considered when developing management alternatives. 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 4.1: Foxtail Barley/Exotic Grasses/Exotic Forbs (*Hordeum jubatum*/Exotic Grasses/Exotic Forbs)

This community phase is a salinized phase of the invaded states; as such, it is predominantly composed of exotic grasses (such as barnyard grass, quackgrass, smooth brome, redtop) and/or exotic strains or hybrids of reed canarygrass (alone or in combination). Foxtail barley, however, is generally a conspicuous component and is an indicator of the saline conditions. Other grasses are largely halophytic species and may include saltgrass, alkaligrass, and scratchgrass.

Restoration R4A

This is the restoration of State 4: Invaded/Saline State to State 2: Native/Invaded State resulting from extended periods of above average precipitation causing an increase in ponding depth above the height of most exotic grasses. This results in considerable mortality sufficient to move the plant composition to more freshwater species.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Salinity levels need to be considered when developing management alternatives. Grazing management should be applied in a manner that enhances/maximizes the competitive advantage of native grass and forb species over the exotic plants. 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 plants. 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; (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 plants while favoring native species (both cool- and warm-season grasses).

The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of cool-season exotic grasses are typically short-lived.

State 5: Invaded/Fresh Water State

This community is the freshwater phase of the Invaded State and appears similar to Community Phase 2.2. Exotic grasses dominate the site and may consist of quackgrass, smooth brome, and barnyard grass (alone or in combination). Although foxtail barley may be present, it is much reduced compared to that of State 4: Invaded/Saline State. Canada thistle, field sowthistle, and lambsquarters are common forbs.

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 and grass-like species 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 5.1: Exotic Cool-Season Grasses/Exotic Forbs/Sedges/Rushes (Exotic Cool-Season Grasses/*Exotic Forbs*/*Carex* spp./*Juncus* spp.)

This community is the freshwater phase of the invaded states and appears similar to Community Phase 2.2. Exotic grasses dominate the site and may consist of quackgrass, smooth brome, and barnyard grass (alone or in combination). Although foxtail barley may be present, it is much reduced compared to that of State 4: Invaded/Saline State. Canada thistle, field sowthistle, and lambsquarters are common forbs. Several species of sedges and rushes may still be present but compose a minor component of the community.

Restoration R5A

This is the restoration of State 5: Invaded/Fresh Water State to State 2: Native/Invaded State during extended periods of above average precipitation leading to an increase in ponding depth above the height of most exotic grasses, resulting in considerable mortality sufficient to move the plant composition to more freshwater species.

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 plants. 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 plants. 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; (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 plants while favoring native species (both cool- and warm-season grasses).

The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of cool-season exotic grasses are typically short-lived.

State 6: Invaded/Eutrophication State

This state results from eutrophication and sedimentation of the site, often due to tillage on or adjacent to the site. Depending upon what seeds, rhizomes, and propagules are present in the substrate, monotypic stands of hybrid cattails or exotic strains/hybrids of reed canarygrass generally develop. A

rise in water levels, particularly when in association with wetlands, may also lead to dominance by cattails.

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 and grass-likes 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 6.1: Hybrid Cattail or Reed Canarygrass (*Typha* x *glauca* or *Phalaris arundinacea*)

Whether the site becomes dominated by hybrid cattail or reed canarygrass is largely the result of which seeds, rhizomes or propagules are present on the site. Either way, the community has little diversity, with the cattail or reed canarygrass forming virtual monocultures. Canada thistle, field sowthistle, and some asters may be present in the reed canarygrass stands. Production on cattail dominated communities may be in the range of 5330 pounds per acre with cattails and graminoids contributing 4800 and 425 pounds per acre, respectively.

Restoration R6A

This is the restoration pathway from State 6: Invaded/Eutrophication State to State 2: Native/Invaded State resulting from extended periods of above average precipitation leading to increased water depth and chemical treatment, mechanical treatment, sediment removal, prescribed burning, and reseeding.

The aquatic version of glyphosate herbicide has been shown to be an effective method in restoration efforts. Reseeding or the planting of plugs of plants (e.g., prairie cordgrass) has also been effective. Physically removing the sediment and associated rhizomes, seeds, etc. above the historical surface (A) horizon, coupled with reseeding and replanting adapted plants, is the most effective method of restoration.

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 plants. 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 plants. 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; (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 plants while favoring native species (both cool- and warm-season grasses).

The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of cool-season exotic grasses are typically short-lived.

State 7: Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T8A pathway. In this MLRA, the most probable origin of this state is plant succession following crop abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which maybe noxious weeds.

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 7.1: Annual/Pioneer Perennial/Exotics

Plant composition of this state can be quite variable due to variations in hydrology, salinity, and other factors. In this MLRA, the most probable origin of this phase 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. However, plants commonly occurring in this state include quackgrass, foxtail barley, barnyard grass, goosefoot, field sowthistle, knotweed, smartweed, burning bush, and beggartick.

Restoration efforts to several states can be successful. It should be noted, however, that well-established stands of Canada thistle, field sowthistle, or quackgrass are particularly difficult to restore.

Restoration R7A

This restoration pathway from State 7: Go-Back State to State 2: Native/Invaded State may be accomplished through a successful hydrological restoration (e.g., breaking tile or plugging a drain) and planting.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years. Adjacent upland ecological sites will need to remain intact or reseeded to native species to prevent sedimentation and nutrient loading to the Shallow Marsh ecological site.

Prescribed grazing (e.g., heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts.

Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Restoration R7B

This restoration pathway from State 7: Go-Back State to State 4: Invaded/Saline State may be accomplished through non-use, no fire, and no planting with saline conditions and a successful hydrological restoration.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years.

Prescribed grazing (e.g., heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts.

Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Restoration R7C

This restoration pathway from State 7: Go-Back State to State 5: Invaded/Fresh Water State may be accomplished through non-use, no fire, and no planting with freshwater conditions and a successful hydrological restoration.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years.

Prescribed grazing (e.g., heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts.

Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Restoration R7D

This restoration pathway from State 7: Go-Back State to State 6: Invaded/Eutrophication State may be accomplished through non-use and no fire under conditions of eutrophication and sedimentation with a successful hydrological restoration.

Context dependence (i.e., factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years.

Prescribed grazing (e.g., heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts.

Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Transition T8A

This 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 a tillage induced compacted layer (plow pan), 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 55A landscape is characterized by mostly nearly level to gently rolling till plains with some steep slopes adjacent to streams. The MLRA includes areas of kettle holes, kames, and ground moraines. MLRA 55A 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 mid- to tall-grass prairie vegetation with quaking aspen, bur oak, green ash, and willow species growing on the higher elevations in Turtle Mountain, on moraines in proximity of Devils Lake, Pembina River Escarpment and Gorge, and various drainageways throughout the MLRA. Numerous depressional wetlands are ringed with quaking aspen. 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 of the Souris and Pembina Rivers. MLRA 55A is located entirely within North Dakota and within the boundaries of the Prairie Pothole Region. The primary land use is cropland. Glacial Lake Souris and the Devils Lake Basin are known for exceptional fertility with major crops including corn, canola, soybeans, and small grains. Together, these two areas make up 73% of the MLRA (Glacial Lake Souris 5500 mi^2, 43%; and the Devils Lake Basin 3810 mi^2, 30%).

Turtle Mountain (1000 mi^2 of which 405 mi^2 are found in North Dakota), in the north-central part of the MLRA on the Canadian border, is approximately 1,950 to 2,541 feet (595 to 775 meters) in elevation, rising approximately 600 to 800 feet (150 meters) above the adjacent till plain. Home to an extensive forest of quaking aspen, bur oak, green ash, and willows, it has an understory of beaked hazel with associates of chokecherry, Saskatchewan serviceberry, downy arrowwood, and rose. Turtle Mountain comprises the largest area of quaking aspen forest in North Dakota.

The Pembina Escarpment extends from the Canadian border southeast to Walhalla where the Pembina River enters the floor of the Red River Valley in MLRA 56A. Mainly found on steep slopes along the Pembina River, the Pembina Gorge is in a rugged and sheltered setting with bur oak, green ash, cottonwood, and American elm. Encompassing approximately 12,500 acres, the Pembina Gorge is one of the largest uninterrupted blocks of woodlands in North Dakota. This segment of the Pembina River is the longest segment of unaltered river valley in the North Dakota.

Two major Hydrologic Unit Areas make up this MLRA. 56% of the MLRA drains into the Souris River while 44% drains into the Red River (via the Pembina River) or into Devils Lake (out-letting to Sheyenne River via a pump, pipeline, canal system). The North Dakota portion of the Souris River watershed is in this MLRA. The Souris River basin drains nearly 23,600 square miles and has a long history of flooding.

By the mid-19th century, over 75% of the MLRA had been converted from mid- to tall-grass prairie or woodland 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. Tile drainage systems have been or are being installed extensively throughout MLRA 55A for sub-surface field drainage to enhance annual crop production.

Historic Communities/Conditions within MLRA 55A:

The northern tall- and mixed-grass prairie along with the quaking aspen forest were disturbance-driven ecosystems with fire, herbivory, and climate functions as the primary ecological drivers (either singly or often in combination). American bison roamed MLRA 55A wintering along the Souris River and migrating through MLRA 55A into MLRAs 56A and 55B. Many species of grassland birds, small mammals, insects, reptiles, amphibians, elk, moose, pronghorn, and large herds of American bison 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, American black bear, grizzly 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 is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 55A:

This area supports natural prairie vegetation characterized by western wheatgrass, green needlegrass, needle and thread, and blue grama. Little bluestem is an important species on the more sloping and shallower soils. Prairie cordgrass, northern reedgrass, big bluestem, and wheat sedge are important species on soils with higher water tables. Western snowberry, leadplant, and prairie rose are commonly interspersed throughout the area. Native forests occur in Turtle Mountain, Pembina Gorge, moraines near Devils Lake, woody draws, scattered tracts along the Souris River, and in the sand dunes in west central region of the MLRA.

Over 75% of MLRA 55A has been converted to annual crop production. European influence has impacted remaining grassland, forestland, and shrubland by domestic livestock grazing, elimination of fire, tree harvest, removal of surface and subsurface hydrology via artificial drainage, and other anthropogenic factors influencing plant community composition and abundance.

Hydrological manipulation is extensive throughout the MLRA. Extensive wetland and subsurface tile drainage have taken place. Ephemeral and intermittent streams and the Souris River have been straightened - removing sinuosity, creating isolated oxbows, and converting riparian zones to annual crop production. These anthropogenic impacts have reduced flood water detention and retention on the landscape. The results have been increasing storm water runoff sediment and nutrient loading

impacting the Souris and Des Lacs Rivers and their tributaries along with Devils Lake and other lakes within the MLRA. The installation of instream structures has reduced aquatic species movement within the MLRA. Two large dams in Saskatchewan, Canada (Rafferty on the Souris River and Alameda on Moose Mountain Creek, a major tributary to the Souris River) were built, in part, to reduce flood peaks on the Souris River. In addition, three USFWS National Wildlife Refuges were created by building two low-head dams on the Souris River and one on the Des Lacs River in North Dakota. Numerous low-head dams are located on the Souris and Des Lacs Rivers in North Dakota. The Eaton Irrigation Project low-head dam, located in the vicinity of Towner, North Dakota, provides flood irrigation to approximately 6,700 acres of hayland and pastureland.

The loss of the American 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. 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.

Included in this MLRA are over 121,000 acres of National Wildlife Refuges and over 77,000 acres of waterfowl production areas owned and managed by the United States Fish and Wildlife Service. White Horse Hill National Game Preserve is a 1,674-acre national wildlife refuge sitting on the south shores of Devils Lake, about 10 miles south of the city of Devils Lake. Numerous state-owned parks, state wildlife management areas, North Dakota Forest Service and Department of Trust Lands are found in the MLRA. Wakopa Wildlife Management Area is the largest WMA covering approximately 6,739 acres.

Some characteristic wildlife species in this area are:

Birds: Common loon, common goldeye, bufflehead, ruffed grouse, broad-winged hawk, alder flycatcher, mourning warbler, mallard, blue-winged teal, red-tailed hawk, American kestrel, killdeer, eastern and western kingbird, American crow, common yellowthroat, clay-colored sparrow, vesper sparrow, red-necked grebe, Savannah sparrow, downy and hairy woodpeckers, black-capped chickadee, white-breasted nuthatch, and brown-headed cowbird.

Mammals: Northern short-tailed shrew, water shrew, beaver, muskrat, mink, long-tailed weasel, American martin, fisher, 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, racoon, American badger, striped skunk, white-tailed deer, elk, moose, and woodchuck, red squirrel, porcupine, and northern flying squirrel.

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

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

Insects play an important role providing ecological services for plant community development. Insects that are scavengers or aid in decomposition provide the food chain baseline sustaining the carnivorous insects feeding upon them. Many insects provide the ecological services necessary for pollination, keeping plant communities healthy and productive. Insects provide a protein food source for numerous species including grassland-nesting birds, woodpeckers, and woodland edge and interior species, and their young. Extensive use of insecticides for specialty crops (such as soybeans, corn, and other crops) has greatly reduced insects within this MLRA.

Species of Concern within MLRA 55A:

The following is a list of species considered "species of conservation priority" in the North Dakota State Wildlife Action Plan (2015) and "species listed as threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 55A at the time this section was developed:

Invertebrates: Dakota skipper, monarch butterfly, and regal fritillary. Within the MLRA, the United States Fish and Wildlife Service lists 5 areas (in Rolette and McHenry Counties) as critical habitat for the Dakota skipper.

Birds: American avocet, American bittern, American kestrel, American white pelican, Baird's sparrow, bald eagle, black tern, black-billed cuckoo, bobolink, canvasback, chestnut-collared longspur, ferruginous hawk, Franklin's gull, grasshopper sparrow, horned grebe, LeConte's sparrow, lesser scaup, loggerhead shrike, marbled godwit, Nelson's sparrow, northern harrier, northern pintail, piping plover, sharp-tailed grouse, short-eared owl, Sprague's pipit, Swainson's hawk, upland sandpiper, western meadowlark, whooping crane, willet, Wilson's phalarope, and yellow rail.

Mammals: American martin, Arctic shrew, big brown bat, gray fox, little brown bat, northern long-eared bat, plains pocket mouse, pygmy shrew, Richardson's ground squirrel, river otter, and Townsend's big-eared bat.

Amphibians/Reptiles: Canadian toad, common snapping turtle, plains hog-nosed snake, and smooth green snake.

Fish: Finescale dace, hornyhead chub, largescale stoneroller, logperch, northern pearl dace, and trout-perch.

Mussels: Black sandshell, creek heelsplitter, creeper, mapleleaf, and pink heelsplitter.

Grassland and Woodland Management for Wildlife in the MLRA 55A

Management activities within the community phase pathways impact wildlife but are essential for maintenance of healthy grassland ecosystems. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on local wildlife species. Ranchers and other land managers must always consider the long-term beneficial management effects of grassland and woodland resources in comparison to typically short-term negative effects to the habitats of 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 for wildlife. Conversion to annual cropping and fragmentation due to transportation and electrical transmission corridors and to rural housing are main causes of fragmentation. This MLRA supports ecological sites that are dominated by woody vegetation and can be located adjacent to ecological

sites that support tall- to mid-statured grasses (Thin Loamy/Shallow Loamy) or are adjacent to ecological sites that support wetland vegetation (Shallow Marsh and Wet Meadow).

Management of these ecological site complexes challenges managers to properly manage the entire landscape. A management strategy for one ecological site may negatively impact an adjacent site. For example, grazing Upland Hardwood Forest or Loamy Savannah ecological sites along with herbaceous dominated Loamy Overflow ecological sites may degrade one site by under-use, favoring woody vegetation or increasing exotic cool-season grasses.

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 for targeted species or species guilds. Managers also need to consider vegetative associations provided by adjacent/intermingled ecological sites for species with home ranges or life requisites that may not be provided by one ecological site. Understanding specific grassland species' sensitivity to woody encroachment and preferred vegetative structure enables managers to determine which grassland-nesting bird species will avoid grassland habitats adjacent to Upland Hardwood Forest or Loamy Savannah ecological sites or woody dominated, Plant Community Phase 5, Loamy ecological site.

Many passerine species utilize MLRA 55A as a major migratory travel corridor. Grassland species sensitive to woody associations during nesting and brooding may utilize the woodier fragmented sites, such as the Wooded State 5.0 in the Loamy ecological site, during migration.

Grassland-nesting birds use various grass heights for breeding, nesting, foraging, or winter habitat. While most species use varying heights, many have a preferred vegetative stature height or sensitivity to woody vegetation. Understanding the sensitivity of grassland species to woody vegetation and preferred vegetative structure enables managers to determine which grassland-nesting bird species avoid grassland habitats adjacent to Upland Hardwood Forest or Loamy Savannah ecological sites. The following chart provides sensitivity to woody vegetation and preferred vegetative stature heights.

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.				

Wet Meadow Wildlife Habitat Interpretation:

Wet Meadow ecological sites are poorly drained soils located in depressions, on low-lying flats, and on floodplains. Associated ecological sites include Limy Subirrigated, Loamy Overflow, Saline Lowland, Loamy, Sodic Subirrigated, Subirrigated Sands, Subirrigated, and Shallow Marsh. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species preferring short- to tall-statured vegetation.

Wet Meadow habitat features and components commonly support grassland-nesting birds, notably birds utilizing wetland vegetation habitats (such as Nelson's and LeConte's sparrow) and sedge wren. Sharp-tailed grouse use this site for wintering and escape cover. Insects rely on associated forbs and grasses for survival and serve as food sources for birds and their young, and as forage for small and large herbivores.

Wet Meadow ecological sites may be found in seven plant community states within a local landscape. Multiple plant community phases exist within this ecological site dependent upon water levels, saturation, water and soil chemistry, and management. Today, these states occur primarily in response to precipitation (extended periods of above average precipitation or drought), water chemistry, fire, grazing, non-use, and other 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 1.0 and State 2.0 Community Phase Pathways to prevent further plant community degradation along Transitional Pathways to invaded plant communities of other States. Native wildlife dependent upon shallow wetlands, as found in the Wet Meadow ecological site, generally benefit from the heterogeneous grasslands/graminoids found in Community Phases in States 1.0 and 2.0. Plant communities within State 2.0 are dependent upon long-term changes in precipitation

(compounded by grazing intensity and frequency). The transition to wetter or drier conditions results in a plant community that is either taller (wetter) in stature, such as Plant Community Phase 2.1 Sedges/Prairie Cordgrass or shorter (drier) in stature, such as 2.3 Foxtail Barley/Mountain Rush-Spikerush/Bare Ground.

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

Hydrological manipulation (surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site's functions, having a significant negative impact to wetland dependent wildlife (such as invertebrates, amphibians, and water birds). Without restoring hydrologic function (which may include range seeding), managers need to reference state and transition models within those sites. Hydrology will need to be fully restored in Wet Meadow and Shallow Marsh ecological sites for these sites to properly function. It is recommended that managers review the appropriate State and Transition Models prior to wetland restoration.

1.0 Reference State

Community Phase 1.1 Sedges/Prairie Cordgrass: This plant community offers quality vegetative cover for wetland wildlife; 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 fire. Prescribed fire maintains a grass-dominated plant community providing habitat for wetland bird species sensitive to woody vegetation.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, wetland birds, and rodents. This plant community contains a variety of forbs providing season-long pollen and nectar. However, due to wet soils, ground nesting pollinator species do not prefer this site. Dakota skippers, regal fritillaries, or monarch butterflies will use this site when swamp milkweed, New England aster, or goldenrods occupy this site.

Wet Meadow ecological sites provide habitat for a diverse suite of aquatic invertebrates providing an important trophic link between macrophytes and vertebrates that depend upon them as food. Rapid warming during spring snowmelt allows the invertebrate population to flourish. The vegetative structure provided by shallow vegetated wetlands increase the abundance of aquatic invertebrates compared to less vegetated sites.

Birds: This plant community provides nesting, foraging, and escape habitats favored by mid- to tallgrass-nesting birds especially those species preferring wetter (hydric) habitats (such as Nelson's sparrow, black tern, northern harrier, sedge wren, American avocet, Wilson's phalarope, etc). This site provides waterfowl pair bonding sites, early season invertebrate food sources, and early season shorebird habitat. The rapid warming during spring snowmelt provides water birds an abundant invertebrate protein source for egg laying. Prescribed fire maintains a grass-dominated plant community providing habitat for bird species sensitive to woody vegetation. This plant community does not provide suitable areas for sharp-tailed grouse lek sites or nesting habitat. However, it does provide winter cover and escape habitat and brood-rearing habitat. This site provides good hunting opportunities for grassland raptors, especially northern harrier.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including arctic and pygmy shrew, rodents, jackrabbits, white-tailed deer, and elk. Tall- to mid-statured vegetation provides suitable food, thermal, protective, and escape cover for small and large herbivores. In addition, it provides foraging opportunities for raccoon, skunks, coyotes, and other mammals that use wetlands and wetland edges for food resources.

Amphibians and Reptiles: This ecological site can provide habitat for the northern leopard frog and Canadian toad. Dependent upon the duration of surface water, this site may provide breeding habitat. Successful egg-laying and tadpole development habitat is dependent upon depth and duration of ponded water.

Fish and Mussels: This ecological site can be directly associated with streams, rivers, or water bodies. This site receives run-on hydrology from adjacent ecological sites and provides hydrology to shallow ground water and other surface waterbodies. Management on Wet Meadow sites, in conjunction with neighboring run-off sites, will have a direct effect on aquatic species in streams and/or tributaries receiving water from Wet Meadow sites. Optimum hydrological function and nutrient cycling limit potential for sediment yield and nutrient loading to the adjacent aquatic ecosystems from Community Phase 1.1.

Community Phase 1.2 Fowl Bluegrass/Spikerushes-Mountain Rush/Forbs: This plant community phase occurs during periods of below average precipitation, lowering the water table. The lower water table allows the plant community to shift towards upland species (such as switchgrass and mid-statured grass-likes, mountain rush, and spike rushes). The forb community remains robust favoring pollinator insects. This plant community provides a food source for grassland nesting birds.

Invertebrates: Provides similar life requisites as Community Phase 1.1. However, drying of the soil during periods of prolonged, below average precipitation allows for increases in forbs which provides increased pollen and nectar sources and increased bare ground for ground-nesting insects. The diverse suite of aquatic invertebrates found in Community Phase 1.1 is reduced and may only be found in spring during periods of snowmelt runoff.

Birds: Provides similar life requisites as Community Phase 1.1. However, decreased surface water reduces invertebrate production and use by waterfowl and shorebirds. The drying of the soil during periods of prolonged, below average precipitation provides additional opportunities for grassland nesting birds that use mid-to tall-statured herbaceous vegetation found in a mesic vs. hydric habitats.

Mammals: A mix of wetland and tall-statured vegetation provides thermal, protective, escape, and winter habitat for a big game animals and other small herbivores.

Amphibians and Reptiles: Drying of the soil during periods of prolonged, below average precipitation removes saturated soil and/or ponded water. Use by northern leopard frog and Canadian toad will decrease. This plant community may provide foraging, but breeding habitat will be lost for egg-laying and tadpole development without ponded water.

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

2.0 Native Invaded State

Community Phase 2.1 Sedges/Prairie Cordgrass: This plant community develops through Transition Pathway T1 due to changes in management and the presence of non-native species (such as reed canarygrass, redtop, Kentucky bluegrass, field sowthistle and Canada thistle). This plant community phase has a very similar appearance and function to the Plant Community 1.1 with a wide array of forbs providing nectar and pollen sources for pollinating species. Managers should consider management within the State 2.0 Community Phase Pathways to avoid transitioning to other states within this ecological site.

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 Fowl Bluegrass/Spikerushes-Mountain Rush/Forbs: This plant community phase occurs with heavy season-long grass coupled with periods of below average precipitation, lowering the water table. Grazing tolerant rush and spikerush species increase while prairie cordgrass and sedges decline.

Invertebrates: Heavy season-long grazing does not allow flowering plants to recover, limiting pollen and nectar resources for bees and other pollinating insects. In addition, a shift from perennial to annual forbs reduces season long pollen and nectar sources for pollinating insect species. Prolonged periods of reduced precipitation favor ground nesting pollinators; however, increased compaction from mechanical impacts or increased livestock presence negatively impacts ground nesting pollinator opportunities. This shift to drier soil conditions reduces or eliminates aquatic invertebrates.

Birds: Provides similar life requisites as Community Phase 1.2. In addition, the drying of the soil during periods of prolonged, below average precipitation provides additional opportunities for grassland nesting birds that use mid-to short-statured herbaceous vegetation found in a mesic vs. hydric habitats.

Mammals: A shift to mid- to short-grass species and drier soil conditions reduces habitat for large mammals, such as white-tailed deer, while still providing vegetative cover for small mammals. Thermal, escape, and winter cover becomes limited for larger ungulates.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.2**.**

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

Community Phase 2.3 Foxtail Barley/Mountain Rush-Spikerushes/Bare Ground: This plant community phase occurs with heavy season-long grazing, coupled with periods of below average precipitation, lowering the water table with increasing salinity. Grazing tolerant foxtail barley begins to dominate the site. Grazing tolerant rush and spikerush species increase along with bare ground.

Invertebrates: Pollinator friendly forbs decrease as salinity and foxtail barley increase, limiting pollen and nectar availability. Bare ground increases but few ground nesting

species, if any within MLRA 55A, use saline soils for nesting sites. This shift to drier soil conditions reduces or eliminates aquatic invertebrates.

Birds: Provides similar life requisites as Community Phase 1.1. In addition, the drying of the soil during periods of prolonged, below average precipitation provides additional opportunities for grassland nesting birds that use short-statured herbaceous vegetation found in a mesic vs. hydric habitats.

Mammals: A shift to short-grass species and drier soil conditions reduces habitat for large mammals, such as white-tailed deer, while still providing vegetative cover for small mammals. Thermal, escape, and winter cover is no longer provided for larger ungulates.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.2.

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

3.0 Wooded State

Community Phase 3.1 Willows: The elimination of fire or mechanical disturbance, via Transitional Pathway T2, allow for sandbar and Bebb willow species to dominate this site. Shade tolerant sedges and rushes dominate the understory. Restoration to State 2.0 (via Restoration Pathway R3A) requires a combination of mechanical and herbicide application coupled with repeated prescribed burns.

Invertebrates: The invasion of woody vegetation reduces habitat for pollinator insects within MLRA 55A. Season-long pollen and nectar availability is limited on this site due to an understory of sedges and rushes. However, willow species provide an early season pollen source for native and honeybees. Overall, pollinator plant diversity is low, limiting season-long nectar and pollen production.

Birds: Dependent on degree of invasion by willow, grassland nesting birds which are sensitive to woody vegetation encroachment will discontinue use of this community phase. Shrub-tolerant grassland birds may continue to use this site. Willow species provide thermal and escape cover for year-long residents. Willow thickets provide habitat for brown-headed cowbirds, increasing nest parasitism on adjacent grassland nesting bird communities.

Mammals: Shrubs will provide increased year-round cover for white-tailed deer, moose, and elk. Mammals, such as porcupines, that prefer woody habitat will use this site.

Amphibians and Reptiles: Willow species should not impact use of this ecological site by the Canadian Toad.

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

4.0 Invaded Saline State

Community Phase 4.1 Foxtail Barley/Exotic Grasses/Exotic Forbs: This plant community phase occurs during periods of below average precipitation lowering the water table and increasing salinity. Coupled with increased animal impact, disturbance-tolerant non-native species (such as foxtail barley, quackgrass, Canada thistle, and field sowthistle) dominate this plant community phase. Foxtail barley will dominate with increased salinity. Extended

periods of above average precipitation along Restoration Pathway R4A can move this plant community back to State 2.0.

Invertebrates: Canada thistle and field sowthistle provide mid- to late-season pollen. This plant community has a low diversity with limited early- to mid-season forbs. Bare ground increases but few ground nesting species, if any within MLRA 55A, use saline soils for nesting sites. This shift to drier soil conditions reduces or eliminates aquatic invertebrates.

Birds: Provides similar life requisites as Community Phase 2.3.

Mammals: Provides similar life requisites as Community Phase 2.2.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.2.

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

5.0 Invaded/Fresh Water State

Community Phase 5.1 Exotic Cool-Season Grasses/Exotic Forbs/Sedges-Rushes: This plant community phase occurs during periods of below average precipitation lowering the water table with water chemistry remaining fresh. Coupled with increased animal impact, disturbance-tolerant non-native species (such as quackgrass, Canada thistle, and field sowthistle) dominate this plant community phase. Foxtail barley will not dominate the site unless water chemistry increases in salinity. Extended periods of above average precipitation along Restoration Pathway R5A can move this plant community back to State 2.0.

Invertebrates: Canada thistle and field sowthistle provide mid- to late-season pollen. This plant community has a low diversity with limited early- to mid-season forbs. Bare ground increases for ground nesting species. This shift to drier soil conditions reduces or eliminates aquatic invertebrates.

Birds: Provides similar life requisites as Community Phase 2.2.

Mammals: Provides similar life requisites as Community Phase 2.2.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.2.

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

6.0 Invaded/Eutrophication State

Community Phase 6.1 Hybrid Cattail or Reed Canarygrass: Eutrophication and sedimentation of the site, often due to tillage on or adjacent to the site, transitions this plant community to one dominated by hybrid cattails or exotic strains/hybrids of reed canarygrass. Hybrid cattail or reed canary grass generally develop into monotypic stands out-competing other grasses, graminoids or forbs. Extended periods of above average precipitation along with mechanical treatment, sediment removal, prescribed burning, and reseeding (via Restoration Pathway R6A) can move this plant community back to State 2.0.

Invertebrates: Saturated to ponded soils favor aquatic invertebrates. Monotypic stands of hybrid cattail or reed canarygrass limit forb species, providing a decrease in pollen and nectar sources for insects. Restoration efforts, including prescribed grazing, can reduce hybrid cattail and reed canarygrass while increasing forb diversity. The initial flush of forbs may be Canada thistle and field sowthistle resulting from restoration efforts, especially prescribed grazing.

Birds: Monotypic stands of hybrid cattail or reed canarygrass reduce water bird use. LeConte's and Nelson's sparrow and yellow rail favor this plant community. American bittern may use this site. Restoration efforts, including prescribed grazing, can reduce hybrid cattail and reed canary grass; this increases open water providing foraging and breeding habitat for dabbling ducks and shore birds including a food source of aquatic invertebrates.

Mammals: Monotypic stands of hybrid cattail or reed canarygrass provide winter cover for large herbivores including white-tailed deer and moose. Depending on degree of ponding or saturation, this plant community may provide season-long escape cover for white-tailed deer. This plant community provides foraging opportunities for raccoon, skunks, coyotes and other mammals that use wetlands and wetland edges for food resources. Tall- to mid-statured vegetation provides suitable food, thermal, protective, and escape cover for small and large herbivores.

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

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

7.0 Go-Back State

Community Phase 7.1 Annual/Pioneer Perennial/Exotics Community: Following cropland abandonment, these plant communities are dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable, but will consist of Canada thistle, field sowthistle, other annual weeds (dock, smartweed, barnyard grass, etc.), quackgrass, foxtail barley, slough grass, and pioneering spikerush species. 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 offers thermal cover and seeds throughout winter. The response by wildlife species will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as wetland restoration, sediment removal, prescribed grazing, burning, inter-seeding, haying, or noxious weed control).

Successful wetland restoration and seeding of native species along Transition Pathway R7A can result in a native grass and forb community in State 2.0. Management activities within State 2.0 are needed to avoid a transition out of State 2.0. Unsuccessful wetland restoration or unsuccessful native forb and grass seeding may lead to States 4.0, 5.0 or 6.0 (dependent upon site hydrological modifications and restoration, salinity, and other site related issues).

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 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

Under unaltered hydrologic conditions, the site is dominated by soils in hydrologic group D; where significantly impacted by drainage practices, these soils are in hydrologic group A/D, B/D, or C/D depending upon soil texture. Infiltration varies from slow to rapid; runoff potential varies from negligible to low for this site depending on surface texture, slope percent, slope shape, 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 shortgrasses form a dense 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).

Hydrological manipulation (surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site. Under natural conditions, this ecological site includes a wide range of soil textures; after hydrologic manipulation, soil texture often becomes a more significant factor in vegetative response. If the degree of manipulation allows soil texture to influence the plant community or if altered soil properties (i.e., salinization or the addition of fill material) results in vegetation change, a transition to a completely different ecological site may have occurred. The transition to an altogether different ecological site will depend upon severity of altered hydrology, soil properties, and corresponding vegetation. Due to the many variables (e.g., hydrology, success, and type of drainage, etc.), impacts to the ecological site will be site-specific. As a result, each situation will require field investigation to determine what, if any, change in ecological site designation is necessary and proceed accordingly.

Without restoring hydrologic function (which may include range seeding), managers need to refer to reference state and transition models within those sites. Hydrology will need to be fully restored in Wet Meadow and Shallow Marsh ecological sites for these sites to properly function. It is recommended that managers review the appropriate State and Transition Models prior to wetland restoration.

Recreational Uses

Hunting and Bird Watching: Over 113,000 acres of National Wildlife Refuges and over 77,000 acres of Waterfowl Production Areas owned and managed by the United States Fish and Wildlife Service are available for public hunting and bird watching. In addition, over 22,000 acres of North Dakota Wildlife Management Areas (WMAs), approximately 8,000 acres of North Dakota Forest Service, and thousands of acres of Department of Trust Lands are scattered throughout the central and western portions of the MLRA; these areas are available for hunting and bird watching. MLRA 55A provides a unique ruffed grouse hunting opportunity in North Dakota on wildlife management areas managed by the North Dakota Game and Fish Department and forest service lands managed by North Dakota Forest Service within the Turtle Mountain.

Camping: Three state parks are located within the MLRA including Lake Metigoshe State Park (Turtle Mt.), Grahams Island State Park (Devils Lake), and the newly designated Pembina Gorge State Park (formerly Pembina Gorge Recreation Area). These Parks provide hiking, biking, birding, canoeing, and wildlife viewing opportunities. Many local parks and private parks provide modern and primitive camping opportunities. The approximately 8,000 acres of North Dakota Forest Service provides primitive camping (no electric or water hookups) as well as fishing and canoeing access at various lakes. These forests and lakes provide access to swimming beaches, picnicking, and an extensive trail system open to hiking, mountain biking, horseback riding, snowmobiling, and cross-country skiing (not groomed). 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 on North Dakota Forest Service lands (18.6 miles), Upper Souris NWR (4.25 miles), Des Lacs NWR (8.5 miles), J. Clark NWR (3.3 miles), White Horse Hill National Game Preserve (3.6 miles), Lake Metigoshe State Park (16 miles), and Grahams Island State Park (2.1 miles; 3 miles cross country skiing). In addition, extensive biking and walking trails are found in local county and city parks. The Turtle Mountain State Recreation Area (ND Forest Service) is located six miles northwest of Bottineau. This recreation area has over 12 miles of trails open to hiking, biking, snowshoeing, horseback riding, and OHV's.

The Pembina Gorge State Park encompasses over 2,800 acres of public land in the Pembina River Gorge. Steep valley cliffs towering over small, isolated prairies and pocketed wetlands surrounded by the largest continuous, undisturbed forest in North Dakota provide opportunities for canoeing, kayaking, hiking, biking, horseback riding, hunting, wildlife observing, birding, and downhill and cross-country skiing. Thirty miles of trails provide snowmobiling, mountain biking, and off-highway vehicles (OHV) opportunities.

Canoeing/Kayaking: Designated canoe and kayaking trails are available within the MLRA. J. Clark Sayler NWR has 12.75 miles of designated trails on the Souris River and Pembina Gorge State Park has 14.25 miles on the Pembina River. The Pembina Gorge State Park offers kayak rentals along

with kayak transportation. Lake Metigoshe State Park offers canoe and kayak rentals along with standup paddleboards, pontoons, cross country skis, snowshoes, etc.

Downhill Skiing: Downhill skiing is available at Bottineau Winter Park within Turtle Mountain and Frost Fire Park at the Pembina Gorge. Full-service rental shops are available along with alpine trails ranging from beginner to expert. Conveyor lifts on the beginner hills to chairlifts are available for skiers.

International Peace Garden: The only peace garden located on the United States/Canada border, the International Peace Garden is a 2,339-acre botanical garden commemorating peace between the United States and Canada along the world's longest unfortified border. It blooms with more than 155,000 flowers and showcases the Peace Chapel, Peace Towers, and Floral Clock. The North American Game Wardens Museum if also located within the boundaries of the International Peace Garden.

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 investigation is needed on areas of this site associated with flood plains. Ludden soils occur on flood plains of the Souris River. Lowe soils occur in upland drainageways. Lamoure soils occur as minor components on flood plains of streams and rivers. The impact of occasional or frequent flooding on these areas needs evaluation. MLRA map units needing investigation are:
    - Fairdale loam, 0 to 2 percent slopes, occasionally flooded (map unit 2q56z)
    - Lowe loam, 0 to 1 percent slopes, occasionally flooded (map unit 2q56h)
    - Lowe-Fluvaquents, channeled complex, 0 to 2 percent slopes, frequently flooded (map unit 2q56j)
    - Ludden silty clay, 0 to 1 percent slopes, frequently flooded (map unit 2q4g1)
    - Ludden silty clay, 0 to 1 percent slopes, frequently flooded (map unit 2q4g1)
    - Ludden-Fluvaquents, channeled complex, 0 to 2 percent slopes, frequently flooded (map unit 2q56m)
- Further investigation of areas of this site on lake shores and in shallow lake basins is needed. These areas are periodically inundated for extended periods. When the progressive soil surveys were completed, these soils were not inundated; currently many of these areas are inundated and have been for many consecutive years. Spatial data revisions may be needed. Major components in this site affected by recent inundation are Lallie and Minnewaukan. Some delineations of these soils have been impacted the construction of a dike along the shores of Devils Lake protecting some areas from flooding while maintaining inundation on other areas. The MLRA map units needing investigation are:
    - Lallie silty clay loam, 0 to 1 percent slopes (map unit 2q551)
    - Minnewaukan loamy fine sand, 0 to 2 percent slopes (map unit 2q553)
- Further investigation is needed on the wide range of landforms and soil textures (and associated properties) and their relationship to hydrology/plant dynamics.
- Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data. 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.

- 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.
- 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:
    - Thirteen components of Tonka, three of Vallers, and one each of Kratka, Marysland, Regan, and Tiffany are currently linked to 53A Wet Meadow (Legacy); these need to be relinked to 55A Wet Meadow.

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
Limy Subirrigated	R055AY040ND	This site occurs on rims of Wet Meadow sites and adjacent flats. The soils range in texture from sandy to clayey. They will form a ball or a ribbon. They are highly calcareous in the upper part of the subsoil and have redoximorphic features at a depth of 18 to 30 inches.
Loamy Overflow	R055AY041ND	This site occurs in upland swales and on floodplains. The surface and subsoil layers form a ribbon 1 to 2 inches long. It is deeper than 30 inches to redoximorphic features.
Saline Lowland	R055AY042ND	This site occurs on rims of depressions and adjacent flats. It has an accumulation of salts in the surface and subsoil layers (E.C. >8 dS/m). Typically, this site does not have a claypan layer, but one is allowed. All textures are included in this site.
Loamy	R055AY047ND	This site occurs on higher, linear slopes on till plains and lake plains. The surface layer and subsoil layers form a ribbon 1 to 2 inches long. It is >30 inches to redoximorphic features.
Subirrigated	R055AY048ND	This site occurs on concave areas of flats and in shallow depressions with occasional, brief ponding. It has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Subirrigated Sands	R055AY049ND	This site occurs somewhat higher on the landscape on sand plains. The subsoil does not form a ribbon. It is >30 inches to redoximorphic features.
Shallow Marsh	R055AY054ND	This site occurs in deep depressions which have frequent ponding through most of the growing season. All textures are included in this site.
Sodic Subirrigated	R055AY058ND	This site occurs on similar, poorly drained landscape positions on sand plains. Redoximorphic features occur within a depth of 18 inches. The soil has a dense, sodic claypan. The surface layer and upper part of subsoil do not have significant salt accumulations (E.C. <8 dS/m).

Similar Sites

Ecological Site Name	Site ID	Narrative
Subirrigated	R055AY048ND	This site occurs on concave areas of flats and in shallow depressions with occasional, brief ponding. It has redoximorphic features at a depth of 18 to 30 inches. All textures are included in this site.
Shallow Marsh	R055AY054ND	This site occurs in deep depressions which have frequent ponding through most of the growing season. All textures are included in this site.

Acknowledgements

We gratefully acknowledge Tom Pabian, Upper Souris River National Wildlife Refuge manager for making the refuge available for field work in developing the ESD and Dr. Shawn DeKeyser, NDSU, for his helpful comments and suggestions.

Developers
ND NRCS: David Dewald, Jonathan Fettig, Alan Gulsvig, Mark Hayek, Chuck Lura, Jeff Printz, Steve Sieler, 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 North Dakota.

Relationship to Other Established Classifications
Level IV Ecoregions of the Conterminous United States: 46a – Pembina Escarpment; 46b – Turtle Mountains; 46c – Glacial Lake Basins; 46d – Glacial Lake Deltas; 46f – End Moraine Complex; 46g – Northern Black Prairie; 46i – Drift Plains; and 46j – Glacial Outwash.

Wetland Description:	**System**	**Subsystem**	**Class**	**Sub-class**	**Water Regime**
Cowardin, et. al., 1979	Palustrine	N/A	Emergent	Persistent	Temporary/Saturated

Other References
Bakker, K.K. 2003. The effect of woody vegetation on grassland nesting birds: an annotated bibliography. The Proceedings of the South Dakota Academy of Science 82:119-141.

Bansal, S. et. al. 2019. Typha (cattail) invasion in North America wetlands: biology, regional problems, impacts, ecosystem services, and management. Wetlands 39:645-684.

Barker, W.T. and W. C. Whitman. 1988. Vegetation of the Northern Great Plains. Rangelands 10(6): 266-272.

Bluemle, J.P. 1985. Geology of Bottineau County, North Dakota. North Dakota Geological Survey Bulletin 78-Part I. 57 pages.

Bluemle. J.P. 2016. North Dakota's geologic legacy. North Dakota State University Press. 382 pages.

Bluemle, J.P. 2015. Turtle Mountain. North Dakota geology- the work of John Bluemle Ph.D. Available at http://johnbluemle.com/21-mountainous-areas-of-nd-turtle-mountain/

Boyd, L. 2001. Wildlife use of wetland buffer zones and their protection under the Massachusetts wetland protection act. University of Massachusetts Department of Natural Resources Conservation. 148 pages.
https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/final_project.pdf

Briske, D.D. (editor). 2017. Rangeland systems – processes, management, and challenges. Springer Series on Environmental Management. 661 pages.

Burgess, R.L. 1965. A study of plant succession in the sandhills of southeastern North Dakota. Proceedings ND Academy of Science 19:62-80

DeByle, N.V. and R.P. Winokur. 1985. Aspen: ecology and management in the western United States. USDA Forest Service General Technical Report RM-119. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 283 pages. Available at
https://www.fs.fed.us/rm/pubs_rm/rm_gtr119.pdf

DeKeyser, E.S., G. Clambey, K. Krabbenhoft, and J. Ostendorf. 2009. Are changes in species composition on central North Dakota rangelands due to non-use management? Rangelands 31:16-19

DeKeyser, E.S., D.R. Kirby, and M.J. Ell. 2003. An index of plant community integrity: development of the methodology for assessing prairie wetland plant communities. Ecological Indicators 3:119-133.
https://www.sciencedirect.com/science/article/pii/S1470160X03000153

Dix, R.L. and F.E. Smeins. 1967. The prairie, meadow, and marsh vegetation of Nelson County, North Dakota. Canadian Journal of Botany 45:21-57.

Dornbusch, M.J., R.F. Limb, and C.K. Gasch. 2018. Facilitation of an exotic grass through nitrogen enrichment by an exotic legume. Rangeland Ecology & Management 71:691-694.

Dyke, S.R., S.K. Johnson, and P.T. Isakson. 2015. North Dakota state wildlife action plan. North Dakota Game and Fish Department, Bismarck, ND. 468 pages.

Ehrenfeld, Joan G. 2002. Effects of exotic plant invasions on soil nutrient cycling processes. Ecosystems 6:503-523.

Eilers, R.G., L.A. Hopkins, and R.E. Smith. 1978. Soils of the Boissevain-Melita area. Manitoba Soil Survey Report No. 20, Manitoba Department of Agriculture. Available at
http://sis.agr.gc.ca/cansis/publications/surveys/mb/mb20/mb20_report.pdf

Ereth, C., J. Hendrickson, D. Kirby, E. DeKeyser, K. Sedevic, and M. West. Controlling Kentucky bluegrass with herbicide and burning is influenced by invasion level. Invasive Plant Science and Management 10: 80-89.

Ewing, J. 1924. Plant Succession on the brush prairie in northwestern Minnesota. Journal of Ecology 12:228-266.

Gilbert, M.C. et. al. 2006. A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of prairie potholes. US Army corps of Engineers, Engineer Research and Development Center, Vickburg, MS. 170 pages.
https://wetlands.el.erdc.dren.mil/pdfs/trel06-5.pdf#view=fit&pagemode=none

Gilgert, W. and S. Zack. 2010. Integrating multiple ecosystem services into ecological site descriptions. *Rangelands*: 32:49-54.

Grant, T.A. and R.K. Murphy. 2005. Changes on woodland cover on prairie refuges in North Dakota, USA. Natural Areas Journal 25:359-368.

Guinan, D.M, and C.S. Rewcastle. 1982. Trends of plant succession in Turtle Mountain Provincial Park. Manitoba Department Natural Resources MS Report No. 82-6. 40 pages.

Heitschmidt, R. K., K. D. Klement, and M. R. Haferkamp. 2005. Interactive effects of drought and grazing on northern great plains rangelands. Rangeland Ecology and Management 58:11-19.

Hendrickson, J.R., P. S. Johnson, M. A. Liebig, K. K. Sedivec, and G. A. Halvorson. 2016. Use of ecological sites in managing wildlife and livestock: an example with prairie dogs. Rangelands

Hendrickson, J.R., S.L. Kronberg, and E.J. Scholljegerdes. 2020. Can targeted grazing reduce abundance of invasive perennial grass (Kentucky Bluegrass) on native mixed-grass prairie? Rangeland Ecology and Management, 73:547-551.

Higgins, K.F. 1984. Lightning fires in grasslands in North Dakota and in pine-savanna lands in nearby South Dakota and Montana. J. Range Manage. 37:100-103.

Higgins, K.F. 1986. Interpretation and compendium of historical fire accounts in the northern great plains. United States Department of Interior, Fish and Wildlife Service. Resource Publication 161. 39 pages.

Higgins, K.F., A.D. Kruse, and J.L. Piehl. 1989. Effects of fire in the Northern Great Plains. U.S. Fish and Wildlife Service and Cooperative Extension Service South, Dakota State University. Extension Circular 761. 48 pages.

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

Hoffman, G.R. and R.R. Alexander. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: a habitat type classification. USDA Forest Service Research Paper RM-276, 48 pages.

Israelsen, K. 2009. Herbicide, Salinity, and Flooding Tolerance of foxtail barley (*Hordeum jubatum* L.) and desirable pasture grasses. M.S. thesis. Utah State University. 95 pages. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1515&context=etd

Johnson, Sandra. 2015. Reptiles and amphibians of North Dakota. North Dakota Game and Fish Department. 64 pages.

Jordan, N. R., D.L. Larson, and S.C. Huerd. 2008. Soil modification by invasive plants: effects on native and invasive species of mixed-grass prairies. Biological Invasions 10:177-190.

Knudson, W. and R. L. Post. 1963. Butterflies of Bottineau County. North Dakota State University Department of Agricultural Entomology. 29 pp.

Kurmis, V., and E. Sucoff. 1999. Population density and height distribution of Corylus cornuta in undisturbed forests of Minnesota: 1965-1984. Can. J. Bot. 67:2409-2413.

Lemke, Richard W., Geology of the Souris River area. North Dakota Geological Survey, Professional Paper, 325 pp. Prepared as a part of a program of the Department of the Interior for development of the Missouri River Basin United States Government Printing Office, Washington, DC:1960.

Mader, E., M. Shepherd, M. Vaughan, and S.H. Black. 2011. Attracting native pollinators: protecting North America's bees and butterflies. Accessed at https://xerces.org, May 1, 2017.

McCartney. D.H. 1993. History of grazing research in the aspen parkland. Canadian Journal of Botany 73:749-763.

Minnesota Department of Natural Resources, Managing your woodland for ruffed grouse, Accessed on February 25, 2019; Available at https://files.dnr.state.mn.us/recreation/hunting/grouse/managing_woodland_ruffed_grouse_flat.pdf

Minnesota Department of Natural Resources. 2005. Field guide to the native plant communities of Minnesota – the prairie parkland and tallgrass aspen parklands provinces. Minnesota DNR.

Minnesota Department of Natural Resources. Ecological system summaries and class factsheets – wetland grasslands, shrublands, and marshes. https://www.dnr.state.mn.us/npc/wetlandgrassland.html

North Dakota Division of Tourism, Accessed on February 25, 2019. Available at https://www.ndtourism.com/sports-recreation

North Dakota Parks and Recreation Department, Accessed on February 25, 2019. Available at http://www.parkrec.nd.gov/recreationareas/recreationareas.html

Palit, R., G. and E.S. DeKeyser. 2022. Impacts and drivers of smooth brome (*Bromus inermis* Leyes.) invasion in native ecosystems. Plants: 10,3390. https://www.mdpi.com/2223-7747/11/10/1340

Palit, R., G. Gramig, and E.S. DeKeyser. 2021. Kentucky bluegrass invasion in the Northern Great Plains and prospective management approaches to mitigate its spread. Plants: 10,817. https://doi.org/10.3390/plants10040817

Potter, L.D. and D. R. Moir. 1961. Phytosociological study of burned deciduous woods, Turtle Mountains North Dakota. Ecology Vol 2, No. 3: 468-480.

Printz, J.L. and J.R. Hendrickson. 2015. Impacts of Kentucky bluegrass Invasion (*Poa pratensis*) on Ecological Processes in the Northern Great Plains. Rangelands 37(6):226-232.

Redmann, Robert E. 1975. Production ecology of grassland plant communities in western North Dakota. Ecological Monographs 45:83-106.

Reeves, J.L., J.D. Derner, M.A. Sanderson, J.R. Hendrickson, S.L. Kronberg, M.K. Petersen, and L.T. Vermeire. 2014. Seasonal weather influences on yearling beef steer production in C_3-dominated Northern Great Plains rangeland. Agriculture, Ecosystems and Environment 183:110-117.

Renton, J. C. 2010. The impact of cattle grazing on aspen regeneration on crown lands in western Manitoba. M.S. thesis, University of Manitoba, Winnipeg. 130 pages.

Riffle, J.W. and G.W. Peterson. 1986. Diseases of trees in the Great Plains. U.S.D.A. Forest Service General Technical Report RM-129. 149 pages. Royer, R. A., 2003. Butterflies of North Dakota: An Atlas and Guide. Minot State University, Minot, ND.

Royer, R. A., 2003. Butterflies of North Dakota: an atlas and guide:
Minot State University, Minot, ND.

Schulz, J.W. 1984. Manipulation of habitat for ruffed grouse on the Wakopa Wildlife Management Area, North Dakota. Pages 109-121 In Robinson, W.L. editor. Ruffed grouse management, state of the art in the early 1980's. Proceedings of a symposium, 45th Midwest Fish and Wildlife Conference, St. Louis, MO. 181 pages. Available at http://wildlife.org/wp-content/uploads/2015/12/Robinson1984_RuffedGrouseManagement_300dpi.pdf

Seabloom, R. 2020. Mammals of North Dakota. North Dakota Institute for Regional Studies, Fargo, ND. 470 pages.

Sedivec, K.D., J.L. Printz. 2014. Ranchers guide to grassland management IV. NDSU Extension Service publication R1707.

Seelig, B. and S. DeKeyser. 2006. Wetland function in the northern prairie pothole tegion. North Dakota State University Extension Service. WQ-1313. 28 pages. https://erams.com/static/wqtool/PDFs/Wave%20Papers/wq1313.pdf

Severson, K. E. and C. Hull Sieg. 2006. The Nature of eastern North Dakota: Pre-1880 Historical Ecology. North Dakota Institute for Regional Studies.

Smith, C., E.S. DeKeyser, C. Dixon, R. Kobiela, and A. Little. Effects of sediment removal on prairie pothole wetland plant communities in North Dakota. Natural Area Journal 36:48-58. https://bioone.org/journals/natural-areas-journal/volume-36/issue-1/043.036.0110/Effects-of-Sediment-Removal-on-Prairie-Pothole-Wetland-Plant-Communities/10.3375/043.036.0110.full

South Dakota Dept. of Game, Fish and Parks. 2014. South Dakota wildlife action plan. Wildlife Division Report 2014-03.

Spaeth, K.E., Hayek, M.A., Toledo, D., and Hendrickson, J. 2019. Cool season grass impacts on native mixedgrass prairie species in the Northern Great Plains. America's Grassland Conference: Working Across Boundaries. The Fifth Biennial Conference on the Conservation of America's Grasslands. Bismarck, ND. 20-22 August.

Stewart. R.E. and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. Resource Publication 92. Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Washington, DC. 57 pages. https://pubs.usgs.gov/rp/092/report.pdf

Thorpe, J.P. 1978. Effects of cattle grazing on understory shrubs in Saskatchewan aspen forests. M.S. thesis, University of Saskatchewan, Saskatoon. 135 pages.

Tidwell, D., D.T. Fogarty, and J.R. Weir. 2021. Woody encroachment in grasslands, a guide for understanding risk and vulnerability. Oklahoma State University, Oklahoma Cooperative Extension Service publication E-1054. 32 pages.

Toledo, D., M. Sanderson, K. Spaeth, J. Hendrickson, and J. Printz. 2014. Extent of Kentucky bluegrass and its effect on native plant species diversity and ecosystem services in the northern great plains of the United State. Invasive Plant Science and Management 7(4): 543-552.

USDA, NRCS. 2021. National range and pasture handbook, (https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/rangepasture/?cid=stelprdb1043084)

USDA, NRCS. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

USDA, NRCS. National Soil Information System, 100 Centennial Mall North, Room 152, Lincoln, NE 68508-3866. (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/tools/?cid=nrcs142p2_053552)

USDA, NRCS. National Water & Climate Center, 1201 NE Lloyd Blvd, Suite 802, Portland, OR 97232-1274. (https://www.wcc.nrcs.usda.gov/)

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

USDA, NRCS, Various Published Soil Surveys.

USDI BLM.1999. Utilization studies and residual measurements. Interagency Technical Reference 1734-3.

U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants; designation of critical habitat for the Dakota skipper and Poweshiek skipperling; Vol. 79 No. Final Rule October 1, 2015, 50 CFR Part 17.

Vinton, M.A. and E.M. Goergen. 2006. Plant-soil feedbacks contribute to the persistence of *Bromus inermis* in tallgrass prairie. Ecosystems 9: 967-976.

Waddington, J., D.H. McCartney, and L.P. Lefkovitch. 1999. Effects of management on species dynamics of Canadian aspen parkland pastures. Journal of Range Management 52:60-67.

Weatherill, R.G., and L.B. Keith. 1969. The effect of livestock grazing on an aspen forest community. Utah State University. Department of Lands and Forests Fish and Wildlife Division Technical Bulletin No. 1. 31 pages.

Whitman, W.H., H. Hanson, and R. Peterson. 1943. Relation of drought and grazing to North Dakota range lands. North Dakota Agricultural Experimentation Bulletin 340.

Site Description Approval

_____ _____
ND, State Range Management Specialist Date

INTERPRETING INDICATORS OF RANGELAND HEALTH, Version 5, REFERENCE SHEET

Ecological site name: __Wet Meadow__ **Ecological site code: _RO55AY055ND_____**
Author(s)/participant(s): _USDA-NRCS North Dakota_____
Contact for lead author: __NRCS State Rangeland Management Specialist___
Date: _Dec. 2021__ **MLRA:** _55A_____ **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.
4. Bare ground: Bare ground is 5% or less. Bare ground may be higher for a short period of time following periods of inundation.
5. Gullies: Active gullies are not expected on this site.
6. Wind-scoured and/or depositional areas: No wind-scoured or depositional areas are expected on this site.
7. Litter movement: Plant litter movement not expected on this site.
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: Grass-likes are dominant and well distributed across the site. Tall rhizomatous grasses, mid- and short-statured bunch grasses and mid- and short-statured rhizomatous grasses 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	Grass-likes (8)		
Subdominant	Tall C4 rhizomatous grasses (1); Mid & short C3 rhizomatous grasses		
Minor	Mid & short C3 bunch grasses; Forbs; Mid & short C4 rhizomatous grasses; Tall C3 rhizomatous grasses; 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 90% with a depth of 0.75 to 1.5 inches. Litter is in contact with soil surface.

15. Annual production: Annual air-dry production is 4600 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 3600 lbs./ac to 5600 lbs./ac, respectively.

16. Invasive plants: State and local noxious species, quackgrass, creeping foxtail, reed canarygrass, smooth bromegrass, Kentucky bluegrass and Russian olive.

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.

Functional/Structural Groups Sheet

State ND **Office** _____ **Ecological site** Wet Meadow **Ecol. site code** RO55AY055ND

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
Grass-likes	woolly sedge, clustered field sedge, wheat sedge, Sartwell's sedge, Bicknell's sedge, fox sedge,
.	shortbeak sedge*, water sedge*, mountain rush, spikerush, green bulrush*, river bulrush*, bulrush*
Tall C4 rhizomatous grasses	prairie cordgrass, switchgrass*
Mid & short C3 bunch grasses	American sloughgrass*, fowl bluegrass*, prairie wedgescale*, rough bentgrass*,
	slender wheatgrass*
Mid & short C3 rhizomatous grasses	northern reedgrass
Forbs	please see plant community table 1.1
Mid & short C4 rhizomatous grasses	spiked muhly, Mexican muhly*, mat muhly*
Tall C3 rhizomatous grasses	reed canarygrass*
Shrub	willow*
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	Grass-likes	>>	Tall C4 rhizomatous grasses > Mid & short C3 rhizomatous grasses	>	Mid & short C3 bunch grasses > Forbs = Mid & short C4 rhizomatous grasses = Tall C3 rhizomatous grasses > 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
Grass-likes	
Tall C4 rhizomatous grasses	
Mid & short C3 bunch grasses	
Mid & short C3 rhizomatous grasses	
Forbs	
Mid & short C4 rhizomatous grasses	
Tall C3 rhizomatous grasses	
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: