Evaluation of Ecological Site Classes and Community Classes for Regional Scale Modeling of Conservation Effects on Grazing Lands: MLRA 54

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INTRODUCTION

The Grazing Lands Component of the Conservation Effects Assessment Project (CEAP-GL) is evaluating the development and use of Ecological Site Classes and Community Classes within Major Land Resource Areas for regional and national scale modeling of conservation effects. National Resources Inventory (NRI) data is correlated to proposed Ecological Site Classes to provide data for the Agricultural Policy/Environmental eXtender (APEX) model and other models. The Rangeland Hydrology and Erosion Model (RHEM) is used to assess runoff and erosion differences between Community Classes.

CLASSIFICATION HIERARCHY AND DEFINITIONS

Ecological Site Class

Ecological Site Classes are proposed subdivisions of a Major Land Resource Area (MLRA) or Land Resource Unit (LRU). They are similar in concept to a general soil survey map unit – a general grouping of ecological sites by major landforms and vegetation types. An Ecological Site Class differs from other kinds of land in the kinds and amounts of vegetation produced, in the responses to disturbances, in recovery mechanisms, and management.

Plant Functional Groups

The Plant Functional/Structural Group indicator is defined in Interpreting Indicators of Rangeland Health (version 4) as, *"A suite or group of species that because of similar shoot or root structure, photosynthetic pathways, nitrogen fixing ability, life cycle, etc., are grouped together on an ecological site basis."*

The presence, dominance and relative proportions of plant functional groups affect soil, hydrologic and biotic variables including:

- the kinds and amounts of canopy and foliar cover
- amount and arrangement of bare ground and litter cover
- plant spacing and amount of basal cover
- runoff and erosion rates
- structure and arrangement of vegetation which then influences the potential to carry fire and regulate fire intensity
- grazing preferences and distribution
- wildlife habitat values

The change in presence, dominance and/or proportion of plant functional groups is the primary attribute used to characterize States and Community Phases within an Ecological Site Description. Standardized plant functional

groups were developed based on growth forms and flowering period. All plant species found in the MLRA were assigned to a plant functional groups. Non-native species were assigned to functional groups designated with (I) - for introduced. Production by functional group was then calculated for each NRI Primary Sampling Unit (PSU) community in the MLRA. Refer to Appendix E for a list of common species and their assigned functional groups used for this project.

Community Class

A Community Class is a proposed plant community classification for an ecological site class. The name of the Community Class is derived using the seven (7) dominant plant functional groups, listed in descending order by annual aboveground production on a dry weight basis. A Community Class is differentiated from other Community Classes by the presence and relative dominance of plant functional groups, and/or by significant differences in annual production.

Plant Community

An actual plant community found at a given location, at a point in time.

MAJOR LAND RESOURCE AREA 54 - ROLLING SOFT SHALE PLAIN

MLRA 54 occurs in the southwest corner of North Dakota and northwest corner of South Dakota. A small portion (3%) of the area extends across the border into Montana. This area is part of the Northern Great Plains Spring Wheat Region - Land Resource Region (LRR F). MLRA 54 is just over 18.7 million acres in size (75,870 square kilometers). The area is mostly unglaciated portions of the Missouri Plateau, but there are some glaciated areas on the eastern and northern edges. The MLRA is characterized by rolling plains, badlands, and buttes. The Missouri River is on the eastern side of the MLRA. Major rivers that run through the MLRA are the Knife, Heart, Cannonball, Cedar, Grand, and Moreau. Elevations range from 1650 feet (505 meters) above mean sea level on the eastern side, to 3600 feet (1100 meters) on the western side.

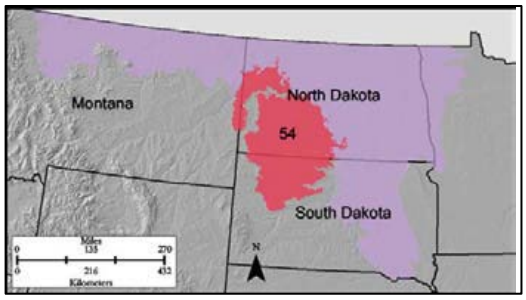

Figure 1. LRR F and MLRA 54 map. Source: Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296 (2006).

This Major Land Resource Area is dominated by grassland vegetation. Important perennial grasses include blue grama, western wheatgrass, needleandthread, sideoats grama, green needlegrass and little bluestem. Common native shrubs include prairie rose, western snowberry, and leadplant. Green ash, chokecherry, and buffaloberry are common along the rivers. Refer to Appendix E for scientific plant names and additional plant classification data used throughout the report.

Important wildlife includes pronghorn antelope, white-tailed deer, mule deer, ring-necked pheasant, ducks, geese, coyotes, and prairie dogs. Listed species include the Dakota skipper, monarch butterfly, native bees, sage grouse, and black-footed ferret.

Climate

The following climate information is excerpted from the Shallow Loamy Ecological Site Description and characterizes the climate in MLRA 54.

"MLRA 54 is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature. Annual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42° F. January is the coldest month with average temperatures ranging from about 13° F (Beach, ND) to about 16° F (Bison, SD). July is the warmest month with temperatures averaging from about 69° F (Beach, ND) to about 72° F (Timber Lake, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57° F. This large annual range attests to the continental nature of this MLRA's climate. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour. Growth of native cool-season plants begins in late March and continues to early- to mid-July. Native warm-season plants begin growth in mid-May and continue to the end of August. Green up of cool-season plants can occur in September and October when adequate soil moisture is present."

Averages

Frost-free period (days):	127
Freeze-free period (days):	148
Mean annual precipitation (inches):	18.0

Table 1. Monthly Precipitation (Inches)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	0.54	0.61	1.07	1.88	2.83	3.29	2.25	2.07	1.45	1.35	0.61	0.55
Medium	0.48	0.49	0.79	1.50	2.45	3.06	2.15	1.78	1.37	1.12	0.55	0.49
Low	0.41	0.37	0.51	1.13	1.98	2.83	2.05	1.49	1.29	0.89	0.48	0.42

Table 2. Monthly Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	28.3	30.4	40.0	56.8	69.3	78.3	85.2	84.3	73.4	60.4	41.5	29.0
Low	2.2	8.7	17.1	28.9	40.5	49.8	54.6	53.0	42.0	31.6	19.0	8.1

The soil temperature regime is frigid and the soil moisture regime is ustic.

Representative Climate Stations

(1) Sidney [MT7560]. Period of record 1949-1999
(2) Carson [ND321370]. Period of record 1948 – 2006*
(3) Timber Lake [SD8307]. Period of record 1948-1999
*This climate station was used for the Rangeland Hydrology and Erosion Model (RHEM) evaluations.

AGRICULTURAL OPERATIONS

Cropland covers about 40 percent of the acres in this MLRA, and rangelands cover about 55 percent. Agricultural producers in MLRA 54 typically raise both crops and livestock, but many only raise livestock. Much of the cropland is used for grass/hay production for feeding livestock in the winter. Important crops include wheat, barley, oats, rye, flax, corn, sunflower, and alfalfa. A few areas along the rivers are irrigated. Wheat is typically planted in early May and harvested from late August through September.

The kind and size of livestock operations are variable, but a typical livestock operation is a cow-calf operation, about 3000-4000 acres in size, with 150-200 mother cows. Stocking rates average 0.6-0.7 AUMs/Ac. Calves are born from January to February in barns and are shipped toward the end of October. Cattle graze on rangelands starting in April - May and come off in November - December. If the operation includes cropland, livestock may graze on crop residues in September - October. During the winter, cattle are fed grass or wheat hay with alfalfa or protein supplement, and/or straight alfalfa hay.

RESOURCE MANAGEMENT SYSTEMS

Conservation Practices Applied

Table 3 shows the kinds and amounts of conservation practices that the landowners in MLRA 54 are investing in on grazing lands. The table shows the most common conservation practices applied with NRCS assistance on grazed rangeland during fiscal years 2006-2011.

Table 3. Common conservation practices applied on grazed rangeland in MLRA 54 from 2006-2011 (NRCS).

Practice Code	Practice Name (units)	Practice Count	Amount Applied	Acres Benefitted
528	Prescribed Grazing (ac)	3,735	862,619	864,832
614	Watering Facility (no)	1,673	5,087	849,499
516	Pipeline (ft)	1,278	4,273,807	567,324
382	Fence (ft)	816	2,614,494	381581
642	Water Well (no)	291	291	115,178
645	Upland Wildlife Habitat Mgmt. (ac)	291	49,339	51,227
533	Pumping Plant (no)	212	211	108,507
561	Heavy Use Area Protection (ac)	177	2,442	71,331
380	Windbreak/Shelterbelt Establishment (ft)	91	259,949	19,326
550	Range Planting (ac)	79	3,475	6,849
378	Pond (no)	67	67	25,817
472	Access Control (ac)	48	2,651	6,059
351	Water Well Decommissioning (no)	29	29	7,082
574	Spring Development (no)	22	22	6,033
512	Forage and Biomass Planting (ac)	17	784	1,874
484	Mulching (ac)	14	3,811	3,339
500	Obstruction Removal (ac)	14	349	2,445
650	Windbreak/Shelterbelt Renovation (ft)	11	22,352	3,132
342	Critical Area Planting (ac)	10	10	1,070

Prescribed Grazing

Prescribed grazing is the most common conservation practice applied to address resource concerns on rangelands in this MLRA. The practice focuses primarily on maintaining proper stocking rates using 25% harvest efficiency for native forage species. Non-native species including Kentucky bluegrass, smooth brome, crested wheatgrass, Japanese brome and cheatgrass are becoming the dominant species on many ecological sites. Prescribed grazing is being used to help maintain dominance by native species. On most operations, grazing patterns utilizing native rangeland and crop/hayland tend to stay the same from year to year.

Watering Facilities

Livestock water is provided by primarily by wells that average 200 to 300 feet in depth. Livestock pipelines, storage tanks and troughs are used to distribute grazing and provide water for livestock and wildlife. Dugout ponds are also used, but are less common.

Brush Management

This practice is rarely applied in this MLRA. Encroachment of woody species is not a significant resource concern.

Range Planting

Range planting is not common in this MLRA. There is typically a sufficient seed source for the desirable species to become re-established with good grazing management. USDA has a standard planting mix for lands enrolled in the Conservation Reserve Program (CRP).

Prescribed Burning

Prescribed Burning is not commonly used in this MLRA, but it plays an important role the ecology of the prairie grasslands. Fire stimulates grass growth and promotes a greater diversity of forbs, which attracts wildlife such as pronghorn antelope and mule deer. The natural fire return interval is thought to be about 7 to 10 years.

Fencing

Standard barbed wire fencing using 3-4 wires is the typical fencing used for livestock control. Some 2-wire electric fence is also used.

Herbaceous Weed Control

This practice is being used to control noxious weeds such as leafy spurge, wormwood, and Canada thistle. Biological control of leafy spurge with flea beetles or moths is successful. Leafy spurge is also controlled using 2,4-D, picloram, and imazapic. Wormwood is controlled with imazapic and aminopyralid. Aminopyralid is used on Canada thistle as well. Ground spraying using trucks is the most common application method.

Upland Wildlife Habitat Management

Most wildlife management applied in this MLRA uses prescribed grazing to improve habitat for ground nesting birds such a sage grouse and pheasant. Wildlife friendly fencing is being installed for antelope.

ECOLOGICAL SITE CLASSES AND COMMUNITY CLASSES

In January 2017, there were 23 ecological sites correlated to soil map unit components in MLRA 54. Those were grouped into ten (10) ecological site classes by working with the state and local NRCS soil and rangeland management scientists in MLRA 54. The groupings are based on landscape position, soil characteristics, plant community composition, plant production and the response to climate, disturbance, use, and management. The ecological site names and numbers shown below are shared among the states (ND, SD, WY, MT), with development of ecological site concepts, descriptions, and soil correlation occurring in partnership among those states.

ECOLOGICAL SITE CLASSES FOR MAJOR LAND RESOURCE AREA 54

Claypan Upland Ecological Site Class

- Thin Claypan R054XY033ND
- Claypan R054XY021ND

Loamy Terrace Ecological Site Class

- Loamy Terrace R054XY041ND
- Loamy Overflow R054XY023ND

Loamy Upland Ecological Site Class

- Clayey R054XY020ND
- Loamy R054XY031ND

Saline Bottomland Ecological Site Class

- Saline Lowland R054XY024ND
- Closed Depression R054XY022ND

Sandy Loam Upland Ecological Site Class

- Sandy Claypan R054XY027ND
- Shallow Sandy R054XY043ND
- Sandy R054XY026ND

Sandy Upland Ecological Site Class

- Sandy Terrace R054XY042ND
- Sands R054XY025ND

Sandy Upland, Limy Ecological Site Class

- Limy Sands R054XY045ND

Shallow Upland Ecological Site Class

- Thin Loamy R054XY038ND
- Shallow Loamy R054XY030ND
- Shallow Gravel R054XY029ND
- Shallow Clayey R054XY028ND
- Thin Sands R054XY034ND
- Very Shallow R054XY035ND

Subirrigated Bottomland Ecological Site Class

- Subirrigated R054XY032ND

Wet Bottomland Ecological Site Class

- Wet Land R054XY036ND
- Wet Meadow R054XY037ND

Each NRI Primary Sampling Unit (PSU) in the MLRA was correlated to a Community Class where possible. PSU data were not used when the species present or vegetation production was questionable. Additional Community Classes that are not currently represented in the ecological site descriptions were added when present in the NRI data (these most commonly were non-native dominated communities). The production for the plant functional groups is calculated from the NRI PSUs that are correlated to the Community Class. Community Class names are derived using the top seven (7) plant functional groups, listed in descending order of annual aboveground air-dry production. Refer to Appendix E for plant taxonomy.

All species and plant community production values are shown as pounds per acre (lbs/ac) in the following ecological site class descriptions and refers to annual aboveground air-dried production.

The following sections describe the ten ecological site classes in MLRA 54.

CLAYPAN UPLAND ECOLOGICAL SITE CLASS

General Description

The Claypan Upland ecological site class occurs on gently undulating to rolling sedimentary uplands. The soils in this site are moderately well to well drained and formed in soft sandstone, siltstone, shales and alluvium.

Geomorphic Features

Landscape Positions:	Alluvial Fan, Alluvial Flat, Hill
Slope (percent):	0 - 25

Representative Soil Features

Soil Depth:	Shallow
Parent Material Kind:	Sandstone, Siltstone, Shale, Alluvium
Parent Material Origin:	Mixed
Surface Texture:	Clay Loam, Silt Loam, Loam, Fine Sandy Loam
Surface Texture Modifier:	None
Subsurface Texture Group:	Clayey
Drainage Class:	Moderate Well to Well
Permeability Class:	Very Slow to Slow
Chemistry:	Sodium: SAR 15-25, EC (mmhos/cm) 8-116
Available Water Capacity:	1 – 5 inches

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 2) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site class. This community class produces about 1150 lbs/ac/yr. dominated by western wheatgrass, blue grama, needleandthread, green needlegrass, thickspike wheatgrass, Sandberg bluegrass, prairie Junegrass, and needleleaf sedge. With continuous heavy grazing, the site may transition to a shortgrass dominated state (State 2) with increases in blue grama and buffalograss, and less production from western wheatgrass and midgrasses such as needleandthread.

With the introduction of non-native species such as Kentucky bluegrass, the site will transition to a Native - Non-Native Herbaceous state (State 3). Native species are dominant in State 3. With non-use and no-fire, the community will transition to a non-native dominated community (State 4). With prescribed burning, long term prescribed grazing and range planting where needed, the site may return to the native dominated state (State 3). The site will not transition from the Native – Non-Native Herbaceous states back to the Native Herbaceous states.

Plowing and tillage convert the reference state to a Planted Herbaceous state. Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 5.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 5.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

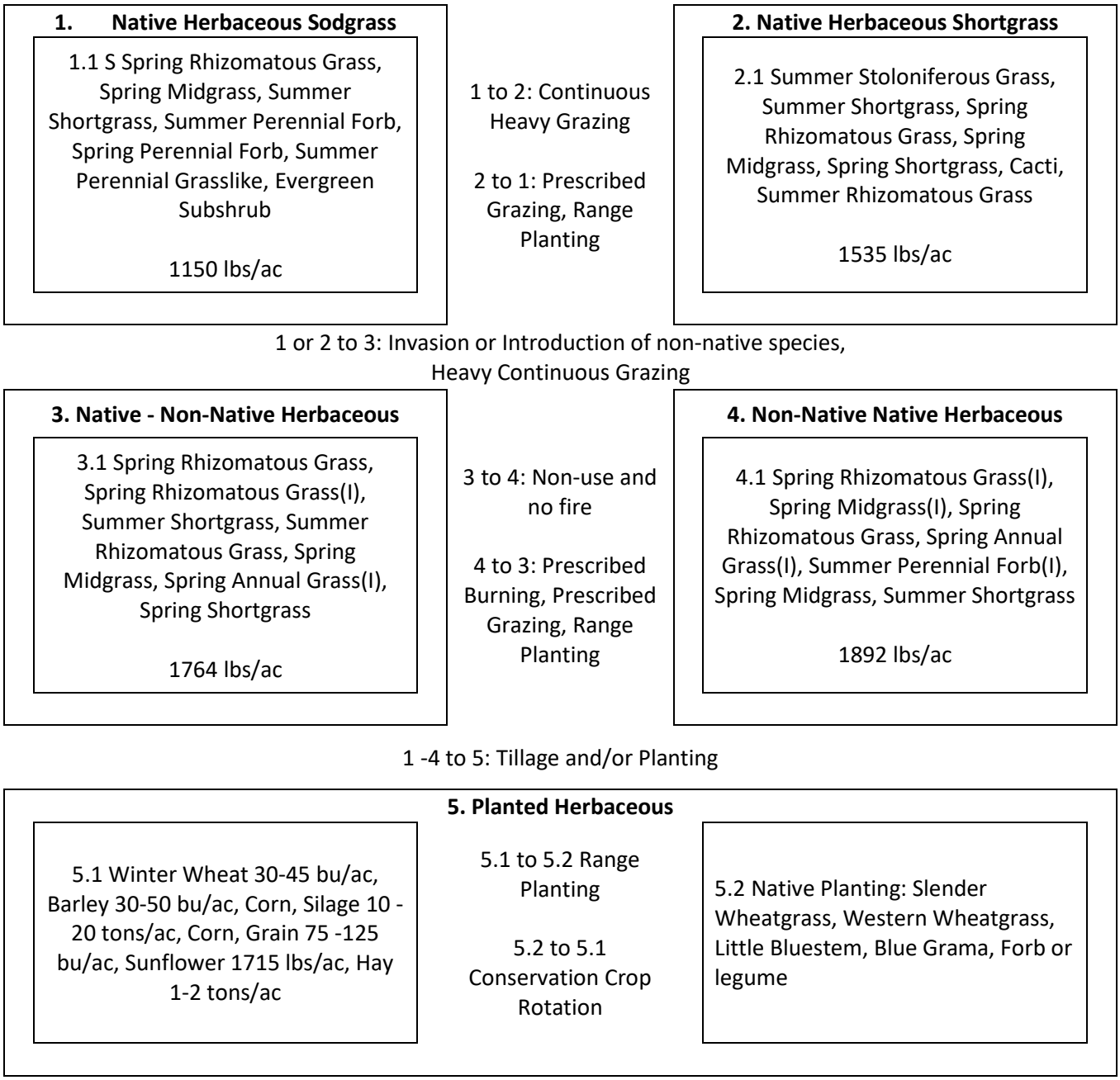

Figure 2. State and Transition Model, MLRA 54, Claypan Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 4. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 4. NRI Community Class Data and RHEM Results - MLRA 54, Claypan Upland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.27.1.1	Spring Rhizomatous Grass(543), Spring Midgrass(172), Summer Shortgrass(165), Summer Stoloniferous Grass(138), Spring Perennial Grasslike(76), Summer Midgrass(72), Summer Perennial Forb(53)	western wheatgrass(PASM)(543), blue grama(BOGR2)(165), Buffalograss(BODA2)(138), needleandthread(HECO26)(87), prairie Junegrass(KOMA)(55), little bluestem(SCSC)(47), sedge(CAREX)(41), Kentucky bluegrass(POPR)(30)	1460	0.27	6.75%	33
054X.27.2.1	Summer Stoloniferous Grass(543), Summer Shortgrass(308), Spring Rhizomatous Grass(217), Spring Midgrass(51), Spring Shortgrass(51), Cacti(50), Summer Rhizomatous Grass(46)	Buffalograss(BODA2)(543), blue grama(BOGR2)(308), western wheatgrass(PASM)(217), Sandberg bluegrass(POSE)(51), inland saltgrass(DISP)(46), silver sagebrush(ARCA13)(43), sixweeks fescue(VUOC)(36), Opuntia spp.(OPUNT)(35)	1535	0.38	7.45%	9
054X.27.3.1	Spring Rhizomatous Grass(608), Spring Rhizomatous Grass(I)(249), Summer Shortgrass(196), Summer Rhizomatous Grass(123), Spring Midgrass(101), Spring Annual Grass(I)(85), Spring Shortgrass(72)	western wheatgrass(PASM)(608), Kentucky bluegrass(POPR)(224), blue grama(BOGR2)(196), inland saltgrass(DISP)(112), Sandberg bluegrass(POSE)(72), Buffalograss(BODA2)(66), cheatgrass(BRTE)(62), prairie Junegrass(KOMA)(57)	1764	0.23	4.87%	26
054X.27.4.1	Spring Rhizomatous Grass(I)(574), Spring Midgrass(I)(304), Spring Rhizomatous Grass(280), Spring Annual Grass(I)(136), Summer Perennial Forb(I)(108), Spring Midgrass(97), Summer Shortgrass(86)	Kentucky bluegrass(POPR)(417), crested wheatgrass(AGCR)(304), western wheatgrass(PASM)(280), smooth brome(BRIN2)(153), cheatgrass(BRTE)(117), sweetclover(MEOF)(108), blue grama(BOGR2)(84), green needlegrass(NAVI4)(53)	1892	0.29	6.46%	27

Supporting Information

The following publications support the State and Transition Model (STM). The first publication corresponds with the STM, in that the grazing management on the study sites result in the same changes in vegetation composition as the STM. The second publication examines pastures, both seeded and native, that were grazed from mid-May-September. The study concluded that season-long grazing was not recommended. This complies with STM findings, which forecast state changes with continuous heavy grazing. The third publication grazing study is in accordance with the STM as the study found that native pastures standing crop was greater at the moderate versus the heavy stocking rate, a finding of the STM as well.

Frank, A.B., D.L. Tanaka, L. Hofmann and R.F. Follett. 1995. Soil carbon and nitrogen of Northern Great Plains grasslands as influenced by long-term grazing. Journal of Range Management 48(5): 470-474.
The objective of this study was to determine the effects that long-term grazing incurs on the soil organic carbon and nitrogen content on the mixed-prairie of the Northern Great Plains. Additionally, the objective was to relate these changes in soil carbon to changes in species composition.

The study occurred on moderately and heavily grazed pastures near Mandan, North Dakota on silt loam soils. Four soil cores were obtained at 6 sites of the same soil, slope and exposure in each pasture and exclosure. Plant residue was removed and saved. Soil bulk density was calculated, as were organic carbon and nitrogen contents. Vegetation composition of each pasture and exclosure was taken from annual reports dating back to 1916.

The results found that vegetation change was greater in the heavily grazed pastures than the moderately grazed and long-term exclosure. The moderately grazed and exclosure maintained a mix of species, but the heavily grazed became dominated by blue grama. In 1994, Kentucky bluegrass became a significant factor of foliar cover for the moderately grazed and exclosure. Soil organic carbon was not statistically different between the exclosure and heavily grazed. However, there was significant difference between the heavily and moderately grazed pastures. Differences in the soil N were small between the varying pastures.

Hofmann, L., R.E. Ries, J.F. Karn and A.B. Frank. 1993. Comparison of seeded and native pastures grazed from mid-May through September. Journal of Range Management 46(3): 251-254.
This study evaluated the use of seeded stands of crested wheatgrass, smooth bromegrass, and western wheatgrass, native mixed prairie on Class II and III land and mixed prairie on Class IV and VI as season-long pastures. Forage production and yearling steer gain were compared.

The research site was on seeded pastures of: 1) silt loam, 2) loam, silt loam and 3) silty clay loam. One pasture was level native and the other was a hilly native pasture. These were all divided into 4 pasture sites and three yearling heifers grazed from late May through early through October. Western wheatgrass pastures were not grazed every year as they take extra time to produced grazable stands. Fifteen 10-point frame basal ground cover readings were taken randomly across each pasture and standing crop was estimated by cutting three strips with a sickle bar mower. Additionally, caged standing crop was sampled in each pasture.

The results showed that western wheatgrass produced the highest average caged standing crop dry matter, followed by crested wheatgrass, smooth bromegrass, level native, and the hilly native pastures. The study found that season-long grazing treatment was not recommended for pastures that had been seeded to crested wheatgrass or smooth bromegrass because of poor summer performance in comparison to native pastures.

Karn, J.F., R.E. Ries and L. Hofmann. 1999. Season-long grazing of seeded cool-season pastures in the Northern Great Plains. Journal of Range Management 52(3): 235-240.
Grazing studies were implemented for 140 days each summer for two years near Mandan, North Dakota. The species that were seeded included western wheatgrass, crested wheatgrass and smooth bromegrass. Native pastures were located adjacent on loam, silt loam and silty clay soils. Both seeded and native pastures underwent 2 replications of moderate and heavy stocking rates. Flat native pastures were fine-silty soils and consisted of blue grama, green needlegrass, needleandthread, western wheatgrass, sedges, three-awn and Kentucky bluegrass. Rolling native pastures consisted of the same, with the addition of little bluestem and some patches of western snowberry and buffaloberry.

Standing crop was measured by hand clipping forage at a 5mm stubble height from 36 plots randomly located in cages. These cages were randomly placed in each seeded pasture and each of the flat and rolling native pastures. Steers were weighed and observed during the study.

Results found that western wheatgrass had the highest average end of season standing crop and the greatest amount of grazed residue. Smooth bromegrass has the lowest end of season standing crop and grazed residue. End of season standing crop averaged over all cool-season and native pastures was greater at the moderate versus the heavy stocking rate.

Additional Literature Pertinent to the State and Transition Model

Hopkins, D.G., M.D. Sweeny, D.R. Kirby, and J.L. Richardson. Effects of revegetation on surficial soil salinity in panspot soils. Journal of Range Management 44(3): 215-220.

LOAMY TERRACE ECOLOGICAL SITE CLASS

General Description

The Loamy Terrace ecological site class occurs on level to nearly level, occasionally to frequently flooded intermittent streams, floodplains and terraces. The soils in this site are moderately well to well drained and formed in mixed alluvium.

Geomorphic Features

Landscape Positions:	Flood Plain, Swale, Terrace
Slope (percent):	0 - 9

Representative Soil Features

Soil Depth:	Deep
Parent Material Kind:	Alluvium
Parent Material Origin:	Mixed
Surface Texture:	Loam, Silt Loam, Clay Loam, Fine Sandy Loam
Surface Texture Modifier:	None
Subsurface Texture Group:	Loamy
Drainage Class:	Moderate to Well
Permeability Class:	Moderately Slow to Rapid
Chemistry:	None
Available Water Capacity:	4 – 7 inches

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 3) was derived from functional group production for the reference communities in the ecological sites correlated to this ecological site class. This community class produces about 3050 lbs/ac/yr. dominated by big bluestem, green needlegrass, western wheatgrass, sideoats grama, porcupinegrass, switchgrass, western snowberry, and blue grama.

With the introduction of non-native species, the site will transition to a Native -- Non-Native Herbaceous state which will have similar characteristics to that of the reference, but it will include non-native species such as Kentucky bluegrass, smooth brome and field bindweed. With non-use and no fire, the native dominated Community Class (2.1) will transition to a non-native dominated Community Class (2.2), dominated by smooth brome, crested wheatgrass, Kentucky bluegrass, and field bindweed with a decrease in western wheatgrass and big bluestem. With prescribed burning, prescribed grazing, the site may return to the native dominated Community Class (2.1). The site will not transition back to the Native Herbaceous state from this state.

Tillage and planting convert both state 1 and 2 to a “Planted Herbaceous” state. Planting and harvesting of annual and perennial crops maintains the cropland community class (3.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

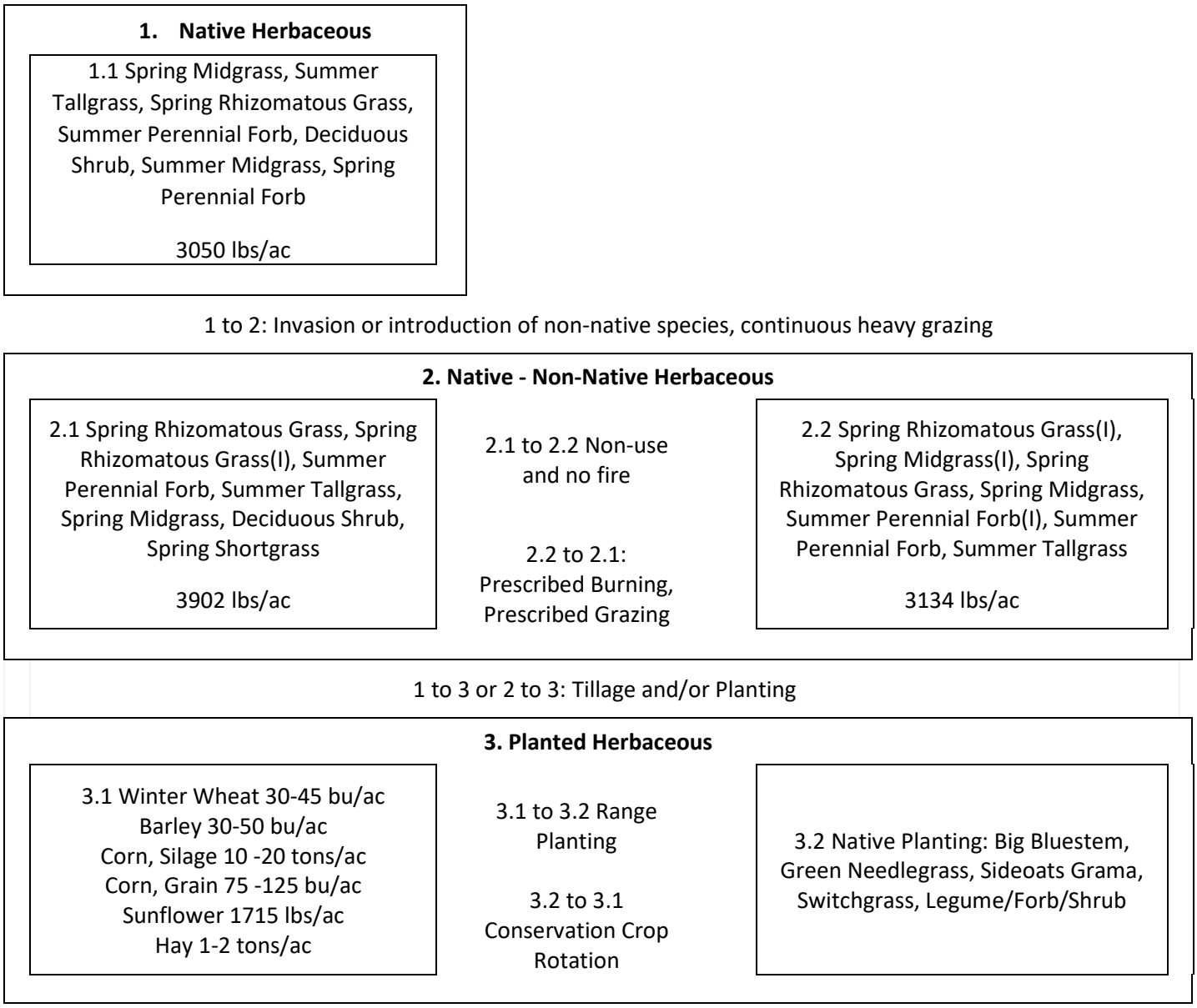

Figure 3. State and Transition Model, MLRA 54 Loamy Terrace ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 5. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 5. NRI Community Class Data and RHEM Results - MLRA 54 Loamy Terrace ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr.	% Runoff	# PSUs
054X.3.1.1	Spring Rhizomatous Grass(609), Spring Midgrass(295), Summer Shortgrass(206), Evergreen Shrub(113), Summer Perennial Forb(95), Spring Perennial Forb(58), Deciduous Shrub(47)	western wheatgrass(PASM)(609), green needlegrass(NAVI4)(268), blue grama(BOGR2)(206), silver sagebrush(ARCA13)(113), white sagebrush(ARLU)(91), western snowberry(SYOC)(47), common yarrow(ACMI2)(46), pigweed(AMARA)(35)	1506	0.13	3.73%	2
054X.3.2.1	Spring Rhizomatous Grass(1164), Spring Rhizomatous Grass(I)(647), Summer Perennial Forb(474), Summer Tallgrass(424), Spring Midgrass(299), Deciduous Shrub(146), Spring Shortgrass(138)	western wheatgrass(PASM)(1164), Kentucky bluegrass(POPR)(544), green needlegrass(NAVI4)(243), big bluestem(ANGE)(196), western snowberry(SYOC)(142), foxtail barley(HOJU)(138), prairie sandreed(CALO)(130), scratchgrass(MUAS)(111)	3902	0.04	2.86%	9
054X.3.2.2	Spring Rhizomatous Grass(I)(1512), Spring Midgrass(I)(801), Spring Rhizomatous Grass(211), Spring Midgrass(107), Summer Perennial Forb(I)(80), Summer Perennial Forb(67), Summer Tallgrass(58)	smooth brome(BRIN2)(837), crested wheatgrass(AGCR)(801), Kentucky bluegrass(POPR)(639), western wheatgrass(PASM)(211), field bindweed(COAR4)(62), needleandthread(HECO26)(57), big bluestem(ANGE)(54), western snowberry(SYOC)(48)	3134	0.05	3.21%	14

Supporting Information

No literature was found that dealt with this ecological site class. It is possible that some of the research used in the Loamy Upland ecological site class was conducted on this ecological site class.

LOAMY UPLAND ECOLOGICAL SITE CLASS

General Description

The Loamy Upland ecological site class occurs on gently undulating to rolling sedimentary uplands. The soils in this site are moderately well to well drained and formed in soft siltstone, shales, sandstone or alluvium.

Geomorphic Features

Landscape Positions:	Alluvial fan, Alluvial flat, Hill
Slope (percent):	0 - 20

Representative Soil Features

Soil Depth:	Moderately Deep to Deep
Parent Material Kind:	Alluvium or Residuum
Parent Material Origin:	Siltstone, Sandstone, Shale or Mixed
Surface Texture:	Loam, Silt Loam, Silty Clay Loam, Silty Clay
Surface Texture Modifier:	None
Subsurface Texture Group:	Clayey to Loamy
Drainage Class:	Moderately Well to Well
Permeability Class:	Very Slow to Moderate
Chemistry:	None
Available Water Capacity:	5 – 9 inches

Vegetation Dynamics

Community Class 1.1 in the STM (Figure 4) was derived from the reference communities in the ecological site descriptions correlated to this ecological site class. This site class produces about 2250 lbs/ac/yr. dominated by western wheatgrass, green needlegrass, blue grama, needleandthread, porcupinegrass prairie Junegrass, plains reedgrass, and big bluestem. With heavy continuous grazing, the will transition to a shortgrass dominated Community Class (1.2) with an increase of buffalograss, blue grama, and threadleaf sedge, and less production from western wheatgrass, needleandthread and green needlegrass. With long term prescribed grazing, the site may transition back Community Class 1.1.

With the introduction or invasion of non-native species, the site will transition to a Native - Non-Native Herbaceous state. Community Class 2.1 will have similar characteristics to that of the reference community but with part of the production coming from non-native species such as Kentucky bluegrass, crested wheatgrass, and white sweetclover. With non-use and no fire, the site will further transition to a non-native dominated community class (2.2) with increased production from Kentucky bluegrass, smooth brome, and crested wheatgrass and decreased production from western wheatgrass and other native species.

Tillage and planting convert the reference state to a “Planted Herbaceous” state. Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 3.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

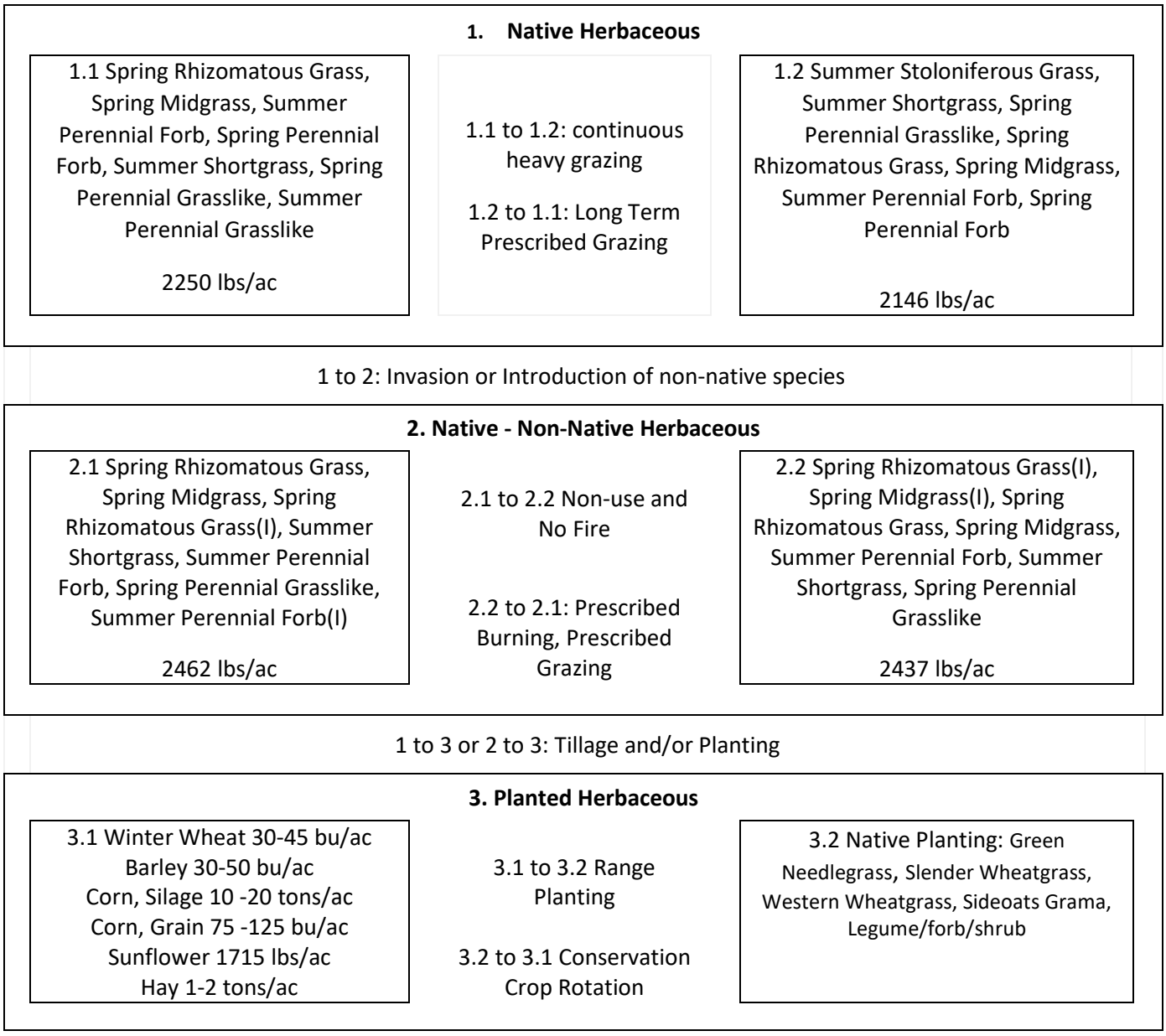

Figure 4. State and Transition Model, MLRA 54 Loamy Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 6. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 6. NRI Community Class Data and RHEM Results - MLRA 54 Loamy Upland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.6.1.1	Spring Rhizomatous Grass(644), Spring Midgrass(465), Summer Shortgrass(243), Summer Stoloniferous Grass(210), Spring Perennial Grasslike(196), Spring Rhizomatous Grass(I)(122), Summer Perennial Forb(102)	western wheatgrass(PASM)(644), blue grama(BOGR2)(242), needleandthread(HECO26)(212), Buffalograss(BODA2)(210), green needlegrass(NAVI4)(143), threadleaf sedge(CAFI)(109), Kentucky bluegrass(POPR)(102), prairie Junegrass(KOMA)(83)	2334	0.96	9.04%	59
054X.6.1.2	Summer Stoloniferous Grass(378), Summer Shortgrass(359), Spring Perennial Grasslike(344), Spring Rhizomatous Grass(337), Spring Midgrass(226), Summer Perennial Forb(167), Spring Perennial Forb(76)	Buffalograss(BODA2)(378), blue grama(BOGR2)(359), western wheatgrass(PASM)(308), threadleaf sedge(CAFI)(229), needleandthread(HECO26)(122), sedge(CAREX)(96), prairie Junegrass(KOMA)(58), silverleaf Indian breadroot(PEAR6)(45)	2146	1.27	8.83%	25
054X.6.2.1	Spring Rhizomatous Grass(590), Spring Midgrass(446), Spring Rhizomatous Grass(I)(379), Summer Shortgrass(179), Summer Perennial Forb(135), Spring Perennial Grasslike(116), Summer Perennial Forb(I)(95)	western wheatgrass(PASM)(590), Kentucky bluegrass(POPR)(307), needleandthread(HECO26)(199), blue grama(BOGR2)(172), green needlegrass(NAVI4)(148), sweetclover(MEOF)(91), prairie Junegrass(KOMA)(83), crested wheatgrass(AGCR)(68), white sweetclover(MEOF)(2)	2462	0.76	6.43%	55
054X.6.2.2	Spring Rhizomatous Grass(I)(938), Spring Midgrass(I)(417), Spring Rhizomatous Grass(226), Spring Midgrass(205), Summer Perennial Forb(160), Summer Shortgrass(89), Spring Perennial Grasslike(77)	Kentucky bluegrass(POPR)(670), crested wheatgrass(AGCR)(414), smooth brome(BRIN2)(255), western wheatgrass(PASM)(226), green needlegrass(NAVI4)(103), blue grama(BOGR2)(86), needleandthread(HECO26)(65), sweetclover(MEOF)(59)	2437	0.20	4.41%	96

Supporting Information

The following publications support the STM. The first publication delves into varying grazing intensities and how they impact the ecosystem processes. In accordance with the STM, the study found that heavy grazing can alter the range condition, but moderate grazing appears sustainable. The second publication examined fire effects on vegetation. The study determined benefits to the plant community through fire as management, which would prevent the state change that would have occurred through “no fire” that the STM indicates. The third publication examined fire effects in conjunction with herbicides. Similar to the second publication, the changes that fire and herbicide created in the plant communities allowed the site to maintain the conditions of its current state. The

fourth publication addressed fire as a management tool as well. Within this study, the C_3/C_4 ratio on the high prairie was unaffected by fire during the growth period. This indicates that the vegetation is able to maintain a stable state.

Biondini, M.E., B.D. Patton and P.E. Nyren. 1998. Grazing Intensity and Ecosystem Processes in a Northern Mixed-Grass Prairie, USA. Ecological Applications 8(2): 469-479.
This study took place at the Central Grasslands Research Center, northwest of Streeter, North Dakota. It was designed to evaluate the ecosystem level impacts of no grazing as compared to sustained moderate and heavy grazing. The study assessed this impact in terms of: 1) plant species basal cover, density, and composition; 2) aboveground net primary production (ANPP), nitrogen content of ANPP (ANPP-N), belowground net primary production (BNPP), and N content of BNPP (BNPP-N); 3) litter and root decomposition and N loss; 4) soil C, total soil N, and net in situ soil N mineralization.

The study took place on well-drained silty range sites, commonly the Williams soil series. Dominant vegetation included Kentucky bluegrass, western wheatgrass, green needlegrass, sedges, and a variety of forbs and shrubs. The experimental design was completely randomized with the three treatments: ungrazed control, moderate grazing, and heavy grazing; which was replicated three times on a total of 9 pastures of 13.2 ha each. A standard 10-point frame was used to measure grass basal cover, which were located on a permanent transect. ANPP was determined with sequential sampling conducted three times a year via clipping. Belowground NPP was estimated with the use of soil cores and root material was oven-dried. All measurements of soil C and N cycling were conducted 7 years post-treatment to establish greater ability to detect changes.

Results found there was no significant difference among grazing treatments for both absolute grass basal cover and total forb density, but there was a significant year effect. With an increase in forb density, came an increase in forb diversity. This was also similar for dominant grasses and forbs as demonstrated with Kentucky bluegrass, blue grama and several sedges; which all increased due to grazing intensity. The only statistical difference among grazing treatments was with ragweed which nearly disappeared with heavy grazing. Differences in ANPP and ANPP-N showed no consistent patterns. There was a very significant effect of heavy grazing on standing dead biomass, litter biomass, and biomass-N. The ungrazed treatment had a higher peak root biomass, peak root biomass-N, and percentage of root N than the grazed treatments. There was a similar trend with NPP and BNPP-N, but it was not statistically significant. The eight years of grazing did not have an effect on total soil C and N, litter decomposition and N loss. There were significant differences in root decomposition and N loss as moderate grazing had a higher decomposition and N loss than the ungrazed and heavily grazed.

The results of this study implicate that in northern mixed-grass prairies, climatic variations, particularly droughts, create major trends in plant species composition and NPP. Further, grazing and grazing systems play a secondary role in these trends. Additionally, this study shows seven years of heavy grazing did lead to declines in standing dead biomass and biomass-N, litter biomass and biomass-N, peak root biomass and biomass-N, and in situ net soil N mineralization; implicating that heavy grazing could have a long-term effect on range condition. Lastly, this study demonstrates that grazing pressures of 50% of ANPP appear to be sustainable and compatible with maintaining range condition.

Gates, E.A., L.T. Vermeire, C.B. Marlow, R.C. Waterman. 2017. Fire and Season of Postfire Defoliation Effects on Biomass, Composition, and Cover in Mixed-Grass Prairie. Rangeland Ecology and Management 70: 430-436.
This study occurred on the Pautre fire in Lodgepole, South Dakota. Three study sites were selected on the burned portion of the Grand River National Grassland. The sites were characteristic of loamy soils and had a variety of vegetation. On the 3B pasture, there was a dominance of crested wheatgrass, needleandthread and blue grama. On the N4B and S4B pastures, vegetation included western wheatgrass, prairie junegrass and green needlegrass.

For the study, exclosures were randomly placed on the burned and unburned sides of the fire perimeter. Biomass, community composition and basal cover were sampled on the sites via quadrats and point-intercept methods. The results found that fire and defoliation did not have interacting effects on biomass, community composition, or basal cover, so the effects were reported separately. For fire effects, the standing biomass was reduced on the burned sites by 25% in the first growing season post-fire. Current-year production, however, increased by 56%. Two growing seasons after the fire, a trend remained of 10% greater current-year production on burned sites. For defoliation effects, two growing seasons post-fire, spring defoliated plots were similar to control, but were 21% greater in standing biomass than summer and fall defoliated plots. Non-defoliated plots had the least standing dead.

In terms of community composition, with fire effects, a total of 43 species were observed across the three sites, 35 of which were native. Species richness was not affected by the fire. Three years post-fire there was some reduction in C3 grasses and an increase in forbs on burned sites, though this was attributable to relative abundance, rather than actual. Prairie junegrass was greater on unburned sites. In terms of defoliation effects on community composition, species richness had a tendency to be greater in fall defoliated versus spring in the second year post-fire. The following year, it was similar for all defoliation effects. For basal cover, fire effects showed litter being eliminated post-fire and bare ground increased by 54%. Two years post-fire, the burned sites were 14.5% less and bare ground was greater by 11.3% compared to unburned plots. Three years post-fire, there were no differences detected between the burned and unburned plots for basal cover. Blue grama tended to be greater on unburned plots two years post-fire, but was not observed to be greater after. For defoliation effects, no changes were significant.

This study determined that there was a lack of compounding effects caused by fire and defoliation following fire. It supports the hypothesis that burning increases current-year productivity and does not negatively affect subsequent-year productivity. Community composition remained stable throughout the study, concluding that fire and/or defoliation does not negatively impact plant community as a whole. Additionally, prairie sagewort was reduced by fire and prairie junegrass was similar or increased by defoliation. Green needlegrass tended to decrease in basal cover in response to summer defoliation. Blue grama did decrease with fire, which was unexpected.

Hendrickson, J.R., and C. Lund. 2010. Plant Community and Target Species Affect Responses to Restoration Strategies. Rangeland Ecology and Management 63(4): 435-442.

In 2002, ten sites were selected on a silty clay loam site south of Mandan, North Dakota. The purpose of the study was to evaluate the effect of burning and herbicides alone and in combination with mowing and litter removal in five different communities. The objective was to assess the efficacy of different treatment combinations to reduce the abundance of Kentucky bluegrass and smooth bromegrass. Dominant plant communities included Kentucky bluegrass, smooth bromegrass, co-dominated Kentucky bluegrass-smooth bromegrass, warm-season native grass of primarily big bluestem, and a mix of exotic species including Kentucky bluegrass, smooth bromegrass, crested wheatgrass, and leafy spurge.

Each plot was randomly assigned a treatment of either: 1) control, 2) burned only (Burn), 3) burned and sprayed with imazapic (Burn/Herbicide), 4) spray only (Herbicide), 5) mowed, but not raked (Mowed), 6) mowed and raked (Mowed/Raked). Three permanent quadrats were established in each plot and individual species were tallied to determine species composition. Precipitation data was also collected.

The results found that Kentucky bluegrass became less dominant with Burn Only or Burn/Herbicide treatment. With smooth brome, the plots that were Mowed/Raked reduced its dominance. Timing of fire may alter the effectiveness as well. Additionally, responses to treatment may be different based on community type and variable years. Overall, the study suggests that management must be based on which invasive is being targeted, the community the invasive

is in, and the importance of monitoring. Effective management will consider the species, community composition and length of time since the treatment was applied.

Steuter, A. A. 1987. C_3/C_4 Production Shift on Seasonal Burns: Northern Mixed Prairie. Journal of Range Management 40(1): 27-31.

This study, which took place in north-central South Dakota, was established to examine the influence of fire on the production of C_3 and C_4 grasses. The high prairie plant community on the site consisted of loam soils, C_4 vegetation including blue grama, sideoats grama, little bluestem, ring muhly and the C_3 vegetation green needlegrass, needleandthread, sedges, and western wheatgrass. The low prairie consisted of fine loam soils with the plant community of C_4 vegetation big bluestem and switchgrass, and C_3 vegetation slender wheatgrass, western wheatgrass, porcupine grass, and blue grass.

For the experimental design, the site was divided into eight experimental units, each on the high and low prairie. The units were randomly assigned 1 to 2 replications of the four treatments: dormant spring burn, mid-summer burn, dormant fall burn and untreated. Herbage was clipped monthly and five sample points were systematically located for a quadrat.

The results for the high prairie community demonstrated that the three seasonal burned treatments maintained greater than 50% C_3 herbage throughout the season. During the second season, there was no difference between C_3 and C_4 grasses. Total current year herbage was significantly reduced only on spring and fall burns at the first sample date. Total current year herbage was lowest on summer burned treatments at the end of the first growing season. On the low prairie community, the C_3/C_4 ratio and herbage accumulation was very responsive to fire treatments. The spring burn showed the highest percentage of green C_4 herbage throughout the growth period. All treatments except the summer burn had a less than 50% green C_3 fraction during August of the first year following the treatment. Growth rates on the untreated sites were substantially less than on burned treatments through August. At the end of the first season, total current year herbage on summer and fall burns were intermediate to the spring burn (highest) and untreated (lowest) sites. Spring burned and untreated had similar C_3 herbage through the season.

It was unexpected that there was an increase in C_3 herbage on all three burn treatments relative to the unburned. The study renders that the use of spring burning will provide a more balanced forage resource on C_3 dominated range.

Additional Literature Pertinent to the State and Transition Model

Karn, J.F. and R.E. Ries. 2002. Free-choice grazing of native range and cool-season grasses. Journal of Range Management 55(5): 469-473.

Lorenz, R.J., G.A. Rogler. 1967. Grazing and Fertilization Affect Root Development of Range Grasses. Journal of Range Management 20 (3): 129-132.

Sanderson, M.A., M.A. Liebig, J.R. Hendrickson, S.L. Kronberg, D. Toledo, J.D. Derner and J.L. Reeves. 2015. Long-term agroecosystem research on northern Great Plains mixed-grass prairie near Mandan, North Dakota. Canadian Journal of Plant Science 95: 1101-1116.

Rauzi, F. and D.E. Smika. 1963. Water Intake on Rangeland as Affected by Simulated Grazing and Fertilization. Journal of Range Management 16(3): 125-128.

SALINE BOTTOMLAND ECOLOGICAL SITE CLASS

General Description

The Saline Bottomland ecological site class occurs in the lowest portion of the landscape on level shallow lake basins, flat enclosed upland depressions and along floodplains. It may be a closed depression or open to further drainage. Flooding and ponding is common, and there may be a seasonal water table providing water for plant growth. Salinity and sodic conditions limit plant growth and response to management actions.

Geomorphic Features

Landscape Positions:	Depression, Flood Plain, Drainageway
Slope (percent):	0 - 2

Representative Soil Features

Soil Depth:	Very Shallow to Deep
Parent Material Kind:	Alluvium
Parent Material Origin:	Mixed
Surface Texture:	Loam, Silt Loam, Silty Clay Loam, Very Fine Sandy Loam
Surface Texture Modifier:	None
Subsurface Texture Group:	Clayey to Loamy
Drainage Class:	Poorly to Somewhat Poorly Drained
Permeability Class:	Very Slow to Slow
Chemistry:	Sodic to Saline: SAR 2-25, EC (mmhos/cm) 4-16
Available Water Capacity:	1 – 6 inches

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 5) was derived from reference communities in the ecological site descriptions for sites correlated to this ecological site class. This site class produces about 2100 lbs/ac/yr dominated by western wheatgrass, inland saltgrass, fowl bluegrass, foxtail barley, Nuttall's alkaligrass, common spikerush, sedge, and rush. With continuous heavy grazing, the site may transition to a foxtail barley, Nuttall's alkaligrass, inland saltgrass, and sedge dominated community (2.1) with less production from western wheatgrass. Long term prescribed grazing may return the site to the reference condition.

With the introduction of non-native species, the site will transition to a Native – Non-Native Herbaceous State. Soil salinity significantly reduces the amount of non-native species invasion on this site class. Non-native species such as Kentucky bluegrass and cheatgrass invade some areas. With rest and lack of fire, these areas can further transition to a non-native dominated plant community (Community Class 2.2).

Tillage and planting convert the site to a "Planted Herbaceous" state. Cropping and harvesting of annual and perennial crops maintain a cropland community class (Community Class 3.1). Average crop yields are likely to be lower than the county averages shown for Community Class 3.1 in Figure 5 due to soil salinity. When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 3.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

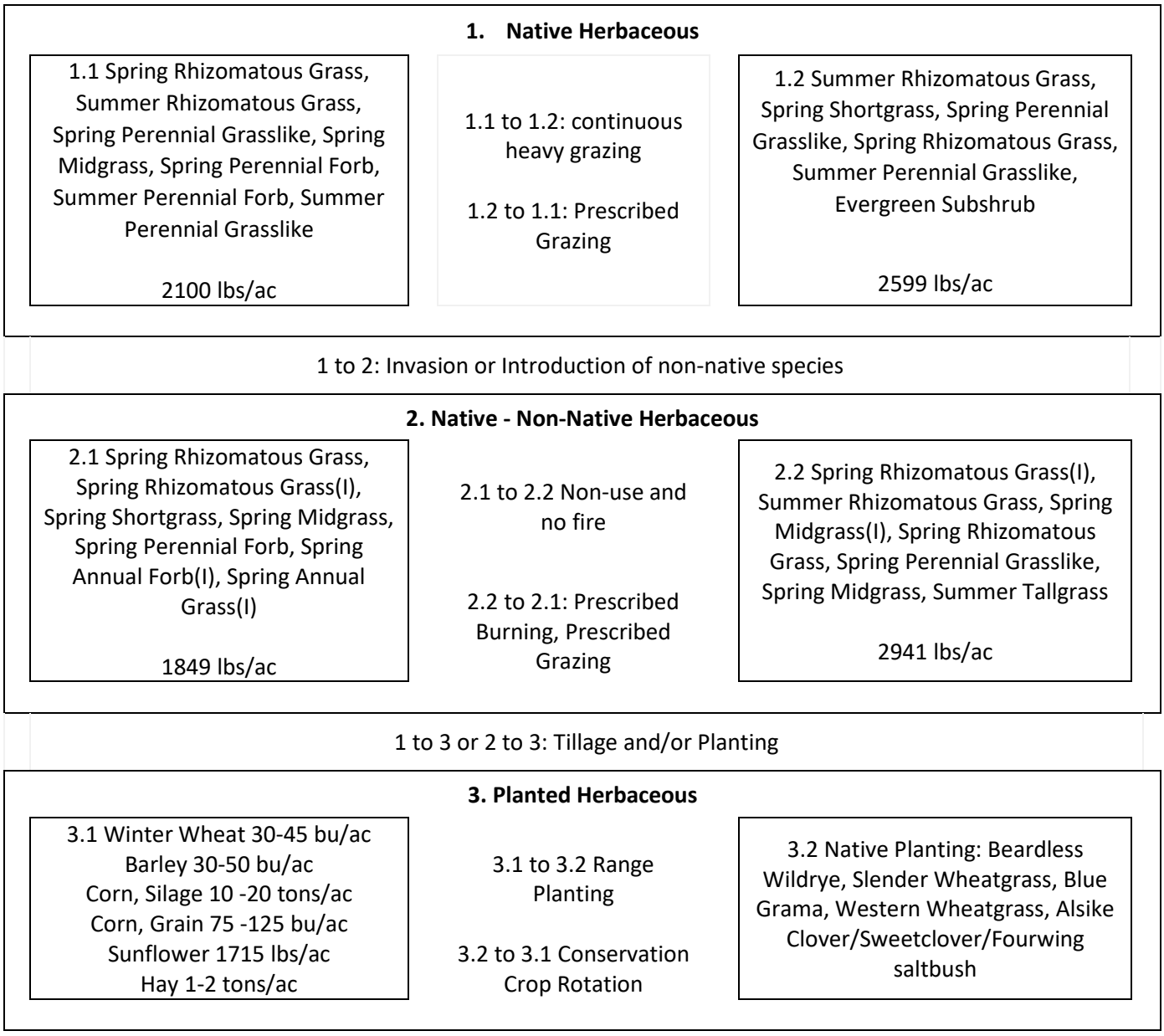

Figure 5. State and Transition Model, MLRA 54 Saline Bottomland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 7. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 7. NRI Community Class Data and RHEM Results - MLRA 54 Saline Bottomland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.35.1.1	Spring Rhizomatous Grass(779), Summer Rhizomatous Grass(521), Summer Perennial Forb(194), Evergreen Subshrub(193), Spring Midgrass(92), Spring Rhizomatous Grass(I)(75), Summer Tallgrass(53)	western wheatgrass(PASM)(779), Nuttall's alkaligrass(PUNU2)(263), inland saltgrass(DISP)(258), California seablite(SUCA)(148), western ragweed(AMPS)(106), Kentucky bluegrass(POPR)(69), prairie Junegrass(KOMA)(65), tall dropseed(SPCO16)(53)	2150	0.08	5.17%	5
054X.35.1.2	Summer Rhizomatous Grass(899), Spring Shortgrass(562), Spring Perennial Grasslike(546), Spring Rhizomatous Grass(125), Summer Perennial Grasslike(96), Evergreen Subshrub(82)	foxtail barley(HOJU)(562), Nuttall's alkaligrass(PUNU2)(486), inland saltgrass(DISP)(405), clustered field sedge(CAPR5)(401), western wheatgrass(PASM)(125), common threesquare(SCPU10)(91), Baltic rush(JUARL)(90), rock tansy(SPCA8)(69)	2599	0.47	10.74%	9
054X.35.2.1	Spring Rhizomatous Grass(907), Spring Rhizomatous Grass(I)(588), Spring Shortgrass(89), Spring Midgrass(58), Spring Perennial Forb(45), Spring Annual Forb(I)(40), Spring Annual Grass(I)(37)	western wheatgrass(PASM)(907), Kentucky bluegrass(POPR)(561), foxtail barley(HOJU)(89), prairie Junegrass(KOMA)(58), yellow salsify(TRDU)(40), common yarrow(ACMI2)(39), cheatgrass(BRTE)(37), green molly(BAAM4)(35)	1849	0.01	3.03%	2
054X.35.2.2	Spring Rhizomatous Grass(I)(852), Summer Rhizomatous Grass(399), Spring Midgrass(I)(265), Spring Rhizomatous Grass(251), Spring Perennial Grasslike(241), Spring Midgrass(177), Summer Tallgrass(162)	Kentucky bluegrass(POPR)(317), smooth brome(BRIN2)(283), crested wheatgrass(AGCR)(265), western wheatgrass(PASM)(251), quackgrass(ELRE4)(251), clustered field sedge(CAPR5)(221), Nuttall's alkaligrass(PUNU2)(219), inland saltgrass(DISP)(180)	2941			3

Supporting Information

No literature was found that dealt with the state and transition model for the sites in this ecological site class.

SANDY LOAM UPLAND ECOLOGICAL SITE CLASS

General Description

The Sandy Loam Upland ecological site class occurs on nearly level, gently undulating to rolling sedimentary uplands. The soils in this site are moderately well to well drained and formed in soft sandstone or alluvium.

Geomorphic Features

Landscape Positions:	Alluvial Fan, Alluvial Flat, Hill, Terrace
Slope (percent):	0 - 20

Representative Soil Features

Soil Depth:	Very Shallow to Deep
Parent Material Kind:	Alluvium or Residuum
Parent Material Origin:	Sandstone or Mixed
Surface Texture:	Loamy Fine Sand, Sandy Loam, Fine Sandy Loam
Surface Texture Modifier:	None
Subsurface Texture Group:	Sandy to Loamy
Drainage Class:	Moderately Well to Excessively
Permeability Class:	Slow to Rapid
Chemistry:	None
Available Water Capacity:	1 – 7 inches

Vegetation Dynamics

Community Class 1.1 in the STM (Figure 6) was derived from the reference communities in the ecological site descriptions correlated to this ecological site class. This ecological site class produces about 1933 lbs/ac/yr. dominated by tallgrass vegetation such as prairie sandreed, western wheatgrass, needleandthread, sand bluestem, blue grama, big bluestem, threadleaf sedge, and little bluestem. With heavy continuous grazing, the site will transition to a shortgrass dominated state (State 2) dominated by blue grama, threadleaf sedge, and buffalograss. Mechanical treatment, fertilizer, and long term prescribed grazing may return the site to reference conditions.

Introduction or invasion of non-native species will transition the site to a Native – Non-Native Herbaceous state. Community Class 2.1 will be similar to the reference community, but with smooth brome, Kentucky bluegrass and other non-natives making up a portion of the annual production. With rest and lack of fire, the site will continue to transition to a non-native dominated community (2.2) dominated by crested wheatgrass, Kentucky bluegrass, and less production from the native species.

Tillage and planting convert the reference state to a “Planted Herbaceous” state. Planting and harvesting of annual and perennial crops maintain a cropland community class (Community Class 4.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 4.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

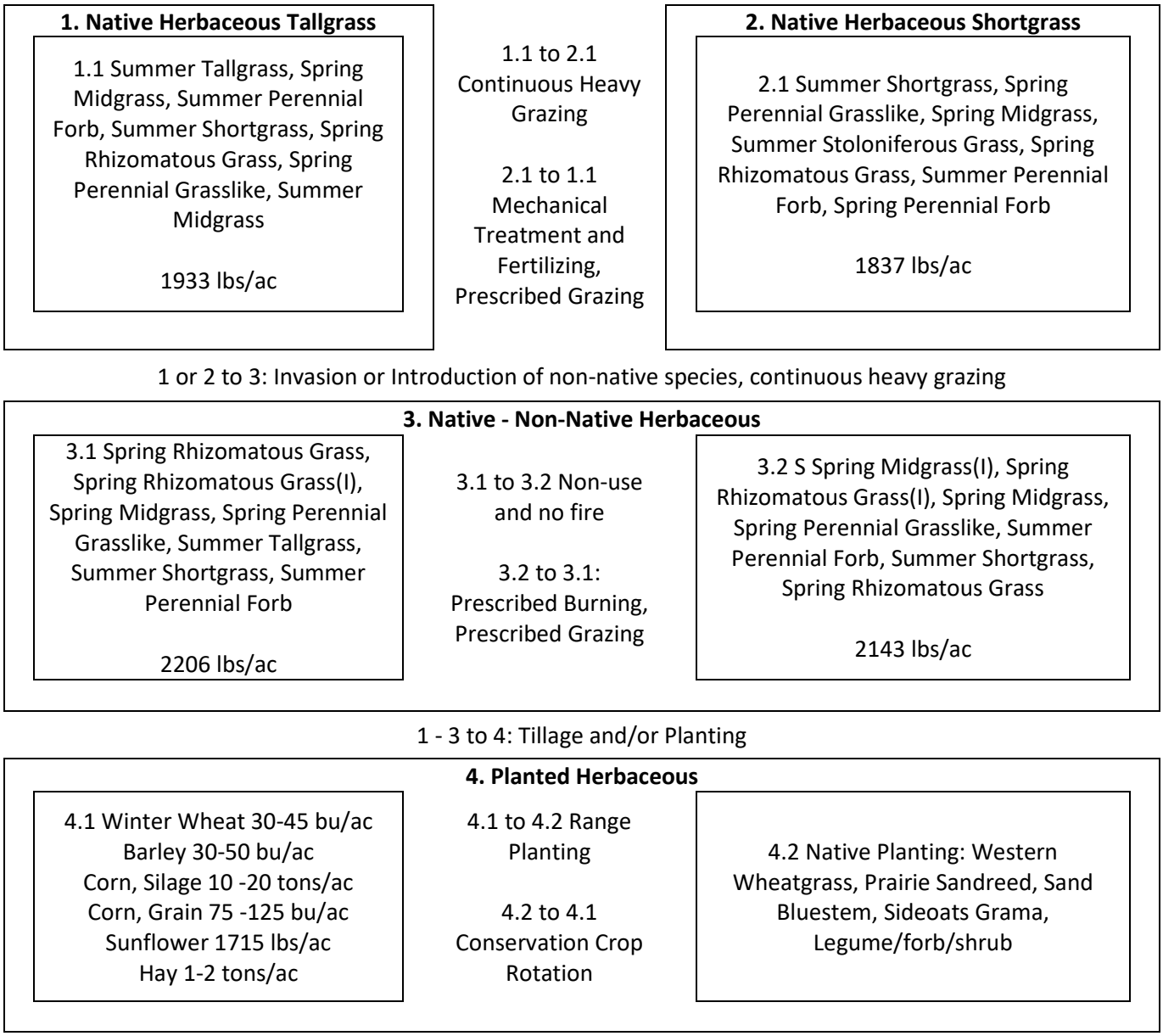

Figure 6. State and Transition Model, MLRA 54 Sandy Loam Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 8. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 8. NRI Community Class Data and RHEM Results - MLRA 54 Sandy Loam Upland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.7.1.1	Spring Midgrass(473), Spring Perennial Grasslike(327), Spring Rhizomatous Grass(265), Summer Midgrass(202), Summer Perennial Forb(153), Summer Shortgrass(152), Summer Tallgrass(114)	needleandthread(HECO26)(353), western wheatgrass(PASM)(265), threadleaf sedge(CAFI)(215), blue grama(BOGR2)(145), little bluestem(SCSC)(133), prairie sandreed(CALO)(113), silver sagebrush(ARCA13)(93), prairie Junegrass(KOMA)(87)	2075	0.26	2.88%	38
054X.7.2.1	Summer Shortgrass(484), Spring Perennial Grasslike(412), Spring Midgrass(220), Summer Stoloniferous Grass(204), Spring Rhizomatous Grass(137), Summer Perennial Forb(116), Spring Perennial Forb(58)	blue grama(BOGR2)(483), threadleaf sedge(CAFI)(267), Buffalograss(BODA2)(204), western wheatgrass(PASM)(137), needleandthread(HECO26)(98), sedge(CAREX)(92), prairie Junegrass(KOMA)(62), long-stolon sedge(CAIN9)(52)	1837	1.36	5.42%	11
054X.7.3.1	Spring Rhizomatous Grass(I)(399), Spring Rhizomatous Grass(330), Spring Midgrass(309), Spring Perennial Grasslike(239), Summer Tallgrass(184), Summer Shortgrass(164), Summer Perennial Forb(124)	western wheatgrass(PASM)(330), needleandthread(HECO26)(224), smooth brome(BRIN2)(185), Kentucky bluegrass(POPR)(178), threadleaf sedge(CAFI)(162), blue grama(BOGR2)(158), prairie sandreed(CALO)(144), crested wheatgrass(AGCR)(85)	2206	0.45	4.93%	34
054X.7.3.2	Spring Midgrass(I)(668), Spring Rhizomatous Grass(I)(458), Spring Midgrass(190), Spring Perennial Grasslike(158), Summer Perennial Forb(140), Summer Shortgrass(112), Spring Rhizomatous Grass(87)	crested wheatgrass(AGCR)(668), Kentucky bluegrass(POPR)(369), needleandthread(HECO26)(130), threadleaf sedge(CAFI)(124), blue grama(BOGR2)(104), western wheatgrass(PASM)(87), little bluestem(SCSC)(63), smooth brome(BRIN2)(60)	2143	0.29	3.54%	29

Supporting Information

The following publications support the STM. The first publication addresses several ecological site groups within this MLRA. Specific to the sandy group, this publication did not address grazing, however, the same increasers and decreasers were observed in this study as those that were evident in the STM. The second publication did specifically address grazing impacts, and as the STM indicated, heavy continuous grazing caused a decrease in the same vegetation as indicated.

Goetz, H. 1969. Composition and Yields of Native Grassland Sites Fertilized at Different Rates of Nitrogen. Journal of Range Management 22(6): 384-390.

This study was conducted on four representative range sites in southwestern North Dakota at the Dickinson Experiment Station. These sites were represented by the four most common soil types in the area: Vebar fine sandy (sandy), Havre silt loam (loamy), Rhodes silt loam (panspots), and Manning silt loam (shallow). The experiment was designed as a random block of three different treatments and a check plot (no nitrogen), which was replicated four times. Yield samples were clipped to ground level at the end of the growing season and forage was hand separated into tallgrasses, midgrasses, shortgrasses, perennial forbs and annual forbs to be oven-dried and weighed. Basal cover was determined each year by point method. The results found that total basal cover on the Vebar site decreased at the end of the three-year period at all rates of nitrogen application. The lower total basal cover resulted mainly from a decrease of blue grama. Slight decreases were observed with needleandthread. Slight increases were observed with prairie sandreed, Plains reedgrass and threadleaf sedge. Other vegetation that were of significant presence on the site, but showed no significant change in basal cover due to fertilization included western wheatgrass, needleandthread, prairie junegrass, needleleaf sedge and Pennsylvania sedge. There was an increase in plant density of prairie sandreed. The results from the Havre site showed a slight decrease in basal cover at all rates of nitrogen. Western wheatgrass and green needlegrass both increased, but needleandthread, plains reedgrass, dwarf sagebrush, and wolfberry decreased. Total plant density increased with increased rate of nitrogen. The total basal cover on the Rhodes site showed a slight increase under all treatments. With increases of fertilizer, western wheatgrass and Sandberg's bluegrass increased in basal cover. This site was the lowest producing of the sites, but increased with nitrogen fertilization.

The Manning site demonstrated increases in basal cover with increases in fertilizer. Western wheatgrass, threadleaf sedge both had noticeable increases with nitrogen application. Needleandthread decreased and blue grama was unaffected. There was a significant increase in plant density of western wheatgrass during the study. Increases in total dry-matter yields were observed from all rates of nitrogen fertilizer on all sites. The conclusions of this study implicate there are variations in the degree of response by individual plant species. Generally, western wheatgrass increased in basal cover and density, while blue grama declined. Further, the study indicates that fertilizing may be a valuable tool in range improvement when the plant and soil factors align.

Rogler, G.A. 1951. A Twenty-Five Year Comparison of Continuous and Rotation Grazing in the Northern Plains. Journal of Range Management 4(1): 35-41.

This grazing experiment was established in 1916 to determine the carrying capacity of native range at the Northern Great Plains Field Station. Pastures were grazed continuously by cattle for 150 days at varying intensities that resulted in both overgrazing and under-grazing. In 1918, additional pasture was obtained to study a deferred and rotational grazing system. The native vegetation in the pastures included dominant species blue grama, western wheatgrass, threadleaf sedge, and needleandthread. Other species included silver sage, white sage, green sage, silverleaf scurfpea and prairie junegrass. Two pastures were continuously grazed; one moderately, one heavily. Measurements were made by permanent quadrats were clipped in the spring, summer and fall.

The results found that species that usually increase with overgrazing such as silver sage and blue grama, either decreased or maintained. Species that decrease with overgrazing such as western wheatgrass, needleandthread, prairie junegrass and silverleaf scurfpea were still abundant after 34 years of grazing. In the continuously heavy grazed pasture, there was strong evidence of overgrazing which showed an increase of silver sage, and a decrease of needleandthread, prairie junegrass, silver leaf scurfpea, white sage and green sage. Under rotation, grasses benefited from the rest periods and showed normal growth.

Additional Literature Pertinent to the STM

Nyren, P.E., W.C. Whitman, J.L. Nelson, and T.J. Conlon. 1983. Evaluation of a Fertilized 3-Pasture System Grazed by Yearling Steers. Journal of Range Management 36(3): 354-358.

SANDY UPLAND ECOLOGICAL SITE CLASS

General Description

The Sandy Upland ecological site class occurs on level to nearly level, gently rolling to strongly sloping sedimentary uplands and occasionally floodplains and terraces. These are typically areas of sand dunes or sand sheets. The soils in this site class are well to somewhat excessively drained and formed from soft sandstone, aeolian deposits or alluvium.

Geomorphic Features

Landscape Positions:	Dune, Flood Plain, Hill, Knoll, Levee, Terrace
Slope (percent):	0 - 50

Representative Soil Features

Soil Depth:	Deep
Parent Material Kind:	Alluvium, Aeolian or Residuum
Parent Material Origin:	Sandstone or Mixed
Surface Texture:	Sand, Fine Sand, Loamy Sand, Loamy Fine Sand
Surface Texture Modifier:	None
Subsurface Texture Group:	Sandy to Loamy
Drainage Class:	Well to Excessively
Permeability Class:	Moderately Rapid to Rapid
Chemistry:	None
Available Water Capacity:	2 – 6 inches

Vegetation Dynamics

Community Class 1.1 in the STM (Figure 7) was derived from the reference communities in the ecological site descriptions correlated to this ecological site class. This site class produces about 2750 lbs/ac/yr. dominated by prairie sandreed, sand bluestem, needleandthread, western wheatgrass, threadleaf sedge, little bluestem, blue grama, and sun sedge. With continuous heavy grazing, the site transitions to a shortgrass dominated state (State 2) with species such as blue grama and threadleaf sedge becoming more dominant.

Introduction or invasion of non-native species such as crested wheatgrass and Kentucky bluegrass transition the site to a Native -- Non-Native Herbaceous state. The native dominated community class (3.1) is similar to the reference community, but with non-native species making up part of the annual production. With non-use and lack of fire, the site will further transition to a non-native dominated community class (3.2).

Tillage and planting convert the reference state to a “Planted Herbaceous” state. Planting and harvesting of annual and perennial crops maintain a cropland community class (Community Class 4.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 4.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

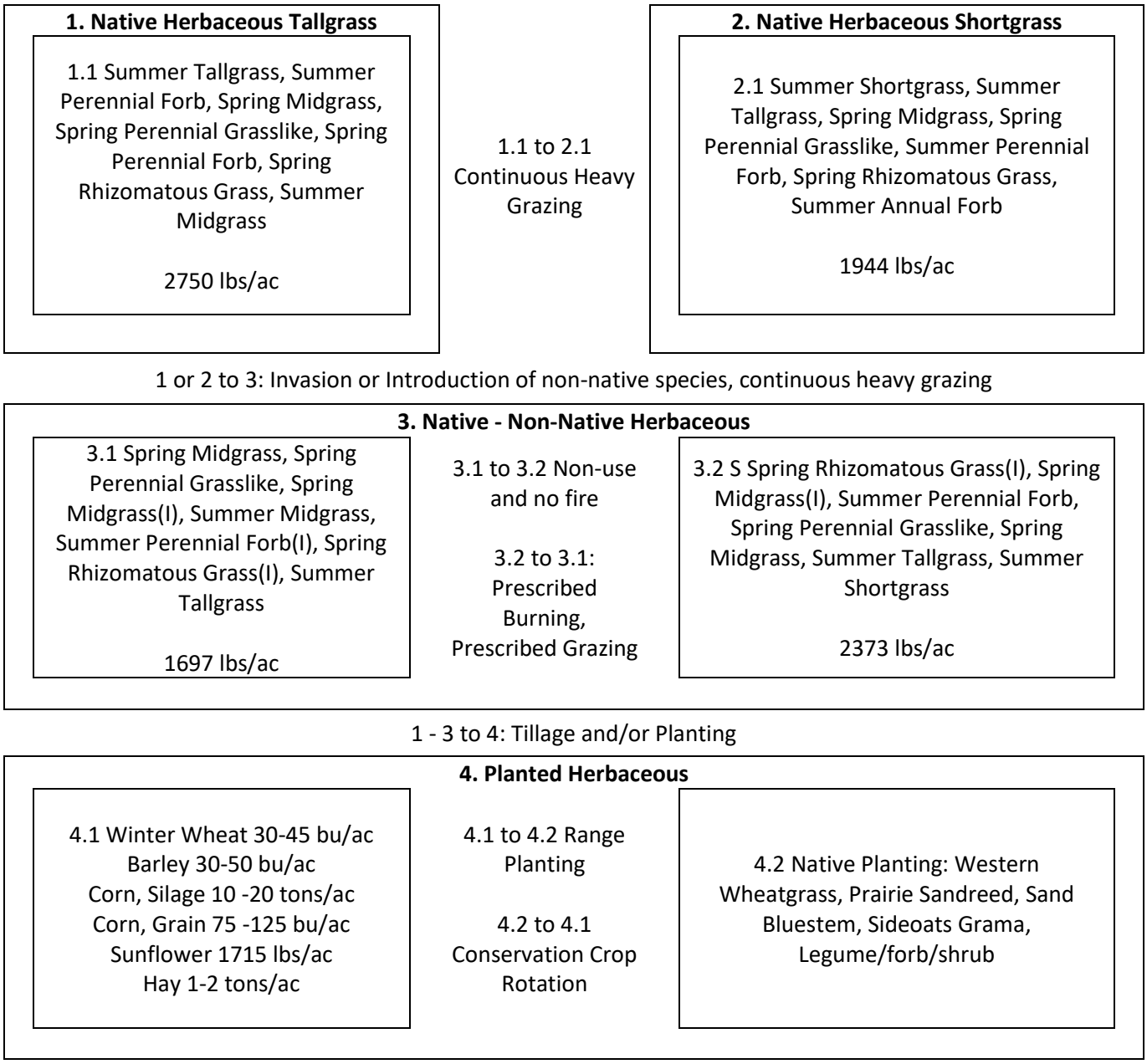

Figure 7. State and Transition Model, MLRA 54 Sandy Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 9. Ground and canopy cover from the NRI PSUs was used to estimate average annual erosion and percent runoff using the Rangeland Hydrology and Erosion Model (RHEM).

Table 9. NRI Community Class Data and RHEM Results - MLRA 54 Sandy Upland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.29.1.1	Spring Midgrass(561), Spring Perennial Grasslike(444), Summer Tallgrass(233), Spring Rhizomatous Grass(232), Summer Shortgrass(177), Summer Perennial Forb(155), Evergreen Subshrub(90)	needleandthread(HECO26)(386), threadleaf sedge(CAFI)(360), western wheatgrass(PASM)(232), prairie sandreed(CALO)(200), blue grama(BOGR2)(177), prairie Junegrass(KOMA)(131), green molly(BAAM4)(89), long-stolon sedge(CAIN9)(81)	2085	0.19	4.30%	7
054X.29.2.1	Summer Shortgrass(511), Summer Tallgrass(375), Spring Midgrass(363), Spring Perennial Grasslike(362), Summer Perennial Forb(153), Spring Rhizomatous Grass(56), Summer Annual Forb(35)	blue grama(BOGR2)(511), prairie sandreed(CALO)(375), threadleaf sedge(CAFI)(306), needleandthread(HECO26)(286), silverleaf Indian breadroot(PEAR6)(88), prairie Junegrass(KOMA)(63), western wheatgrass(PASM)(56), long-stolon sedge(CAIN9)(56)	1944	0.48	3.19%	3
054X.29.3.1	Spring Midgrass(474), Spring Perennial Grasslike(291), Spring Midgrass(I)(174), Summer Midgrass(169), Summer Perennial Forb(I)(168), Spring Rhizomatous Grass(I)(135), Summer Tallgrass(126)	needleandthread(HECO26)(418), crested wheatgrass(AGCR)(174), little bluestem(SCSC)(169), leafy spurge(EUES)(168), long-stolon sedge(CAIN9)(154), threadleaf sedge(CAFI)(136), Kentucky bluegrass(POPR)(129), prairie sandreed(CALO)(126)	1697	0.17	2.40%	4
054X.29.3.2	Spring Rhizomatous Grass(I)(753), Spring Midgrass(I)(350), Summer Perennial Forb(291), Spring Perennial Grasslike(271), Spring Midgrass(255), Summer Tallgrass(118), Summer Shortgrass(79)	Kentucky bluegrass(POPR)(570), crested wheatgrass(AGCR)(350), needleandthread(HECO26)(235), threadleaf sedge(CAFI)(231), smooth brome(BRIN2)(167), blue grama(BOGR2)(76), leadplant(AMCA6)(70), prairie sandreed(CALO)(67)	2373	0.16	2.47%	7

Supporting Information

No literature was found that dealt with the state and transition model for this ecological site class. It is possible that some of the research used in the Sandy Loam ecological site class was conducted on this ecological site class.

SANDY UPLAND, LIMY ECOLOGICAL SITE CLASS

General Description

The Sandy Upland, Limy ecological site class occurs on moderately steep to steep slopes formed from soft calcareous sandstone. He soils are moderately deep to very deep with a loamy fine sand to loamy sand surface. Infiltration is rapid. Erosion and deposition is common. Site stability relies on maintaining a cover of vegetation and cryptobiotic crusts.

Geomorphic Features:

Landscape Position:	Hills, Knolls, Ridges
Slope (percent):	6-35

Representative Soil Features

Soil Depth:	Moderately Deep to Very Deep
Parent Material Kind:	Alluvium, Aeolian
Parent Material Origin:	Sandstone
Surface Texture:	Loamy Fine Sandy to Loamy Sand
Surface Texture Modifier:	None
Subsurface Texture Group:	Sandy
Drainage Class:	Somewhat Excessively Drained
Permeability Class:	Rapid
Chemistry:	Calcareous throughout
Available Water Capacity:	2-3 inches

Vegetation Dynamics

Community Class 1.1 in the STM (Figure 8) was derived from functional group production for the reference community in the ecological site description that was correlated to this ecological site class. The reference plant community for this ecological site class produces approximately 1800 lbs/ac per year dominated by little bluestem, prairie sandreed, sand bluestem, threadleaf sedge, sideoats grama, blue grama, needleandthread, and porcupinegrass.

With heavy continuous grazing or regular early spring grazing, the site is likely to transition to a midgrass/shortgrass community (1.2). The vegetation includes short grasses, grass-likes, little bluestem and forbs. This state is extremely stable, and it is difficult to return it to the reference community. To return to reference conditions long term prescribed grazing must be applied.

State and Transition Model

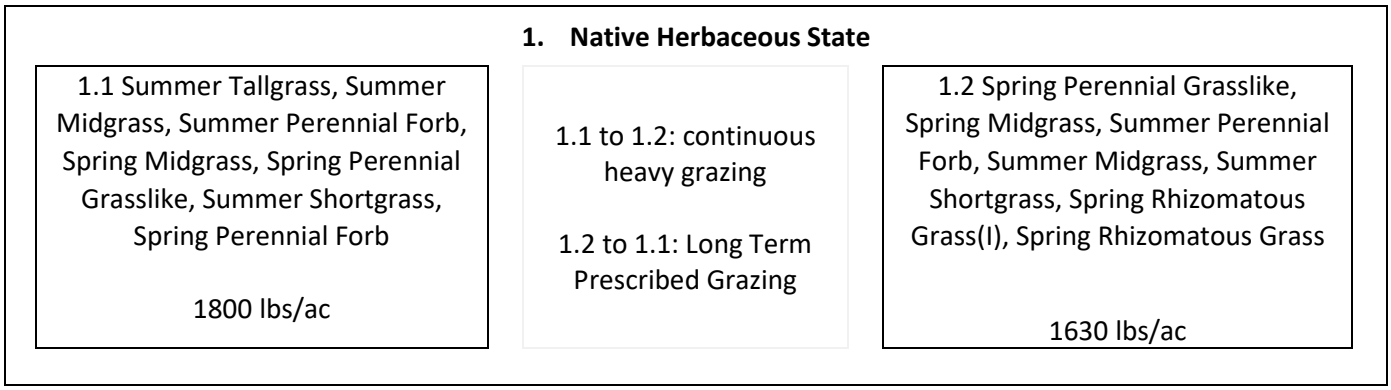

Figure 8. State and Transition Model, MLRA 54 Sandy Upland, Limy ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes were possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 10. Ground and canopy cover from the NRI PSUs was then used to estimate average annual erosion and percent runoff using RHEM.

Table 10. NRI Community Class Data and RHEM Results - MLRA 54 Sandy Upland, Limy ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.30.1.1	Summer Midgrass(1051), Summer Perennial Forb(288), Spring Midgrass(251), Spring Perennial Grasslike(122), Spring Perennial Forb(50), Summer Tallgrass(44), Spring Rhizomatous Grass(I)(29)	little bluestem(SCSC)(1000), needleandthread(HECO26)(140), tarragon(ARDR4)(86), porcupinegrass(HESP11)(50), dotted blazing star(LIPU)(45), sideoats grama(BOCU)(43), white sagebrush(ARLU)(42)	1849	0.62	3.64%	4
054X.30.1.2	Spring Perennial Grasslike(683), Spring Midgrass(458), Summer Perennial Forb(107), Summer Midgrass(105), Summer Shortgrass(87), Spring Rhizomatous Grass(I)(64), Spring Rhizomatous Grass(56)	threadleaf sedge(CAFI)(679), needleandthread(HECO26)(369), little bluestem(SCSC)(93), prairie Junegrass(KOMA)(88), blue grama(BOGR2)(87), Kentucky bluegrass(POPR)(64), western wheatgrass(PASM)(56), dotted blazing star(LIPU)(47)	1630	0.32	3.47%	4

Supporting Information

No supporting information was found for the state and transition model sites in this site class.

SHALLOW UPLAND ECOLOGICAL SITE CLASS

General Description

The Shallow Upland ecological site class occurs on gently undulating, rolling, moderately steep to steep sedimentary uplands. The soils in this site are well drained and formed in soft siltstone, shale, mudstone, sandstone, porcellanite, loess deposits, glacial till deposits, or alluvium.

Geomorphic Features

Landscape Positions:	Escarpment, Hill, Knoll, Ridge
Slope (percent):	2 – 50

Representative Soil Features

Soil Depth:	Very Shallow to Shallow
Parent Material Kind:	Mixed
Parent Material Origin:	Mixed
Surface Texture:	Clay, Silty Clay, Silty Clay Loam, Silty Loam, Loam, Sandy Loam, Loamy Fine Sand, Loamy Sand
Surface Texture Modifier:	None
Subsurface Texture Group:	Loamy
Drainage Class:	Well to Excessively
Permeability Class:	Very Slow to Very Rapid
Chemistry:	None
Available Water Capacity:	1 – 6 inches

Vegetation Dynamics

Community Class 1.1 in the STM (Figure 9) was derived from functional group production for the reference communities in the ecological site descriptions correlated to this ecological site class. This community class produces about 1340 lbs/ac/yr. dominated by western wheatgrass, needleandthread, little bluestem, sideoats grama, plains muhly, green needlegrass, sand bluestem, and blue grama. With heavy continuous grazing, the site will transition to a shortgrass dominated state (State 2) with a decrease in lwestern wheatgrass, and needleandthread and an increase in blue grama and threadleaf sedge. With long term prescribed grazing, mechanical treatment, and fertilizer, the site may return to the reference state.

Introduction or invasion of non-native species including crested wheatgrass, smooth brome, and Kentucky bluegrass will transition the site to a Native -- Non-Native Herbaceous state. The native dominated community class (3.1) in this state is similar to the reference community, but with non-native species making up a significant amount of the annual production. With rest and lack of fire, the site will transition to a non-native dominated community class (3.2). Long term Prescribed Grazing with a normal interval of natural or Prescribed Burning may transition the site back to the native dominated site class (3.1). The site will not transition back to the Native Herbaceous States (States 1 or 2) from the Native – Non-Native state.

Tillage and planting convert the reference state to a Planted Herbaceous state. Planting and harvesting of annual and perennial crops maintain a cropland community class (Community Class 4.1). When seeded to native perennial grasses, the site transitions to a native planted community class (Community Class 4.2). Native planting species shown are those recommended for the Conservation Reserve Program (CRP).

State and Transition Model

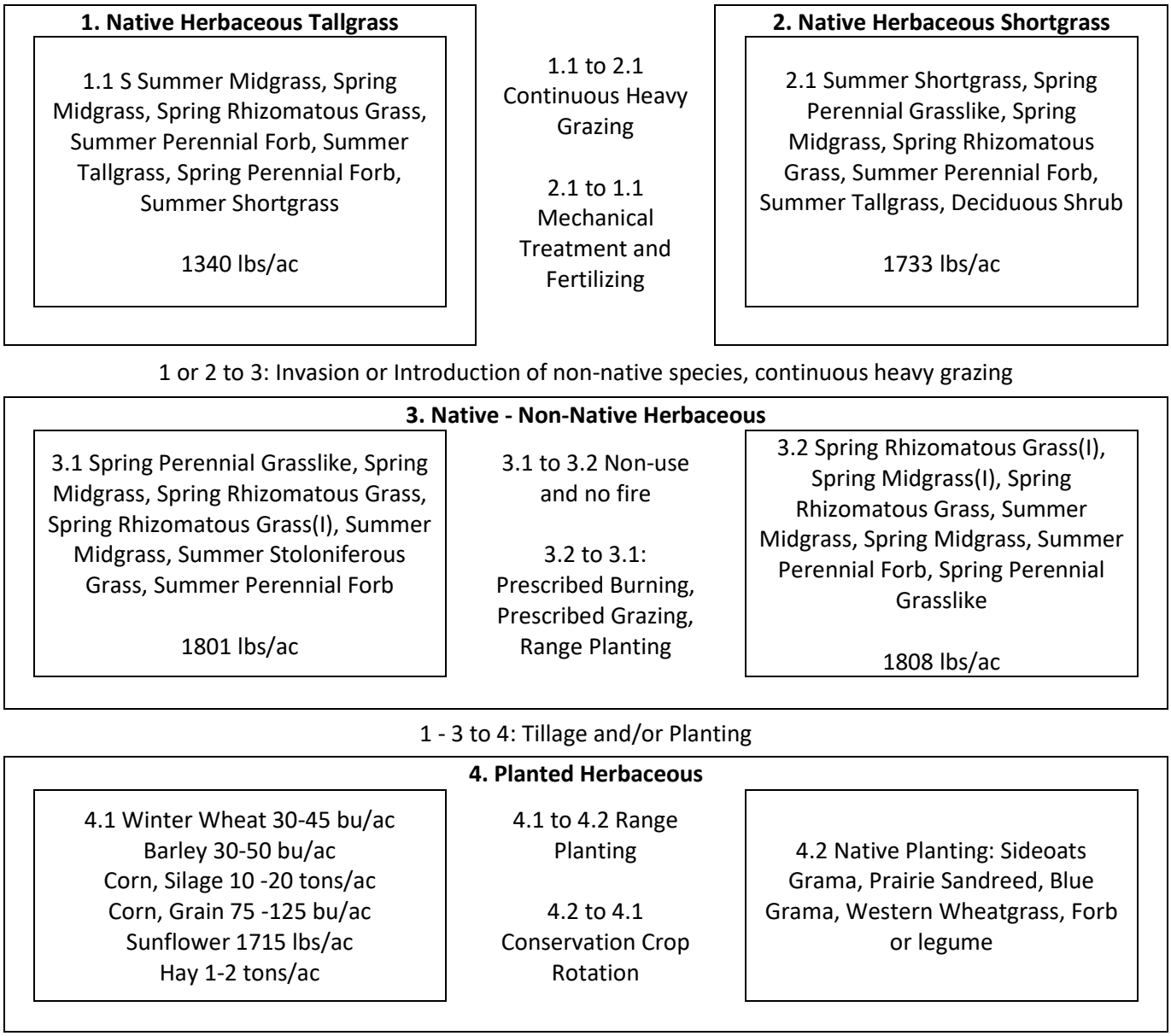

Figure 9 State and Transition Model, MLRA 54 Shallow Upland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes were possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 11. Ground and canopy cover from the NRI PSUs was then used to estimate average annual erosion and percent runoff using RHEM.

Table 11. NRI Community Class Data and RHEM Results - MLRA 54 Shallow Upland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.18.1.1	Summer Midgrass(479), Spring Midgrass(331), Spring Rhizomatous Grass(231), Spring Perennial Grasslike(179), Summer Perennial Forb(132), Summer Tallgrass(92), Summer Shortgrass(86)	little bluestem(SCSC)(381), western wheatgrass(PASM)(231), needleandthread(HECO26)(165), threadleaf sedge(CAFI)(152), blue grama(BOGR2)(85), prairie sandreed(CALO)(85), prairie Junegrass(KOMA)(55), porcupinegrass(HESP11)(55)	1684	0.57	6.19%	47
054X.18.2.1	Summer Shortgrass(413), Spring Perennial Grasslike(341), Spring Midgrass(163), Spring Rhizomatous Grass(154), Summer Perennial Forb(146), Summer Tallgrass(98), Deciduous Shrub(94)	blue grama(BOGR2)(413), threadleaf sedge(CAFI)(196), western wheatgrass(PASM)(154), sedge(CAREX)(145), prairie sandreed(CALO)(80), western snowberry(SYOC)(79), Buffalograss(BODA2)(76), needleandthread(HECO26)(58)	1733	5.30	12.46%	10
054X.18.3.1	Spring Perennial Grasslike(292), Spring Midgrass(284), Spring Rhizomatous Grass(213), Spring Rhizomatous Grass(I)(164), Summer Midgrass(161), Summer Stoloniferous Grass(153), Summer Perennial Forb(127)	western wheatgrass(PASM)(213), needleandthread(HECO26)(182), threadleaf sedge(CAFI)(160), Buffalograss(BODA2)(153), little bluestem(SCSC)(108), blue grama(BOGR2)(107), sedge(CAREX)(96), crested wheatgrass(AGCR)(91)	1801	0.62	7.56%	17
054X.18.3.2	Spring Rhizomatous Grass(I)(442), Spring Midgrass(I)(216), Spring Rhizomatous Grass(191), Summer Midgrass(177), Spring Midgrass(171), Summer Perennial Forb(152), Spring Perennial Grasslike(124)	Kentucky bluegrass(POPR)(279), crested wheatgrass(AGCR)(216), western wheatgrass(PASM)(191), smooth brome(BRIN2)(152), little bluestem(SCSC)(133), threadleaf sedge(CAFI)(88), needleandthread(HECO26)(78), blue grama(BOGR2)(75)	1808	0.69	6.73%	17

Supporting Information

The following publications support the state and transition model (STM). The first publication does not demonstrate transitional state changes, but does support the STM in that the same vegetation and management that is stated in the STM characterize the sites. The second publication indicates a site that although it does display some erosion, with little grazing disturbance, maintains the vegetation in agreeance to the STM reference state.

Dix, R.L. 1958. Some Slope-Plant Relationships in the Grasslands of the Little Missouri Badlands of North Dakota. Journal of Range Management 11(2): 88-92.
This study, located in Billings County, North Dakota focused on describing the vegetational characteristics of four grassland sites that differed in slope and exposure to determine the similarities and differences.

The soils of the sites were well-drained clay loam series. The native vegetation on moderate slopes included blue grama, western wheatgrass, thread-leaf sedge, and needleandthread. On steeper slopes vegetation included little bluestem, plains muhly, sideoats grama, and little club-moss. Sandy soils were dominated by prairie sandgrass. Grazing by livestock had been limited only to stray cattle for the past 20 years.

The vegetation was sampled with 40 quadrats per stand at 20 pace intervals, measuring the frequency index for each species. Results found that blue grama and western wheatgrass decrease, while little bluestem and plains muhly will increase. Stands highest in sedges and blue grama were found on steep slopes of which erosion was evident, as well as stands of plains muhly, little bluestem and sedges, which are topped with sandstone concretions. Stands high in blue grama and western wheatgrass were found on gentler sloped areas of deposition and erosion. Successional relationships were not evident between the stands, but disturbances by erodibility caused a lack of vegetal stability. Overall, the study found that the most critical factor in determining kinds and numbers of plants on sites is the soil moisture, and in conjunction, the exposure, slope and topography.

Frank, A.B. and J.F. Kearn. 2003. Vegetation indices, CO2 flux, and biomass for Northern Plains Grasslands. Journal of Range Management 56(4): 382-387.
This study took place on three grassland sites at the Northern Great Plains Research Laboratory in Mandan, North Dakota over a three-year period. The objective was to determine the relationship between normalized difference vegetation index (NDVI) and CO2 flux, aboveground biomass, and leaf area index. The vegetation of the sites were dominated by western wheatgrass, needleandthread, little bluestem, sideoats grama, Kentucky bluegrass and blue grama. The characteristic soils of the sites were loamy, shallow, and fine silty and each had been under various degrees of long-term continuous grazing.

Green biomass and leaf area index was measured at each site by clipping quadrats. CO2, water vapor and evapotranspiration were also measured with instrumentation towers.

The results found that the greatest average monthly precipitation occurs in June with 21% of the annual precipitation. The temporal dynamics if the biophysical parameters at each site measured to be characteristics of cool-season grasslands in terms of the CO2 flux, evapotranspiration and biomass accumulation. These all increased in the spring, peaked in the summer, and decreased in the late summer, which was similar across the sites through the years. Peak biomass differed slightly throughout the years, but generally occurred in late-June or late-July. CO2 flux had greater variation throughout the study, which was especially noted during drought periods. The greater the shrub density and the less the site was grazed indicated the greater the CO2 uptake was. Rates of evapotranspiration were of a similar seasonal pattern to that of biomass and CO2 flux. The rates of NDVI were similar across all three sites, which was low in the spring, increased in June, and decreased when plants senesced in autumn.

The conclusions of this study suggest that relationships between NDVI and biomass, leaf area index, CO2 flux, and evapotranspiration for three grassland sites with variable degrees of management and plant composition were generally similar. This suggests that NDVI has potential for predicting canopy CO2 flux rates.

Halvorson, G.A. and K.J. Lang. 1989. Revegetation of salt water blowout site. Journal of Range Management 42(1): 61-65.

This study took place between Dunn and McKenzie Counties in North Dakota. The objectives of the study were to measure the effectiveness of applied reclamation practices by comparing the kind and quantity of each plant species and to study the changes in sodium absorption ratio (SAR) and electrical conductivity (EC).

The vegetation of the site was diverse with an abundance of Rocky Mountain Juniper, and a variety of grasses including western wheatgrass, blue grama, sideoats grama, inland saltgrass, green needlegrass and needleandthread. Additionally, shrubs commonly observed were sagebrush and buckbrush.

The site had undergone a salt blowout and was in stages of reclamation using calcium chloride via irrigation water. An area approximately 1 ha in size on a south-facing slope was chosen for a detailed analysis of vegetation, through plant density and basal cover estimates by quadrat. The site was split into two halves, one of which was reclaimed, and both of which were broadcast seeded. Soil samples were taken throughout the study to estimate SAR and EC.

The results found that the blowout caused significant damage to the vegetation on the site; which was clear when compared to a nearby reference site. Reference site species with the highest percent basal cover include western wheatgrass, needleleaf sedge, blue grama and needleandthread. Further into the study, vegetation had changed on the contaminated site that was not reclaimed including the decrease in all grass species with the only species with appreciable percent cover and plant density being western wheatgrass and inland saltgrass. The site that was reclaimed had highest percent basal cover and density included western wheatgrass, blue grama, and inland saltgrass. On the reference site, 14% basal cover was grasses and sedges, on the contaminated site it was only 0.8%, and on the reclaimed it was 14.2%. There was a significant decrease in SAR on reclaimed sites.

SUBIRRIGATED BOTTOMLAND ECOLOGICAL SITE CLASS

General Description

The Subirrigated Bottomland ecological site class occurs on gently undulating to rolling sedimentary bottoms. This site receives run-on and/or subsurface water flows from adjacent uplands. It has a shallow water table available for plant growth at least seasonally in most years. Surface water may be present all or part of the year. Wetland soils and obligate wetland vegetation may be present. Flooding and/or ponding occurs rarely to occasionally. Potential plant community production is significantly higher than that of adjacent uplands, and the response to management is more rapid because of the availability of water. This ecological site class has the highest wildlife diversity.

Geomorphic Features

Landscape Positions:	Alluvial Fan, Alluvial Flat, Flood Plain
Slope (percent)	0 - 2

Representative Soil Features

Soil Depth:	Moderately Deep to Deep
Parent Material Kind:	Alluvium
Parent Material Origin:	Mixed
Surface Texture:	Loam, Silt Loam, Fine Sandy Loam
Surface Texture Modifier:	None
Subsurface Texture Group:	Loamy
Drainage Class:	Poorly to Somewhat Poorly Drained
Permeability Class:	Moderate to Moderately Rapid
Chemistry:	None
Available Water Capacity:	3 – 7 inches

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 10) was derived from functional group production for the reference communities in the ecological site description correlated to this ecological site class. There are no NRI Primary Sampling Units (PSUs) correlated to this site class, so community data is all from the ecological site descriptions.

The reference state of the Subirrigated Bottomland ecological site class includes 4000 pounds per acre dominated by big bluestem, switchgrass, western snowberry, northern reedgrass, prairie cordgrass, willow, Indiangrass, and silver buffaloberry. With heavy continuous grazing, the site will transition to a “Native - Invaded Herbaceous” state. This state will have a reduced production of 3000 pound per acre made up of Kentucky bluegrass, big bluestem, western wheatgrass, sedges, northern reedgrass, prairie cordgrass, Indiangrass, green ash and peachleaf willow. Plowing and tillage convert the reference state to a Planted Herbaceous State (State 3).

State and Transition Model

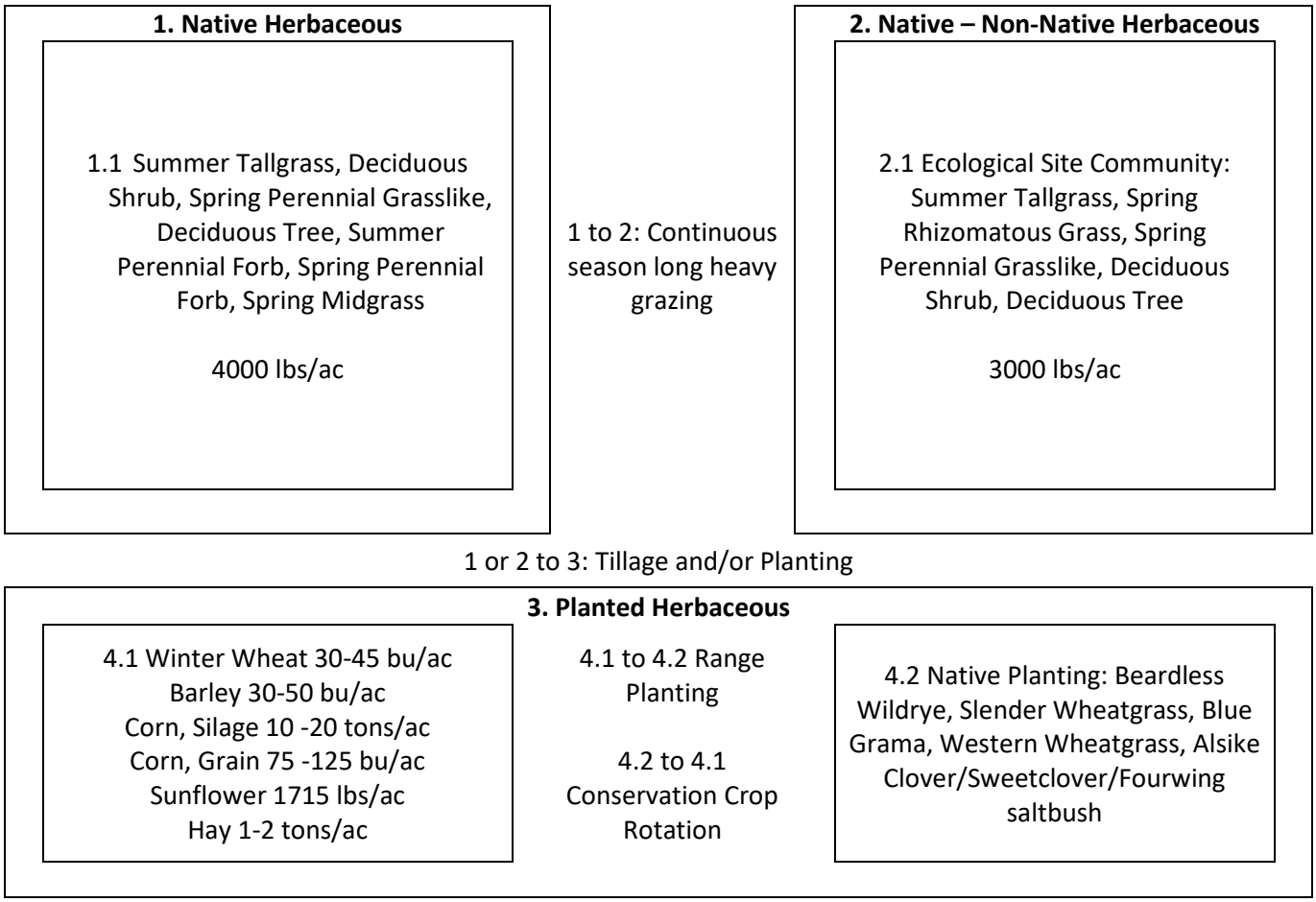

Figure 10. State and Transition Model, MLRA 54 Subirrigated Bottomland ecological site class.

Supporting Information

The following publication support the State and Transition Model (STM). This publication addresses the invasion of Kentucky bluegrass and how fire and herbicides may increase the abundance of natives and decrease the invasives.

Ereth, C.B., J.R. Hendrickson, D. Kirby, E. S. Dekeyser, K.K. Sedivec and M.S. West. 2017. Controlling Kentucky Bluegrass with Herbicide and Burning Is Influenced by Invasion Level. Invasive Plant Science and Management 10(1): 80-89.

The objectives of this study were to determine the effect of time of burning on Kentucky bluegrass and native grass relative to basal cover and to evaluate if combining herbicides with burning could increase the effectiveness of restoration treatments. Lastly, the study evaluated the impact of initial Kentucky bluegrass cover on treatment responses.

The study occurred on three research sites, which were excluded of livestock grazing, each of which had varying degrees of Kentucky bluegrass invasion. The soils of the sites were loamy fine sand of level to slightly sloping to poorly drained depressions. However, the primary ecological site was subirrigated sands that occurred on all three sites.

Kentucky bluegrass cover was quantified using fifty 10-point frames to estimate basal cover. The study was of a split-plot design, creating a total of seven different treatments. Fall and spring burns were applied as were herbicide treatments. These included: 1) control, 2) fall-burned, no herbicide, 3) fall-burned, plus imazapic, 4) fall-burned,

plus glyphosate, 5) spring-burned, no herbicide, 6) spring-burned, plus imazapic, and 7) spring-burned, plus glyphosate.

The results found that there were no significant differences between fall-burned without herbicide, spring-burned without herbicide, and the unburned control for the sites that had moderate and high invasions. With the low invasions, cover was greater on spring-burned than fall-burned. The lack of response to burning was surprising to researchers. Fall-bring with glyphosate was effective in increasing native grasses and reducing Kentucky bluegrass in moderate and highly invaded sites. Spring burn with glyphosate in the fall increased natives and decreased Kentucky bluegrass compared to fall-burned and untreated controls in low and moderately invaded sites. Overtime, the method did seem ineffective in changing species composition, however in the highly invaded sites. For the imazapic, there was generally no difference from fire alone or the unburned control. Fall-burn with spring application of imazapic did provide a greater abundance of natives and lower abundance of Kentucky bluegrass as compared to controls in low- and moderate-invaded sites. However, as with glyphosate, the effects diminished years later.

WET BOTTOMLAND ECOLOGICAL SITE CLASS

General Description

The Wet Bottomland ecological site class occurs on level to gently sloping sedimentary floodplains. This site receives run-on and/or subsurface water flows from adjacent uplands. It has a shallow water table available for plant growth at least seasonally in most years. Surface water may be present all or part of the year. Wetland soils and obligate wetland vegetation may be present. The soils in this site are poorly drained and formed in alluvium. Ponded water conditions and slow permeability strongly influences the soil-water-plant relationship.

Geomorphic Features

Landscape Positions:	Depression, Flood Plain, Oxbow
Slope (percent):	0 - 10

Representative Soil Features

Soil Depth:	Moderately Deep to Deep
Parent Material Kind:	Alluvium
Parent Material Origin:	Mixed
Surface Texture:	Loam, Silt Loam, Silty Clay Loam, Silty Clay
Surface Texture Modifier:	None
Subsurface Texture Group:	Loamy, Clayey
Drainage Class:	Poorly to Somewhat Poorly Drained
Permeability Class:	Very Slow to Moderate
Chemistry:	None
Available Water Capacity:	5 – 8 inches

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 11) was derived from functional group production for the reference communities in the ecological site descriptions correlated to this ecological site class. This community class produces about 5200 lbs/ac/yr. dominated by prairie cordgrass, wheat sedge, northern reedgrass, woolly sedge, spikerush, American sloughgrass, and shortbeak sedge. Introduction or invasion of non-native species including crested wheatgrass, smooth brome, and Kentucky bluegrass will transition the site to a Native -- Non-Native Herbaceous state. This state is similar to the reference community, but non-natives make up a significant amount of the annual production.

State and Transition Model

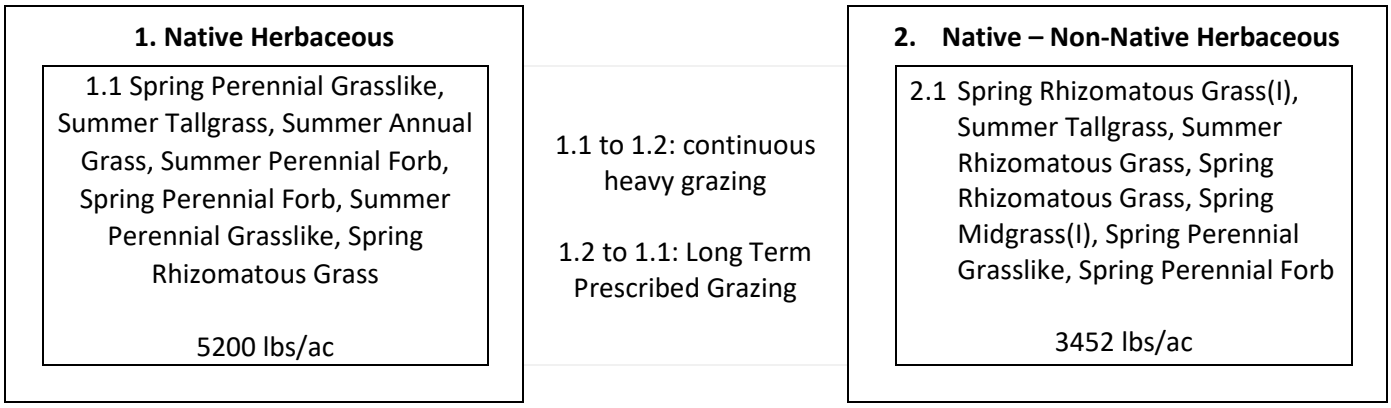

Figure 11. State and Transition Model, MLRA 54 Wet Bottomland ecological site class.

NRI Primary Sampling Units (PSUs) were correlated to these community classes were possible. Community class production, functional group dominance, and dominant species based on available NRI data are shown in Table 12. The Rangeland Hydrology and Erosion Model (RHEM) was not run on these NRI points, because the use of the model is not appropriate for these kinds of saturated soils. Most erosion and runoff in this site class is related to flooding.

Table 12. NRI Community Class Data (no RHEM results) - MLRA 54 Wet Bottomland ecological site class.

Comm Class ID	Community Class Name (Avg Lbs/Ac)	Dominant Species (Symbol)(Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
054X.22.1.1	Summer Tallgrass(2310), Spring Perennial Grasslike(1361), Summer Perennial Forb(I)(273), Spring Rhizomatous Grass(I)(162), Summer Rhizomatous Grass(59), Spring Shortgrass(56), Summer Perennial Forb(16)	prairie cordgrass(SPPE)(1461), switchgrass(PAVI2)(849), Baltic rush(JUARL)(846), clustered field sedge(CAPR5)(515), field sowthistle(SOAR2)(273), Kentucky bluegrass(POPR)(162), scratchgrass(MUAS)(59), foxtail barley(HOJU)(56)	4237			1
054X.22.2.1	Spring Rhizomatous Grass(I)(1902), Summer Tallgrass(370), Summer Rhizomatous Grass(321), Spring Rhizomatous Grass(286), Spring Midgrass(I)(173), Spring Perennial Grasslike(152), Spring Perennial Forb(72)	smooth brome(BRIN2)(1271), Kentucky bluegrass(POPR)(630), prairie cordgrass(SPPE)(352), mat muhly(MURI)(321), western wheatgrass(PASM)(286), crested wheatgrass(AGCR)(173), clustered field sedge(CAPR5)(75), common dandelion(TAOF)(72)	3452			3

Supporting Information

The following publication supports the STM. Although this study is focused on nutrient composition of macrophytes, it supports the STM vegetation evaluations for this ecological site group.

Kirby, D.R., D.M. Green and T.S. Mings. 1989. Nutrient composition of selected emergent macrophytes in Northern Prairie wetland. Journal of Range Management 42(4): 323-326.

This purpose of this study was to determine the nutritive quality of emergent macrophytes from seasonal wetlands near Streeter, North Dakota.

The primary wetland species observed were American sloughgrass, tall mannagrass, common reed, whitetop or sprangletop, and prairie cordgrass. Additionally, several grass-like species were observed including slough sedge, spikerush, Baltic rush, hardstem bulrush and three square.

Four samples were taken of each species twice a month, with grass species being separated to leaf and stem. In vitro dry matter digestibility (IVDMD) was estimated and linear models generated. Results found that species and season differences occurred in the plant groupings for each chemical component. The IVDMD was greater for American sloughgrass and prairie cordgrass than any other grass species. Leaf IVDMD had rapid seasonal decline for tall mannagrass, common reed and whitetop.

APPENDIX A. MLRA 54, ECOLOGICAL SITE CLASSES SHOWING THE ECOLOGICAL SITES, ECOLOGICAL SITE IDS, AND PLANT COMMUNITY CLASSES THAT WERE CORRELATED TO EACH SITE CLASS.

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Claypan Upland**	Claypan	R054XY021ND
		Thin Claypan	R054XY033ND
		Plant Community Class Names	**Plant Community Class ID**
		Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Perennial Grasslike, Evergreen Subshrub	054X.27.1.1
		Summer Stoloniferous Grass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Midgrass, Spring Shortgrass, Cacti, Summer Rhizomatous Grass	054X.27.2.1
		Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Rhizomatous Grass, Spring Midgrass, Spring Annual Grass(I), Spring Shortgrass	054X.27.3.1
		Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass	054X.27.4.1
MLRA	**Ecological Site Class Name**	**Ecological Site Names**	**Ecological Site ID**
54	**Loamy Terrace**	Loamy Overflow	R054XY023ND
		Loamy Terrace	R054XY041ND
		Plant Community Class Names	**Plant Community Class ID**
		Spring Midgrass, Summer Tallgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Deciduous Shrub, Summer Midgrass, Spring Perennial Forb	054X.3.1.1
		Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Perennial Forb, Summer Tallgrass, Spring Midgrass, Deciduous Shrub, Spring Shortgrass	054X.3.2.1
		Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb(I), Summer Perennial Forb, Summer Tallgrass	054X.3.2.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Loamy Upland**	Clayey	R054XY020ND
		Loamy	R054XY031ND
		Plant Community Class Names	**Plant Community Class ID**
		Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass, Spring Perennial Grasslike, Summer Perennial Grasslike	054X.6.1.1
		Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb	054X.6.1.2
		Spring Rhizomatous Grass, Spring Midgrass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Perennial Forb, Spring Perennial Grasslike, Summer Perennial Forb(I)	054X.6.2.1
		Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Summer Shortgrass, Spring Perennial Grasslike	054X.6.2.2
MLRA	**Ecological Site Class Name**	**Ecological Site Names**	**Ecological Site ID**
54	**Saline Bottomland**	Closed Depression	R054XY022ND
		Saline Lowland	R054XY024ND
		Plant Community Class Names	**Plant Community Class ID**
		Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Perennial Grasslike, Spring Midgrass, Spring Perennial Forb, Summer Perennial Forb, Summer Perennial Grasslike	054X.35.1.1
		Summer Rhizomatous Grass, Spring Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Perennial Grasslike, Evergreen Subshrub	054X.35.1.2
		Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Spring Shortgrass, Spring Midgrass, Spring Perennial Forb, Spring Annual Forb(I), Spring Annual Grass(I)	054X.35.2.1
		Spring Rhizomatous Grass(I), Summer Rhizomatous Grass, Spring Midgrass(I), Spring Rhizomatous Grass, Spring Perennial Grasslike, Spring Midgrass, Summer Tallgrass	054X.35.2.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Sandy Loam Upland**	Sandy	R054XY026ND
		Sandy Claypan	R054XY027ND
		Plant Community Class Names	**Plant Community Class ID**
		Summer Tallgrass, Spring Midgrass, Summer Perennial Forb, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Midgrass	054X.7.1.1
		Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Summer Stoloniferous Grass, Spring Rhizomatous Grass, Summer Perennial Forb, Spring Perennial Forb	054X.7.2.1
		Spring Rhizomatous Grass(I), Spring Rhizomatous Grass, Spring Midgrass, Spring Perennial Grasslike, Summer Tallgrass, Summer Shortgrass, Summer Perennial Forb	054X.7.3.1
		Spring Midgrass(I), Spring Rhizomatous Grass(I), Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Summer Shortgrass, Spring Rhizomatous Grass	054X.7.3.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Sandy Upland**	Sands	R054XY025ND
		Sandy Terrace	R054XY042ND
		Plant Community Class Names	**Plant Community Class ID**
		Summer Tallgrass, Summer Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Midgrass	054X.29.1.1
		Summer Shortgrass, Summer Tallgrass, Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb	054X.29.2.1
		Spring Midgrass, Spring Perennial Grasslike, Spring Midgrass(I), Summer Midgrass, Summer Perennial Forb(I), Spring Rhizomatous Grass(I), Summer Tallgrass	054X.29.3.1
		Spring Rhizomatous Grass(I), Spring Midgrass(I), Summer Perennial Forb, Spring Perennial Grasslike, Spring Midgrass, Summer Tallgrass, Summer Shortgrass	054X.29.3.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Sandy Upland, Limy**	Limy Sands	R054XY045ND
		Plant Community Class Names	**Plant Community Class ID**
		Summer Tallgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Summer Shortgrass, Spring Perennial Forb	054X.30.1.1
		Spring Perennial Grasslike, Spring Midgrass, Summer Perennial Forb, Summer Midgrass, Summer Shortgrass, Spring Rhizomatous Grass(I), Spring Rhizomatous Grass	054X.30.1.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Shallow Upland**	Shallow Clayey	R054XY028ND
		Shallow Gravel	R054XY029ND
		Shallow Loamy	R054XY030ND
		Thin Loamy	R054XY038ND
		Thin Sands	R054XY034ND
		Very Shallow	R054XY035ND
		Plant Community Class Names	**Plant Community Class ID**
		Summer Midgrass, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Tallgrass, Spring Perennial Forb, Summer Shortgrass	054X.18.1.1
		Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Tallgrass, Deciduous Shrub	054X.18.2.1
		Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Midgrass, Summer Stoloniferous Grass, Summer Perennial Forb	054X.18.3.1
		Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Summer Midgrass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Grasslike	054X.18.3.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Subirrigated Bottomland**	Subirrigated	R054XY032ND
		Plant Community Class Names	**Plant Community Class ID**
		Summer Tallgrass, Spring Perennial Grasslike, Summer Perennial Forb(I), Spring Rhizomatous Grass(I), Summer Rhizomatous Grass, Spring Shortgrass, Summer Perennial Forb	054X.34.1.1
		Ecological Site Community: Summer Tallgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Deciduous Shrub, Deciduous Tree	054X.34.2.2

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
54	**Wet Bottomland**	Wet Land	R054XY036ND
		Wet Meadow	R054XY037ND
		Plant Community Class Names	**Plant Community Class ID**
		Spring Perennial Grasslike, Summer Tallgrass, Summer Annual Grass, Summer Perennial Forb, Spring Perennial Forb, Summer Perennial Grasslike, Spring Rhizomatous Grass	054X.22.1.1
		Spring Rhizomatous Grass(I), Summer Tallgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Midgrass(I), Spring Perennial Grasslike, Spring Perennial Forb	054X.22.2.1

APPENDIX B. MLRA 54, ECOLOGICAL SITE CLASS AND COMMUNITY CLASS SUMMARY

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
Claypan Upland	Native Herbaceous	054X.27.1.1	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Perennial Grasslike, Summer Rhizomatous Grass	1150	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Stoloniferous Grass, Spring Perennial Grasslike, Summer Midgrass, Summer Perennial Forb	western wheatgrass(PASM), blue grama(BOGR2), Buffalograss(BODA2), needleandthread(HECO26), prairie Junegrass(KOMA), little bluestem(SCSC), sedge(CAREX), Kentucky bluegrass(POPR)	1460	33
Claypan Upland	Native Herbaceous	054X.27.2.1			Summer Stoloniferous Grass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Midgrass, Spring Shortgrass, Cacti, Summer Rhizomatous Grass	Buffalograss(BODA2), blue grama(BOGR2), western wheatgrass(PASM), Sandberg bluegrass(POSE), inland saltgrass(DISP), silver sagebrush(ARCA13), sixweeks fescue(VUOC), Opuntia spp.(OPUNT)	1535	9
Claypan Upland	Native - Non-Native Herbaceous	054X.27.3.1			Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Rhizomatous Grass, Spring Midgrass, Spring Annual Grass(I), Spring Shortgrass	western wheatgrass(PASM), Kentucky bluegrass(POPR), blue grama(BOGR2), inland saltgrass(DISP), Sandberg bluegrass(POSE), Buffalograss(BODA2), cheatgrass(BRTE), prairie Junegrass(KOMA)	1764	26
Claypan Upland	Native - Non-Native Herbaceous	054X.27.4.1			Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass	Kentucky bluegrass(POPR), crested wheatgrass(AGCR), western wheatgrass(PASM), smooth brome(BRIN2), cheatgrass(BRTE), sweetclover(MEOF), blue grama(BOGR2), green needlegrass(NAVI4)	1892	27

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
Loamy Terrace	Native Herbaceous	054X.3.1.1	Spring Midgrass, Summer Tallgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Deciduous Shrub, Summer Midgrass, Spring Perennial Forb	3050	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Evergreen Shrub, Summer Perennial Forb, Spring Perennial Forb, Deciduous Shrub	western wheatgrass(PASM), green needlegrass(NAVI4), blue grama(BOGR2), silver sagebrush(ARCA13), white sagebrush(ARLU), western snowberry(SYOC), common yarrow(ACMI2), pigweed(AMARA)	1506	2
Loamy Terrace	Native - Non-Native Herbaceous	054X.3.2.1			Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Perennial Forb, Summer Tallgrass, Spring Midgrass, Deciduous Shrub, Spring Shortgrass	western wheatgrass(PASM), Kentucky bluegrass(POPR), green needlegrass(NAVI4), big bluestem(ANGE), western snowberry(SYOC), foxtail barley(HOJU), prairie sandreed(CALO), scratchgrass(MUAS)	3902	9
Loamy Terrace	Native - Non-Native Herbaceous	054X.3.2.2			Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb(I), Summer Perennial Forb, Summer Tallgrass	smooth brome(BRIN2), crested wheatgrass(AGCR), Kentucky bluegrass(POPR), western wheatgrass(PASM), field bindweed(COAR4), needleandthread(HECO26), big bluestem(ANGE), western snowberry(SYOC)	3134	14
Loamy Upland	Native Herbaceous	054X.6.1.1	Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb, Summer Shortgrass, Spring	2250	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Stoloniferous Grass, Spring Perennial Grasslike, Spring Rhizomatous Grass(I), Summer Perennial Forb	western wheatgrass(PASM), blue grama(BOGR2), needleandthread(HECO26), Buffalograss(BODA2), green needlegrass(NAVI4), threadleaf sedge(CAFI), Kentucky bluegrass(POPR),	2334	59

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
			Perennial Grasslike, Summer Perennial Grasslike			prairie Junegrass(KOMA)		
Loamy Upland	Native Herbaceous	054X.6.1.2			Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb	Buffalograss(BODA2), blue grama(BOGR2), western wheatgrass(PASM), threadleaf sedge(CAFI), needleandthread(HECO26), sedge(CAREX), prairie Junegrass(KOMA), silverleaf Indian breadroot(PEAR6)	2146	25
Loamy Upland	Native - Non-Native Herbaceous	054X.6.2.1			Spring Rhizomatous Grass, Spring Midgrass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Perennial Forb, Spring Perennial Grasslike, Summer Perennial Forb(I)	western wheatgrass(PASM), Kentucky bluegrass(POPR), needleandthread(HECO26), blue grama(BOGR2), green needlegrass(NAVI4), sweetclover(MEOF), prairie Junegrass(KOMA), crested wheatgrass(AGCR), white sweetclover(MEOF)	2462	55
Loamy Upland	Native - Non-Native Herbaceous	054X.6.2.2			Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Summer Shortgrass, Spring Perennial Grasslike	Kentucky bluegrass(POPR), crested wheatgrass(AGCR), smooth brome(BRIN2), western wheatgrass(PASM), green needlegrass(NAVI4), blue grama(BOGR2), needleandthread(HECO26), sweetclover(MEOF)	2437	96
Saline Bottomland	Native Herbaceous	054X.35.1.1	Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Perennial Grasslike, Spring Midgrass, Spring	2100	Spring Rhizomatous Grass, Summer Rhizomatous Grass, Summer Perennial Forb, Evergreen Subshrub, Spring Midgrass, Spring Rhizomatous Grass(I), Summer Tallgrass	western wheatgrass(PASM), Nuttall's alkaligrass(PUNU2), inland saltgrass(DISP), California seablite(SUCA), western ragweed(AMPS), Kentucky bluegrass(POPR),	2150	5

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
			Perennial Forb, Summer Perennial Forb, Summer Perennial Grasslike			prairie Junegrass(KOMA), tall dropseed(SPCO16)		
Saline Bottomland	Native Herbaceous	054X.35. 1.2			Summer Rhizomatous Grass, Spring Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Perennial Grasslike, Evergreen Subshrub	foxtail barley(HOJU), Nuttall's alkaligrass(PUNU2), inland saltgrass(DISP), clustered field sedge(CAPR5), western wheatgrass(PASM), common threesquare(SCPU10), Baltic rush(JUARL), rock tansy(SPCA8)	2599	9
Saline Bottomland	Native - Non-Native Herbaceous	054X.35. 2.1			Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Spring Shortgrass, Spring Midgrass, Spring Perennial Forb, Spring Annual Forb(I), Spring Annual Grass(I)	western wheatgrass(PASM), Kentucky bluegrass(POPR), foxtail barley(HOJU), prairie Junegrass(KOMA), yellow salsify(TRDU), common yarrow(ACMI2), cheatgrass(BRTE), green molly(BAAM4)	1849	2
Saline Bottomland	Native - Non-Native Herbaceous	054X.35. 2.2			Spring Rhizomatous Grass(I), Summer Rhizomatous Grass, Spring Midgrass(I), Spring Rhizomatous Grass, Spring Perennial Grasslike, Spring Midgrass, Summer Tallgrass	Kentucky bluegrass(POPR), smooth brome(BRIN2), crested wheatgrass(AGCR), western wheatgrass(PASM), quackgrass(ELRE4), clustered field sedge(CAPR5), Nuttall's alkaligrass(PUNU2), inland saltgrass(DISP)	2941	3
Saline Bottomland	Planted Herbaceous	054X.35. 3.1			Spring Rhizomatous Grass, Summer Stoloniferous Grass, Spring Rhizomatous Grass(I), Summer Rhizomatous Grass, Spring Perennial Grasslike, Summer Annual Forb, Spring Shortgrass	western wheatgrass(PASM), Buffalograss(BODA2), smooth brome(BRIN2), Kentucky bluegrass(POPR), saltgrass(DISTI), sedge(CAREX), curlycup gumweed(GRSQ), foxtail barley(HOJU)	2663	1

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
Sandy Loam Upland	Native Herbaceous	054X.7.1.1	Summer Tallgrass, Spring Midgrass, Summer Perennial Forb, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Midgrass	1933	Spring Midgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Midgrass, Summer Perennial Forb, Summer Shortgrass, Summer Tallgrass	needleandthread(HECO26), western wheatgrass(PASM), threadleaf sedge(CAFI), blue grama(BOGR2), little bluestem(SCSC), prairie sandreed(CALO), silver sagebrush(ARCA13), prairie Junegrass(KOMA)	2075	38
Sandy Loam Upland	Native Herbaceous	054X.7.2.1			Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Summer Stoloniferous Grass, Spring Rhizomatous Grass, Summer Perennial Forb, Spring Perennial Forb	blue grama(BOGR2), threadleaf sedge(CAFI), Buffalograss(BODA2), western wheatgrass(PASM), needleandthread(HECO26), sedge(CAREX), prairie Junegrass(KOMA), long-stolon sedge(CAIN9)	1837	11
Sandy Loam Upland	Native - Non-Native Herbaceous	054X.7.3.1			Spring Rhizomatous Grass(I), Spring Rhizomatous Grass, Spring Midgrass, Spring Perennial Grasslike, Summer Tallgrass, Summer Shortgrass, Summer Perennial Forb	western wheatgrass(PASM), needleandthread(HECO26), smooth brome(BRIN2), Kentucky bluegrass(POPR), threadleaf sedge(CAFI), blue grama(BOGR2), prairie sandreed(CALO), crested wheatgrass(AGCR)	2206	34
Sandy Loam Upland	Native - Non-Native Herbaceous	054X.7.3.2			Spring Midgrass(I), Spring Rhizomatous Grass(I), Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Summer Shortgrass, Spring Rhizomatous Grass	crested wheatgrass(AGCR), Kentucky bluegrass(POPR), needleandthread(HECO26), threadleaf sedge(CAFI), blue grama(BOGR2), western wheatgrass(PASM), little bluestem(SCSC), smooth brome(BRIN2)	2143	29
Sandy Upland	Native Herbaceous	054X.29.1.1	Summer Tallgrass, Summer	2750	Spring Midgrass, Spring Perennial Grasslike, Summer	needleandthread(HECO26), threadleaf sedge(CAFI), western	2085	7

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
			Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Midgrass		Tallgrass, Spring Rhizomatous Grass, Summer Shortgrass, Summer Perennial Forb, Evergreen Subshrub	wheatgrass(PASM), prairie sandreed(CALO), blue grama(BOGR2), prairie Junegrass(KOMA), green molly(BAAM4), long-stolon sedge(CAIN9)		
Sandy Upland	Native Herbaceous	054X.29. 2.1			Summer Shortgrass, Summer Tallgrass, Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb	blue grama(BOGR2), prairie sandreed(CALO), threadleaf sedge(CAFI), needleandthread(HECO26), silverleaf Indian breadroot(PEAR6), prairie Junegrass(KOMA), western wheatgrass(PASM), long-stolon sedge(CAIN9)	1944	3
Sandy Upland	Native - Non-Native Herbaceous	054X.29. 3.1			Spring Midgrass, Spring Perennial Grasslike, Spring Midgrass(I), Summer Midgrass, Summer Perennial Forb(I), Spring Rhizomatous Grass(I), Summer Tallgrass	needleandthread(HECO26), crested wheatgrass(AGCR), little bluestem(SCSC), leafy spurge(EUES), long-stolon sedge(CAIN9), threadleaf sedge(CAFI), Kentucky bluegrass(POPR), prairie sandreed(CALO)	1697	4
Sandy Upland	Native - Non-Native Herbaceous	054X.29. 3.2			Spring Rhizomatous Grass(I), Spring Midgrass(I), Summer Perennial Forb, Spring Perennial Grasslike, Spring Midgrass, Summer Tallgrass, Summer Shortgrass	Kentucky bluegrass(POPR), crested wheatgrass(AGCR), needleandthread(HECO26), threadleaf sedge(CAFI), smooth brome(BRIN2), blue grama(BOGR2), leadplant(AMCA6), prairie sandreed(CALO)	2373	7
Sandy Upland, Limy	Native Herbaceous	054X.30. 1.1	Summer Tallgrass, Summer Midgrass, Summer	1800	Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Spring	little bluestem(SCSC), needleandthread(HECO26), tarragon(ARDR4), porcupinegrass(HESP1	1849	4

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
			Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Summer Shortgrass, Spring Perennial Forb		Perennial Forb, Summer Tallgrass, Spring Rhizomatous Grass(I)	1), dotted blazing star(LIPU), sideoats grama(BOCU), white sagebrush(ARLU)		
Sandy Upland, Limy	Native Herbaceous	054X.30.1.2			Spring Perennial Grasslike, Spring Midgrass, Summer Perennial Forb, Summer Midgrass, Summer Shortgrass, Spring Rhizomatous Grass(I), Spring Rhizomatous Grass	threadleaf sedge(CAFI), needleandthread(HECO26), little bluestem(SCSC), prairie Junegrass(KOMA), blue grama(BOGR2), Kentucky bluegrass(POPR), western wheatgrass(PASM), dotted blazing star(LIPU)	1630	4
Shallow Upland	Native Herbaceous	054X.18.1.1	Summer Midgrass, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Tallgrass, Spring Perennial Forb, Summer Shortgrass	1340	Summer Midgrass, Spring Midgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Perennial Forb, Summer Tallgrass, Summer Shortgrass	little bluestem(SCSC), western wheatgrass(PASM), needleandthread(HECO26), threadleaf sedge(CAFI), blue grama(BOGR2), prairie sandreed(CALO), prairie Junegrass(KOMA), porcupinegrass(HESP11)	1684	47
Shallow Upland	Native Herbaceous	054X.18.2.1			Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Tallgrass, Deciduous Shrub	blue grama(BOGR2), threadleaf sedge(CAFI), western wheatgrass(PASM), sedge(CAREX), prairie sandreed(CALO), western snowberry(SYOC), Buffalograss(BODA2), needleandthread(HECO26)	1733	10
Shallow Upland	Native - Non-Native Herbaceous	054X.18.3.1			Spring Perennial Grasslike, Spring Midgrass, Spring	western wheatgrass(PASM), needleandthread(HEC	1801	17

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
					Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Midgrass, Summer Stoloniferous Grass, Summer Perennial Forb	O26), threadleaf sedge(CAFI), Buffalograss(BODA2), little bluestem(SCSC), blue grama(BOGR2), sedge(CAREX), crested wheatgrass(AGCR)		
Shallow Upland	Native - Non-Native Herbaceous	054X.18.3.2			Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Summer Midgrass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Grasslike	Kentucky bluegrass(POPR), crested wheatgrass(AGCR), western wheatgrass(PASM), smooth brome(BRIN2), little bluestem(SCSC), threadleaf sedge(CAFI), needleandthread(HECO26), blue grama(BOGR2)	1808	17
Subirrigated Bottomland	Native Herbaceous	054X.34.1.1	Summer Tallgrass, Deciduous Shrub, Spring Perennial Grasslike, Deciduous Tree, Summer Perennial Forb, Spring Perennial Forb, Spring Midgrass					
Subirrigated Bottomland	Native – Non-Native Herbaceous	054X.34.2.1	Ecological Site Community: Summer Tallgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Deciduous Shrub, Deciduous Tree					
Wet Bottomland	Native Herbaceous	054X.22.1.1	Spring Perennial Grasslike, Summer Tallgrass, Summer Annual Grass, Summer	5200	Summer Tallgrass, Spring Perennial Grasslike, Summer Perennial Forb(I), Spring Rhizomatous Grass(I), Summer Rhizomatous Grass, Spring Shortgrass,	prairie cordgrass(SPPE), switchgrass(PAVI2), Baltic rush(JUARL), clustered field sedge(CAPR5), field sowthistle(SOAR2), Kentucky	4237	1

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol) (Lbs/ac)	NRI Lbs/ Ac	# PSUs
			Perennial Forb, Spring Perennial Forb, Summer Perennial Grasslike, Spring Rhizomatous Grass		Summer Perennial Forb	bluegrass(POPR), scratchgrass(MUAS), foxtail barley(HOJU)		
Wet Bottomland	Native - Non-Native Herbaceous	054X.22.2.1			Spring Rhizomatous Grass(I), Summer Tallgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Midgrass(I), Spring Perennial Grasslike, Spring Perennial Forb	smooth brome(BRIN2), Kentucky bluegrass(POPR), prairie cordgrass(SPPE), mat muhly(MURI), western wheatgrass(PASM), crested wheatgrass(AGCR), clustered field sedge(CAPR5), common dandelion(TAOF)	3452	3

APPENDIX C. MLRA 54, NRI PERCENT COVER VALUES BY COMMUNITY CLASS

Site Class Name	Comm Class ID	Bunch-grass	Sodgrass	Shrub	Forb + AnnGrass	Lichen	BareGrnd	Rock	Litter	Basal	Avg Plant Ht (ft)	Avg % Slope
Claypan Upland	054X.27.1.1	33%	34%	2%	15%	4%	15%	1%	73%	2%	1.07	5
	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Stoloniferous Grass, Spring Perennial Grasslike, Summer Midgrass, Summer Perennial Forb											
Claypan Upland	054X.27.2.1	33%	19%	0%	19%	0%	21%	0%	66%	4%	0.44	3
	Summer Stoloniferous Grass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Midgrass, Spring Shortgrass, Cacti, Summer Rhizomatous Grass											
Claypan Upland	054X.27.3.1	23%	43%	3%	19%	1%	8%	0%	83%	2%	1.02	4
	Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Rhizomatous Grass, Spring Midgrass, Spring Annual Grass(I), Spring Shortgrass											
Claypan Upland	054X.27.4.1	29%	45%	1%	14%	1%	11%	0%	76%	2%	0.91	3
	Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Annual Grass(I), Summer Perennial Forb(I), Spring Midgrass, Summer Shortgrass											
Loamy Terrace	054X.3.1.1	22%	61%	11%	1%	0%	2%	0%	91%	3%	1.17	2
	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Evergreen Shrub, Summer Perennial Forb, Spring Perennial Forb, Deciduous Shrub											
Loamy Terrace	054X.3.2.1	15%	50%	4%	20%	0%	3%	0%	96%	1%	1.50	1
	Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Perennial Forb, Summer Tallgrass, Spring Midgrass, Deciduous Shrub, Spring Shortgrass											
Loamy Terrace	054X.3.2.2	6%	72%	5%	4%	0%	2%	0%	96%	2%	1.04	2
	Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb(I), Summer Perennial Forb, Summer Tallgrass											
Loamy Upland	054X.6.1.1	39%	39%	2%	10%	0%	15%	0%	60%	17%	0.90	6
	Spring Rhizomatous Grass, Spring Midgrass, Summer Shortgrass, Summer Stoloniferous Grass, Spring Perennial Grasslike, Spring Rhizomatous Grass(I), Summer Perennial Forb											
Loamy Upland	054X.6.1.2	34%	44%	1%	16%	1%	11%	0%	63%	16%	0.86	6
	Summer Stoloniferous Grass, Summer Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Forb											
Loamy Upland	054X.6.2.1	32%	45%	3%	15%	0%	6%	0%	79%	9%	1.24	8
	Spring Rhizomatous Grass, Spring Midgrass, Spring Rhizomatous Grass(I), Summer Shortgrass, Summer Perennial Forb, Spring Perennial Grasslike, Summer Perennial Forb(I)											
Loamy Upland	054X.6.2.2	33%	48%	4%	9%	0%	2%	0%	91%	4%	0.99	7
	Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb, Summer Shortgrass, Spring Perennial Grasslike											
Saline Bottomland	054X.35.1.1	31%	43%	2%	12%	0%	10%	0%	78%	3%	1.10	1
	Spring Rhizomatous Grass, Summer Rhizomatous Grass, Summer Perennial Forb, Evergreen Subshrub, Spring Midgrass, Spring Rhizomatous Grass(I), Summer Tallgrass											
Saline Bottomland	054X.35.1.2	47%	28%	1%	10%	0%	37%	0%	44%	1%	1.33	1
	Summer Rhizomatous Grass, Spring Shortgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Perennial Grasslike, Evergreen Subshrub											
Saline Bottomland	054X.35.2.1	7%	73%	1%	14%	0%	2%	0%	98%	0%	1.05	0
	Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Spring Shortgrass, Spring Midgrass, Spring Perennial Forb, Spring Annual Forb(I), Spring Annual Grass(I)											
Sandy Loam Upland	054X.7.1.1	47%	40%	2%	8%	4%	5%	0%	82%	3%	1.00	13
	Spring Midgrass, Spring Perennial Grasslike, Spring Rhizomatous Grass, Summer Midgrass, Summer Perennial Forb, Summer Shortgrass, Summer Tallgrass											
Sandy Loam Upland	054X.7.2.1	48%	33%	3%	7%	1%	33%	1%	52%	2%	0.67	7
	Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Summer Stoloniferous Grass, Spring Rhizomatous Grass, Summer Perennial Forb, Spring Perennial Forb											
Sandy Loam Upland	054X.7.3.1	36%	40%	3%	11%	1%	17%	0%	58%	9%	0.91	9
	Spring Rhizomatous Grass(I), Spring Rhizomatous Grass, Spring Midgrass, Spring Perennial Grasslike, Summer Tallgrass, Summer Shortgrass, Summer Perennial Forb											

Site Class Name	Comm Class ID	Bunch-grass	Sodgrass	Shrub	Forb + AnnGrass	Lichen	BareGrnd	Rock	Litter	Basal	Avg Plant Ht (ft)	Avg % Slope
Sandy Loam Upland	054X.7.3.2	50%	34%	3%	6%	0%	9%	0%	77%	5%	1.00	13
	Spring Midgrass(I), Spring Rhizomatous Grass(I), Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Summer Shortgrass, Spring Rhizomatous Grass											
Sandy Upland	054X.29.1.1	12%	29%	4%	12%	0%	35%	0%	60%	0%	0.79	3
	Spring Midgrass, Spring Perennial Grasslike, Summer Tallgrass, Spring Rhizomatous Grass, Summer Shortgrass, Summer Perennial Forb, Evergreen Subshrub											
Sandy Upland	054X.29.2.1	58%	24%	6%	2%	0%	17%	5%	68%	4%	0.55	27
	Summer Shortgrass, Summer Tallgrass, Spring Midgrass, Spring Perennial Grasslike, Summer Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb											
Sandy Upland	054X.29.3.1	19%	72%	1%	1%	0%	2%	0%	95%	3%	0.83	14
	Spring Midgrass, Spring Perennial Grasslike, Spring Midgrass(I), Summer Midgrass, Summer Perennial Forb(I), Spring Rhizomatous Grass(I), Summer Tallgrass											
Sandy Upland	054X.29.3.2	28%	52%	15%	4%	0%	3%	0%	92%	3%	1.19	10
	Spring Rhizomatous Grass(I), Spring Midgrass(I), Summer Perennial Forb, Spring Perennial Grasslike, Spring Midgrass, Summer Tallgrass, Summer Shortgrass											
Sandy Upland, Limy	054X.30.1.1	68%	8%	4%	6%	6%	16%	1%	64%	8%	1.11	20
	Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Spring Perennial Grasslike, Spring Perennial Forb, Summer Tallgrass, Spring Rhizomatous Grass(I)											
Sandy Upland, Limy	054X.30.1.2	35%	55%	1%	1%	0%	18%	1%	76%	2%	0.56	16
	Spring Perennial Grasslike, Spring Midgrass, Summer Perennial Forb, Summer Midgrass, Summer Shortgrass, Spring Rhizomatous Grass(I), Spring Rhizomatous Grass											
Shallow Upland	054X.18.1.1	48%	27%	5%	5%	1%	13%	2%	76%	5%	0.84	16
	Summer Midgrass, Spring Midgrass, Spring Rhizomatous Grass, Spring Perennial Grasslike, Summer Perennial Forb, Summer Tallgrass, Summer Shortgrass											
Shallow Upland	054X.18.2.1	43%	37%	4%	6%	2%	22%	0%	44%	22%	0.64	16
	Summer Shortgrass, Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Summer Perennial Forb, Summer Tallgrass, Deciduous Shrub											
Shallow Upland	054X.18.3.1	37%	33%	5%	17%	1%	8%	2%	73%	7%	0.98	14
	Spring Perennial Grasslike, Spring Midgrass, Spring Rhizomatous Grass, Spring Rhizomatous Grass(I), Summer Midgrass, Summer Stoloniferous Grass, Summer Perennial Forb											
Shallow Upland	054X.18.3.2	36%	42%	9%	5%	0%	9%	1%	75%	9%	1.21	20
	Spring Rhizomatous Grass(I), Spring Midgrass(I), Spring Rhizomatous Grass, Summer Midgrass, Spring Midgrass, Summer Perennial Forb, Spring Perennial Grasslike											

APPENDIX D. MLRA 54, REPRESENTATIVE SOIL MAP UNIT COMPONENTS

Claypan Upland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
SD601	Meade County, S.D., Northern Part	GaA	Gerdrum	60193
SD031	Corson County, South Dakota	RlB	Rhoades	53077
SD601	Meade County, S.D., Northern Part	BpB	Bullock	47106
SD105	Perkins County, South Dakota	AaB	Bullock	46355
SD105	Perkins County, South Dakota	RmC	Rhoades	43444

Loamy Terrace Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
D105	Perkins County, South Dakota	Sd	Shambo	28552
SD105	Perkins County, South Dakota	Ta	Trembles	28347
SD601	Meade County, S.D, Northern Part	Hc	Havre	22325
ND025	Dunn County, North Dakota	E4161A	Straw	17021
SD031	Corson County, South Dakota	Kc	Korchea	16069
ND057	Mercer County, North Dakota	E3527B	Bowbells	15966

Loamy Upland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
ND037	Grant County, North Dakota	E2803B	Amor	60467
SD031	Corson County, South Dakota	RaB	Reeder	60269
SD105	Perkins County, South Dakota	RcC	Reeder	60209
ND089	Stark County, North Dakota	E2803B	Amor	45026
SD105	Perkins County, South Dakota	MdC	Morton	43926

Saline Bottomland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
ND001	Adams County, North Dakota	E4005A	Harriet	14373
ND025	Dunn County, North Dakota	E4005A	Harriet	13374
SD041	Dewey County, South Dakota	Hc	Heil	11786
ND037	Grant County, North Dakota	E4005A	Harriet	10125

Sandy Loam Upland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
SD105	Perkins County, South Dakota	VaC	Vebar	68033
SD105	Perkins County, South Dakota	TwC	Twilight	49229
SD041	Dewey County, South Dakota	VeB	Vebar	45659
ND037	Grant County, North Dakota	E1625B	Vebar	42504
SD105	Perkins County, South Dakota	VaD	Vebar	34660
SD105	Perkins County, South Dakota	VaC	Cohagen	34016

Sandy Upland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
SD105	Perkins County, South Dakota	Bb	Banks	19473
ND037	Grant County, North Dakota	E4195A	Velva	8546
ND001	Adams County, North Dakota	E1403D	Telfer	7899
ND057	Mercer County, North Dakota	E1808B	Lihen	7807
SD031	Corson County, South Dakota	TdA	Telfer	6756

Sandy Upland, Limy Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
ND001	Adams County, North Dakota	E1403D	Beisigl	21063
ND037	Grant County, North Dakota	E1403D	Beisigl	7686
ND011	Bowman County, North Dakota	E1403D	Beisigl	7606
ND033	Golden Valley County, North Dakota	E1403D	Beisigl	7550
ND059	Morton County, North Dakota	E1403D	Beisigl	6072

Shallow Upland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
SD601	Meade County, S.D., Northern Part	CaD	Cabbart	53602
SD105	Perkins County, South Dakota	CaE	Cabba	49851
SD031	Corson County, South Dakota	CbD	Cabba	48775
SD601	Meade County, S.D, Northern Part	DeC	Delridge	45170
SD137	Ziebach County, South Dakota	LcD	Lantry	44120
SD105	Perkins County, South Dakota	RcC	Lantry	32841

Subirrigated Bottomland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
ND059	Morton County, North Dakota	E4131A	Havrelon	2457
ND041	Hettinger County, North Dakota	E1845A	Peta	1360
ND059	Morton County, North Dakota	E4206B	Banks	1302
ND065	Oliver County, North Dakota	E4131A	Havrelon	1069
ND059	Morton County, North Dakota	E4120A	Havrelon	614

Wet Bottomland Ecological Site Class

Area Symbol	Soil Survey Area	Map Unit	Component	Component Acres
ND053	McKenzie County, North Dakota	E4039A	Mckeen	6725
SD031	Corson County, South Dakota	La	Lallie	4429
ND105	Williams County, North Dakota	E4039A	Mckeen	4363
SD105	Perkins County, South Dakota	Db	Dimmick	3184
ND037	Grant County, North Dakota	E4701A	Arveson	2006
ND025	Dunn County, North Dakota	E4711A	Dimmick	1905

APPENDIX E. MLRA 54, COMMON PLANTS AND FUNCTIONAL GROUPS

Common Name	Accepted Symbol	Scientific Name	Functional Group
alfalfa	MEDIC	Medicago	Spring Perennial Forb(I)
alfalfa	MESA	Medicago sativa	Spring Perennial Forb(I)
alkali sacaton	SPAI	Sporobolus airoides	Summer Midgrass
alpine golden buckwheat	ERFL4	Eriogonum flavum	Summer Perennial Forb
Alyssum	ALYSS	Alyssum	Spring Annual Forb(I)
alyssumleaf phlox	PHAL3	Phlox alyssifolia	Spring Perennial Forb
American bird's-foot trefoil	LOUN	Lotus unifoliolatus	Summer Annual Forb
American licorice	GLLE3	Glycyrrhiza lepidota	Summer Perennial Forb
American milkvetch	ASAM3	Astragalus americanus	Summer Perennial Forb
American sloughgrass	BESY	Beckmannia syzigachne	Summer Annual Grass
American vetch	VIAM	Vicia americana	Herbaceous Vine
annual ragweed	AMAR2	Ambrosia artemisiifolia	Summer Annual Forb
aromatic aster	SYOB	Symphyotrichum oblongifolium	Summer Perennial Forb
wormwood	ARTEM	Artemisia	Evergreen Shrub
aster	ASTER	Aster	Spring Perennial Forb
aster	SYMPH4	Symphyotrichum	Summer Perennial Forb
ballhead ipomopsis	IPCO5	Ipomopsis congesta	Summer Perennial Forb
Baltic rush	JUARL	Juncus balticus	Spring Perennial Grasslike
bastard toadflax	COUM	Comandra umbellata	Spring Perennial Forb
beaked spikerush	ELRO2	Eleocharis rostellata	Summer Perennial Grasslike
bearded wheatgrass	ELTRS	Elymus subsecundus	Summer Perennial Grasslike
bearded wheatgrass	ELCA11	Elymus caninus	Spring Tallgrass(I)
bedstraw	GALIU	Galium	Spring Perennial Forb
big bluestem	ANGE	Andropogon gerardii	Summer Tallgrass
big sagebrush	ARTR2	Artemisia tridentata	Evergreen Shrub
bighead pygmycudweed	EVPR	Evax prolifera	Spring Annual Forb
bindweed	CONVO	Convolvulus	Summer Perennial Forb(I)
bird's-foot trefoil	LOCO6	Lotus corniculatus	Spring Perennial Forb(I)
black medick	MELU	Medicago lupulina	Summer Annual Forb(I)
blacksamson echinacea	ECAN2	Echinacea angustifolia	Summer Perennial Forb
bladderpod	LESQU	Lesquerella	Spring Perennial Forb
blazing star	LIATR	Liatris	Summer Perennial Forb
blue flax	LIPE2	Linum perenne	Summer Perennial Forb(I)
blue grama	BOGR2	Bouteloua gracilis	Summer Shortgrass
blue lettuce	LATA	Lactuca tatarica	Summer Perennial Forb
bluebunch wheatgrass	PSSP6	Pseudoroegneria spicata	Spring Midgrass
borage	BORAG	Borage	Spring Annual Forb
Branched false goldenweed	OOMU	Oonopsis multicaulis	Deciduous Subshrub

Common Name	Accepted Symbol	Scientific Name	Functional Group
breadroot	PEDIO2	Pediomelum	Spring Perennial Forb
bristlegrass	SETAR	Setaria	Summer Midgrass
brittle pricklypear	OPFR	Opuntia fragilis	Cacti
broadbeard beardtongue	PEAN4	Penstemon angustifolius	Spring Perennial Forb
broom snakeweed	GUSA2	Gutierrezia sarothrae	Evergreen Subshrub
buckwheat	ERIOG	Eriogonum	Spring Perennial Forb
buffaloberry	SHEPH	Shepherdia	Deciduous Shrub
buffalobur nightshade	SORO	Solanum rostratum	Spring Annual Forb
buffalograss	BODA2	Bouteloua dactyloides	Summer Stoloniferous Grass
bulrush	SCHOE6	Schoenoplectus	Summer Perennial Grasslike
California seablite	SUCA	Suaeda californica	Evergreen Subshrub
Canada bluegrass	POCO	Poa compressa	Spring Rhizomatous Grass(I)
Canada goldenrod	SOCA6	Solidago canadensis	Summer Perennial Forb
Canada thistle	CIAR4	Cirsium arvense	Summer Perennial Forb(I)
Canada wildrye	ELCA4	Elymus canadensis	Spring Midgrass
Canadian anemone	ANCA8	Anemone canadensis	Spring Perennial Forb
Canadian horseweed	COCA5	Conyza canadensis	Spring Annual Forb
candle anemone	ANCY	Anemone cylindrica	Summer Perennial Forb
Carolina draba	DRRE2	Draba reptans	Spring Annual Forb
catchfly	SILEN	Silene	Spring Annual Forb
cheatgrass	BRTE	Bromus tectorum	Spring Annual Grass(I)
chokecherry	PRVI	Prunus virginiana	Deciduous Shrub
cinquefoil	POTEN	Potentilla	Summer Perennial Forb
climbing false buckwheat	POSC3	Polygonum scandens	Herbaceous Vine
clover	TRIFO	Trifolium	Spring Perennial Forb
clustered field sedge	CAPR5	Carex praegracilis	Spring Perennial Grasslike
common barley	HOVU	Hordeum vulgare	Spring Annual Grass
common chickweed	STME2	Stellaria media	Spring Annual Forb(I)
common dandelion	TAOF	Taraxacum officinale	Spring Perennial Forb
common milkweed	ASSY	Asclepias syriaca	Summer Perennial Forb
common mouse-ear chickweed	CEFO2	Cerastium fontanum	Summer Perennial Forb(I)
common pepperweed	LEDE	Lepidium densiflorum	Spring Annual Forb
common snowberry	SYAL	Symphoricarpos albus	Deciduous Shrub
common spikerush	ELPA3	Eleocharis palustris	Spring Perennial Grasslike
common starlily	LEMO4	Leucocrinum montanum	Spring Perennial Forb
common sunflower	HEAN3	Helianthus annuus	Summer Annual Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group
common wheat	TRAE	Triticum aestivum	Spring Annual Grass(I)
common yarrow	ACMI2	Achillea millefolium	Spring Perennial Forb
common yellow oxalis	OXST	Oxalis stricta	Summer Perennial Forb
coneflower	RATIB	Ratibida	Summer Perennial Forb
coneflower	ECHIN	Echinacea	Summer Perennial Forb
Conyza	CONYZ	Conyza	Spring Annual Forb
creeping jenny	LYNU	Lysimachia nummularia	Summer Perennial Forb(I)
creeping juniper	JUHO2	Juniperus horizontalis	Evergreen Shrub
creeping meadow foxtail	ALAR	Alopecurus arundinaceus	Spring Rhizomatous Grass(I)
crested wheatgrass	AGCR	Agropyron cristatum	Spring Midgrass(I)
curly dock	RUCR	Rumex crispus	Spring Perennial Forb(I)
curlycup gumweed	GRSQ	Grindelia squarrosa	Summer Annual Forb
curlytop knotweed	POLA4	Polygonum lapathifolium	Summer Annual Forb
currant	RIBES	Ribes	Deciduous Shrub
Cusick's bluegrass	POCU3	Poa cusickii	Spring Perennial Grasslike
Dalea spp.	DALEA	Dalea	Deciduous Subshrub
davy mannagrass	GLLE2	Glyceria leptostachya	Spring Midgrass
deathcamas	ZIGAD	Zigadenus	Spring Perennial Forb
desert biscuitroot	LOFO	Lomatium foeniculaceum	Spring Perennial Forb
dotted blazing star	LIPU	Liatris punctata	Summer Perennial Forb
dwarf false indigo	AMNA	Amorpha nana	Deciduous Subshrub
eastern pasqueflower	PUPA5	Pulsatilla patens	Spring Perennial Forb
eastern poison ivy	TORA2	Toxicodendron radicans	Deciduous Subshrub
Evening Primrose	OENOT	Oenothera	Spring Perennial Forb
fall rosette grass	DIWI5	Dichanthelium wilcoxianum	Summer Shortgrass
false boneset	BREU	Brickellia eupatorioides	Summer Perennial Forb
false flax	CAMEL	Camelina	Summer Annual Forb
false pennyroyal	HEDEO	Hedeoma	Summer Annual Grass(I)
fescue	FESTU	Festuca	Spring Midgrass
fetid marigold	DYPA	Dyssodia papposa	Summer Annual Forb
field bindweed	COAR4	Convolvulus arvensis	Summer Perennial Forb(I)
field chickweed	CEAR4	Cerastium arvense	Summer Perennial Forb
field pennycress	THAR5	Thlaspi arvense	Spring Annual Forb(I)
field pepperweed	LECA5	Lepidium campestre	Spring Annual Forb(I)
field pussytoes	ANNE	Antennaria neglecta	Spring Perennial Forb
field sagewort	ARCAB4	Artemisia campestris ssp. borealis var. borealis	Summer Perennial Forb
field sagewort	ARCA12	Artemisia campestris	Summer Perennial Forb
field sowthistle	SOAR2	Sonchus arvensis	Summer Perennial Forb(I)
fireberry hawthorn	CRCH	Crataegus chrysocarpa	Deciduous Shrub
flax	LINUM	Linum	Spring Perennial Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group
fleabane	ERIGE2	Erigeron	Summer Perennial Forb
flexile milkvetch	ASFL2	Astragalus flexuosus	Summer Perennial Forb
Flodman's thistle	CIFL	Cirsium flodmanii	Summer Perennial Forb
foothill arnica	ARFU3	Arnica fulgens	Spring Perennial Forb
fourwing saltbush	ATCA2	Atriplex canescens	Evergreen Shrub
fowl bluegrass	POPA2	Poa palustris	Spring Midgrass
foxtail barley	HOJU	Hordeum jubatum	Spring Shortgrass
Gardner's saltbush	ATGA	Atriplex gardneri	Evergreen Subshrub
goatsbeard	TRAGO	Tragopogon	Summer Perennial Forb
goldenaster	CHRYS7	Chrysopsis	Summer Perennial Forb
goldenrod	SOLID	Solidago	Spring Perennial Forb
goosefoots	CHENO	Chenopodium	Spring Annual Forb
greasewood	SAVE4	Sarcobatus vermiculatus	Evergreen Shrub
green ash	FRPE	Fraxinus pennsylvanica	Deciduous Tree
green carpetweed	MOVE	Mollugo verticillata	Spring Annual Forb
green dragon	ARDR3	Arisaema dracontium	Spring Perennial Forb
green molly	BAAM4	Kochia americana	Evergreen Subshrub
green needlegrass	NAVI4	Nassella viridula	Spring Midgrass
groundplum milkvetch	ASCR2	Astragalus crassicarpus	Spring Perennial Forb
hairy false goldenaster	HEVI4	Heterotheca villosa	Spring Perennial Forb
hairy grama	BOHI2	Bouteloua hirsuta	Summer Shortgrass
hardstem bulrush	SCAC3	Schoenoplectus acutus	Spring Perennial Grasslike
Heller's rosette grass	DIOL	Dichanthelium oligosanthes	Spring Midgrass
herb sophia	DESO2	Descurainia sophia	Spring Annual Forb
hoary fleabane	ERCA4	Erigeron canus	Summer Perennial Forb
hoary puccoon	LICA12	Lithospermum canescens	Spring Perennial Forb
Horsetail	EQUIS	Equisetum	Spring Perennial Grasslike
Indiangrass	SONU2	Sorghastrum nutans	Summer Tallgrass
Indianhemp	APCA	Apocynum cannabinum	Summer Perennial Forb
inland rush	JUIN2	Juncus interior	Spring Perennial Grasslike
inland saltgrass	DISP	Distichlis spicata	Summer Rhizomatous Grass
intermediate wheatgrass	THIN6	Thinopyrum intermedium	Spring Rhizomatous Grass(I)
Japanese brome	BRAR5	Bromus japonicus	Spring Annual Grass(I)
Juniper	JUNIP	Juniperus	Coniferous Tree
Kentucky bluegrass	POPR	Poa pratensis	Spring Rhizomatous Grass(I)
knotweed	POLYG4	Polygonum	Summer Perennial Forb
kochia	BASC5	Kochia scoparia	Spring Annual Forb(I)
lacy tansyaster	MAPI	Machaeranthera pinnatifida	Spring Perennial Forb
lambsquarters	CHAL7	Chenopodium album	Spring Annual Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group
lambstongue ragwort	SEIN2	Senecio integerrimus	Spring Perennial Forb
large Indian breadroot	PEES	Pediomelum esculentum	Summer Perennial Forb
leadplant	AMCA6	Amorpha canescens	Deciduous Subshrub
leafy spurge	EUES	Euphorbia esula	Summer Perennial Forb(I)
lemon scurfpea	PSLA3	Psoralidium lanceolatum	Spring Perennial Forb
lesser spikemoss	SEDE2	Selaginella densa	Fern
lettuce	LACTU	Lactuca	Summer Annual Forb(I)
lilac penstemon	PEGR5	Penstemon gracilis	Spring Perennial Forb
little barley	HOPU	Hordeum pusillum	Spring Annual Grass
little bluestem	SCSC	Schizachyrium scoparium	Summer Midgrass
littleleaf pussytoes	ANMI3	Antennaria microphylla	Spring Perennial Forb
littlepod false flax	CAMI2	Camelina microcarpa	Spring Annual Forb(I)
locoweed	OXYTR	Oxytropis	Spring Annual Forb
longbract spiderwort	TRBR	Tradescantia bracteata	Summer Perennial Forb
longleaf phlox	PHLO2	Phlox longifolia	Spring Perennial Forb
long-stolon sedge	CAIN9	Carex inops	Spring Perennial Grasslike
Louisiana broomrape	ORLU	Orobanche ludoviciana	Summer Perennial Forb
maidenstears	SIVU	Silene vulgaris	Summer Perennial Forb(I)
marsh muhly	MURA	Muhlenbergia racemosa	Spring Rhizomatous Grass
mat muhly	MURI	Muhlenbergia richardsonis	Summer Rhizomatous Grass
matted sandmat	CHSE4	Chamaesyce serpens	Summer Annual Forb
meadow zizia	ZIAP	Zizia aptera	Spring Perennial Forb
milfoil	ACHIL	Achillea	Spring Perennial Forb
milfoil wattle	ACMI	Acacia millefolia	Deciduous Shrub
milkvetch	ASTRA	Astragalus	Spring Perennial Forb
milkweed	ASCLE	Asclepias	Spring Perennial Forb
mint	MENTH	Mentha	Spring Perennial Forb(I)
Missouri goldenrod	SOMI2	Solidago missouriensis	Summer Perennial Forb
Missouri milkvetch	ASMI10	Astragalus missouriensis	Spring Perennial Forb
Montana wheatgrass	ELAL7	Elymus albicans	Summer Rhizomatous Grass
mountain big sagebrush	ARTRV	Artemisia tridentata ssp. vaseyana	Evergreen Shrub
mouse-ear chickweed	CERAS	Cerastium	Summer Annual Forb(I)
mustard	BRASS2	Brassica	Spring Annual Forb(I)
muttongrass	POFE	Poa fendleriana	Spring Shortgrass
Nailwort	PARON	Paronychia	Summer Perennial Forb
narrowleaf goosefoot	CHLE4	Chenopodium leptophyllum	Summer Annual Forb
narrowleaf stoneseed	LIIN2	Lithospermum incisum	Spring Annual Forb
needleandthread	HECO26	Hesperostipa comata	Spring Midgrass
needleandthread	HECOC8	Hesperostipa comata ssp. comata	Spring Midgrass
needlegrass	HESPE11	Hesperostipa	Spring Midgrass

Common Name	Accepted Symbol	Scientific Name	Functional Group
needleleaf sedge	CADU6	Carex duriuscula	Summer Perennial Grasslike
New England aster	SYNO2	Symphyotrichum novae-angliae	Summer Perennial Forb
nightshade	SOLAN	Solanum	Spring Perennial Forb
northern bedstraw	GABO2	Galium boreale	Spring Perennial Forb
Norwegian cinquefoil	PONO3	Potentilla norvegica	Summer Annual Forb
Nuttall's alkaligrass	PUNU2	Puccinellia nuttalliana	Spring Rhizomatous Grass
Nuttall's saltbush	ATNU2	Atriplex nuttallii	Evergreen Shrub
oak	QUERC	Quercus	Evergreen Tree
obtuse sedge	CAOB4	Carex obtusata	Summer Perennial Grasslike
old man's whiskers	GETR	Geum triflorum	Spring Perennial Forb
Onion spp.	ALLIU	Allium	Spring Perennial Forb
Opuntia spp.	OPUNT	Opuntia	Cacti
orchardgrass	DAGL	Dactylis glomerata	Spring Midgrass(I)
other introduced annual forbs	2FA		Spring Annual Forb(I)
other native annual forbs	2FA		Spring Annual Forb
other native perennial forbs	2FP		Spring Perennial Forb
pale agoseris	AGGL	Agoseris glauca	Spring Perennial Forb
pasqueflower	PULSA	Pulsatilla	Spring Perennial Forb
peachleaf willow	SAAM2	Salix amygdaloides	Deciduous Shrub
Pennsylvania cinquefoil	POPE8	Potentilla pensylvanica	Summer Perennial Forb
Pennsylvania sedge	CAPE6	Carex pensylvanica	Spring Perennial Grasslike
pennycress	MICRO18	Microthlaspi	Spring Annual Forb(I)
pennycress	THLAS	Thlaspi	Spring Perennial Forb(I)
Penstemon spp.	PENST	Penstemon	Summer Perennial Forb
pepperweed	LEPID	Lepidium	Spring Annual Forb
Philadelphia fleabane	ERPH	Erigeron philadelphicus	Spring Perennial Forb
phlox	PHLOX	Phlox	Spring Perennial Forb
plains bluegrass	POAR3	Poa arida	Spring Rhizomatous Grass
plains milkvetch	ASGI5	Astragalus gilviflorus	Spring Perennial Forb
plains milkweed	ASPU	Asclepias pumila	Summer Perennial Forb
plains muhly	MUCU3	Muhlenbergia cuspidata	Summer Midgrass
plains pricklypear	OPPO	Opuntia polyacantha	Cacti
plains reedgrass	CAMO	Calamagrostis montanensis	Summer Rhizomatous Grass
Plantago spp.	PLANT	Plantago	Spring Annual Forb
porcupinegrass	HESP11	Hesperostipa spartea	Spring Midgrass
prairie bluebells	MELA3	Mertensia lanceolata	Spring Perennial Forb
prairie cordgrass	SPPE	Spartina pectinata	Summer Tallgrass

Common Name	Accepted Symbol	Scientific Name	Functional Group
prairie dropseed	SPHE	Sporobolus heterolepis	Summer Midgrass
prairie fleabane	ERST3	Erigeron strigosus	Summer Annual Forb
prairie Junegrass	KOMA	Koeleria macrantha	Spring Midgrass
prairie rose	ROAR3	Rosa arkansana	Deciduous Subshrub
prairie sagewort	ARFR4	Artemisia frigida	Evergreen Subshrub
prairie sandreed	CALO	Calamovilfa longifolia	Summer Tallgrass
prairie spiderwort	TROC	Tradescantia occidentalis	Summer Perennial Forb
prairie thermopsis	THRH	Thermopsis rhombifolia	Spring Perennial Forb
prairie threeawn	AROL	Aristida oligantha	Summer Midgrass
prairie wedgescale	SPOB	Sphenopholis obtusata	Spring Annual Grass(I)
prickly lettuce	LASE	Lactuca serriola	Spring Annual Forb(I)
prickly rose	ROAC	Rosa acicularis	Deciduous Subshrub
Prunus spp.	PRUNU	Prunus	Deciduous Shrub
purple dalea	DALA4	Dalea lasiathera	Spring Perennial Forb
purple locoweed	OXLA3	Oxytropis lambertii	Summer Perennial Forb
purple meadow-rue	THDA	Thalictrum dasycarpum	Spring Perennial Forb
purple milkvetch	ASAG2	Astragalus agrestis	Spring Perennial Forb
purple prairie clover	DAPU5	Dalea purpurea	Summer Perennial Forb
purple threeawn	ARPU9	Aristida purpurea	Summer Midgrass
Pursh seepweed	SUCA2	Suaeda calceoliformis	Summer Annual Forb
pussytoes	ANTEN	Antennaria	Spring Perennial Forb
pygmyflower rockjasmine	ANSE4	Androsace septentrionalis	Summer Annual Forb
quackgrass	ELRE4	Elymus repens	Spring Rhizomatous Grass(I)
rabbitbrush	CHRYS9	Chrysothamnus	Evergreen Shrub
rabbit-tobacco	PSOB3	Pseudognaphalium obtusifolium	Summer Annual Forb
ragweed	AMBRO	Ambrosia	Summer Annual Forb
rayless alkali aster	SYCI2	Symphyotrichum ciliatum	Summer Annual Forb
rayless sunflower	HERA	Helianthus radula	Summer Perennial Forb
reed canarygrass	PHAR3	Phalaris arundinacea	Spring Rhizomatous Grass
reedgrass	CALAM	Calamagrostis	Summer Rhizomatous Grass
rockcress	ARABI2	Arabis	Spring Perennial Forb
rockjasmine	ANDRO3	Androsace	Summer Perennial Forb
rose	ROSA5	Rosa	Deciduous Shrub
rosy pussytoes	ANRO2	Antennaria rosea	Summer Perennial Forb
rough bentgrass	AGSC5	Agrostis scabra	Summer Midgrass
rough cocklebur	XAST	Xanthium strumarium	Spring Annual Forb
rough false pennyroyal	HEHI	Hedeoma hispida	Summer Annual Forb
rubber rabbitbrush	ERNA10	Ericameria nauseosa	Evergreen Shrub
rush	JUNCU	Juncus	Spring Perennial Grasslike
rush skeletonplant	LYJU	Lygodesmia juncea	Spring Perennial Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group
Russian thistle	SAKA	Salsola kali	Spring Annual Forb(I)
saline saltbush	ATSU2	Atriplex subspicata	Spring Annual Forb
sand bluestem	ANHA	Andropogon hallii	Summer Tallgrass
sand dropseed	SPCR	Sporobolus cryptandrus	Summer Midgrass
sand muhly	MUAR2	Muhlenbergia arenicola	Summer Midgrass
sand sagebrush	ARFI2	Artemisia filifolia	Evergreen Shrub
Sandberg bluegrass	POSE	Poa secunda	Spring Shortgrass
sandcherry	PRPU3	Prunus pumila	Deciduous Shrub
sanddune wallflower	ERCA14	Erysimum capitatum	Spring Perennial Forb
scaly blazing star	LISQ	Liatris squarrosa	Summer Perennial Forb
scarlet beeblossom	GACO5	Gaura coccinea	Summer Perennial Forb
scarlet globemallow	SPCO	Sphaeralcea coccinea	Spring Perennial Forb
Schweinitz's flatsedge	CYSC3	Cyperus schweinitzii	Summer Perennial Grasslike
scouringrush horsetail	EQHY	Equisetum hyemale	Fern
scratchgrass	MUAS	Muhlenbergia asperifolia	Summer Rhizomatous Grass
scurfpea	PSORA2	Psoralidium	Spring Perennial Forb
sedge	CAREX	Carex	Spring Perennial Grasslike
seepweed	SUAED	Suaeda	Evergreen Subshrub
sheep fescue	FEOV	Festuca ovina	Spring Midgrass
shortawn foxtail	ALAE	Alopecurus aequalis	Spring Midgrass
shortbeak sedge	CABR10	Carex brevior	Spring Perennial Grasslike
shortbristle nneedleandthread	HECU9	Hesperostipa curtiseta	Spring Midgrass
shy wallflower	ERIN7	Erysimum inconspicuum	Spring Perennial Forb
Siberian elm	ULPU	Ulmus pumila	Deciduous Tree
sideoats grama	BOCU	Bouteloua curtipendula	Summer Midgrass
silver buffaloberry	SHAR	Shepherdia argentea	Deciduous Shrub
silver cinquefoil	POAR8	Potentilla argentea	Summer Perennial Forb(I)
silver sagebrush	ARCA13	Artemisia cana	Evergreen Subshrub
silverberry	ELCO	Elaeagnus commutata	Deciduous Shrub
silverleaf Indian breadroot	PEAR6	Pediomelum argophyllum	Summer Perennial Forb
silverscale saltbush	ATAR2	Atriplex argentea	Summer Annual Forb
silverweed cinquefoil	ARAN7	Argentina anserina	Spring Perennial Forb
sixweeks fescue	VUOC	Vulpia octoflora	Spring Annual Grass
skeletonplant	LYGOD	Lygodesmia	Spring Perennial Forb
skullcap	SCUTE	Scutellaria	Spring Annual Forb
skunkbush sumac	RHTR	Rhus trilobata	Deciduous Shrub
slender goldenweed	MAGR10	Machaeranthera gracilis	Spring Annual Forb
slender milkvetch	ASGR3	Astragalus gracilis	Spring Perennial Forb
slender wheatgrass	ELTR7	Elymus trachycaulus	Spring Midgrass

Common Name	Accepted Symbol	Scientific Name	Functional Group
slimflower scurfpea	PSTE5	Psoralidium tenuiflorum	Summer Perennial Forb
small geranium	GEPU2	Geranium pusillum	Spring Annual Forb(I)
small tumbleweed mustard	SILO3	Sisymbrium loeselii	Summer Annual Forb(I)
small-flower fame flower	PHPA29	Talinum parviflorum	Summer Perennial Forb
small-leaf pussytoes	ANPA4	Antennaria parvifolia	Summer Perennial Forb
smooth blue aster	SYLA3	Symphyotrichum laeve	Summer Perennial Forb
smooth brome	BRIN2	Bromus inermis	Spring Rhizomatous Grass(I)
smooth horsetail	EQLA	Equisetum laevigatum	Fern
smoothsheath sedge	CALA14	Carex laevivaginata	Summer Perennial Grasslike
snowberry	SYMPH	Symphoricarpos	Deciduous Shrub
soapweed yucca	YUGL	Yucca glauca	Monocot Shrub
spiderwort	TRADE	Tradescantia	Summer Perennial Forb
spikeoat	AVHO3	Helictotrichon hookeri	Spring Midgrass
spiny phlox	PHHO	Phlox hoodii	Spring Perennial Forb
Sporobolus spp.	SPORO	Sporobolus	Summer Midgrass
Sprengel's sedge	CASP7	Carex sprengelii	Spring Perennial Grasslike
spurge	EUPHO	Euphorbia	Summer Perennial Forb
stemless four-nerve daisy	TEAC	Tetraneuris acaulis	Summer Perennial Forb
stickseed	HACKE	Hackelia	Summer Perennial Forb
stickseeds	LAPPU	Lappula	Spring Annual Forb
sticky cinquefoil	POGL9	Potentilla glandulosa	Spring Perennial Forb
stickywilly	GAAP2	Galium aparine	Spring Annual Forb
stiff goldenrod	OLRI	Oligoneuron rigidum	Summer Perennial Forb
stiff sunflower	HEPA19	Helianthus pauciflorus	Summer Perennial Forb
stiffstem flax	LIRI	Linum rigidum	Summer Annual Forb
sunflower	HELIA3	Helianthus	Summer Annual Forb
sweetclover	MELIL	Melilotus	Spring Annual Forb(I)
sweetclover	MEOF	Melilotus officinalis	Spring Annual Forb(I)
switchgrass	PAVI2	Panicum virgatum	Summer Tallgrass
tall cinquefoil	POAR7	Potentilla arguta	Summer Perennial Forb
tall yellow sweetclover	MEAL3	Melilotus altissimus	Summer Perennial Forb(I)
tanseyleaf tansyaster	MATA2	Machaeranthera tanacetifolia	Spring Perennial Forb
tansymustard	DESCU	Descurainia	Spring Annual Forb
tarragon	ARDR4	Artemisia dracunculus	Summer Perennial Forb
textile onion	ALTE	Allium textile	Spring Perennial Forb
thickspike wheatgrass	ELLA3	Elymus lanceolatus	Spring Tallgrass
thistle	CIRSI	Cirsium	Summer Perennial Forb
threadleaf sedge	CAFI	Carex filifolia	Spring Perennial Grasslike
Threeawn	ARIST	Aristida	Summer Midgrass

Common Name	Accepted Symbol	Scientific Name	Functional Group
trefoil	LOTUS	Lotus	Spring Perennial Forb
triangle orache	ATPR	Atriplex prostrata	Summer Annual Forb
trumpet flower	COLLO	Collomia	Summer Annual Forb
tumblegrass	SCPA	Schedonnardus paniculatus	Summer Midgrass
tumblemustard	THELY3	Thelypodiopsis	Spring Annual Forb
twistspine pricklypear	OPMA2	Opuntia macrorhiza	Cacti
upright prairie coneflower	RACO3	Ratibida columnifera	Summer Perennial Forb
velvety goldenrod	SOMO	Solidago mollis	Summer Perennial Forb
vetch	VICIA	Vicia	Herbaceous Vine
violet woodsorrel	OXVI	Oxalis violacea	Spring Perennial Forb
wallflower	ERYSI	Erysimum	Spring Perennial Forb
wavyleaf thistle	CIUN	Cirsium undulatum	Summer Perennial Forb
western daisy fleabane	ERBE2	Erigeron bellidiastrum	Summer Annual Forb
western poison ivy	TORY	Toxicodendron rydbergii	Deciduous Subshrub
western ragweed	AMPS	Ambrosia psilostachya	Summer Perennial Forb
western rockjasmine	ANOC2	Androsace occidentalis	Summer Annual Forb
western snowberry	SYOC	Symphoricarpos occidentalis	Deciduous Shrub
western wheatgrass	PASM	Pascopyrum smithii	Spring Rhizomatous Grass
Wheat	TRITI	Triticum	Spring Annual Grass(I)
white ash	FRAM2	Fraxinus americana	Deciduous Tree
white heath aster	SYER	Symphyotrichum ericoides	Summer Perennial Forb
white pasqueflower	PUOC	Pulsatilla occidentalis	Spring Perennial Forb
white penstemon	PEAL2	Penstemon albidus	Spring Perennial Forb
white prairie aster	SYFA	Symphyotrichum falcatum	Summer Perennial Forb
white prairie clover	DACA7	Dalea candida	Summer Perennial Forb
white sagebrush	ARLUL2	Artemisia ludoviciana ssp. ludoviciana	Spring Perennial Forb
white sagebrush	ARLU	Artemisia ludoviciana	Summer Perennial Forb
white sweetclover	MEOF	Melilotus alba	Spring Annual Forb(I)
whitetop	CADR	Cardaria draba	Spring Perennial Forb(I)
whorled milkweed	ASVE	Asclepias verticillata	Summer Perennial Forb
whorled milkwort	POVE	Polygala verticillata	Summer Annual Forb
whorled milkwort	POAM9	Polygala ambigua	Summer Annual Forb
wild bergamot	MOFI	Monarda fistulosa	Summer Perennial Forb
wild mint	MEAR4	Mentha arvensis	Summer Perennial Forb
wild oat	AVFA	Avena fatua	Spring Annual Grass(I)
windflower	ANEMO	Anemone	Summer Perennial Forb
winterfat	KRLA2	Krascheninnikovia lanata	Evergreen Subshrub
witchgrass	PACA6	Panicum capillare	Summer Annual Grass
Woods' rose	ROWO	Rosa woodsii	Deciduous Shrub
woodsorrel	OXALI	Oxalis	Spring Perennial Forb
woolly plantain	PLPA2	Plantago patagonica	Spring Annual Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group
wormwood	ARAB3	Artemisia absinthium	Spring Perennial Forb(I)
Wyoming besseya	BEWY	Besseya wyomingensis	Spring Perennial Forb
yellow owl's-clover	ORLU2	Orthocarpus luteus	Spring Annual Forb
yellow salsify	TRDU	Tragopogon dubius	Spring Annual Forb(I)
yellow sundrops	CASE12	Calylophus serrulatus	Summer Perennial Forb
Yucca spp.	YUCCA	Yucca	Monocot Shrub

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