Ecological site FX053A99X150
Subirrigated (Sb)

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 053A–Northern Dark Brown Glaciated Plains

The Northern Dark Brown Glaciated Plains, MLRA 53A, is a large, agriculturally and ecologically significant area. It consists of approximately 6.1 million acres and stretches 140 miles from east to west and 120 miles from north to south, encompassing portions of 8 counties in northeastern Montana and northwestern North Dakota. This region represents part of the southern edge of the Laurentide Ice Sheet during maximum glaciation. It is one of the driest and westernmost areas within the vast network of glacially derived prairie pothole landforms of the Northern Great Plains and falls roughly between the Missouri Coteau to the east and the Brown Glaciated Plains to the west. Elevation ranges from 1,800 feet (550 meters) to 3,300 feet (1,005 meters).

Soils are primarily Mollisols, but Inceptisols and Entisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). The bedrock is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur in glacial outwash channels and along major drainages, including portions of the Missouri, Poplar, and Big Muddy Rivers. Large eolian deposits of sand occur in the vicinity of the ancestral Missouri River channel east of Medicine Lake (Fullerton et al., 2004). The northwestern portion of the MLRA contains a large unglaciated area containing paleoterraces and large deposits of sand and gravel known as the Flaxville gravel.

Much of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton and Colton, 1986; Fullerton et al., 2004). Subsequent erosion from major stream and river systems has created numerous drainageways throughout much of the MLRA. The result is a geologically young landscape that is predominantly a dissected till plain interspersed with alluvial deposits and dominated by soils in the Mollisol and Inceptisol orders. Much of this area is typic ustic, making these soils very productive and generally well suited to production agriculture.

Dryland farming is the predominant land use, and approximately 50 percent of the land area is used for cultivated crops. Winter, spring, and durum varieties of wheat are the major crops, with over 48 million bushels produced annually (USDA-NASS, 2017). Areas of rangeland typically are on steep hillslopes along drainages. The rangeland is mostly native mixedgrass prairie similar the Stipa-Agropyron, Stipa-Bouteloua-Agropyron, and Stipa-Bouteloua faciations (Coupland, 1950; 1961). Cool-season grasses dominate and include rhizomatous wheatgrasses, needle and thread, western porcupine grass, and green needlegrass. Woody species are generally rare; however, many of the steeper drainages support stands of trees and shrubs such as green ash and chokecherry. Seasonally ponded, prairie pothole wetlands may occur throughout the MLRA, but the greatest concentrations are in the east and northeast where receding glaciers stagnated and formed disintegration moraines with hummocky topography and numerous areas of poorly drained soils.

Classification relationships

NRCS Soil Geography Hierarchy
• Land Resource Region: Northern Great Plains
• Major Land Resource Area (MLRA): 053A Northern Dark Brown Glaciated Plains

National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007)
• Domain: Dry
• Division: Temperate Steppe
• Province: Great Plains-Palouse Dry Steppe Province 331
• Section: Glaciated Northern Grasslands Section 331L
• Subsection: Glaciated Northern Grasslands Subsection 331La
• Landtype association/Landtype phase: N/A

National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)
• Class: Mesomorphic Shrub and Herb Vegetation Class (2)
• Subclass: Shrub and Herb Wetland Subclass (2.C)
• Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)
• Division: Eastern North American Temperate and Boreal Freshwater Marsh, Wet Meadow and Shrubland Division (2.C.4.Nd)
• Macrogroup: *Spartina pectinata* - Typha spp. - Schoenoplectus spp. Great Plains Marsh, Wet Meadow, Shrubland and Playa Macrogroup (2.C.4.Nd.5)
• Group: *Spartina pectinata* - *Calamagrostis stricta* - Carex spp. Great Plains Wet Prairie, Wet Meadow and Seepage Fen Group (2.C.4.Nd.5.b)

EPA Ecoregions
• Level 1: Great Plains (9)
• Level 2: West-Central Semi-Arid Prairies (9.3)
• Level 3: Northwestern Glaciated Plains (42)
• Level 4: Glaciated Dark Brown Prairie (42i)
Glaciated Northern Grasslands (42j)

Ecological site concept

Subirrigated is an ecological site of limited extent occurring on floodplains and stream terraces. The distinguishing characteristics of this site are that it receives additional moisture from groundwater, and a seasonal water table occurs 24 to 40 inches below the soil surface. Soils for this ecological site are typically very deep (more than 60 inches), somewhat poorly drained, and derived from alluvium. Characteristic vegetation is sedges (Carex spp.), slimstem reedgrass (*Calamagrostis stricta*), and prairie cordgrass (*Spartina pectinata*).

Associated sites

FX053A99X713	**Saline Lowland (SLL)** This site is adjacent to the Subirrigated ecological site in similar landscape positions but in areas where salts have accumulated due to geology, hydrology, or soil properties.
FX053A99X061	**Riparian Woodland (RW)** This site is adjacent to the Subirrigated ecological site, typically on similar landscape positions, but where riparian woody plants are dominant.
FX053A99X060	**Overflow (Ov)** This site is adjacent to the Subirrigated ecological site, typically on higher terraces where ground water is greater than 40 inches below the surface and the primary moisture source is surface water.
FX053A99X084	**Slough (Sl)** This site is adjacent to the Subirrigated ecological site, typically in oxbows or channels where flooding is very frequent, the water table is shallow and persistent, and frequent ponding occurs.

Similar sites

FX053A99X061	**Riparian Woodland (RW)** This site differs from the Subirrigated ecological site in that it is dominated by riparian woody species. Shrubs and trees dominate the site in terms of cover and production.
FX053A99X084	**Slough (Sl)** This site differs from the Subirrigated ecological site in that depth to a water table is less than 24 inches and the site receives frequent long duration ponding. It is located in oxbows, old channels, or depressions on floodplains and is more productive. Vegetation is dominated by hydrophytes such as bulrush and cattail.
FX053A99X713	**Saline Lowland (SLL)** This site differs from the Subirrigated ecological site in that soils are saline, sodic, or saline-sodic (EC ≥ 4 or SAR ≥ 13). It supports more sodium-tolerant vegetation and is less productive.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex* (2) *Calamagrostis stricta*

Legacy ID

R053AY719MT

Physiographic features

This ecological site occurs on alluvial fans and floodplain steps of perennial or intermittent streams, near springs or seeps, or other areas that have a seasonal water table 24 to 40 inches below the soil surface. Slopes typically range from 0 to 2 percent. This site occurs on all aspects.

Table 2. Representative physiographic features

Landforms	(1) River valley > Flood-plain step (2) River valley > Alluvial fan (3) Till plain > Drainageway
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,800–3,300 ft
Slope	0–2%
Water table depth	24–40 in
Aspect	Aspect is not a significant factor

Climatic features

The Northern Dark Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Coupland, 1958; Richardson and Hanson, 1977; Heidel et al., 2000). The majority of precipitation occurs as steady, soaking, frontal system rains in late spring to early summer. Summer rainfall comes mainly from convection thunderstorms that typically deliver scattered amounts of rain in intense bursts. These storms may be accompanied by damaging winds and large-diameter hail and result in flash flooding along low-order streams. Approximately 80 percent of the annual precipitation occurs during the growing season. June is the wettest month, followed by July and May (Richardson and Hanson, 1977; Heidel et al., 2000). Average annual precipitation ranges from 11 inches (280 mm) near Richey, Montana, to 15 inches (380 mm) in the Little Muddy drainage near Williston, North Dakota, but precipitation varies greatly from year to year. On average, severe drought and very wet years occur with the same frequency, which is 1 out of 10 years (Coupland, 1958; Heidel et al., 2000). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). The frost-free period for this ecological site ranges from 90 to 130 days, and the freeze-free period ranges from 115 to 155 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	115-155 days
Precipitation total (characteristic range)	11-15 in
Frost-free period (average)	110 days
Freeze-free period (average)	135 days
Precipitation total (average)	13 in

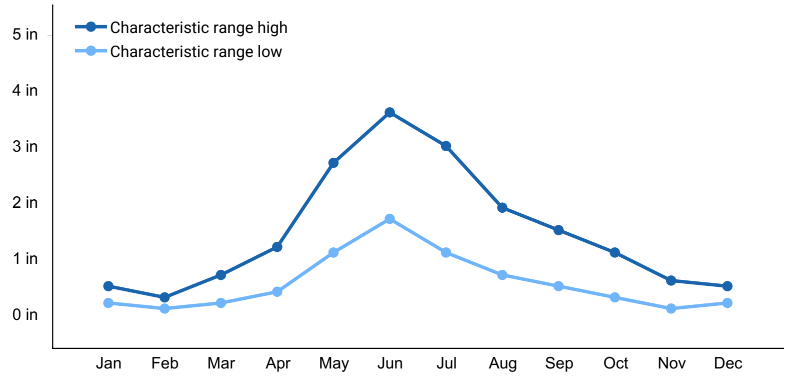


Figure 1. Monthly precipitation range

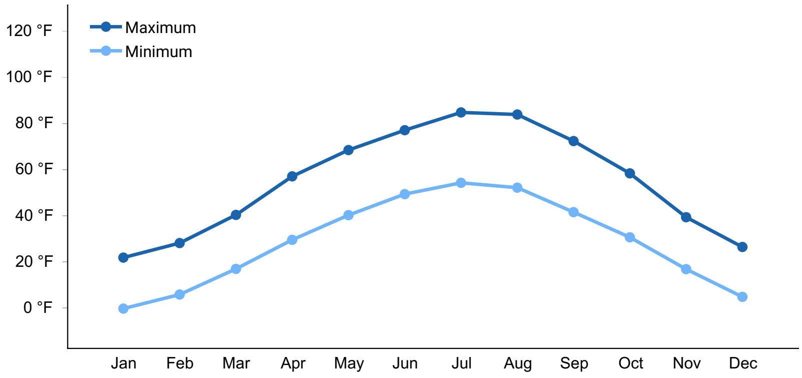


Figure 2. Monthly average minimum and maximum temperature

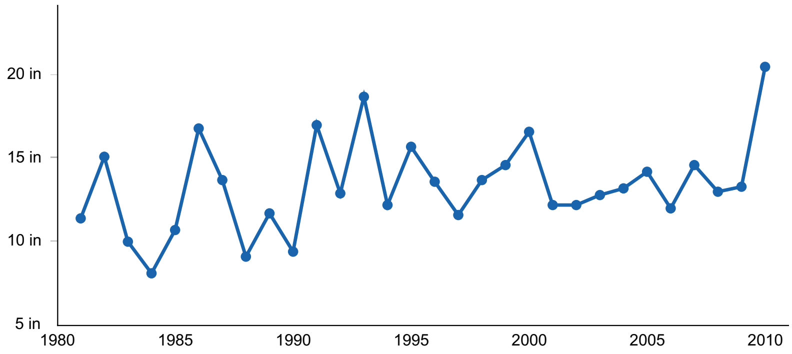


Figure 3. Annual precipitation pattern

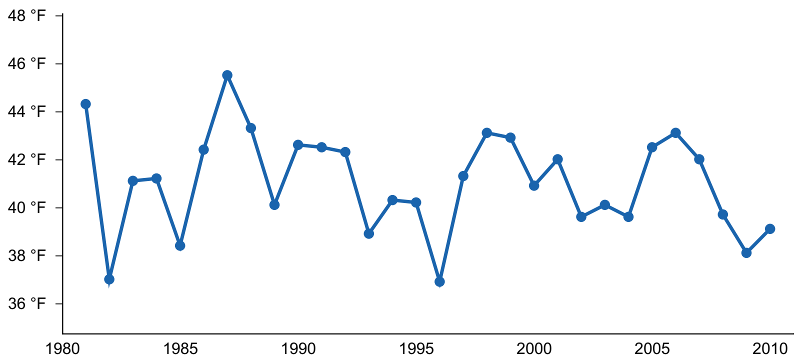


Figure 4. Annual average temperature pattern

Climate stations used

- (1) BREDETTE [USC00241088], Poplar, MT
- (2) CULBERTSON [USC00242122], Culbertson, MT
- (3) OPHEIM 10 N [USC00246236], Opheim, MT
- (4) OPHEIM 12 SSE [USC00246238], Opheim, MT
- (5) PLENTYWOOD [USC00246586], Plentywood, MT
- (6) SCOBEY 4 NW [USC00247425], Scobey, MT
- (7) SIDNEY [USC00247560], Sidney, MT
- (8) VIDA 6 NE [USC00248569], Vida, MT
- (9) WILLISTON SLOULIN INTL AP [USW00094014], Williston, ND

Influencing water features

This is a floodplain or drainageway site that receives additional moisture from groundwater and occasionally stream overflow. When on floodplains, the site may be flooded for brief durations during major flood events. A seasonal groundwater table is present between 24 and 40 inches below the soil surface, particularly during spring.

Wetland description

Palustrine Emergent

Soil features

Soils for this ecological site are typically very deep (more than 60 inches), somewhat poorly drained, and derived from alluvium. All soils in this site concept are endosaturated, meaning that they receive additional moisture from groundwater. A seasonal water table is present at a depth of 24 to 40 inches below the soil surface. These soils have an aquic moisture regime and a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface horizon textures in this site are typically loam, silt loam, or silty clay loam. The underlying horizons are typically comprised of stratified alluvial deposits, characterized by many thin layers of sediment deposited by past flood events. In the upper 20 inches, electrical conductivity is less than 4 and the sodium absorption ratio is less than 13. Calcium carbonate equivalent is typically less than 15 percent throughout the soil profile. Soil pH classes are neutral to slightly alkaline in the surface horizon and slightly alkaline to moderately alkaline in the subsurface horizons. Typically, the upper 20 inches of soil does not contain coarse fragments.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Silt loam (3) Silty clay loam
Drainage class	Somewhat poorly drained

Soil depth	60–72 in
Electrical conductivity (0-20in)	0–3 mmhos/cm
Sodium adsorption ratio (0-20in)	0–12

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Subirrigated provisional ecological site in MLRA 53A consists of five vegetative states: The Historic Reference State (1), the Contemporary Reference State (2), the Altered State (3). the Invaded State (4), and the Cropland State (5). Plant communities associated with the Subirrigated ecological site evolved under the combined influences of climate, fire, grazing, and hydrology. Extreme climatic variability results in frequent droughts, which can have great influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

The historic ecosystem experienced periodic lightning-caused fires with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). Generally, fires were less frequent on the Subirrigated ecological site than on adjacent drier sites, however, early reports indicate that fires did occur in wetlands (Higgins, 1986). The Subirrigated ecological site is resilient to fire and the most significant effects of fire are most likely removing excess litter accumulations and triggering resprouting and reseeding of cattail and hardstem bulrush (Esser, 1995; Gucker, 2008).

Native grazers also shaped these plant communities. American bison (Bison bison) were the dominant historic grazer, but pronghorn (Antilocapra americana), elk (Cervus canadensis), and deer (Odocoileus spp.) were also common. Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) also played an important role in the ecology of these communities (Lockwood, 2004).

Hydrology is a crucial dynamic on this site. Depth and duration of the seasonal water table strongly influences species composition on this ecological site. Hydrologic alterations that modify the depth and the persistence of the seasonal water table may have a significant effect on species composition and production. In some cases, salinization may occur. On portions of this site the hydrology has been significantly altered by irrigation, major dams, and diversions. The implications of this alteration have not been fully studied and require further investigation.

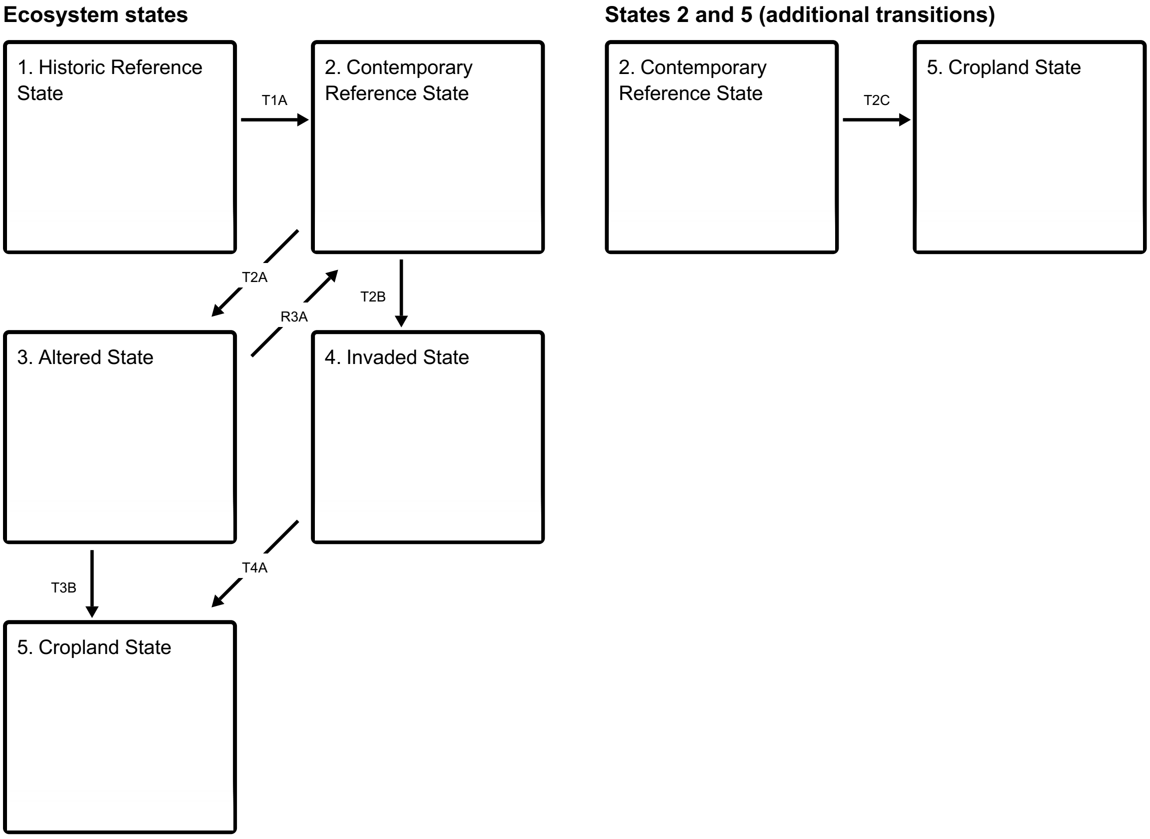
Improper grazing of this site can result in a reduction in the cover of the palatable sedges and cool-season midgrasses (Hansen et al., 1995). Tall, warm-season rhizomatous grasses may sustain trampling damage. Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year, or that do not provide adequate cover to prevent soil erosion over time. These practices may include, but are not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years. Over time species diversity, particularly of sedges, can be significantly reduced by improper grazing. Periods of drought can also reduce sedges and rhizomatous grasses. Further degradation of the site due to improper grazing can result in low vigor of rhizomatous grasses and dominance of unpalatable forbs and rushes. On some sites, sedges can be reduced to a single, unpalatable species (Hansen et al., 1995). Unpalatable forbs may also be common.

Most, if not all, extant examples of this site have some degree of invasion by non-native species. This site is highly susceptible to invasion by non-native species. Perennial grasses such as non-native bluegrasses (Poa spp.), smooth brome (*Bromus inermis*), and reed canarygrass (*Phalaris arundinacea*) are the most common invasive species. These species are widespread throughout the Northern Great Plains and can invade relatively undisturbed grasslands (DeKeyser et al., 2013; Grant et al., 2009; Toledo et al., 2014). In most cases native ecological function is relatively intact, but in some cases non-native grasses will displace native species and dominate the ecological functions of the site. Noxious weeds are also a major concern on this site. Leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), and Russian knapweed (*Acroptilon repens*), also known as hardheads, are common on this site and capable of displacing native species.

The Subirrigated ecological site is often considered prime farmland and large portions of this site have been converted to cropland, mostly for perennial hay. Common crop species include alfalfa (*Medicago sativa*), orchardgrass (*Dactylis glomerata*), creeping foxtail (*Alopecurus arundinaceus*), and grass/alfalfa mixes. Annual crops such as wheat and barley are occasionally planted as part of a rotation or when renovating hay fields. Sometimes irrigation is applied with flood irrigation being most common. Water is typically diverted from nearby streams and delivered to fields via canals. Extensive irrigation systems are in place on many parts of the major river drainages. Irrigated cropland is extremely valuable in the region, and once the site is converted it is unlikely to be taken out of production.

The state-and-transition model (STM) diagram and legend suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support vegetative states not displayed in the STM diagram. Landowners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The reference community phase may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State and transition model



T1A - Introduction of non-native invasive species such as Kentucky bluegrass, noxious weeds, etc.

T2A - Prolonged improper grazing

T2B - Displacement of native species by non-native invasive species (Kentucky bluegrass, noxious weeds, etc.)

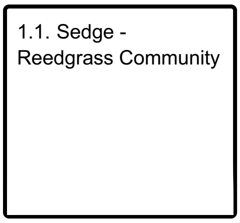
T2C - Conversion to cropland

R3A - Proper grazing management, normal or above-normal moisture, revegetation (management intensive and costly)

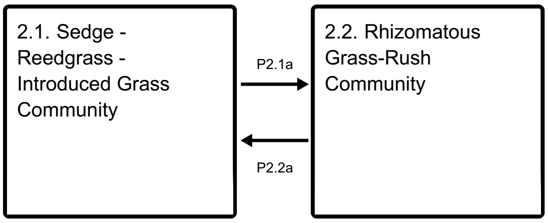
T3B - Conversion to cropland

T4A - Conversion to cropland

State 1 submodel, plant communities



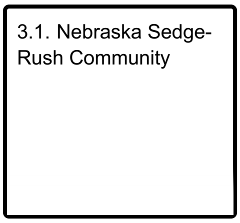
State 2 submodel, plant communities



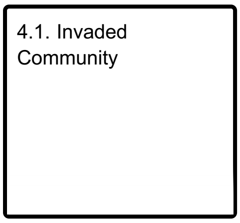
P2.1a - Drought, improper grazing management

P2.2a - Return to normal or above average precipitation, proper grazing management

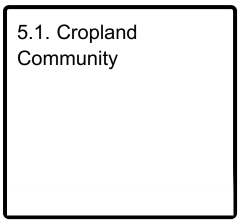
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Historic Reference State

The Historic Reference State (1) contains one community phase characterized by sedges, and reedgrasses. This state is considered extinct and is included here for historical reference purposes. It evolved under the combined influences of climate, grazing, fire, and floodplain hydrology. In general, this state was resilient to grazing and fire, although these factors could influence species composition in localized areas. Hydrology, particularly of groundwater, was an important ecological driver for this site. Depth and duration of the seasonal water table strongly influenced species composition and productivity.

Community 1.1
Sedge - Reedgrass Community

The Sedge - Reedgrass Community Phase (1.1) was characterized by numerous sedges and reedgrasses. Common species were beaked sedge (*Carex rostrata*), water sedge (*Carex aquatilis*), and slimstem reedgrass (*Calamagrostis stricta*). Other grass species that may have occurred are slender wheatgrass (*Elymus trachycaulus*), prairie cordgrass (*Spartina pectinata*) and tufted hairgrass (*Deschampsia cespitosa*). Forbs comprised about 10 percent of the cover and shrubs 5 percent or less.

State 2
Contemporary Reference State

The Contemporary Reference State (2) contains two community phases characterized by sedges, reedgrasses, and other mid-statured rhizomatous grasses. It evolved under the combined influences of climate, grazing, fire, and floodplain hydrology, with hydrology having the greatest influence on cover and production. This state differs from the historical reference state in that it is influenced by introduced plant species and has altered fire and grazing regimes. In general, this state is resilient to grazing and fire, although these factors can influence species composition in localized areas.

Community 2.1
Sedge - Reedgrass - Introduced Grass Community

The Sedge - Reedgrass - Introduced Grass Community Phase (2.1) is predominantly native species, but it has some degree of non-native grass establishment. This phase has a high diversity of sedges and species such as beaked sedge, water sedge, and woolly sedge (*Carex pellita*) are common. Mid-statured rhizomatous grasses are also common and may include slimstem reedgrass, prairie cordgrass, and slender wheatgrass. Forbs comprise about 10 percent of the cover and shrubs 5 percent or less. Non-native species such as Kentucky bluegrass (*Poa pratensis*) typically comprise 1 to 3 percent of the plant community.

Community 2.2
Rhizomatous Grass-Rush Community

The Rhizomatous Grass-Rush Community Phase (2.2) occurs when site conditions decline due to drought or improper grazing management. It is characterized by a decline in sedge diversity and an increase in rushes (Juncus spp). Sensitive species such as beaked sedge are in decline and are replaced by more resilient species, particularly Nebraska sedge (*Carex nebrascensis*) (Hansen et al., 1995). Mid-statured rhizomatous grasses are also decreasing, although some of the more resilient species such as prairie cordgrass may persist longer than other species. Unpalatable forbs such as American Licorice (*Glycyrrhiza lepidota*) and cudweed sagewort (*Artemisia ludoviciana*) may also increase in this phase.

Pathway P2.1a
Community 2.1 to 2.2

Drought, improper grazing management, or a combination of these factors can shift the Sedge-Reedgrass-Introduced Grass Community Phase (2.1) to the Rhizomatous Grass-Rush Community Phase (2.2). These factors favor a decrease in species diversity and an increase in rushes and unpalatable forbs.

Pathway P2.2a
Community 2.2 to 2.1

Normal or above-average spring precipitation and proper grazing management transition the Rhizomatous Grass-Rush Community Phase (2.2) back to the Sedge-Reedgrass-Introduced Grass Community Phase (2.1).

State 3
Altered State

The Altered State (3) consists of one community phase. The dynamics of this state are driven by long term improper grazing management. Species diversity of sedges is greatly reduced, often consisting of only one species. Rushes and unpalatable forbs increase at the expense of rhizomatous grasses and palatable sedges. Proper grazing management can reduce rush cover and increase the cover of rhizomatous grasses, but this recovery may take decades.

Community 3.1
Nebraska Sedge-Rush Community

The Nebraska Sedge-Rush Community Phase (3.1) occurs when site conditions decline due to long-term improper grazing management. Under these conditions Nebraska sedge increases, displacing other sedge species and sometimes forming a monoculture. It also forms a dense root mat that is resistant to grazing and may prevent reestablishment of other graminoid species long after a change in management occurs (Hansen et al., 1995). Rhizomatous grasses such as slimstem reedgrass and prairie cordgrass have been largely eliminated and replaced by rushes. Unpalatable forbs such as American licorice and cudweed sagewort may also be common in the phase.

State 4
Invaded State

The Invaded State (4) occurs when invasive plant species invade adjacent native grassland communities and displace the native species. Data suggest that native species diversity declines significantly when invasive species exceed 30 percent of the plant community. The most common concerns are non-native perennial grasses such as Kentucky bluegrass, which is widespread throughout the Northern Great Plains (Toledo et al., 2014). Kentucky bluegrass is very competitive and displaces native species by forming dense root mats, altering nitrogen cycling, and having allelopathic effects on germination (DeKeyser et al., 2013). It may also alter soil surface hydrology and modify soil surface structure (Toledo et al., 2014). Plant communities dominated by Kentucky bluegrass have significantly less cover of native grass and forb species (Toledo et al., 2014; DeKeyser et al., 2009). Invasive grass species can invade relatively undisturbed grasslands, although it is not clear what triggers them to displace native species. In some cases, they have been found to substantially increase under long-term grazing exclusion (DeKeyser et al., 2009, 2013; Grant et al., 2009), but a consistent correlation to grazing management practices cannot be made at this time. Reduced plant species diversity, simplified structural complexity, and altered biologic processes result in a state that is substantially departed from both the Reference State (1) and the Contemporary Reference State (2). Noxious weeds such as leafy spurge and Canada thistle are not widespread in MLRA 53A, but they can be a concern in localized areas. These species are very aggressive perennials. They typically displace native species and dominate ecological function when they invade a site. In some cases, these species can be suppressed through intensive management (herbicide application, biological control, or intensive grazing management). Control efforts are unlikely to eliminate noxious weeds, but their density can be sufficiently suppressed so that species composition and structural complexity are similar to that of the Contemporary Reference State (2). However, cessation of control methods will most likely result in recolonization of the site by the noxious species.

Community 4.1
Invaded Community

Encroachment by introduced grasses, noxious weeds, and other invasive species is common. Reduced plant species diversity, simplified structural complexity, and altered biologic processes result in a state that is substantially departed from both the Reference State (1) and the Contemporary Reference State (2).

State 5
Cropland State

The Cropland State (5) occurs when land is put into cultivation. Deep, fertile soils and favorable moisture conditions make the Subirrigated ecological site prime farmland. Additionally, its proximity to perennial streams make it possible to apply irrigation. Because of this, many acres of the Subirrigated ecological site have been converted to farmland, particularly along the major rivers. It is most commonly planted to non-native perennial species for production of hay. Common species include alfalfa, orchardgrass, creeping foxtail, and grass/alfalfa mixes. Annual crops such as wheat and barley are occasionally planted in rotation with perennial species. In some cases, irrigation is applied in an attempt to increase production. Flood irrigation is most common but center pivot sprinklers are used in some areas. Cropping and irrigation projects have vastly altered vegetation and hydrology on much of the Subirrigated ecological site. Once the site is converted to production agriculture, land values increase significantly and it is unlikely that the site will be converted back to natural vegetation.

Community 5.1
Cropland Community

Typically non-native, perennial hay. Cool-season cereal grains such as wheat or barley may also be grown in some instances.

Transition T1A
State 1 to 2

Introduction of non-native grass species occurred in the early 20th century. The naturalization of these species in relatively undisturbed grasslands, coupled with changes in fire and grazing regimes, transitions the Reference State (1) to the Contemporary Reference State (2).

Transition T2A
State 2 to 3

Improper grazing practices weaken the resilience of the Contemporary Reference State (2) and drive its transition to the Altered State (3). The Contemporary Reference State (2) transitions to the Shortgrass State (3) when species diversity is severely reduced and mid-statured grasses become rare. Grazing resistant species such as Nebraska sedge and Baltic rush (*Juncus arcticus* ssp. littoralis) dominate the plant community.

Transition T2B
State 2 to 4

The Contemporary Reference State (2) transitions to the Invaded State (4) when aggressive introduced species or noxious weeds displace native species. The most common concerns on this site are introduced forbs such as curly dock and noxious weeds. The precise triggers of this transition are not clear and further investigation is needed. In addition, other rangeland health attributes, such as reproductive capacity of native grasses and soil quality, have been substantially altered.

Transition T2C
State 2 to 5

Tillage or application of herbicide followed by seeding of cultivated crops such as wheat, barley or introduced hay, transitions the Contemporary Reference State (2) to the Cropland State (5).

Restoration pathway R3A
State 3 to 2

A reduction in livestock grazing pressure alone may not be sufficient to return the Altered State (3) to the Contemporary Reference State (2). Nebraska sedge in particular can resist displacement by other species (Hansen et al., 1995). Intensive grazing management and revegetation may be necessary, but these are labor intensive and costly. Therefore, returning the Altered State (3) to the Contemporary Reference State (2) can require considerable energy and cost and may not be feasible within a reasonable amount of time.

Conservation practices

Critical Area Planting
Prescribed Grazing
Range Planting

Transition T3B
State 3 to 5

Tillage or application of herbicide followed by seeding of cultivated crops such as wheat, barley or introduced hay, transitions the Altered State (3) to the Cropland State (5).

Transition T4A
State 4 to 5

Tillage or application of herbicide followed by seeding of cultivated crops such as wheat, barley or introduced hay, transitions the Invaded State (4) to the Cropland State (5).

Additional community tables

Inventory data references

Only one field plot was available for this site, but data was collected from this plot for six consecutive years. These data, in conjunction with a review of the scientific literature and professional experience, were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/10/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**