Ecological site FX053A99X713
Saline Lowland (SLL)

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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 mixed-grass prairie similar to 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: Temperate and Boreal Grassland and Shrubland Subclass (2.B)
• Formation: Temperate Grassland and Shrubland Formation (2.B.2)
• Division: Central North American and Shrubland Division (2.B.2.Nb)
• Macrogroup: Great Plains Saline Wet Meadow and Marsh Macrogroup (2.C.5.Na.1)
• Group: Great Plains Saline Wet Meadow and Marsh Group (2.C.5.Na.1.a)

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

Saline Lowland is a somewhat extensive ecological site occuring on alluvial fans, floodplains, drainageways, and stream terraces. The distinguishing characteristics of this site are that it receives additional moisture from surface water and/or groundwater; and that saline, sodic, or saline-sodic conditions are evident in the upper 20 inches of soil. Sometimes, but not always, a seasonal water table is present at a depth of 24 inches or more below the soil surface. Soils for this ecological site are typically very deep (more than 60 inches), somewhat poorly to well drained, and derived from alluvium. Characteristic vegetation is western wheatgrass (*Pascopyrum smithii*), alkali cordgrass (*Spartina gracilis*), and sodium-tolerant bunchgrasses such as alkali sacaton (*Sporobolus airoides*) and Nuttall's alkaligrass (*Puccinellia nuttalliana*).

Associated sites

FX053A99X060	**Overflow (Ov)** This site is adjacent to the Saline Lowland ecological site on similar landscapes and terrace positions, but in areas that have not accumulated salts in the soil profile.
FX053A99X061	**Riparian Woodland (RW)** This site is adjacent to the Saline Lowland ecological site, usually on lower terraces where flooding is more frequent, salts have not accumulated, and riparian woody plants are dominant.
FX053A99X084	**Slough (Sl)** This site is adjacent to the Saline Lowland ecological site, usually in oxbows or channels where flooding is very frequent and a water table is shallow and persistent.

Similar sites

FX053A99X705	**Discharge Closed Depression (CdD)** This site differs from the Saline Lowland ecological site in that it occurs in depressions rather than floodplains and has different hydrology.

FX053A99X060	**Overflow (Ov)** This site differs from the Saline Lowland ecological site in that soils do not contain accumulated salts in the upper 20 inches. This site supports a diverse herbaceous plant community and is typically more productive.
FX053A99X093	**Saline Upland (SU)** This site differs from the Saline Lowland ecological site in that it occurs in uplands or ephemeral drainageways and does not receive enough additional moisture to significantly increase production; whereas the Saline Lowland ecological site is found on higher order stream reaches and receives enough additional moisture to significantly increase production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Spartina gracilis*

Legacy ID

R053AY713MT

Physiographic features

This ecological site occurs on level to nearly level drainageways, depressions, or floodplain steps. The slopes are generally less than 4 percent. This site occurs on all aspects. Aspect is not a significant factor.

Table 2. Representative physiographic features

Landforms	(1) Till plain > Drainageway (2) River valley > Depression (3) River valley > Flood-plain step
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,800–3,300 ft
Slope	0–4%
Water table depth	24–72 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

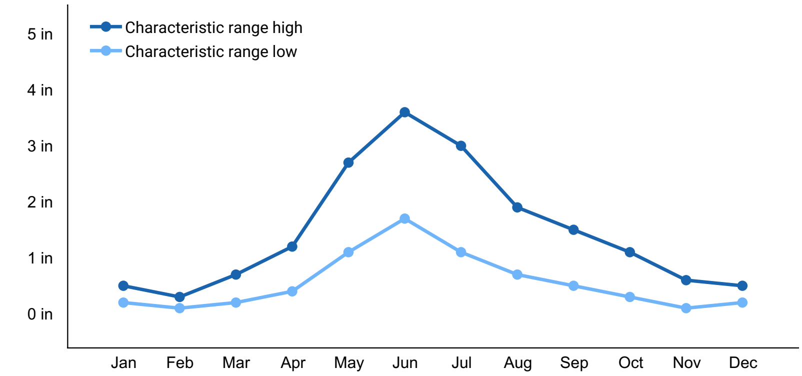


Figure 1. Monthly precipitation range

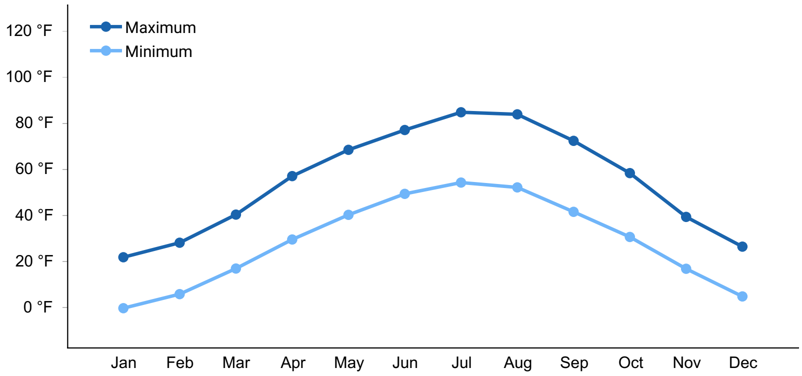


Figure 2. Monthly average minimum and maximum temperature

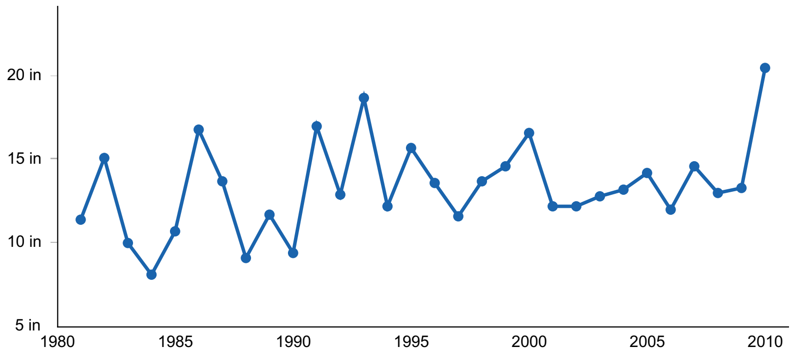


Figure 3. Annual precipitation pattern

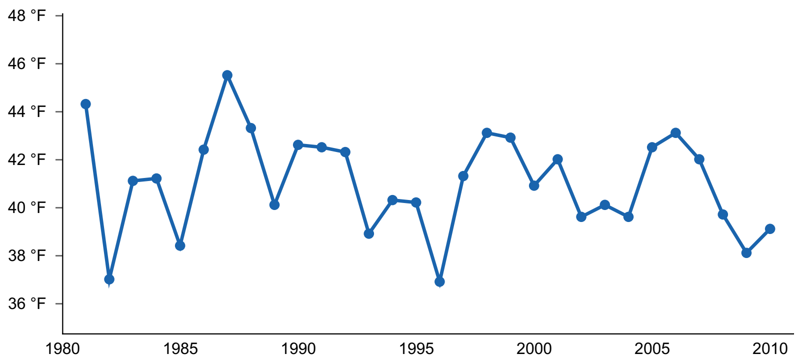


Figure 4. Annual average temperature pattern

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 drainageway or floodplain site that receives additional moisture from groundwater, stream overflow, or both. When on floodplains, the site may be flooded for brief durations during major flood events. On some sites, 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 to well drained, and derived from alluvium. All soils in this concept are characterized by an accumulation of salts in the upper 20 inches and receive additional moisture from surface water, groundwater, or both. On some sites a seasonal groundwater table is present 24 inches or more below the soil surface. The moisture regime varies from typic ustic to aquic, depending on the depth to a water table, and the soil temperature regime is frigid (Soil Survey Staff, 2014).

Surface horizon textures in this site are commonly loam, clay loam, silty clay or clay. The underlying horizon textures are typically loam, clay loam or clay, but may be stratified with textures of fine sandy loam, silt loam, or silty clay loam. Calcium carbonate equivalent is typically less than 15 percent throughout the soil profile. The upper 20 inches of soil contain accumulated salts, as evidenced by an electrical conductivity of 4 or more, a sodium absorption ratio of 13 or more, or both. Soil pH classes are neutral to strongly alkaline in the surface horizon and slightly alkaline to very strongly alkaline in the subsurface horizons. Content of coarse fragments is less than 35 percent in the upper 20 inches of soil.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock

Surface texture	(1) Loam (2) Clay loam (3) Silty clay (4) Clay
Drainage class	Well drained to somewhat poorly drained
Soil depth	60–72 in
Calcium carbonate equivalent (0-72in)	0–15%
Electrical conductivity (0-20in)	4–8 mmhos/cm
Sodium adsorption ratio (0-20in)	13–20

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 Saline Lowland provisional ecological site in MLRA 53A consists of six states: the Historic Reference State (1), the Contemporary Reference State (2), the Altered State (3), the Invaded State (4), the Cropland State (5), and the Post-Cropland State (6). Plant communities associated with this ecological site evolved under the combined influences of climate, grazing, hydrology, and fire. Extreme climatic variability results in frequent droughts, which have the greatest 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). The precise effects of the historic fire return interval are not definitive, but in general the mixed-grass ecosystem was resilient to fire. Potential effects are generally temporary and may include reduction of litter, fluctuations in production, and changes in species composition (Vermeire et al., 2011, 2014).

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. Additionally, small mammals such as prairie dogs (Cynomys spp.) and ground squirrels (Urocitellus spp.) influenced this plant community (Salo et al., 2004). Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) also played an important role in the ecology of these communities (Lockwood, 2004). The mixed-grass ecosystem was resilient to grazing, although localized areas could experience shifts in species composition due to heavy grazing.

Following European settlement, fire was largely eliminated, domestic livestock replaced native ungulates as the primary grazers, and non-native species were introduced to the ecosystem. Aside from drought, livestock grazing is now the principle disturbance on the landscape.

Improper grazing of this site can result in a reduction in the cover of the mid-statured cool-season, rhizomatous wheatgrasses and sodium-tolerant bunchgrasses along with an increase in inland saltgrass (*Distichlis spicata*) and foxtail barley (*Hordeum jubatum*). 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 and/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. Further degradation of the site due to improper grazing can result in a community dominated by foxtail barley and unpalatable forbs such as povertyweed (*Iva axillaris*). Mid-statured rhizomatous grasses are eliminated or nearly so.

Hydrology is another major ecological driver for this site. Hydrologic alterations, particularly alterations that raise the water table or cause excessive flooding and ponding of the site, may have a significant effect on species composition and production. In some cases, severe salinization may occur. On a large portion 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.

The effects of an altered fire regime are not completely understood at the time of this writing, but evidence suggests that long-term fire suppression can result in accumulations of litter and may contribute to increased abundance of non-native species.

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Potential invasive species on this site are curly dock (*Rumex crispus*), knotweed (Polygonum spp), and kochia (*Bassia scoparia*). In most cases native ecological function is relatively intact, but invasive species dynamics are not well understood at this time and further investigation is needed to fully document ecological pathways and processes.

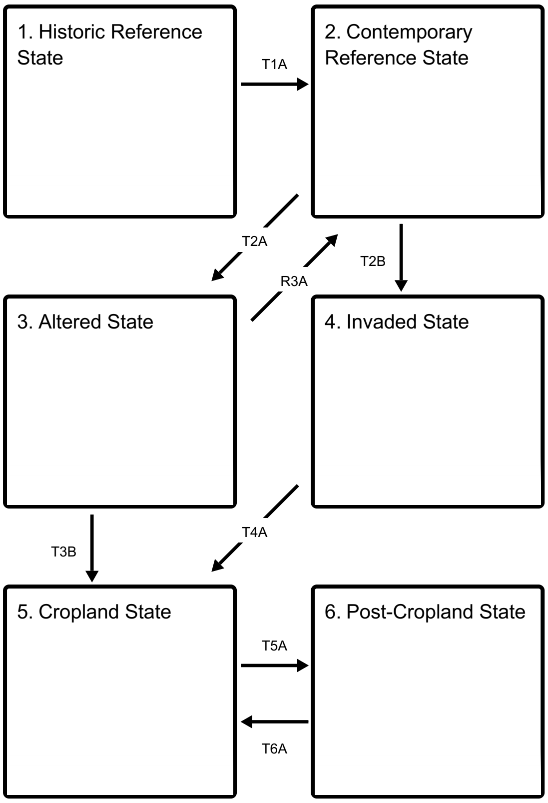
The Saline Lowland ecological site is poorly suited to cropland. Regardless, some of it has been converted to cropland. Cereal grains such as wheat and barley are, at best, marginally successful on this site. Typically, cropping operations are directed at increasing perennial hay production. Seeding of introduced grasses for hay production may be successful, particularly if salt-tolerant species such as RS, or hybrid, wheatgrass (*Elymus hoffmannii*) are used. Irrigation is sometimes used in an effort to increase production, but this site is poorly suited to irrigation practices due to accumulated salts, very low intake rates, and in some cases, a seasonally high water table.

When taken out of production, the site is either allowed to revert back to perennial grassland or is seeded with introduced species. Sites left to undergo natural plant succession after cultivation can, over several decades, support rhizomatous grasses such as western wheatgrass and inland saltgrass, Those sites seeded with non-native species, particularly salt-tolerant grasses, may persist with this cover type indefinitely. Even when reseeded to native species, the site is unlikely to return to reference conditions in a reasonable amount of time.

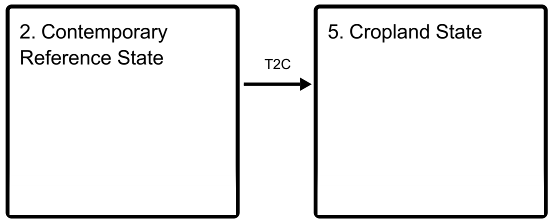
The state-and-transition model (STM) (Figure 3) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance 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

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Introduction of non-native invasive species such as introduced forbs, or noxious weeds.

T2A - Improper grazing, hydrologic alteration, or a combination of these factors

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

T2C - Conversion to cropland

R3A - Range seeding, grazing land mechanical treatment, timely moisture, proper grazing management (management intensive and costly)

T3B - Conversion to cropland

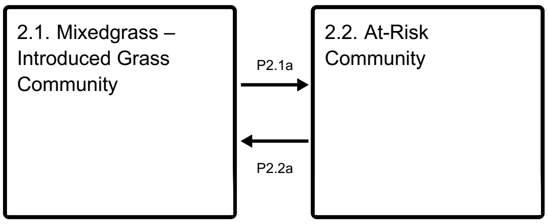
T4A - Conversion to cropland

T5A - Cessation of annual cropping

T6A - 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

3.1. Foxtail Barley/Forb Community

State 4 submodel, plant communities

4.1. Invaded Community

State 5 submodel, plant communities

5.1. Cropland Community

State 6 submodel, plant communities

6.1. Abandoned Cropland Community

6.2. Perennial Grass Community

State 1
Historic Reference State

The Historic Reference State (1) contains one community phase characterized by mid-statured rhizomatous wheatgrasses and sodium tolerant bunchgrasses. This state is considered extinct and is included here for historical reference purposes. It evolved under the combined influences of climate, grazing, and fire, with climatic variation having the greatest influence on cover and production. In general, this state was resilient to grazing; however, localized areas likely received heavy grazing, which resulted in the species composition shifting to short-statured species. Fire most likely resulted in short-term shifts in species composition to more warm-season grasses such as blue grama and fewer cool-season bunchgrasses.

Community 1.1
Mixedgrass Community

The Mixedgrass Community Phase (1.1) was characterized by mid-statured rhizomatous wheatgrasses and sodium tolerant bunchgrasses. The predominant species was western wheatgrass (*Pascopyrum smithii*). Sodium-tolerant bunchgrasses such as alkali sacaton (*Sporobolus airoides*) and Nutall’s alkaligrass (*Puccinellia nuttalliana*) were common. Other grass species that may have occurred are inland saltgrass (*Distichlis spicata*), foxtail barley (*Hordeum jubatum*), and; on wetter sites, alkali cordgrass (*Spartina gracilis*). Forbs comprised about 5 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 mid-statured rhizomatous wheatgrasses, sodium tolerant bunchgrasses, and, in some areas, mid-statured, warm-season grasses. It evolved under the combined influences of climate, grazing, and fire, with climatic variation 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
Mixedgrass – Introduced Grass Community

The Mixedgrass – Introduced Grass Community Phase (2.1) is predominantly native species, but it has some degree of non-native grass establishment. The predominant species is western wheatgrass, but sodium-tolerant bunchgrasses such as alkali sacaton and Nutall's alkaligrass are also common. Mid-statured, warm-season grasses such as alkali cordgrass may be common on the wetter portions of this site. Minor grass species include inland saltgrass and foxtail barley. Forbs comprise about 5 percent of the cover and shrubs 5 percent or less. Non-native species such as curly dock (*Rumex crispus*) typically comprise 1 to 3 percent of the plant community.

Community 2.2
At-Risk Community

The At-Risk Community Phase (2.2) occurs when site conditions decline due to drought or improper grazing management. It is characterized by an increase in inland saltgrass and a decline in rhizomatous wheatgrasses. Sodium-tolerant bunchgrasses such as alkali sacaton and Nutall's alkaligrass are rare or absent. Foxtail barley 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 Mixedgrass - Introduced Grass Community Phase (2.1) to the At-Risk Community Phase (2.2). These factors favor a decrease in rhizomatous wheatgrasses and an increase in inland saltgrass and foxtail barley.

Pathway P2.2a
Community 2.2 to 2.1

Normal or above-normal spring precipitation and proper grazing management transition the At-Risk Community (2.2) back to the Mixedgrass – Introduced Grass Community (2.1).

State 3
Altered State

The Altered State (3) consists of one community phase. The dynamics of this state are driven by improper grazing management, hydrologic alteration, or a combination of these factors. Foxtail barley and unpalatable forbs increase at the expense of rhizomatous grasses. Hydrologic alterations that raise the water table may also cause a decline in rhizomatous grasses and an increase in foxtail barley. Proper grazing management or hydrologic restoration can reduce foxtail barley cover and increase the cover of rhizomatous wheatgrasses. This recovery may take decades, especially if soil properties are substantially altered.

Community 3.1
Foxtail Barley/Forb Community

The Foxtail Barley/Forb Community Phase (3.1) occurs when site conditions decline due to long-term improper grazing management or when water tables rise due to altered hydrology. Rhizomatous grasses such as western wheatgrass and inland saltgrass have been largely eliminated. Foxtail barley and unpalatable forbs such as povertyweed (*Iva axillaris*) are common and dominate the plant community.

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. Invasive species dynamics on this site are not well understood, but potential invasive species on this site are curly dock, knotweed, and kochia. 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 forbs, 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. This site is poorly suited to crops; however, many acres are cultivated despite its limitations. Occasionally, cereal grains such wheat, and barley are attempted, but this site is poorly suited to such crops and cereal grain production is generally unsuccessful. Most frequently, the site is planted to non-native perennial species for production of hay.

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.

State 6
Post-Cropland State

The Post-Cropland State (6) occurs when cultivated cropland is abandoned and allowed to either revegetate naturally or is seeded back to perennial species for grazing or wildlife use. This state can transition back to the Cropland State (5) if the site is put back into cultivation.

Community 6.1
Abandoned Cropland Community

The Abandoned Cropland Community Phase (6.1) typically occurs when cropland is abandoned with no further management. It may also occur when cropland is abandoned and then seeded to perennial forage species and the reseeding fails. In the absence of active management, the site can revegetate naturally and, over time, potentially return to a perennial grassland community with western wheatgrass. Shortly after cropland is abandoned, annual forbs, biennial forbs, and foxtail barley invade the site. Eventually, these pioneering species are replaced by western wheatgrass. Invasion of the site by exotic species, such as curly dock, will depend upon the site's proximity to a seed source. Fifty or more years after cultivation, these sites may have species composition similar to phases in the Contemporary Reference State (2). However, soil quality is consistently lower than under conditions prior to cultivation and a shift to the Contemporary Reference State (2) is unlikely within a reasonable time frame (Dormaar and Smoliak, 1985).

Community 6.2

Perennial Grass Community

The Perennial Grass Community Phase (6.2) occurs when the site is seeded to perennial species for livestock forage or wildlife cover. Seedings typically are comprised of introduced salt-tolerant perennial grasses such as RS or hybrid wheatgrass, which can persist for several decades. A mixture of native species may also be seeded to provide species composition and structural complexity similar to those of the Contemporary Reference State (2). However, soil quality conditions have been substantially altered and will not return to pre-cultivation conditions within a reasonable time frame (Dormaar et al., 1990).

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, hydrologic alteration, or a combination of these factors weaken the resilience of the Contemporary Reference State (2) and drive its transition to the Altered State (3).

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 restore the Altered State (3) to the Contemporary Reference State (2). Practices such as range seeding (Hart et al., 1985) or restoration of the natural hydrology may be necessary, but these are management 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

Prescribed Grazing
Grazing Land Mechanical Treatment
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).

Transition T5A
State 5 to 6

The transition from the Cropland State (5) to the Post-Cropland State (6) occurs with the cessation of cultivation. The site may also be seeded to perennial forage species. Such seedings may be comprised of introduced grasses and legumes, or a mix of native species.

Transition T6A
State 6 to 5

Tillage or application of herbicide followed by seeding of cultivated crops such as wheat, barley or introduced hay, transitions the Post-Cropland State (6) to the Cropland State (5).

Additional community tables

Inventory data references

Data for this provisional ecological site was obtained from one medium-intensity plot representing the Contemporary Reference State (2). Two medium intensity plots from MLRA 53B were also used for comparison purposes. These plots were used in conjunction with a review of the scientific literature and professional experience to approximate the plant communities for this state. Information for remaining states was obtained from professional experience and a review of the scientific literature. 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:**

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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:**

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

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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:**