Ecological site FX053A99X093
Saline Upland (SU)

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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 Mixedgrass and Fescue Prairie Macrogroup (2.B.2.Nb.2)
• Group: Hesperostipa comata - *Bouteloua gracilis* Dry Mixedgrass Prairie Group (2.B.2.Nb.2.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

Saline Upland is an ecological site of limited extent occurring on alluvial fans, drainageways, and terraces in MLRA 53A. The distinguishing characteristic of this site is that saline, sodic, or saline-sodic conditions are evident in the upper 20 inches of soil. Soils for this ecological site are typically very deep (more than 60 inches), well drained, and derived from clayey alluvium or outwash deposits. Characteristic vegetation is western wheatgrass (*Pascopyrum smithii*), Gardner's saltbush (*Atriplex gardneri*), and winterfat (*Krascheninnikovia lanata*).

Associated sites

FX053A99X032	**Loamy (Lo)** The Loamy ecological site occurs on similar landscapes and slope positions as Saline Upland but in areas where salts have not accumulated in the soil profile.
FX053A99X701	**Clay (Cl)** The Clay ecological site occurs on similar landscapes and slope positions as Saline Upland but in areas where salts have not accumulated in the soil profile.

Similar sites

FX053A99X032	**Loamy (Lo)** This site differs from Saline Upland in that soils do not exhibit saline, sodic, or saline-sodic conditions in the upper 20 inches of the profile. This is evidenced by the lack of sodium-tolerant shrubs, such as saltbush and greasewood.
FX053A99X701	**Clay (Cl)** This site differs from Saline Upland in that soils do not exhibit saline, sodic, or saline-sodic conditions in the upper 20 inches of the profile. This is evidenced by the lack of sodium-tolerant shrubs, such as saltbush and greasewood.

FX053A99X713	**Saline Lowland (SLL)** This site differs from Saline Upland in that Saline Lowland is found on drainageways or floodplains and receives additional moisture from ground or surface water, whereas the Saline upland site occurs in uplands and does not receive additional moisture.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex gardneri* (2) *Krascheninnikovia lanata*
Herbaceous	(1) *Pascopyrum smithii*

Legacy ID

R053AY714MT

Physiographic features

This ecological site occurs on nearly level to moderately sloping flats, hills, or stream terraces. Slopes are generally less than 20 percent but may range up to 35 or 40 percent. This site occurs on all aspects.

Table 2. Representative physiographic features

Landforms	(1) Till plain > Flat (2) Till plain > Hill (3) River valley > Stream terrace
Flooding frequency	None
Ponding frequency	None
Elevation	549–1,006 m
Slope	0–20%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–45%

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 4. Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	115-155 days
Precipitation total (characteristic range)	279-381 mm
Frost-free period (average)	110 days
Freeze-free period (average)	135 days
Precipitation total (average)	330 mm

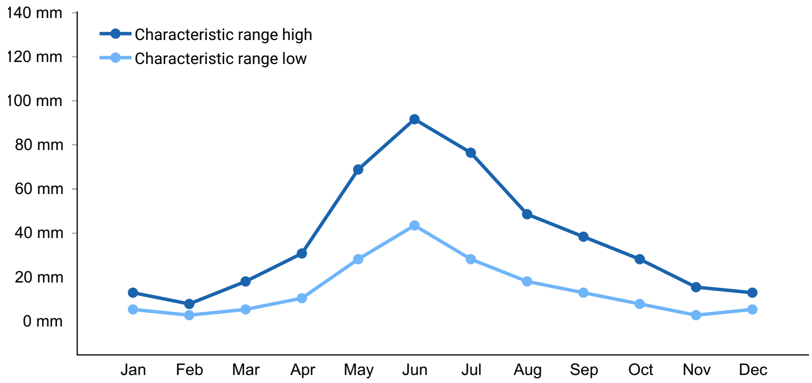


Figure 1. Monthly precipitation range

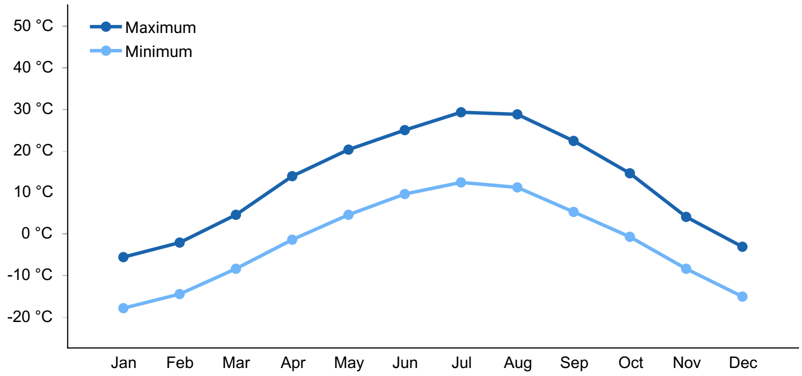


Figure 2. Monthly average minimum and maximum temperature

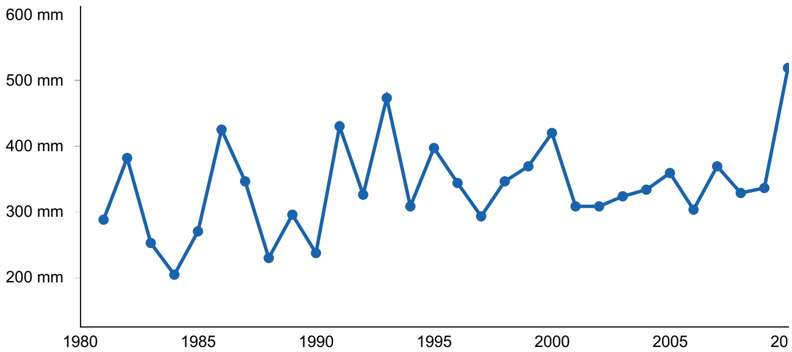


Figure 3. Annual precipitation pattern

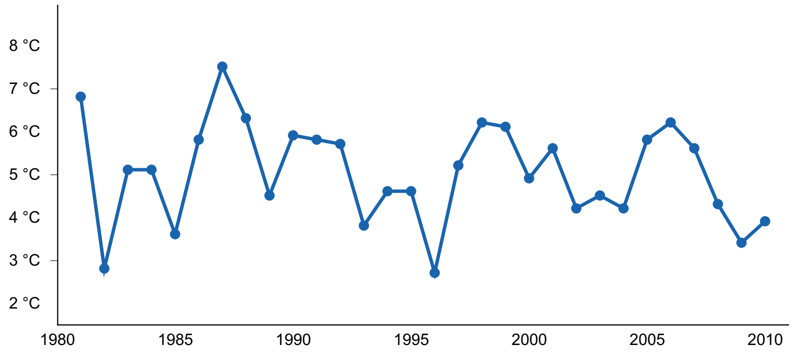


Figure 4. Annual average temperature pattern

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 upland ecological site and is not influenced by a water table or run in from adjacent sites. Due to the semi-arid climate in which it occurs, the water budget is normally contained within the soil pedon. Soil moisture is recharged by spring rains, but it but rarely exceeds field capacity in the upper 40 inches before being depleted by evapotranspiration. During intense precipitation events, precipitation rates frequently exceed infiltration rates and this site delivers moisture to downslope sites via surface runoff. Moisture loss through evapotranspiration exceeds precipitation for the majority of the growing season and soil moisture is the primary limiting factor for plant production on this ecological site.

Soil features

Soils for this ecological site are typically very deep (more than 60 inches), well drained, and derived from clayey alluvium or outwash deposits. They have a typic ustic moisture regime, which means that the soils are moist in some or all parts for either 180 cumulative days or 90 consecutive days during the growing season but are dry in some or all parts for over 90 cumulative days, and a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface horizon textures in this site are most commonly loam, clay loam or clay. The underlying horizon textures are typically clay loam or clay, but may also include 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 5. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock (2) Glaciofluvial deposits–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Clay loam (3) Clay
Drainage class	Well drained

Soil depth	152–183 cm
Calcium carbonate equivalent (0-182.9cm)	0–15%
Electrical conductivity (0-50.8cm)	4–8 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	13–20
Subsurface fragment volume <=3" (0-50.8cm)	0–34%
Subsurface fragment volume >3" (0-50.8cm)	0–34%

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 Upland provisional ecological site in MLRA 53A consists of six states: the Historic Reference State (1), the Contemporary Reference State (2), the Shortgrass 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, 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). Due to the dominance of cool-season graminoids, annual production is highly dependent upon mid- to late-spring precipitation (Heitschmidt and Vermeire, 2005; Anderson, 2006).

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 grasses and an increase in shortgrasses such as blue grama (*Bouteloua gracilis*) (Smoliak et al., 1972; Smoliak, 1974). 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. Periods of extended drought (approximately 3 years or more) can reduce mid-statured, cool-season grasses and shift the species composition of this community to one dominated by blue grama (Coupland, 1958, 1961). Further degradation of the site due to improper grazing can result in a community dominated by shortgrasses such as blue grama and subshrubs such as broom snakeweed (*Gutierrezia sarothrae*) and rubber rabbitbrush (*Ericameria nauseosa*).

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Non-native grasses such as crested wheatgrass (*Agropyron cristatum*), and annual bromes (Bromus spp.) are the most common invasive species. These species are widespread throughout the Northern Great Plains and can invade relatively undisturbed grasslands (Heidinga and Wilson, 2002; Henderson and Naeth, 2005). 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.

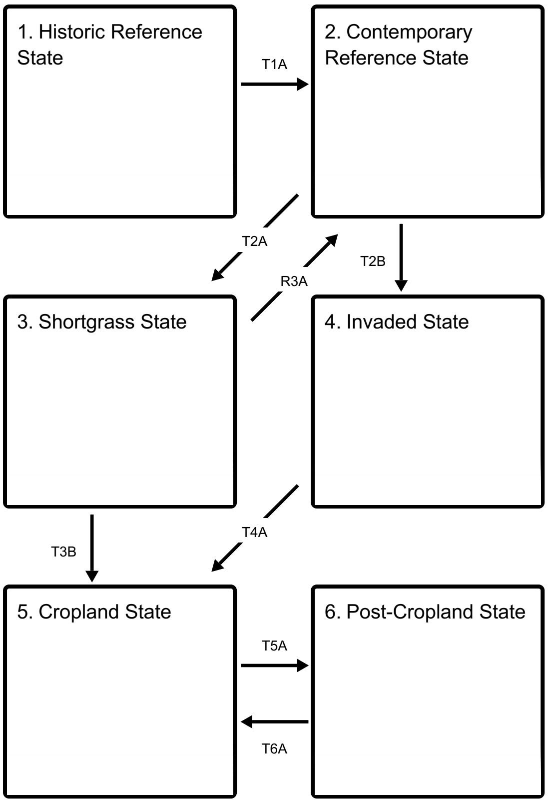
The effects of an altered fire regime are not completely understood at the time of this writing, but evidence suggests that long-term fire suppression can result in accumulations of litter and may contribute to increased abundance of non-native grasses (Murphy and Grant, 2005; Vermeire et al., 2011; Whisenant, 1990). Conversely, fire return intervals of less than 6 years, such as annual burning, can reduce productivity and shift species composition toward warm-season, short-statured grasses (Shay et al., 2001; Smith and McDermid, 2014).

The Saline Upland ecological is not well suited to cropland, regardless, many acres have been converted to cropland. Cereal grains, such as wheat and barley, or perennial hay are the most common crops. When taken out of production, this site is either allowed to revert back to perennial grassland or is seeded back to perennial grass. Such seedings may be comprised of introduced grasses and legumes or a mix of native species. Sites left to undergo natural plant succession after cultivation can, over several decades, support native vegetation similar to the Reference State (1) (Christian and Wilson, 1999) although it may take over 75 years for soil organic matter to return to its pre-disturbed state (Dormaar et al., 1990). Sites seeded with non-native species may persist with this cover type indefinitely (Christian and Wilson, 1999). A mix of native species may also be seeded, however, a return to the Reference State (1) in a reasonable amount of time is unlikely.

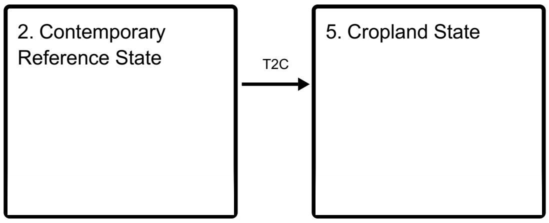
The state-and-transition model (STM) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance from local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

T2A - Prolonged drought, improper grazing management, or a combination of these factors

T2B - Displacement of native species by non-native invasive species (introduced grasses, 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)

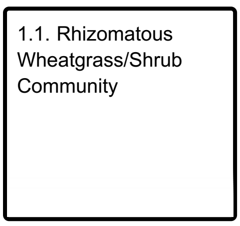
T3B - Conversion to cropland

T4A - Conversion to cropland

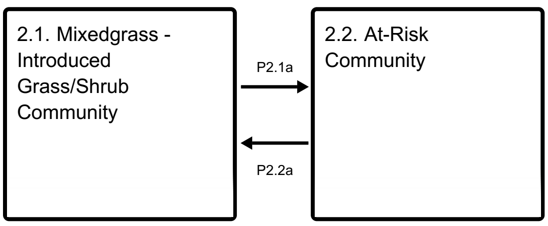
T5A - Cessation of annual cropping

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. Shortgrass/Subshrub 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 rhizomatous wheatgrasses and shrubs. 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 may have resulted in shifts in the species composition. Fire dynamics are not well understood, but fire influence on this site was likely low due to the sparse vegetation.

Community 1.1
Rhizomatous Wheatgrass/Shrub Community

The Rhizomatous Wheatgrass/Shrub Phase (1.1) was characterized by predominance of rhizomatous wheatgrasses, particularly western wheatgrass (*Pascopyrum smithii*). Thickspike wheatgrass (*Elymus lanceolatus*) was generally more abundant in the northern extent of this ecological site. Palatable shrubs such as Gardner saltbush (*Atriplex gardneri*) and winterfat (*Krascheninnikovia lanata*) were common. Shortgrasses were present at low cover and included prairie Junegrass (*Koeleria macrantha*) and blue grama (*Bouteloua gracilis*).

State 2
Contemporary Reference State

The Contemporary Reference State (2) contains two community phases characterized by shortgrasses and rhizomatous wheatgrasses. 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 although grazing can influence species composition in localized areas. Fire dynamics are not well understood, but fire influence is most likely low due to the sparse vegetation.

Community 2.1
Mixedgrass - Introduced Grass/Shrub Community

The Mixedgrass - Introduced Grass/Shrub Community Phase (2.1) is predominantly native mid-statured rhizomatous wheatgrasses and shrubs but has some degree of non-native grass establishment. Rhizomatous wheatgrasses are the dominant cover and are mostly western wheatgrass, but thickspike wheatgrass may also occur, particularly in the northern extent of this site. Palatable shrubs such as Gardner saltbush and winterfat (*Krascheninnikovia lanata*) are common. Shortgrasses such as prairie Junegrass and blue grama occur at low cover. Foxtail barley (*Hordeum jubatum*) may also be present at low cover. Non-native species typically comprise 1 to 3 percent of the plant community and may include field brome (*Bromus arvensis*), cheatgrass (*Bromus tectorum*), and curly dock (*Rumex crispus*).

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 nearly equal proportions of shortgrasses and rhizomatous wheatgrasses. Shortgrasses such as blue grama are increasing while rhizomatous wheatgrasses are in decline and have been substantially reduced in both cover and vigor. Palatable shrubs sustain browsing damage and are beginning to decline in vigor in this phase. Unpalatable subshrubs and forbs such as broom snakeweed (*Gutierrezia sarothrae*) and curlycup gumweed (*Grindelia squarrosa*) are also increasing 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/Shrub Community Phase (2.1) to the At-Risk Community Phase (2.2). These factors favor an increase in shortgrasses such as blue grama and a decrease in midgrasses (Coupland, 1961).

Pathway P2.2a
Community 2.2 to 2.1

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

State 3
Shortgrass State

The Shortgrass State (3) consists of one community phase. The dynamics of this state are driven by long-term drought, improper grazing management, or a combination of these factors. Shortgrasses increase with long-term improper grazing at the expense of cool-season midgrasses Coupland, 1961; Biondini and Manske, 1996). In particular, communities dominated by blue grama can alter soil properties, creating conditions that resist establishment of other grass species (Dormaar and Willms, 1990; Dormaar et al., 1994). Reductions in stocking rates can reduce shortgrass cover and increase the cover of cool-season midgrasses, although this recovery may take decades (Dormaar and Willms, 1990; Dormaar et al., 1994).

Community 3.1
Shortgrass/Subshrub Community

The Shortgrass/Subshrub Community Phase (3.1) occurs when site conditions decline due to long-term drought or improper grazing. Mid-statured rhizomatous wheatgrasses and palatable shrubs such as Gardner saltbush have been largely eliminated. Short-statured grasses such as blue grama and subshrubs such as broom snakeweed and rubber rabbitbrush (*Ericameria nauseosa*) dominate the plant community. Unpalatable forbs such as curlycup gumweed may also be common in this 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. Invasive species dynamics on this site are not well understood. Potential invasive species on this site are annual brome grasses, curly dock, and noxious weeds. 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. 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 rhizomatous wheatgrasses and shortgrasses. Shortly after cropland is abandoned, annual forbs, biennial forbs, and annual grasses invade the site. Eventually, these pioneering species are replaced by perennial species such as western wheatgrass. Invasion of the site by exotic species, such as annual bromes and 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

Prolonged drought, improper grazing practices, or a combination of these factors weaken the resilience of the Contemporary Reference State (2) and drive its transition to the Shortgrass State (3). The Contemporary Reference State (2) transitions to the Shortgrass State (3) when mid-statured graminoids become rare and contribute little to production. Shortgrasses and subshrubs dominate the plant community.

Transition T2B
State 2 to 4

The Contemporary Reference State (2) transitions to the Invaded State (4) when invasive grasses, forbs, or noxious weeds displace native species. Exotic plant species dominate the site in terms of cover and production. Site resilience has been substantially reduced. 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 winter wheat, spring wheat, and barley, 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 reduce the cover of shortgrasses in the Shortgrass State (3) (Dormaar and Willms, 1990). Blue grama, in particular, can resist displacement by other species (Dormaar and Willms, 1990; Laycock, 1991; Dormaar et al., 1994; Lacey et al., 1995). Intensive management, such as reseeding and mechanical treatment, may be necessary (Hart et al., 1985), but these practices are labor intensive and costly. Therefore, returning the Shortgrass State (3) to the Contemporary Reference State (2) may require considerable energy and cost and may not be feasible within a reasonable amount of time.

Conservation practices

Grazing Land Mechanical Treatment
Range Planting

Prescribed Grazing

Transition T3B
State 3 to 5

Tillage or application of herbicide followed by seeding of cultivated crops, such as winter wheat, spring wheat, and barley, transitions the Shortgrass 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 winter wheat, spring wheat, and barley, 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

No field plots were available for this site. A review of the scientific literature and professional experience was 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	07/01/2024
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:**