Ecological site FX053A99X705
Discharge Closed Depression (CdD)

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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 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: Shrub and Herb Wetland Subclass (2.C)
• Formation: Salt Marsh Formation (2.C.5)
• Division: *Distichlis spicata* - Hordeum jubatum Great Plains Saline Marsh Division (2.C.5.Na)
• Macrogroup: Great Plains Saline Wet Meadow and Marsh Macrogroup (2.C.5.Na.1)
• Group: *Distichlis spicata* - Hordeum jubatum - *Pascopyrum smithii* 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)

USFWS (Cowardin et al., 1979)
• Palustrine Emergent Temporarily Flooded and Palustrine Emergent Seasonally Flooded

Classification of natural ponds and lakes in the Glaciated Prairie Region (Stewart and Kantrud, 1971)
• Ephemeral Pond, Temporary Pond, and Seasonal Pond

Ecological site concept

Discharge Closed Depression is a somewhat extensive ecological site occurring in depressions on till plains and moraines. The distinguishing characteristics of this ecological site are that it is located in closed depression landforms, receives groundwater discharge as well as surface runoff from adjacent uplands, and contains hydric soils. The ponding duration is typically temporary or seasonal, however, it is highly variable depending on catchment size and annual precipitation. Soils for this ecological site are typically very deep (more than 60 inches), poorly drained, derived from alluvium, and are frequently very slightly to slightly saline. Characteristic vegetation is western wheatgrass (*Pascopyrum smithii*), inland saltgrass (*Distichlis spicata*), and foxtail barley (Hordeum jubatum).

Associated sites

FX053A99X040	**Loamy Steep (LoStp)** The Loamy Steep ecological site is on slopes greater than 15 percent surrounding the Discharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Discharge Closed Depression ecological site.
FX053A99X071	**Recharge Closed Depression (CdR)** The Recharge Closed Depression ecological site is on similar landforms as the Discharge Closed Depression ecological site. It typically is found in higher topographic positions and is the primary source of groundwater for the Discharge Closed Depression ecological site.
FX053A99X032	**Loamy (Lo)** The Loamy ecological site is in uplands surrounding the Discharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Discharge Closed Depression ecological site.

FX053A99X062	**Swale (Se)** The Swale ecological site is in upland coulees and swales. It is typically upslope from the Discharge Closed Depression ecological site on till plains and moraines. It contributes surface water to the Discharge Closed Depression ecological site.

Similar sites

FX053A99X084	**Slough (Sl)** The Slough ecological site is on flood plains, usually in oxbows or channels where flooding is very frequent and a water table is shallow and persistant. Its hydroperiod is typically much longer than that of the Discharge Closed Depression ecological site. This site typically contains deep marsh vegetation.
FX053A99X060	**Overflow (Ov)** The Overflow ecological site is on flood plains, usually on higher terraces that receive additional moisture from runoff and stream overflow. Vegetation is dominated by facultative upland species.
FX053A99X071	**Recharge Closed Depression (CdR)** The Recharge Closed Depression ecological site differs from the Discharge Closed Depression ecological site in that it receives its moisture primarily from surface runoff rather than groundwater discharge. Water and soils are typically non-saline and vegetation is more diverse. A wide variety of sedges, spikerushes, and grasses are present.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Hordeum jubatum*

Legacy ID

R053AY703MT

Physiographic features

The Discharge Closed Depression ecological site occurs in closed depressions on till plains. It is typically found on disintegration moraines but may also occur on ground moraines.

Table 2. Representative physiographic features

Geomorphic position, flats	(1) Dip

Landforms	(1) Till plain > Disintegration moraine > Closed depression (2) Till plain > Ground moraine > Closed depression
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	549–1,006 m
Slope	0–2%
Ponding depth	0–30 cm
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)	279-381 mm
Frost-free period (average)	110 days
Freeze-free period (average)	135 days
Precipitation total (average)	330 mm

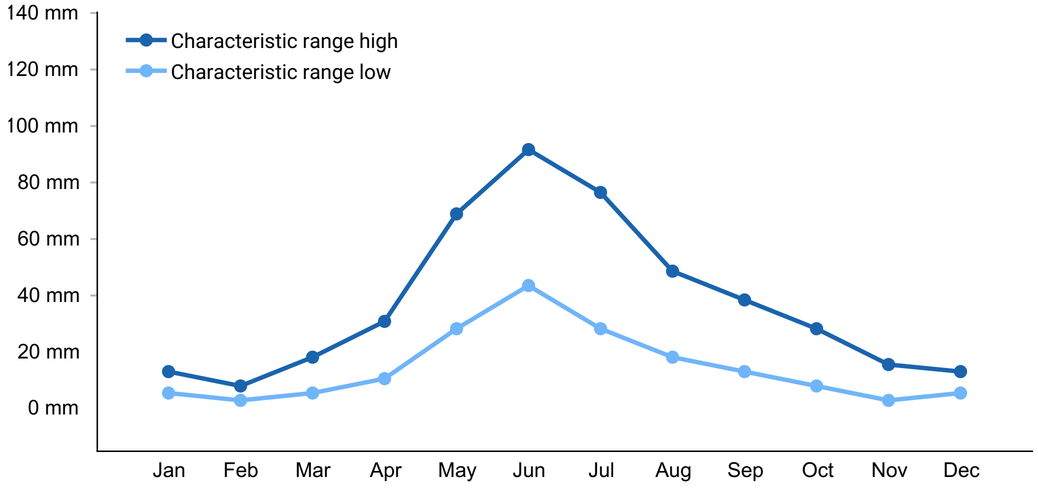


Figure 1. Monthly precipitation range

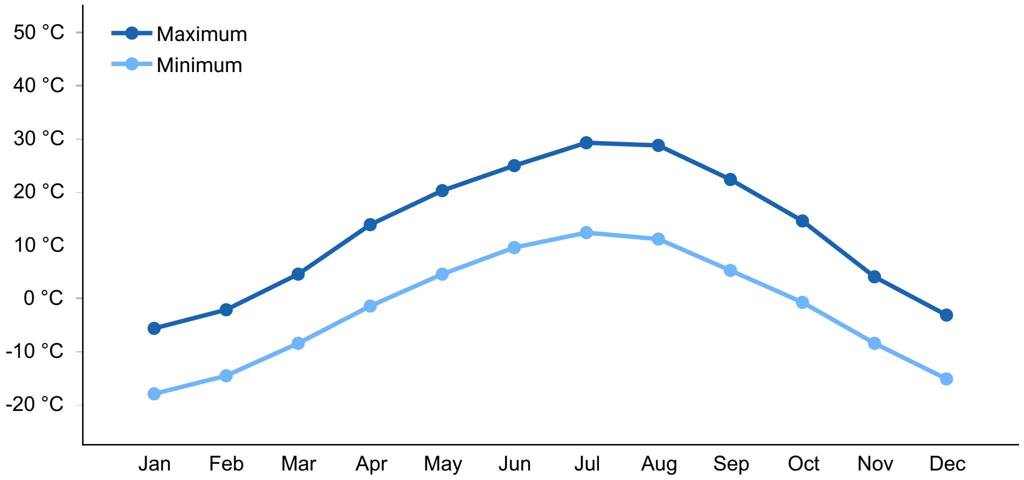


Figure 2. Monthly average minimum and maximum temperature

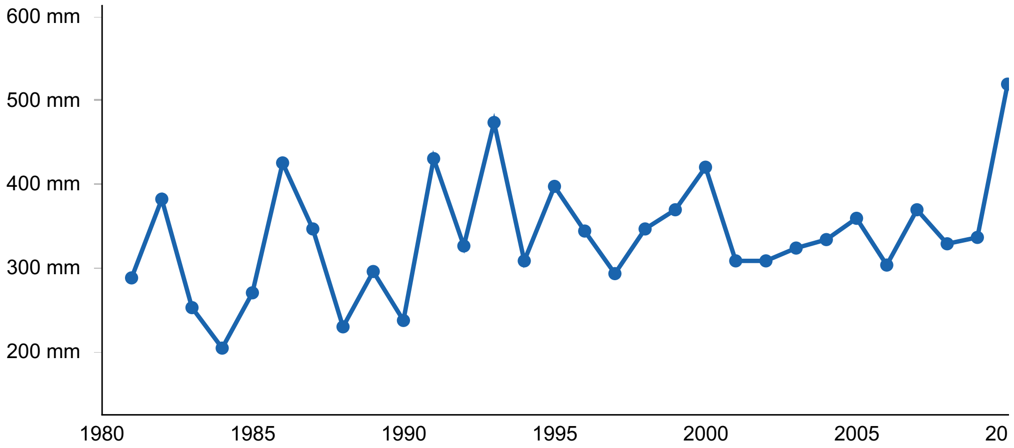


Figure 3. Annual precipitation pattern

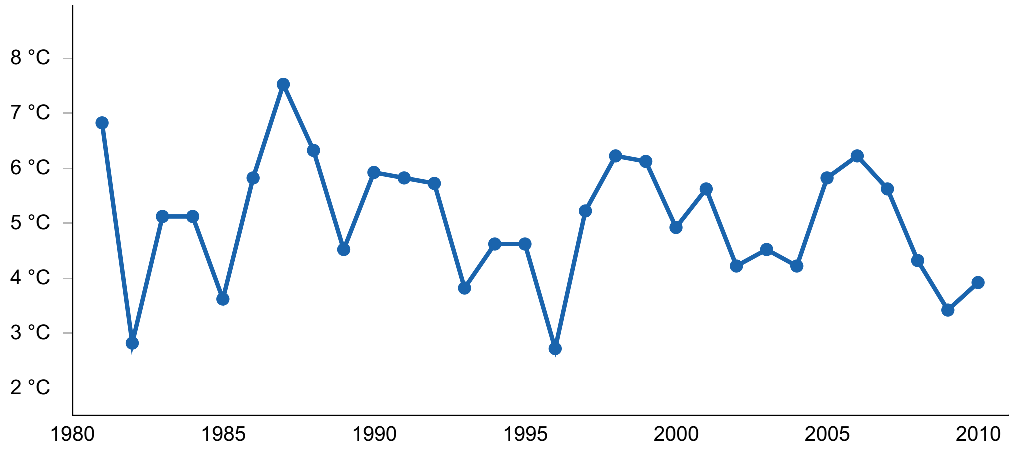


Figure 4. Annual average temperature pattern

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 a depressional wetland site that receives additional moisture via groundwater discharge as well as surface runoff. Hydrology is most similar to a discharge depressional hydrogeomorphic (HGM) model. Due to the semi-arid climate, groundwater tables are localized and are only present for a few months in the spring. During the spring, groundwater flows into the Discharge Closed Depression ecological site, typically from the Recharge Closed Depression ecological site. Surface runoff into the site also occurs during intense precipitation events. Water ponds on the surface for a brief time, then is lost by evapotranspiration. Typically, the ponding duration is 4 weeks or less, although some sites may pond water for 3 to 4 months. Ponding depth is typically 1 foot or less.

Wetland description

Palustrine Emergent Temporarily Flooded and Palustrine Emergent Seasonally Flooded

Soil features

Soils for this ecological site are typically very deep (more than 60 inches to bedrock), poorly drained, and derived from clayey alluvium. They are endosaturated, meaning that they receive additional moisture from groundwater, and have hydric features. Ponding frequency varies from occasional to frequent and duration varies from brief to long depending on catchment size and annual precipitation. They have an aquic moisture regime, which means that the soils are saturated within 40 inches (100 cm) of the mineral soil surface for some time during the year, and a frigid soil temperature regime (Soil Survey Staff, 2014).

Soil textures in the surface horizon on this site are typically clay, clay loam, silty clay or silty clay loam; and the underlying horizons are typically clay. Hydric features such as redox or gleying may be present in any horizon. In the surface 20 inches, electrical conductivity is typically 8 or less and the sodium absorption ratio is 13 or less. Calcium carbonate equivalent is typically 5 to 15 percent in the upper 5 inches of soil. Soil pH classes are slightly alkaline to strongly alkaline in the surface horizon and moderately alkaline or strongly 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) Clay (2) Clay loam (3) Silty clay (4) Silty clay loam
Drainage class	Poorly drained to very poorly drained
Soil depth	152–183 cm
Electrical conductivity (0-50.8cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	0–13

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 Discharge Closed Depression provisional ecological site in MLRA 53A consists of six vegetative states: The Historic Reference state (1), the Current Potential state (2), the Invaded state (3), the Undrained Cropland state (4), the Impounded state (5) and the Drained Cropland state (6). Plant communities associated with the Discharge Closed Depression ecological site evolved under the combined influences of climate, grazing, hydrology, and fire. 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).

Hydrology is a crucial dynamic on this site. The site receives water from groundwater discharge from adjacent sites and surface runoff from spring snowmelt and from high intensity thunderstorms. The duration of ponding, or hydroperiod, dramatically influences the vegetation of the site. The hydroperiod varies depending by the catchment size and by annual precipitation patterns. The majority of sites in MLRA 53A contain water for only a few weeks in the spring. Larger catchment basins, above average precipitation cycles, or a combination of these factors may increase the hydroperiod to several months. Plant communities vary depending on the hydroperiod.

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 mixedgrass 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 mixedgrass 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.

Plant communities on the Discharge Closed Depression ecological site are very complex. Much of the dynamics of this site are still under investigation and are not fully understood. Frequently, sites contain multiple plant community zones that correspond to the hydroperiod for that portion of the site. In the ephemeral communities (1.1, 2.1) the hydroperiod is only 7 to 10 days early in the spring and the site supports facultative upland species. The center of the depression is dominated by a wheatgrass plant community intermixed with scattered plants of foxtail barley. Periods of above average precipitation or depressions with a moderate catchment size will transition to the temporarily ponded communities (1.2, 2.2). In this phase the hydroperiod increases to 1.5 to 4 weeks and the site begins to support more hydrophytic vegetation. There are typically two distinct vegetation zones with a wheatgrass-foxtail barley plant community occupying the center of the depression. The rim of the depression transitions to wheatgrass plant community. The seasonally ponded communities (1.3, 2.3) occur primarily in depressions that have large catchment basins, although they can occur in moderate-sized catchment basins during periods of above average precipitation. The hydroperiod for these communities is much longer, typically 1 to 4 months, and is sufficient for a significant amount of hydrophytic vegetation to establish. The center of the depression frequently supports a foxtail barley dominated plant community, this is surrounded by a wheatgrass-foxtail barley plant community, and a rim of wheatgrass. All plant communities are often dynamic and diversity varies from site to site. Further study is needed to fully describe all major species and plant community dynamics.

Disturbances to the Discharge Closed Depression ecological site can have significant effects on hydrology and vegetation. Disturbances that directly affect the site include, but are not limited to, excavation, draining, impoundment, conversion to cropland, and grazing. The effects of improper grazing of this site have not been documented in detail, but improper grazing is known to cause a reduction in palatable forage species and an increase in unpalatable species such as curlycup gumweed (*Grindelia squarrosa*) and mountain rush (*Juncus arcticus* ssp. littoralis), also known as Baltic rush. 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 may not be providing adequate cover to prevent soil erosion over time. This may include, but is not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years.

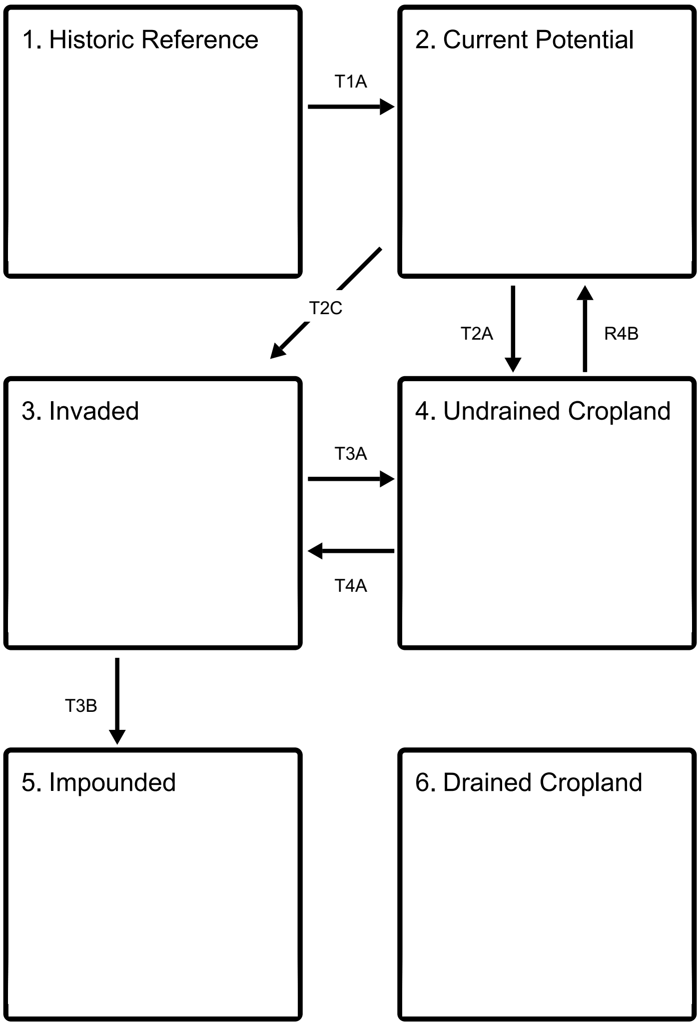
The most common disturbance on this site is most likely conversion to cropland. Smaller depressions, particularly those with ephemeral hydroperiods, are frequently farmed through with no further alteration. Seasonally ponded depressions are typically too wet to farm without artificial drainage. Typically, water is drained by ditching, then the site is converted to cropland. In these cases, the natural hydrology is severely altered and the site is unlikely to return to reference conditions without significant restoration. Another common alteration of hydrology is impoundment of water for livestock or wildlife. Impoundment increases the hydroperiod and effectively converts the site from a temporarily or seasonally ponded wetland to a semi-permanent wetland.

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Non-native species such as curly dock (*Rumex crispus*) commonly invade this site. Sites that are ephemeral or temporarily ponded are particularly prone to invasion by these species. Invasive species on seasonally ponded sites have not been studied, however invasive species such as saltcedar (*Tamarix ramosissima*) may be a concern in some areas. Noxious weeds such as Canada thistle and leafy spurge (*Euphorbia esula* L.) have also been documented on this site.

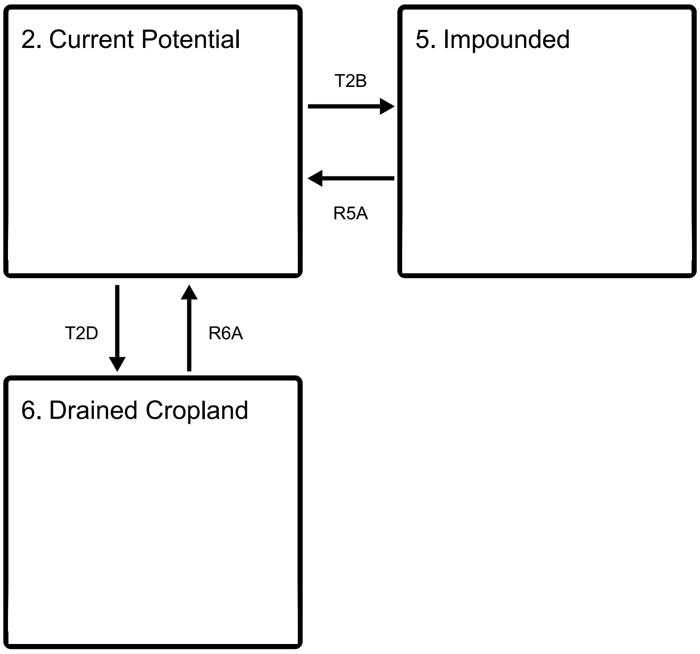
The state-and-transition model (STM) diagram and legend suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support vegetative states not displayed in the STM diagram. Landowners and land managers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

Ecosystem states



States 2, 5 and 6 (additional transitions)



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

T2C - Displacement of native species by invasive species (introduced grasses, noxious weeds, etc.)

T2A - Tillage or herbicide application and seeding of annual crops

T2B - Artificial impoundment of water

T2D - Artificial drainage, tillage or herbicide application, and seeding of annual crops

T3A - Tillage or herbicide application and seeding of annual crops

T3B - Artificial impoundment of water

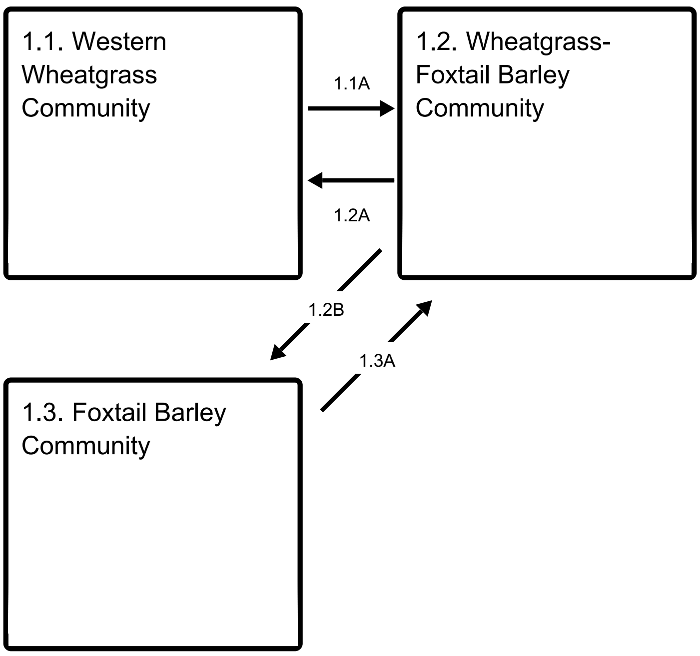
R4B - Cessation of annual cropping combined with reestablishment of native species

T4A - Cessation of annual cropping combined with introduction of invasive species

R5A - Restoration of natural hydrology and reestablishment of native species (labor intensive and costly)

R6A - Restoration of natural hydrology and reestablishment of native species (labor intensive and costly)

State 1 submodel, plant communities



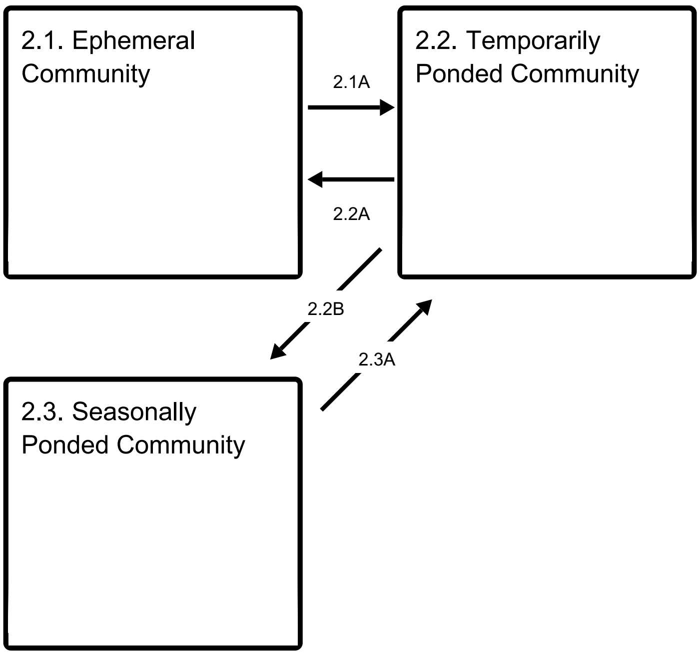
1.1A - 2 to 3 consecutive years of above average precipitation.

1.2A - Drought

1.2B - 2 to 3 consecutive years of above average precipitation: larger catchment area.

1.3A - Drought

State 2 submodel, plant communities



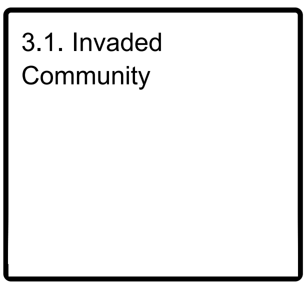
2.1A - 2 to 3 consecutive years of above average precipitation

2.2A - Drought

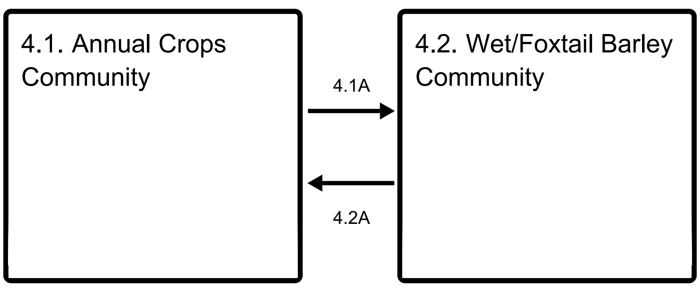
2.2B - 2 to 3 consecutive years of above average precipitation: larger catchment area

2.3A - Drought

State 3 submodel, plant communities



State 4 submodel, plant communities



4.1A - 1 more years of above average precipitation.

4.2A - Average or below average precipitation

State 5 submodel, plant communities

5.1. Bulrush Community

State 6 submodel, plant communities

6.1. Drained Cropland Community

State 1
Historic Reference

The Historic Reference state (1) contained three community phases characterized by varying degrees of seasonal ponding. This state is considered extinct and is included here for historical reference purposes. Seasonal ponding was a key dynamic on this site and varied depending on annual precipitation patterns and catchment size. Vegetation was characterized concentric rings, or zones, within the depression that correspond to the hydroperiod of that particular zone. Some phases only exhibited one vegetation zone dominated by facultative upland species while other phases exhibited two or more zones with the most hydrophytic vegetation in the center of the depression and subsequent, drier plant communities toward the edges.

Community 1.1
Western Wheatgrass Community

The Western Wheatgrass Phase (1.1) typically occurred in depressions with small catchment areas but may also have occurred in depressions with moderate catchment areas during drought years. The hydroperiod in this phase was very short, typically 10 days or less. The western wheatgrass (*Pascopyrum smithii*) plant community was the only one present, frequently with scattered plants of foxtail barley intermixed.

Community 1.2
Wheatgrass-Foxtail Barley Community

The Wheatgrass-Foxtail Barley Phase (1.2) typically occurred in depressions with moderate-sized catchment areas during normal years but may have also occurred in small catchment areas during wet cycles or large catchment areas during drought. In this phase the hydroperiod ranged from 1.5 to 4 weeks. Vegetation exhibited zonation in this phase. The center of the depression was a wheatgrass-foxtail barley plant community surrounded by a western wheatgrass plant community on the rim of the depression.

Community 1.3
Foxtail Barley Community

The Foxtail Barley Phase (1.3) typically occurred in depressions with large catchment areas, although it could occur in moderate-sized catchment areas during wet cycles. The hydroperiod in this phase was 1 to 4 months and the vegetation typically exhibited three or more zones. The wettest zone in this phase was frequently a foxtail barley-dominated plant community. This transitioned into a middle zone of wheatgrass-foxtail barley, then to a western wheatgrass dominated plant community on the rim.

Pathway 1.1A
Community 1.1 to 1.2

In small catchment areas, 2 to 3 years of above-average precipitation transitioned the Western Wheatgrass Phase (1.1) to the Wheatgrass-Foxtail Barley Phase (1.2). Moderate-sized catchment areas transitioned to this phase during average precipitation years.

Pathway 1.2A
Community 1.2 to 1.1

In moderate-sized catchment areas, drought transitioned the Wheatgrass-Foxtail Barley Phase (1.2) to the Western Wheatgrass Phase (1.1). Small catchment areas transitioned to this phase during average precipitation years.

Pathway 1.2B
Community 1.2 to 1.3

In moderate-sized catchment areas, 2 to 3 years of above-average precipitation transitioned the Wheatgrass-Foxtail Barley Phase (1.2) to the Western Wheatgrass Phase (1.3).

Pathway 1.3A
Community 1.3 to 1.2

On large catchment areas, drought transitioned the Foxtail Barley Phase (1.3) to the Wheatgrass-Foxtail Barley Phase (1.2). Moderate-sized catchment areas transitioned to this phase during average-precipitation years.

State 2
Current Potential

The Current Potential state (2) contains three community phases. Seasonal ponding is a key dynamic on this site and varies depending on annual precipitation patterns and catchment size. Vegetation is characterized concentric rings, or zones, within the depression that correspond to the hydroperiod of that particular zone. The Ephemeral Phase (2.1) may only exhibit one vegetation zone dominated by facultative upland species. Other phases may exhibit two or more zones with the most hydrophytic vegetation in the center of the depression and subsequent, drier plant communities toward the edges.

Community 2.1
Ephemeral Community

The Ephemeral Phase (2.1) typically occurs in depressions with small catchment areas, but can also occur in depressions with moderate catchment areas during drought years. The hydroperiod in this phase is very short, typically 10 days or less. The western wheatgrass plant community is the only one present, frequently with scattered plants of foxtail barley intermixed. Non-native species comprise 1 to 3 percent of the plant community and may include Kentucky bluegrass (*Poa pratensis*) and curly dock (*Rumex crispus*).

Community 2.2
Temporarily Ponded Community

The Temporarily Ponded Phase (2.2) typically occurs in depressions with moderate-sized catchment areas during normal years, but may also occur in small catchment areas during wet cycles or large catchment areas during drought. In this phase the hydroperiod ranges from 1.5 to 4 weeks. Vegetation begins to exhibit zonation in this phase. At the center of the depression, ponding is longest and a wheatgrass-foxtail barley plant community appears. A western wheatgrass plant community is usually present around the rim of the depression. A number of minor graminoid species such as American sloughgrass and Baltic rush (*Juncus arcticus* ssp. littoralis) may also be present. Non-native species such as curly dock are present at low cover.

Community 2.3
Seasonally Ponded Community

The Seasonally Ponded Phase (2.3) typically occurs in depressions with large catchment areas, although it can occur in moderate-sized catchment areas during wet cycles. The hydroperiod in this phase is 1 to 4 months and the vegetation typically exhibits three or more zones. The wettest zone in this phase is frequently a foxtail barley-dominated plant community. This transitions into a middle zone of wheatgrass-foxtail barley. The rim of the depression in this phase is typically a western wheatgrass dominated plant community. A number of minor species such as common threesquare (*Schoenoplectus pungens*), hardstem bulrush (*Schoenoplectus acutus*), and inland saltgrass (*Distichlis spicata*) may also be present. Non-native species such as curly dock are present at low cover.

Pathway 2.1A
Community 2.1 to 2.2

In small catchment areas, 2 to 3 years of above-average precipitation will transition the Ephemeral Phase (2.1) to the Temporarily Ponded Phase (2.2). Moderate-sized catchment areas will transition to this phase during average precipitation years.

Pathway 2.2A
Community 2.2 to 2.1

In moderate-sized catchment areas, drought will transition the Temporarily Ponded Phase (2.2) to the Ephemeral Phase (2.1). Small catchment areas will transition to this phase during average precipitation years.

Pathway 2.2B
Community 2.2 to 2.3

In moderate-sized catchment areas, 2 to 3 years of above-average precipitation will transition the Temporarily Ponded Phase (2.2) to the Seasonally Ponded Phase (2.3).

Pathway 2.3A
Community 2.3 to 2.2

On large catchment areas, drought will transition the Seasonally Ponded Phase (2.3) to the Temporarily Ponded Phase (2.2). Moderate-sized catchment areas will transition to this phase during average-precipitation years.

State 3
Invaded

The Invaded state (3) 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. Non-native perennial grasses, such Kentucky bluegrass are the most widespread concerns. Kentucky bluegrass is widespread throughout the Northern Great Plains (Toledo et al., 2014) and mainly affects the ephemeral and temporarily ponded phases of this site. It 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 sites, and 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. 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 Current Potential state (2). However, cessation of control methods will most likely result in recolonization of the site by the noxious species.

Community 3.1
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 4
Undrained Cropland

The Undrained Cropland state (4) occurs when native vegetation is killed out, either by tillage or by herbicide application, and the site is seeded to annual crops. No other alterations are made to the natural hydrology or soils. This state typically only occurs in the Ephemeral Phase (2.1) and the Temporarily Ponded Phase (2.2). In this state the site is suitable for spring seeded crops such as spring wheat and barley, although seeding of crops may be delayed 2 to 3 weeks due to wet soil conditions. In wet years, this state may be too wet to farm and will transition to the Wet/Foxtail Barley Phase (4.2).

Community 4.1
Annual Crops Community

The Annual Crops Phase (4.1) occurs when land is put into cultivation. Major crops include spring wheat, barley, and peas.

Community 4.2
Wet/Foxtail Barley Community

The Wet/Foxtail Barley Phase (4.2) occurs when precipitation is above average and the site is too wet to seed crops. Foxtail barley and annual weeds such as Kochia (*Bassia scoparia*) may colonize the site.

Pathway 4.1A
Community 4.1 to 4.2

One or more years of above average precipitation transitions the Annual Crops Phase (4.1) to the Wet/Foxtail Barley Phase (4.2)

Pathway 4.2A
Community 4.2 to 4.1

Average or below-average precipitation transitions the Wet/Foxtail Barley Phase (4.2) to the Annual Crops Phase (4.1)

State 5
Impounded

The Impounded state (5) occurs when water is artificially impounded on the site by damming or excavation. Water may be impounded for livestock water or for wildlife. Impoundment of water typically transitions the site to a semi-permanent wetland with open water, deep marsh, and drawdown vegetation zones. In many cases impoundment creates a larger wetland with high quality habitat for wildlife. In other cases, such as when an excavated pond is constructed in the center of the depression, a small semi-permanent wetland is created in the center while the remainder of the depression is drained, thus reducing total wetland area. In either case the natural hydrology of the site is significantly altered, resulting in a new state with different plant communities and ecological dynamics.

Community 5.1
Bulrush Community

The Bulrush Phase (5.1) occurs when water is impounded and the site is semi-permanently ponded. The hydroperiod in this phase is typically 6 to 9 months. Vegetation zonation has reached its maximum. Typically the center of the site is open water, which is surrounded by a deep marsh zone dominated by hardstem bulrush (*Schoenoplectus acutus*), and common threesquare (*Schoenoplectus pungens*). The rim of the depression is characterized by a drawdown zone supporting foxtail barley or western wheatgrass-foxtail barley depending on ponding duration.

State 6
Drained Cropland

The Drained Cropland state (6) occurs when the site is drained, tilled or sprayed, and seeded to annual crops. Surface water is typically drained by means of surface ditches, diversions, or both. Following drainage, remaining native vegetation is killed out either by tillage or herbicide application, then the site is seeded to annual crops. The hydrology of the site is significantly altered and no longer functions in its natural condition.

Community 6.1
Drained Cropland Community

The Drained Cropland Phase (6.1) occurs when land is drained and put into cultivation. Major crops include spring wheat, winter wheat, and barley.

Transition T1A
State 1 to 2

Introduction of non-native grass and forb 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 Current Potential state (2).

Transition T2C
State 2 to 3

The Current Potential state (2) transitions to the Invaded state (3) when aggressive perennial grasses or noxious weeds displace native species. The most common concerns are introduced bluegrasses, which are widespread invasive species in the Northern Great Plains (Henderson and Naeth, 2005; Toledo et al., 2014). The precise triggers of this transition are not clear, but data suggest that exclusion of grazing and fire may be a contributing factor in some cases (DeKeyser et al., 2013). In addition, other rangeland health attributes, such as reproductive capacity of native grasses and soil quality, have been substantially altered.

Transition T2A
State 2 to 4

Tillage or application of herbicide and seeding of cultivated crops such as wheat, barley, or introduced hay transitions the Current Potential state (2) to the Undrained Cropland state (4). This transition occurs primarily in the Ephemeral Phase (2.1) or the Temporarily Ponded Phase (2.2).

Transition T2B
State 2 to 5

Artificial impoundment of water by damming or excavation transitions the Current Potential state (2) to the Impounded state (4).

Transition T2D
State 2 to 6

The combination of artificial drainage, tillage or herbicide application, and seeding of annual crops transitions the Current Potential state (2) to the Drained Cropland state (4). This transition occurs primarily in the Seasonally Ponded Phase (2.3).

Transition T3A
State 3 to 4

Tillage or application of herbicide and seeding of cultivated crops such as wheat, barley, or introduced hay transitions the Invaded state (3) to the Undrained Cropland state (4).

Transition T3B
State 3 to 5

Artificial impoundment of water by damming or excavation transitions the Invaded state (3) to the Impounded state (5).

Restoration pathway R4B
State 4 to 2

Cessation of annual cropping combined with reestablishment of native species transitions the site from the Undrained Cropland state (4) to the Contemporary Reference state (2). Specialized seeding techniques may be necessary, depending on site conditions, as well as intensive weed control to prevent invasion of non-native grasses and noxious weeds. These restoration methods are labor intensive, costly, and may be not be practical in all situations.

Conservation practices

Brush Management
Wetland Restoration
Herbaceous Weed Control

Transition T4A
State 4 to 3

Cessation of annual cropping combined with the introduction of invasive species transitions the site from the Undrained Cropland state (4) to the Invaded state (3).

Restoration pathway R5A
State 5 to 2

Restoration of natural hydrology and reestablishment of native species transitions the site from the Impounded state (5) to the Current Potential state (2). Specialized seeding techniques may be necessary, depending on site conditions, as well as intensive weed control to prevent invasion of non-native grasses and noxious weeds. Restoration of natural hydrology may require removal of dams or refilling of excavated pits. These restoration methods are labor intensive, very costly, and may be impractical, perhaps even detrimental, in some situations.

Conservation practices

Brush Management
Wetland Restoration
Herbaceous Weed Control

Restoration pathway R6A
State 6 to 2

Cessation of annual cropping combined with restoration of natural hydrology and reestablishment of native species transitions the site from the Drained Cropland state (6) to the Current Potential state (2). Specialized seeding techniques may be necessary, depending on site conditions, as well as intensive weed control to prevent invasion of non-native grasses and noxious weeds. Restoration of natural hydrology may require removal of diversions, plugging drainage ditches, or both. These restoration methods are labor intensive, very costly, and may be impractical in some situations.

Conservation practices

Brush Management
Wetland Restoration
Herbaceous Weed Control

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	04/22/2025
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):**

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

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

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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):**

---

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:**