USDA Natural Resources Conservation Service

Ecological site FX052X01X032
Loamy (Lo) Dry Grassland

Last updated: 8/02/2019
Accessed: 05/06/2024

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.

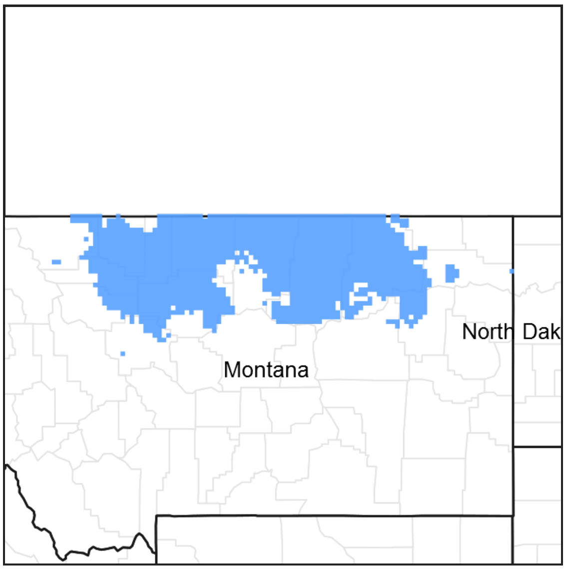


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive and agriculturally and ecologically significant area consisting of around 14.5 million acres that stretches across 350 miles from east to west encompassing portions of 15 counties in north-central Montana. This region represents the southwestern limit of the Laurentide Ice Sheet and is considered to be the driest and westernmost area within the vast network of glacially-derived prairie pothole landforms of the northern Great Plains. Elevation ranges from 2,000 feet (610 meters) to 4,600 feet (1,400 meters).

Soils are primarily Mollisols but Entisols, Inceptisols, Alfisols and Vertisols are also common. Till from continental glaciation is the predominant parent material but alluvium and bedrock are also frequently encountered. Till deposits are typically less than 50 feet thick and in some areas glacially deformed bedrock can be found at or near the soil surface (Soller 2001). Underlying sedimentary bedrock largely consisting of Cretaceous shale, sandstone and mudstone (Vuke et al. 2007) is commonly exposed on hillslopes, particularly along drainage ways. Significant alluvial deposits occur along glacial outwash channels and major drainages which include portions of the Missouri, Teton, Marias, Milk and Frenchman Rivers. Large glacial lakes, particularly in the western half of the MLRA, deposited clayey and silty lacustrine sediments (Fullerton et al. 2013).

Much of the western portion of this MLRA was glaciated towards the end of the Wisconsin age with the maximum glacial extent occurring approximately 20,000 years ago (Fullerton et al. 2004). The result is a geologically young landscape that is predominantly a level till plain interspersed with lake plains and dominated by soils in the Mollisol and Vertisol orders. These soils are very productive and generally are well-suited to dryland farming. Much of this area is aridic-ustic and crop-fallow dryland wheat farming is the predominant land use with rangeland typically being found on steep hillslopes along drainages.

Rangeland, much of it native mixed grass prairie, increases in abundance in the eastern half of the MLRA. The Wisconsin-age till in the north-central part of this area typically formed large disintegration moraines with steep slopes and numerous poorly-drained potholes. A large portion of Wisconsin-age till found on the type of the level terrain that would typically be optimal for farming has large amounts of less-suitable sodium-affected Natrustalfs. Significant portions of Blaine, Phillips, and Valley Counties were glaciated approximately 150,000 years ago during the Illinoisan age and due to erosion and dissection of the landscape much of these areas have steeper slopes and more exposed bedrock than areas glaciated during Wisconsin age (Fullerton et al. 1986).
While much of the rangeland in the aridic ustic portion of MLRA 52 is classified as belonging to the ‘dry grassland’ climatic zone, sites in portions of southern MLRA 52 may belong to the ‘dry shrubland’ climatic zone. The dry shrubland zone represents the northernmost extent of big sagebrush (Artemisia tridentata) steppe on the Great Plains. As similar soils occur in both southern and northern portions of the MLRA it is currently hypothesized that climate is the primary driving factor affecting big sagebrush distribution in this area but the precise factors have so far proven to be elusive and are for the time of this writing not yet fully understood.

Sizeable tracts of largely unbroken rangeland in the eastern half of the MLRA and adjacent southern Saskatchewan are home to the Northern Montana Population of Greater Sage Grouse (Centrocercus urophasianus) and large portions of this area are considered to be a Priority Area for Conservation (PAC) by the U.S. fish and Wildlife Service (U.S. Fish and Wildlife Service 2013). This population is unique among sage grouse populations in the fact that many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrates to the northern portion of the MLRA which lacks big sagebrush (dry grassland) to spend rest of the year (Smith 2013).

Areas of the till plain near the Bearpaw and Highwood Mountains as well as the Sweetgrass Hills and Rocky Mountain foothills are at higher elevations and receive higher amounts of precipitation and have a typic-ustic moisture regime. These areas have significantly more rangeland production than the drier aridic-ustic portions of the MLRA and have enough moisture to produce a crops annually as opposed to bi-annually in the drier areas. Ecological sites in this higher precipitation area are classified as the moist grassland climatic zone.

Classification relationships

NRCS Soil Geography Hierarchy
Land Resource Region: Northern Great Plains
Major Land Resource Area: 52
Climatic Zone: Dry Grassland

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: Northwestern Glaciated Plains 331D
• Subsection: Montana Glaciated Plains 331Dh
• 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, Meadow, and Shrubland Formation (2.B.2)
• Division: Great Plains Grassland and Shrubland Division (2.b.2.Nb)
• Macrogroup: Hesperostipa comata – Pascopyrum smithii – Festuca hallii Grassland Macrogroup (2.B.2.Nb.2)
• Group: Pascopyrum smithii – Hesperostipa comata – Schizachyrium scoparium – Bouteloua spp. Mixedgrass Prairie Group (2.B.2.Nb.2.c)
• Alliance: Pascopyrum smithii – Nassella viridula Northwestern Great Plains Herbaceous Alliance
• Association: Pascopyrum smithii -Hesperostipa comata Central Mixedgrass Herbaceous Vegetation

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

Ecological site concept

The Loamy Dry Grassland site occurs on till plains, hillslopes, outwash fans, alluvial fans, and high stream terraces. This site is characterized by moderately deep to very deep (greater than 20 inches to bedrock) medium textured soils on slopes less than 15%. Surface textures are of the fine-loamy or fine silty textural family (< 35% clay) and soils frequently have a mollic epipedon. $CaCO_3$ is less than 5% in the surface 5 inches. The dominant plant community on this site is needle and thread (Hesperostipa comata) and rhizomatous wheatgrasses; primarily western (Pascopyrum smithii) and/or thickspike (Elymus lanceolatus). Other grasses include prairie Junegrass (Koeleria macrantha), blue grama (Bouteloua gracilis), Sandberg bluegrass (Poa secunda) and plains reedgrass (Calamagrostis montanensis). Green needlegrass (Nassella viridula) is present when moisture conditions are made more favorable by soil texture or micro relief. Silver sagebrush is the most common shrub. Figure 1 illustrates the distribution of this ecological site based on current data. This map is approximate, is not intended to be definitive, and may be subject to change. Field verification using the appropriate MLRA key is required for proper identification of this ecological site.

Associated sites

FX052X01X040	**Loamy-Steep (Lostp) Dry Grassland** Occurs on steeper slopes (15% or greater) adjacent to the Loamy site. Soils are similar to the Loamy site.
FX052X01X006	**Claypan (Cp) Dry Grassland** Occupies similar landscapes to the Loamy site. In the natric soils complex Claypan is found in mid-level micro topography whereas Loamy occupies higher positions.
FX052X01X030	**Limy (Ly) Dry Grassland** Generally, found on crests, shoulders, or summits and where slope shares are convex rather than linear or concave. Soils contain 5% or greater $CaCO_3$ in the surface 5 inches (evidenced by strong or violet effervescence).
FX052X01X062	**Swale (Se) Dry Grassland** Generally found downslope from the loamy site in swales and drainageways. Receives additional moisture from surface water run in. Soils are > 20" deep and mollic or pachic with higher available water holding capacity.

Similar sites

FX052X03X032	**Loamy (Lo) Dry Shrubland** Differs from Loamy Dry Grassland in that annual temperatures are slightly warmer and site supports big sagebrush rather than silver sagebrush.
FX052X01X001	**Clayey (Cy) Dry Grassland** Differs from Loamy Dry Grassland in that soils contain greater than 35% clay in the surface 4 inches.
FX052X01X030	**Limy (Ly) Dry Grassland** Differs from Loamy Dry Grassland in that' soils contain 5% or greater $CaCO_3$ in the surface 5 inches (evidenced by strong or violet effervescence).
FX052X01X110	**Sandy (Sy) Dry Grassland** Differs from Loamy Dry Grassland in that soils are a Coarse-Loamy textural family in the surface 4 inches as opposed to Fine-Loamy.
FX052X01X006	**Claypan (Cp) Dry Grassland** Differs from Loamy Dry Grassland in that soils contain an abrupt root-restrictive clay layer within 10 inches of the soil surface.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R052XY032MT

Physiographic features

The Loamy Dry Grassland ecological site is the most extensive ecological site in MLRA 52. The majority of MLRA 52 is covered by a broad till plain and this site largely occurs on ground, recessional or end moraines but can also occur on other landforms such as outwash fans or terraces. This site is typically found on linear and concave slope positions where slopes are less than 15 percent. This site is also found on convex slope positions but in these instances the soil is most likely to have accumulations of secondary carbonates at depths of only 5 to 10 inches below the soil surface.

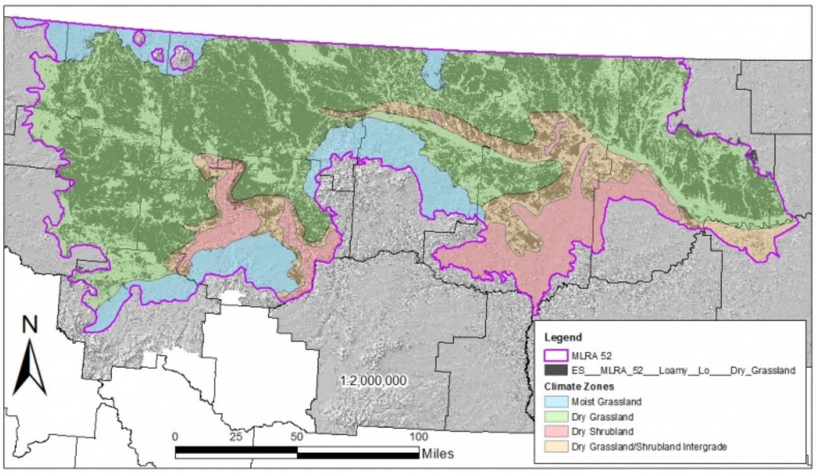


Figure 2. Figure 1. Extent of the Loamy Dry Grassland Ecological Site within MLRA 52 based on soil mapunit component.

Table 2. Representative physiographic features

Landforms	(1) Till plain > Moraine (2) Till plain > Outwash fan (3) Terrace
Elevation	2,000–3,870 ft
Slope	0–14%
Aspect	Aspect is not a significant factor

Climatic features

The Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Cooper et al., 2001). The average frost-free period for this ecological site is 120 days. 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. Severe drought occurs on average in 2 out of every 10 years. Annual precipitation ranges from 10 to 14 inches, and 70 to 80 percent of this occurs during the growing season (Cooper et al., 2001). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

During the winter months the western half of MLRA 52 commonly experiences chinook winds, which are strong west to southwest surface winds accompanied by abrupt increases in temperature. The chinook winds are strongest on the western boundary of the MLRA near the Rocky Mountain foothills and decrease eastward. In addition to producing damaging winds, prolonged chinook episodes can result in drought or vegetation kills due to the reaction of plants to a “false spring” (Oard, 1993).

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	140 days
Precipitation total (average)	12 in

Climate stations used

- (1) CARTER 14 W [USC00241525], Floweree, MT
- (2) CHESTER [USC00241692], Chester, MT
- (3) TIBER DAM [USC00248233], Chester, MT
- (4) HARLEM [USC00243929], Harlem, MT
- (5) MALTA 7 E [USC00245338], Malta, MT
- (6) TURNER 11N [USC00248415], Turner, MT
- (7) CONRAD [USC00241974], Conrad, MT
- (8) SHELBY [USC00247500], Shelby, MT
- (9) GLASGOW [USW00094008], Glasgow, MT
- (10) HAVRE CITY CO AP [USW00094012], Havre, MT

Influencing water features

This site is not influenced by groundwater table or other soil hydrology. Moisture loss through potential evapotranspiration exceeds precipitation for the majority of the growing season. With the exception of May and June, the site is generally in a state of moisture deficit.

Soil features

Soils that best represent the central concept of this ecological site are the benchmark soil series Joplin, Phillips and Scobey. These three series cover more than 3 million acres of MLRA 52 combined. Scobey and Joplin are in the Argiustolls Great Group and have a relatively dark mollic epipedon and an underlying argillic horizon where clay has accumulated through weathering. Phillips is in the Haplustalfs Great Group and also has an argillic horizon but does not contain enough organic matter in the surface to have a mollic epipedon. Joplin is fine-loamy and has mixed minerology whereas Phillips and Scobey are fine family and have smectitic mineralogy. The soil moisture regime for these and all soils in this ecological site concept is ustic bordering on aridic 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. These soils have a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface textures found in this site are typically loam or clay and contain 18 to 35 percent clay. Underlying horizons typically, but not always, have an argillic horizon that contains between 18 to 45 clay depending on the soil series. Organic matter in the surface typically ranges from 1-3 percent and moist colors vary from brown (10YR 4/3) to very dark grayish brown (10YR 3/2). Depth to secondary carbonates is usually between 5 and 20 inches below the soil surface.
The surface of these soils does not typically react with hydrochloric acid within the upper 5 inches and if present at all the Calcium Carbonate Equivalent in the surface 5 inches is less than 5 percent. The soil depth class for this is site can be moderately deep (between 20 and 40 inches to bedrock) in places where bedrock is present but is typically very deep (greater than 60 inches to bedrock). Coarse fragments are less than 35 percent of the upper 20 inches of soil and are typically less than 15 percent.

Table 4. Representative soil features

Parent material	(1) Till (2) Glaciofluvial deposits (3) Alluvium
Surface texture	(1) Loam (2) Clay loam
Drainage class	Well drained
Soil depth	20–72 in
Available water capacity (0-40in)	6.5–7 in
Calcium carbonate equivalent (0-5in)	0–4%
Electrical conductivity (0-20in)	0–3 mmhos/cm
Sodium adsorption ratio (0-20in)	0–12
Soil reaction (1:1 water) (0-40in)	5.6–9
Subsurface fragment volume <=3" (0-20in)	0–34%
Subsurface fragment volume >3" (0-20in)	0–34%

Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical 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 Loamy ecological site in MLRA 52 Dry Grassland consists of six states: The Historic Reference State (1.0), the Contemporary Reference State (2.0), the Shortgrass State (3.0), the Invaded State (4.0), Annual Cropland (5.0), and the Post-Cropland State (6.0).

The presumed Historic Reference Community Phase of the Loamy ecological site was dominated by mid-statured, cool-season perennial grasses characterized by a rhizomatous wheatgrass-needle and thread community. Mat-forming, warm-season perennial grasses were also an important component of this site, although their contribution varied with climate and disturbance. This site had a minor component of short-statured, cool-season grasses and sedges as well as other mid-statured, cool-season grasses. A variety of perennial and annual forbs as well as prairie, or fringed, sagewort (Artemsia frigida) occurred on the site, but their composition and cover varied with climate and disturbance (Coupland 1961). Dense spike-moss (*Selaginella densa*), more locally known and hereafter referred to as dense clubmoss, is a major component of this ecological site that may provide significant ground cover. The cover of dense clubmoss was highly variable and dependent fire frequency, climate, and grazing.

Plant communities associated with the Loamy ecological site evolved under the combined influences of climate, grazing, and fire. Extreme climatic variability results in frequent droughts, which can 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 grasses, annual production is highly dependent upon mid- to late-spring precipitation (Heitschmidt and Vermeire 2005, Anderson 2006).

Native grazers also shaped these plant communities. Bison (Bison bison) were the dominant historic grazer, but pronghorn (Antilocarpa 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.) also influenced this plant community (Salo et al. 2004). Grasshoppers and periodic outbreaks of the now extinct Rocky Mountain locust (Melanoplus spretus; Lockwood 2004) also played an important role in the ecology of these communities.

The historic reference community experienced relatively frequent lightning-caused fires with estimated fire return intervals of 6-25 years (Bragg 1995). The majority of these lightning-caused fires occurred in July and August. Historically, Native Americans selectively set small, frequent fires during spring and fall to correspond with the movement of bison (Higgins 1986).

Frequent fire is no longer a major disturbance to this ecological site due to fire suppression and cessation of fires ignited by Native Americans. This lack of frequent fires has resulted in an increase in litter accumulation in some areas, providing ideal conditions for seed germination and seedling establishment of non-native annual brome species, such as field, or Japanese, brome (*Bromus arvensis*; Whisenant 1990). These species have become naturalized in relatively undisturbed grasslands (Ogle et al. 2003, Harmoney 2007), and their presence can reduce the production of cool season perennial grasses (Haferkamp et al. 1997). Fire suppression may also be one mechanism that triggers increased cover of dense clubmoss (Rowe 1969, Shay et al. 2001). The cover of dense clubmoss is generally less on recently burned sites (Dix 1960, Wilson and Shay 1990); however, its abundance may also vary greatly from site to site without discernable reason. In general, mechanisms affecting dense clubmoss abundance are not well understood and require further investigation.

Improper grazing of this site can result in a reduction in the cover of the cool season wheatgrasses and, eventually a decrease in other cool season, mid-statured bunchgrasses, and an increase in blue grama (Smoliak et al. 1972, Smoliak 1974). Periods of extended drought can reduce mid-statured, cool season, rhizomatous wheatgrasses, shifting the species composition of this community to one dominated by blue grama and needle and thread (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 Sandberg bluegrass (Adams et al. 2013). Cover of mid-statured rhizomatous grasses and bunchgrasses is severely reduced or absent. Cover of prairie sagewort can also increase.

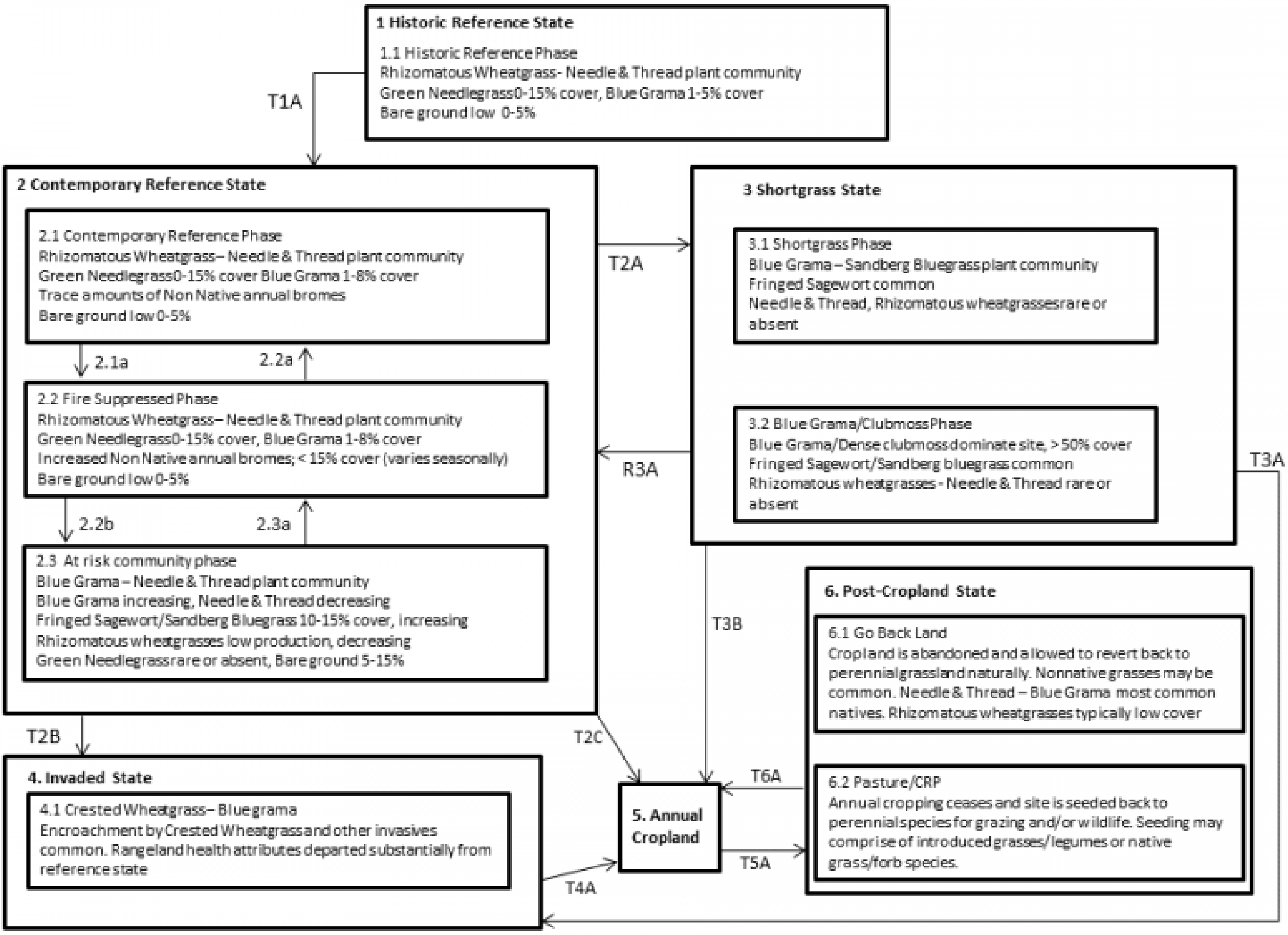
Much of the highly productive Loamy ecological site has been converted to annual cropland. Seeding of introduced grasses, particularly crested wheatgrass (*Agropyron cristatum*), was a common practice on eroded and abandoned agricultural areas after the droughts of the 1930s (Rogler and Lorenz 1983). Crested wheatgrass is a highly drought tolerant and competitive cool season, perennial bunchgrass (DeLuca and Lesica 1986). Crested wheatgrass can invade relatively undisturbed grasslands, reducing cover and production of native cool-season midgrasses (Heidinga and Wilson 2002, Henderson and Naeth 2005). Russian wildrye (*Psathyrostachys juncea*), though less widespread, was introduced in the 1950s to provide forage for livestock (Dormaar et al. 1995). Although Russian wildrye is typically planted in monocultures, this species is not considered invasive. Under ideal conditions, it may be able to spread into adjacent degraded plant communities (Ogle et al. 2012), but such conditions are unlikely in MLRA 52.

When this site is 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 blue grama and cool season midgrasses, although cover and production of these species is lower than in the reference state. However, those sites seeded with non-native species, particularly crested wheatgrass, may persist as this cover type indefinitely (Christian and Wilson 1999).

The STM diagram 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. Land owners 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 cover and production values are representative and are not intended to cover the full range of conditions, species, and responses for the site. Cover values are presented as foliar cover unless otherwise noted. Species composition by dry weight is provided when describing the herbaceous plant communities.

State and transition model

R52XY032MT Loamy Dry Grassland



R05252XY032MT Loamy Dry Grassland

Legend

- 2.1a long term fire suppression
- 2.2a return of historic fire regime
- 2.2b drought, improper grazing management, multiple fires in close succession
- 2.3a proper grazing management, timely moisture
- T1A naturalization of non-native species (typically Japanese brome, cheatgrass, common dandelion, yellow sweetclover, and yellow salsify)
- T2A prolonged drought, improper grazing, or a combination of these factors
- T2B introduction of aggressive perennial grasses (mostly Crested Wheatgrass)
- T3A introduction of weedy species combined with improper grazing management and/or drought
- R3A range seeding, grazing land mechanical treatment, timely moisture, proper grazing management (management intensive and costly)
- T2C, T3B, T4A, T6A conversion to annual cropland
- T5A Cessation of annual cropping

State 1
Historic Reference State

The Historic Reference State contains a single community phase characterized by mid-statured, cool-season grasses. This phase evolved under the combined influences of climate, grazing, and fire.

Community 1.1
Historic Reference Phase

The Historic Reference Plant Community was dominated by rhizomatous wheatgrasses and needle and thread. Both western wheatgrass and thickspike wheatgrass occurred in this community. In northern portions of the Northern Great Plains, particularly the Canadian provinces, thickspike wheatgrass was the dominant wheatgrass in this community (Coupland 1950, Coupland 1961). Western wheatgrass increased in dominance to the south due to its greater tolerance of higher temperatures and drought conditions (Coupland 1961, Cooper et al. 2001). The northern portion of MLRA 52 appears to include the area of transition in dominance between thickspike wheatgrass and western wheatgrass (Heidel et al. 2000, Cooper et al. 2001), but these two wheatgrass species can co-occur. The perennial bunchgrass needle and thread often co-dominated this community in terms of cover and production. The warm-season, mat-forming blue grama occurred with relatively low cover in the historic reference phase; however, frequent fires or prolonged drought led to an increase in cover of blue grama and a decrease in the cover and production of cool-season grasses (Coupland 1950, Umbanhowar 2004). The cool season, perennial bunchgrass green needlegrass, typically more abundant on sites with finer-textured soils, occurred on examples of the Loamy site where microsite conditions provided protection from wind and enhanced soil moisture (Coupland 1950, 1961, Cooper et al. 2001). The historic reference phase had a minor component of short-statured, cool-season grasses and sedges including prairie Junegrass, Sandberg bluegrass, threadleaf sedge (*Carex filifolia*), and needleleaf sedge (*C. duriuscula*), as well as mid-statured, cool-season species such as plains reedgrass. Commonly occurring perennial forbs included spiny, or Hood's phlox (*Phlox hoodii*) and scarlet globemallow (*Sphaeralcea coccinea*) and the subshrub prairie sagewort, but their composition and cover varied with climate and disturbance (Coupland 1961). The principal shrub on this site, if present, was silver sagebrush, although canopy cover was generally less than 5%. The cover of dense clubmoss was variable and dependent upon both the frequency and severity of fire, drought, and hoof action by grazing animals (Coupland 1950, VanDyne and Vogel 1967, Clarke et al. 1947). The amount of bare soil was low, typically 0-5%.

State 2
Contemporary Reference State

The Contemporary Reference State consists of three community phases. The dynamics of this state are driven by the combined influences of climate, grazing, and fire. Dense clubmoss may be present in any of the phases within this state, however, its density is highly variable and the dynamics of this species are not well understood. Research has shown that its density is effected by drought, fire, and hoof action by grazing animals (Coupland 1950, VanDyne and Vogel 1967, Clarke et al. 1947). However, its abundance may vary greatly from site to site without discernable reason. In general, this state is characterized by a predominance of mid-statured, cool season grasses. As ecological condition declines; mid-statured grasses decrease and are replaced by short statured grasses such as blue grama and Sandberg bluegrass. Community Phases 2.1 and 2.2 have similar species composition but differ primarily in the amount of litter accumulation and the cover of non-native annual bromes. The At-Risk Community Phase (2.3) is dominated by blue grama and needle and thread, although needle and thread decreases in this phase while blue grama is increasing. Improper grazing management, fire suppression, and drought can transition this state to the Shortgrass State (3).The cool-season, rhizomatous wheatgrass component has low production and decreases in the At-Risk Community Phase (2.3). If present on the site, the cool-season bunchgrass green needlegrass also decreases and will become rare or disappear from the site. Shortgrasses, particularly blue grama and Sandberg bluegrass increase in the At-Risk Community Phase (2.3) as does prairie sagewort.

Community 2.1
Contemporary Reference Phase

The Contemporary Reference Plant Community is dominated by rhizomatous wheatgrasses and needle and thread. Both western wheatgrass and thickspike wheatgrass can occur in this community. In northern portions of the Northern Great Plains, particularly the Canadian provinces, thickspike wheatgrass is the dominant wheatgrass in this community phase (Coupland 1950, Coupland 1961). Western wheatgrass increases in dominance to the south due to its greater tolerance of higher temperatures and droughty conditions (Coupland 1961, Cooper et al. 2001). The northern portion of MLRA 52 appears to include the area of transition in dominance between thickspike wheatgrass and western wheatgrass (Heidel et al. 2000, Cooper et al. 2001), but these two wheatgrass species can co-occur. The perennial bunchgrass needle and thread often co-dominates this community in terms of both cover and production. The warm-season, mat-forming blue grama occurs with relatively low cover; however, frequent fires or prolonged drought can lead to an increase in cover of blue grama and a decrease in the cover and production of cool-season grasses (Coupland 1950, Umbanhowar 2004). The cool season, perennial bunchgrass green needlegrass, typically more abundant on sites with finer-textured soils, occurs on examples of the Loamy site where microsite conditions enhance soil moisture and provide protection from wind (Coupland 1950, 1961, Cooper et al. 2001). This phase has a minor component of short-statured, cool-season grasses and sedges including prairie Junegrass, Sandberg bluegrass, and threadleaf sedge as well as mid-statured, cool-season species such as plains reedgrass. Commonly occurring perennial forbs include spiny phlox and scarlet globemallow and the subshrub prairie sagewort, but their composition and cover vary with climate and disturbance (Coupland 1961). The principal shrub on this site, if present, is silver sagebrush, although canopy cover is generally less than 5%. The natural fire regime is maintained in the Contemporary Reference Phase, which influences the accumulation of litter as well as the presence of non-native annual brome grasses. Although non-native annual bromes, particularly field brome, have become naturalized in the Contemporary Reference Phase, frequent fires can reduce litter accumulation enough to limit field brome germination (Whisenant 1990). However, long-term fire suppression drives the shift to the Fire Suppressed Phase (2.2).

Community 2.2
Fire Suppressed Phase

Figure 5. Figure 2 Community Phase 2.2 Fire Suppressed Phase for Loamy Dry Grassland ecological site; Phillips soils. Photo by Montana Natural Heritage Program, Phillips County, Montana, 2012

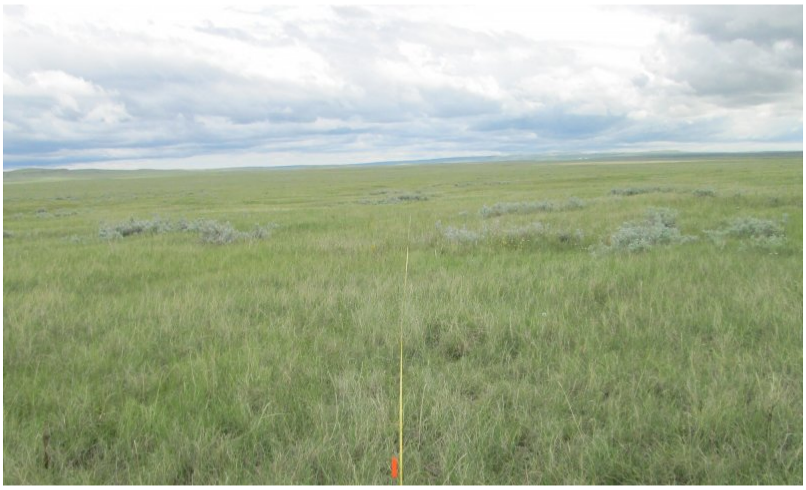


Figure 6. Figure 2 Community Phase 2.2 Fire Suppressed Phase for Loamy Dry Grassland ecological site; Evanston soils. Photo by Montana Natural Heritage Program, Blaine County, Montana, 2013

The Fire Suppressed Phase is similar in composition, cover, and production to the Contemporary Reference Phase (2.1) except that both the accumulation of litter and the cover of non-native annual bromes has increased due to lack of frequent fire. The cover of annual bromes varies depending upon the amount of fall precipitation, when seed germination typically occurs (Baskin and Baskin 1981). Until the Fire Suppressed Phase crosses the threshold into the Shortgrass State (3), the Invaded State (4), or the Annual Cropland State (5), this phase can return to the Contemporary Reference Phase (2.1) with a return to the historic fire return interval. The following tables characterize the Fire Suppressed Phase (2.2) by the following elements: Plant Community Phase Composition and Foliar Cover Annual Production Soil Surface Cover Canopy Structure

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	320	610	900
Forb	50	90	135
Shrub/Vine	30	60	90
Total	**400**	**760**	**1125**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-5%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	35-65%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0-5%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	5-15%	2-10%
>0.5 <= 1	–	0-5%	35-60%	0-5%
>1 <= 2	–	0-1%	15-20%	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Figure 8. Plant community growth curve (percent production by month). MT005, MLRA 52 (cool season dominant). Typically occurs in Reference or Contemporary Reference State.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			10	25	45	15	5				

Community 2.3
At Risk Community Phase

Multiple fires in close succession, improper grazing management, prolonged drought or a combination of these factors can shift the Fire Suppressed Phase (2.2) towards the At Risk Community Phase (2.3). This community phase is characterized by an increase in the warm-season, mat-forming blue grama. The cover of blue grama in this phase equals or exceeds needle and thread, which decreases in this phase. Rhizomatous wheatgrasses have low production and have decreased considerably. If present on the site, the cool-season, bunchgrass green needlegrass also decreases and will become rare or disappear from the site. The shortgrass, Sandberg bluegrass and the subshrub, prairie sagewort, increase in this phase. Annual bromes are still present in this phase with similar dynamics to phase 2.1 or 2.2, depending on fire frequency and precipitation patterns. The At Risk Community Phase is considerably less productive than either the Contemporary Reference Phase (2.1) or the Fire Suppressed Phase (2.2) due to the significant decrease in cool-season midgrasses. Until the At Risk Community Phase crosses the threshold into the Shortgrass State (3), the Invaded State (4), or the Annual Cropland State (5), this phase can return to the Fire Suppressed Phase (2.2) with proper grazing management and normal or above-normal spring precipitation. Continued improper grazing management will drive this community phase to the Shortgrass State (3).

Pathway 2.1a
Community 2.1 to 2.2

Increased litter accumulation as a result of long-term fire suppression enhances the conditions necessary for germination of non-native annual brome grasses (Whisenant 1990). Increasing cover of annual bromes can shift the Contemporary Reference Phase (2.1) to the Fire Suppressed Phase (2.2).

Pathway 2.2a
Community 2.2 to 2.1

A return to the historic fire return interval can shift the Fire Suppressed Phase (2.2) back to the Contemporary Reference Phase (2.1). Reductions in the cover of annual bromes to trace amounts will indicate a return to the Contemporary Reference Phase (2.1).

Pathway 2.2b
Community 2.2 to 2.3

Improper grazing management, prolonged drought, multiple fires in close succession, or a combination of these factors can shift the Fire Suppressed Phase (2.2) to the At Risk Community Phase (2.3). These factors favor an increase in blue grama and a decrease in cool-season midgrasses (Coupland 1961, Shay et al. 2001). On the Loamy site, fires more frequent than the estimated natural fire regime can shift the community to one dominated by warm-season grasses. Repeated removal of litter can elevate soil temperatures, favoring blue grama, which is more tolerant of these warmer and drier conditions (Smith and McDermid 2014).

Pathway 2.3a
Community 2.3 to 2.2

The At Risk Community Phase (2.3) can return to the Fire Suppressed Phase (2.2) with proper grazing management and normal or above-normal spring precipitation.

State 3
Shortgrass State

The Shortgrass State consists of two community phases. The dynamics of this state are driven by improper grazing management, long-term drought, or a combination of these factors. Primary grasses in the Shortgrass State are blue grama and Sandberg bluegrass. Rhizomatous wheatgrasses and needle and thread have low production and poor vigor in this phase and prairie sagewort is common. Blue grama increases with long-term improper grazing at the expense of cool-season midgrasses (Coupland 1961, Biondini and Manske 1996, Derner and Whitman 2009). Reductions in stocking rates can reduce blue grama cover and increase the cover of cool-season midgrasses, although this recovery may take decades (Dormaar and Willms 1990, Dormaar et al. 1994). Dense clubmoss may or may not be present in this state and the dynamics of this species are not well understood. In some cases it is abundant on heavily grazed areas, but in others it is rare or absent. Its abundance varies greatly from site to site without discernable reason, therefore, it is not considered a reliable indicator of past grazing use (Montana State

College 1949). Annual bromes are also present in this state. They are naturalized but usually do not have a significant ecological impact, however, their abundance varies depending on precipitation and germination conditions.

Community 3.1
Shortgrass Phase

Figure 9. Figure 3 Community Phase 3.1 Shortgrass Phase for Loamy Dry Grassland ecological site; Yamacall soils. Photo by Charlie French (Soil Scientist USDA-NRCS), Blaine County, Montana, 2015

On sites where clubmoss is not present, the Shortgrass Plant Community occurs as the result of long-term improper grazing management. The Shortgrass Plant Community is dominated by the warm season, mat-forming blue grama and cool-season shortgrasses, particularly Sandberg bluegrass. Long-term improper grazing management has considerably reduced the cover and annual production of this site, changing the structure of this plant community from a mid-statured grassland to a shortgrass community (Derner and Hart 2007). Cool season, rhizomatous wheatgrasses and needle and thread have decreased significantly in this phase, and grazing tolerant species like blue grama and Sandberg bluegrass have increased. Prairie sagewort also increases in this phase.

Figure 10. Plant community growth curve (percent production by month). MT041, MLRA 52 (warm season dominant). Typically occurs in the Short Grass State.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			5	20	50	20	5				

Community 3.2
Blue Grama/Dense Spike-moss Phase

On sites where clubmoss is present, the Blue Grama/Dense Clubmoss Plant Community occurs as the result of long-term improper grazing management. It is similar to the shortgrass phase in that cool season, rhizomatous wheatgrasses and needle and thread have decreased significantly while grazing tolerant species like blue grama and Sandberg bluegrass have increased. Prairie sagewort also increases in this phase. Dense clubmoss is common in this phase; often comprising more than 50% basal cover.

State 4
Invaded State

The Invaded State (4) occurs when invasive plant species, primarily crested wheatgrass, invade adjacent native grassland communities. An estimated 20 million acres of crested wheatgrass have been planted in the western U.S. (Holechek 1981). Since the 1930s, crested wheatgrass has been planted to improve forage for livestock (Roglers and Lorenz 1983, Laycock 1988). Beginning in the mid-1980s, crested wheatgrass was often seeded on lands enrolled in the Conservation Reserve Program (CRP; Roath 1988, DeLuca and Lesica 1996). Crested wheatgrass is extremely drought tolerant, establishes readily on a variety of soil types, has high seedling vigor, and provides highly productive early season forage for livestock (Rogler and Lorenz 1983). Once established, monocultures of crested wheatgrass can persist for at least 60 years (Krzic et al. 2000, Henderson and Naeth 2005), as crested wheatgrass stands resist recruitment of native plant species (Looman and Heinrichs 1973, Henderson and Naeth 2005, Fansler and Mangold 2011). Crested wheatgrass produces abundant seeds that can dominate the seedbank of invaded grasslands (Henderson and Naeth 2005), although crested wheatgrass cover decreases with increasing distance from seeded areas (Heidinga and Wilson 2002). The early growth of crested wheatgrass allows this species to take advantage of early season soil moisture, which may result in competitive exclusion of native cool-season rhizomatous wheatgrasses and bunchgrasses such as needle and thread and prairie Junegrass (Christian and Wilson 1999, Heidinga and Wilson 2002, Henderson and Naeth 2005). If already established, the warm-season, mat-forming blue grama may compete successfully with crested wheatgrass (Heidinga and Wilson 2002), although the ability of blue grama to persist in invaded stands is unknown due to its low seed production (Coupland 1950) and narrow germination requirements (Lauenroth et al. 1994). Reduced soil quality, (Dormaar et al. 1995), reduced plant species diversity, and simplified structural complexity (Henderson and Naeth 2005) result in a state that is substantially departed from the Reference State (2).

Community 4.1
Crested Wheatgrass - Blue Grama

Figure 11. Figure 4 Community Phase 4.1 Invaded State for Loamy Dry Grassland ecological site; Ethridge soils. Photo by Scott Brady, Blaine County, Montana, 2014

Encroachment by Crested Wheatgrass and other invasives common. Rangeland health attributes departed substantially from reference state

State 5
Annual Cropland

The Annual Cropland State (5) occurs when land is put into cultivation. Major crops in MLRA 52 include winter and spring wheat, as well as barley.

State 6
Post-Cropland State

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

Community 6.1
Go Back Land

In the absence of active management, the site can re-vegetate naturally and, over time, potentially return to a perennial grassland community with needle and thread and blue grama. Shortly after cropland is abandoned, annual and biennial forbs and annual brome grasses invade the site (Samuel and Hart 1994). The site is highly susceptible to erosion due to the absence of perennial species. Eventually these pioneering annual species are replaced by perennial forbs and perennial shortgrasses such as Sandberg bluegrass and blue grama. Depending on the historical management of the site, perennial bunchgrasses such as needle and thread may also return; however, species composition will depend upon the seed bank. Cover and production of cool-season rhizomatous wheatgrasses is low, even after several decades (Dormaar and Smoliak 1985, Dormaar et al. 1994, Christian and Wilson 1999). Invasion of the site by exotic species such as crested wheatgrass and annual bromes 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 conditions prior to cultivation (Dormaar and Smoliak 1985, Christian and Wilson 1999), making a shift to the Contemporary Reference State (2) unlikely within a reasonable timeframe.

Community 6.2
Pasture/CRP

When the site is seeded to perennial forage species, particularly perennial grasses such as crested wheatgrass, this community phase can persist for several decades. Monocultures of crested wheatgrass can persist for at least 60 years (Krzic et al. 2000, Henderson and Naeth 2005). A mixture of native species may also be seeded, which provides species composition and structural complexity similar to that 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 timeframe.

Transition T1A
State 1 to 2

Non-native annual brome (Bromus) species, introduced in the early to mid-20th century, have become naturalized in relatively undisturbed grasslands (Ogle et al. 2003, Harmoney 2007). The presence of these species can reduce the production of cool season perennial grasses (Haferkamp et al. 1997). Lack of frequent fires can weaken the resilience of the Historic Reference State (1) by increasing litter accumulation, which improves soil moisture and provides ideal conditions for seed germination and seedling establishment of non-native annual brome species, such as field brome (*B. arvensis*; Whisenant 1990). This increase in non-native species shifts the Historic Reference State (1) toward the Contemporary Reference State (2).

Transition T2A
State 2 to 3

The Contemporary Reference State (2) transitions to the Shortgrass State (3) when cool-season midgrasses become rare and contribute little to production. Shortgrasses, particularly the warm-season, mat-forming blue grama, as well as Sandberg bluegrass, dominate the plant community. Improper grazing practices and prolonged drought or a combination of these factors weaken the resilience of the Contemporary Reference State (2) and drive its transition to the Shortgrass State (3).

Transition T2B
State 2 to 4

The Contemporary Reference State (2) transitions to the Invaded State (4) when invasive plant species, particularly crested wheatgrass, invade the Contemporary Reference State (2). These communities are often adjacent to seeded pastures. Exotic plant species dominate the site in terms of cover and production. Site resilience has been substantially reduced and other rangeland health attributes such as reproductive capacity of native grasses (Henderson and Naeth 2005) and soil quality (Smoliak and Dormaar 1985, Dormaar et al. 1995) have been substantially altered from the Reference State.

Transition T2C
State 2 to 5

The Contemporary Reference State (2) will transition to the Annual Cropland State (5) when the site is placed into cultivation with crops such as winter and spring wheat and barley.

Restoration pathway R3A

State 3 to 2

Blue grama can resist displacement by other species (Dormaar and Willms 1990, Laycock 1991, Dormaar et al. 1994, Lacey et al. 1995). A reduction in livestock grazing pressure alone may not be sufficient to reduce the cover of blue grama in the Shortgrass State (3) (Dormaar and Willms 1990), and mechanical treatments may be necessary (Hart et al. 1985). Therefore, returning the Shortgrass State (3) to the Contemporary Reference State (2) can require considerable cost, energy, and time.

Transition T3A
State 3 to 4

The Shortgrass State (3) transitions to the Invaded State (4) when invasive plant species, particularly crested wheatgrass, invade the Shortgrass State (3). This transition can occur when native plant communities are adjacent to seeded pastures. Exotic plant species, particularly crested wheatgrass, dominate the site in terms of cover and production. Crested wheatgrass can outcompete native grasses (Vaness and Wilson 2007), weakening site resilience and impacting rangeland health attributes such as the reproductive capacity of native grasses (Henderson and Naeth 2005) and soil quality (Smoliak and Dormaar 1985, Dormaar et al. 1995).

Transition T3B
State 3 to 5

The Shortgrass State (3) transitions to the Annual Cropland State (5) when the site is placed into cultivation with crops such as winter and spring wheat and barley.

Transition T4A
State 4 to 5

The transition from the Invaded State (4) to the Annual Cropland State (5) occurs when the site is placed into cultivation with crops such as winter and spring wheat and barley.

Transition T5A
State 5 to 6

The transition from the Annual 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 as crested wheatgrass and alfalfa or a mix of native species.

Transition T6A
State 6 to 5

The Post-Cropland State (6) transitions back to the Annual Cropland State (5) when the site is converted to cropland.

Additional community tables

Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-Stature, cool season rhizomatous grasses**			130–365	
	western wheatgrass	PASM	*Pascopyrum smithii*	120–338	5–50
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	120–338	0–45
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–35	0–10
2	**Mid stature, cool season bunchgrasses**			130–365	
	needle and thread	HECO26	*Hesperostipa comata*	130–365	5–40
	green needlegrass	NAVI4	*Nassella viridula*	0–155	0–15
3	**Short stature graminoids**			40–115	
	threadleaf sedge	CAFI	*Carex filifolia*	0–80	0–5
	blue grama	BOGR2	*Bouteloua gracilis*	15–45	1–8
	prairie Junegrass	KOMA	*Koeleria macrantha*	15–45	1–5
	needleleaf sedge	CADU6	*Carex duriuscula*	10–35	2–7
	Sandberg bluegrass	POSE	*Poa secunda*	0–5	0–5
4	**Other Native Graminoids**			20–55	
	Grass, perennial	2GP	*Grass, perennial*	20–55	1–5
Forb					
5	**Perennial forbs**			50–135	
	Forb, native	2FN	*Forb, native*	20–55	0–5
	American vetch	VIAM	*Vicia americana*	10–25	0–5
	spiny phlox	PHHO	*Phlox hoodii*	10–25	0–2
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	5–10	0–2
	dotted blazing star	LIPU	*Liatris punctata*	5–10	0–1
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–5	0–5
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–5	0–1
Shrub/Vine					
6	**Native Shrubs and Halfshrubs**			25–65	
	prairie sagewort	ARFR4	*Artemisia frigida*	15–35	0–2
	silver sagebrush	ARCA13	*Artemisia cana*	10–20	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–5	0–1
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–5	0–1
7	**Cactus**			5–25	
	plains pricklypear	OPPO	*Opuntia polyacantha*	5–25	0–1

Animal community

Grassland communities within the Loamy Ecological Site of MLRA 52C support a diverse animal community. Grasshopper species can significantly impact plant production during outbreaks or periods of drought, competing with other grazers on this site (Branson and Sword 2010). Grasshopper density and species richness can increase with changes in vegetation structure and composition associated with disturbances such as fire and grazing (Joern 2005).

Although amphibians use wetlands throughout MLRA 52 for breeding, most amphibian species, including Boreal Chorus Frog (Pseudacris maculata), Western Tiger Salamander (Ambystoma mavortium), and Plains Spadefoot (Spea bombifrons), rely on the surrounding grasslands for survival during the non-breeding season (Semlitsch 2000, Mushet et al. 2012). Similarly, several reptile species including Prairie Rattlesnake (Crotalus viridis), Gophersnake (Pituophis catenifer), and Plains Gartersnake (Thamnophis radix) occur throughout grassland communities.

A variety of migratory grassland birds breed throughout this ecological site. Eight bird species that are endemic or restricted to the Northern Great Plains (Knopf 1996) breed in MLRA 52. The composition of grassland birds varies with vegetation structure (Madden et al. 2000, Henderson and Davis 2014), and the species composition of the breeding bird community will vary depending upon the state and/or community phase occurring on the site. For example, species such as Sprague's Pipit (Anthus spragueii) and Baird's Sparrow (Ammodramus bairdii) are more abundant in native, mixed-grass communities (Madden et al. 2000, Davis et al. 2013) associated with the Contemporary Reference State (2). Similarly, species such as McCown's Longspur (Rhynchophanes mccownii) primarily occur in plant communities dominated by shortgrasses (With 2010). Most endemic grassland songbirds have reduced abundance and nesting success in grasslands that have been planted with non-native, perennial grasses, analogous to the Pasture/CRP community phase (6.2) of the Post-Cropland State (6) (Davis et al. 2013). Other bird species such as Long-billed Curlew (Numenius americanus) and Greater Sage-Grouse (Centrocercus urophasianus) rely on a variety of habitats for nesting and brood-rearing, emphasizing the importance of managing for diverse vegetation structure (Derner et al. 2009).

Upland nesting waterfowl species , including Lesser Scaup (Aythya affinis), Mallard (Anas platyrhynchos), Gadwall (Anas strepera), American Wigeon (Anas americana), Green-Winged Teal (Anas crecca), Blue-Winged Teal (Anas discors), and Northern Pintail (Anas acuta) require extensive grasslands represented by this ecological site for nesting and brood-rearing (Stephens et al. 2005). Additionally, several raptor species including Northern Harrier (Circus cyaneus), Swainson's Hawk (Buteo swainsoni), and Ferruginous Hawk (Buteo regalis), as well as Short-eared Owl (Asio flammeus) breed in these plant communities.

Rodents such as Richardson's Ground Squirrel (Urocitellus richardsonii) and Black-tailed Prairie Dog (Cynomys ludovicianus) play an important role in plant species composition and production through the excavation of soils to create burrows (Bylo et al. 2014). Historically, native ungulate grazers, in conjunction with fire and drought, played an important ecological role in shaping the composition and structure of the plant communities on this site. Historic grazers included bison (Bison bison), elk (Cervus elaphus), deer (Odocoileus spp.), and pronghorn (Antilocapra americana; Knopf and Samson 1997). Cattle have largely replaced these species as the dominant grazer of this site.

Hydrological functions

Plant communities in the Contemporary Reference State provide high infiltration rates and minimal surface water runoff and soil erosion. High cover of blue grama in the Shortgrass State may limit the ability of cool-season midgrasses to utilize available moisture.

Recreational uses

This ecological site offers fair to good opportunities for nature observation, photography, and hunting.

Wood products

This ecological site has little to no potential for wood products.

Other products

This ecological site is suitable for grazing by cattle. The site's productive soils also make this site highly valuable as annual cropland.

Other information

For plant preferences by animal kind refer to: Field Office Technical Guide, Section II, Ecological Site Descriptions, General Information.

Inventory data references

A total of 20 plots ranging from Tier 1 to Tier 3 intensity were used as a basis for this ecological site. Five of these were Tier 3 data plots representing the Fire Suppressed Community Phase (2.2). Vegetation data collection protocols followed (Herrick et al. 2009). Additional data for State 2 was obtained from nine Tier 1 intensity plots. Community Phase 3.1 is supported by one Tier 2 and four Tier 1 intensity plots. One Tier 1 intensity plot was obtained in Community Phase 4.1. Other community phases are considered provisional based on the sources identified in the narratives associated with each community phase. No quantitative data were obtained for these phases. The plant community data tables contained herein represent the Fire Suppressed Community Phase (2.2).

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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	05/06/2024
Approved by	
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:**