USDA Natural Resources
Conservation Service

Ecological site FX052X02X131
Shallow Clay (Swc) Moist Grassland

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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.

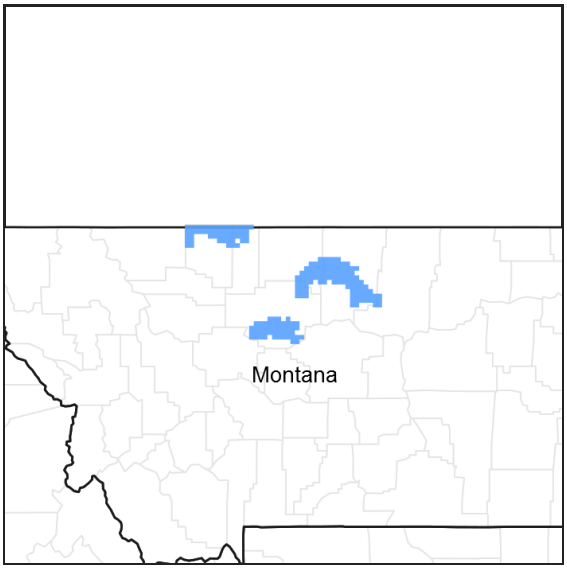

Figure 1. Mapped extent

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, agriculturally and ecologically significant area. It consists of approximately 14.5 million acres and 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 common. Till deposits are typically less than 50 feet thick, and in some areas glacially deformed bedrock occurs at or near the soil surface (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 along glacial outwash channels and major drainages, including 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, and the maximum glacial extent occurred 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. Crop-fallow dryland wheat farming is the predominant land use. Areas of rangeland typically are on steep hillslopes along drainages.

The rangeland, much of which is native mixedgrass 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 occurring on the type of 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. Due to erosion and dissection of the landscape, many of these areas have steeper slopes and more exposed bedrock than areas glaciated during the Wisconsin age (Fullerton and Colton, 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 climatic zone represents the northernmost extent of the big sagebrush (Artemisia tridentata) steppe on the Great Plains. Because 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. However, the precise factors are not fully understood at this time.

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 because many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrate to the northern portion of the MLRA, which lacks big sagebrush (dry grassland), to live the 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, 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 crops annually rather than just bi-annually, as 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 (MLRA): 052 Brown Glaciated Plains
• Climate Zone: Moist 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: Hesperostipa comata - *Bouteloua gracilis* Dry Mixedgrass Prairie Group (2.B.2.Nb.2.b)
• Alliance: Pseudoroegneria spicata - *Pascopyrum smithii* - Hesperostipa comata Grassland Alliance
• Association: Pseudoroegneria spicata - *Pascopyrum smithii* Grassland

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)
Glaciated Northern Grasslands (42j)
Cherry Patch Moraines (42m)
Milk River Pothole Upland (42n)

Ecological site concept

This provisional ecological site occurs in the Moist Grassland climatic zone of MLRA 52. 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. Onsite evaluations are necessary, particularly in boundary or intergrade areas where ecological sites from multiple climate zones may overlap. Shallow Clay Moist Grassland is an ecological site of limited extent occurring on areas of the till plain near the various mountain ranges as well as the Sweetgrass Hills in MLRA 52. This ecological site occurs on hillslopes, badlands, and bluffs where soils are less than 20 inches deep and have a clay content greater than 35 percent. Slopes vary from 0 to 60 percent, but are typically greater than 15 percent.

The distinguishing characteristics of this site are lithic or paralithic bedrock less than 20 inches from the soil surface and a clay content of greater than 35 percent. Soils are derived from clayey residuum, or clayey alluvium over shale. Soil surface textures (upper 4 inches) contain more than 35 percent clay. Underlying horizons are typically weakly developed and commonly contain shale fragments. Calcium carbonate equivalent is typically less than 5 percent, but may be up to 10 percent in some cases. This site is nonacid, with pH values greater than 5.6 throughout the soil profile. Characteristic vegetation is rhizomatous wheatgrasses, bluebunch wheatgrass (Pseudoroegneria spicata), and prairie Junegrass (Koeleria macrantha).

Associated sites

FX052X02X001	**Clayey (Cy) Moist Grassland** This site occurs on gentler slopes upslope from the Shallow Clay Moist Grassland ecological site. It is most common on summits where the slope is less than 15 percent and soil depth is 20 inches deep or greater.
FX052X02X005	**Clayey-Steep (Cystp) Moist Grassland** This site occurs on moderate to steeply sloping hillslopes adjacent to the Shallow Clay Moist Grassland ecological site where bedrock occurs at a depth greater than 20 inches. It typically occupies a backslope position similar to the Shallow Clay Moist Grassland ecological site.

Similar sites

FX052X02X005	**Clayey-Steep (Cystp) Moist Grassland** This site differs from the Shallow Clay Moist Grassland ecological site in that depth to bedrock is greater than 20 inches.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R052XY749MT

Physiographic features

Shallow Clay Moist Grassland is an ecological site of limited extent occurring in the moist areas of MLRA 52. The majority of MLRA 52 is covered by a broad till plain, but this ecological site largely occurs at higher elevations near the various mountain ranges and the Sweetgrass Hills. It mostly occurs on hillslopes, badlands, and bluffs. Slopes vary from 0 to 60 percent, but are typically greater than 15 percent.

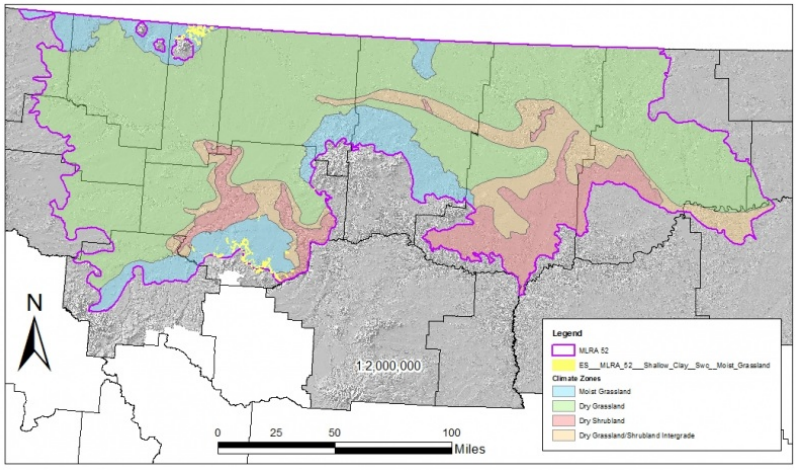

Figure 2. Figure 1. General distribution of the Shallow Clay Moist Grassland ecological site by map unit extent.

Table 2. Representative physiographic features

Landforms	(1) Till plain > Hillslope (2) Till plain > Bluff (3) Badlands
Elevation	1,097–1,399 m
Slope	0–60%
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 110 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 10 years. Annual precipitation ranges from 13 to 17 inches, 70 to 80 percent of which 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 a reaction of plants to a “false spring” (Oard, 1993).

Table 3. Representative climatic features

Frost-free period (average)	110 days
Freeze-free period (average)	135 days
Precipitation total (average)	381 mm

Climate stations used

- (1) GERALDINE [USC00243445], Geraldine, MT
- (2) GOLDBUTTE 7 N [USC00243617], Sunburst, MT

Influencing water features

This is a semi-arid upland ecological site and the water budget is normally contained within the soil pedon. Steep slopes combined with high clay content result in very high runoff potential. Intense precipitation events deliver large amounts of surface runoff downslope. Moisture loss through evapotranspiration exceeds precipitation for the majority of the growing season. Soil moisture levels are greatest in May and June but rarely reach field capacity. Soil moisture is the primary limiting factor for plant production on this ecological site.

Soil features

The soil series that best represents the central concept of this ecological site is Wayden. This soil is in the Ustorthents great group and is characterized by a surface horizon that lacks enough organic matter to have a mollic epipedon and by contact with paralithic bedrock within 20 inches of the soil surface. The Wayden soil has smectitic minerology and is in the clayey family, meaning that it contains more than 35 percent clay and is shallow (less than 20 inches to bedrock). The soil moisture regime for these and all soils in this ecological site concept is typic ustic, 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 horizon textures found in this site are typically clay loam or clay and contain greater than 35 percent clay. The underlying horizons typically contain 35 to 50 percent clay and have clay textures. Underlying horizons are weakly developed and frequently contain shale chips. Organic matter content in the surface horizon typically ranges from 1 to 2 percent, and moist colors vary from light olive brown (2.5Y 5/3) to dark grayish brown (2.5Y 4/2). The upper 5 inches of these soils sometimes, but not always, reacts with hydrochloric acid. The calcium carbonate equivalent in the upper 5 inches is generally 10 percent or less. Soil pH class is moderately acid to slightly alkaline in the surface horizon and moderately acid to strongly alkaline in the subsurface horizons. The soil depth class for this site is shallow or very shallow (less than 20 inches to bedrock). Content of coarse fragments is less than 35 percent and typically less than 15 percent.

Table 4. Representative soil features

Parent material	(1) Residuum
Surface texture	(1) Clay loam (2) Clay
Drainage class	Well drained
Soil depth	0–51 cm
Available water capacity (0-101.6cm)	5.08–7.62 cm
Calcium carbonate equivalent (0-12.7cm)	0–10%
Electrical conductivity (0-50.8cm)	0–3 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	5.6–9
Subsurface fragment volume <=3" (0-50.8cm)	0–34%
Subsurface fragment volume >3" (0-50.8cm)	0–34%

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM) (Figure 2), 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 Shallow Clay Moist Grassland provisional ecological site in MLRA 52 Dry Grassland consists of three states: The Reference State (1), the Altered State (2), and the Invaded State (3). Plant communities associated with this ecological site evolved under the combined influences of climate, grazing, and fire. Extreme climatic variability results in frequent droughts, which have the greatest influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). Due to the dominance of cool-season graminoids, annual production is highly dependent upon mid- to late-spring precipitation (Heitschmidt and Vermeire, 2005; Anderson, 2006).

Native grazers also shaped these plant communities. 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 historic ecosystem experienced periodic lightning-caused fires with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). Generally, the mixedgrass ecosystem is resilient to fire and the primary effects of the historic fire return interval are reduction of litter and short-term fluctuations in production (Vermeire et al., 2011, 2014). It is not known how significant fire was on the Shallow Clay Moist Grassland ecological site. It is believed that the frequency of fire would be less than that of adjacent sites due to the broken topography but further investigation of fire dynamics is needed to better assess this concept.

Improper grazing of this site can result in a reduction in the cover of the mid-statured bunchgrasses and an increase in shortgrasses and subshrubs such as broom snakeweed (*Gutierrezia sarothrae*). Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year and/or that do not provide adequate cover to prevent soil erosion over time. These practices may include, but are not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years. Further degradation of the site due to improper grazing can result in a community dominated by subshrubs. Shortgrasses may remain common, but vigor is declining. Unpalatable forbs such as curlycup gumweed (*Grindelia squarrosa*) may also be common. Periods of extended drought (approximately 3 years or more) may have similar effects. Non-native annual bromes have become naturalized in relatively undisturbed grasslands (Ogle et al., 2003; Harmoney, 2007) and can be present in any state within the scope of this ecological site. Their abundance varies depending on precipitation and germination conditions. Under normal conditions they typically do not have a significant ecological impact on this ecological site. However, it is hypothesized that annual bromes may proliferate and dominate the ecological dynamics of this site under certain conditions. The ecological mechanisms of this are unclear and the Invaded State (3) is considered hypothetical until further investigation of invasive species dynamics is completed.

Because of the shallow soil and generally steep slopes, this ecological site is unsuitable for cropland. Therefore, this ecological site has remained in native vegetation.

The STM diagram (Figure 2) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The reference community phase may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State 1: Reference State
The Reference State (1) contains two community phases characterized by a rhizomatous wheatgrasses and mid-statured bunchgrasses. This state evolved under the combined influences of climate, grazing, and fire with climatic variation having the greatest influence on cover and production. In general, this state was resilient to grazing and fire.

Phase 1.1: Mixedgrass Community Phase
The Mixedgrass Community Phase (1.1) is characterized by a rhizomatous wheatgrasses, mid-statured bunchgrasses, and shortgrasses. Western wheatgrass (*Pascopyrum smithii*) is the predominant rhizomatous wheatgrass species. Thickspike wheatgrass (*Elymus lanceolatus*) may also be present, becoming more common in the northern extent of this site. Common bunchgrass species are bluebunch wheatgrass and green needlegrass (*Nassella viridula*). The predominant shortgrass species is prairie Junegrass, but blue grama (*Bouteloua gracilis*) and Sandberg bluegrass (*Poa secunda*) may also occur. Common forbs are white prairie aster (*Symphyotrichum falcatum*) and prairie thermopsis (*Thermopsis rhombifolia*). The subshrub prairie sagewort (*Artemisia frigida*) occurs in trace amounts. The principle shrub is silver sagebrush (*Artemisia cana*); but creeping juniper (*Juniperus horizontalis*), and prairie rose (*Rosa arkansana*) can also occur. The approximate species composition of the reference plant community is as follows:

Percent composition by weight*
Rhizomatous Wheatgrass 35%

Mid-Statured Bunchgrasses 25%
Bluebunch Wheatgrass (5-20%)
Green Needlegrass (5-10%)
Plains Muhly (0-20%)

Prairie Junegrass 10%
Other Native Grasses 15%
Perennial Forbs 10%
Shrubs/Subshrubs 5%

Estimated Total Annual Production (lbs/ac)*
Low - Insufficient Data
Representative Value - 650
High - Insufficient Data
* Estimated based on current data – subject to revision

Phase 1.2: At-Risk Community Phase
The At-Risk Community Phase (1.2) occurs when site conditions decline due to drought or improper grazing management. It is characterized by an increase in shortgrasses, such as prairie Junegrass, and a decline in mid-statured grasses. The cover of shortgrasses equals or exceeds the cover of mid-statured grasses. Cool-season bunchgrasses such as bluebunch wheatgrass and green needlegrass are rare or absent. Rhizomatous wheatgrass have been drastically reduced and have declining vigor. Subshrubs such as broom snakeweed and rubber rabbitbrush (*Ericameria nauseosa*) may also increase in this phase.

Community Phase Pathway 1.1a
Drought, improper grazing management, or a combination of these factors can shift the Mixedgrass Community Phase (1.1) to the At-Risk Community Phase (1.2). These factors favor an increase in shortgrasses such as prairie Junegrass and a decrease in midgrasses (Coupland, 1961).

Community Phase Pathway 1.2a
Normal or above-normal spring precipitation and proper grazing management transitions the At-Risk Community Phase (1.2) back to the Mixedgrass Community Phase (1.1).

Transition T1A
Prolonged drought, improper grazing practices, or a combination of these factors weaken the resilience of the Reference State (1) and drive its transition to the Altered State (2). The Reference State (1) transitions to the Altered State (2) when mid-statured grasses become rare and contribute little to production. Shortgrasses such as

prairie Junegrass remain common, but vigor is reduced. Subshrubs such as broom snakeweed and rubber rabbitbrush dominate the plant community.

Transition T1B
The Reference State (1) transitions to the Invaded State (3) when non-native grasses or noxious weeds invade the Reference State (1). Exotic plant species dominate the site in terms of cover and production. Site resilience has been substantially reduced. In addition, 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 (1).

State 2: Altered State
The Altered State (2) consists of one community phase. The dynamics of this state are driven by long-term drought, improper grazing management, or a combination of these factors. Cool-season midgrasses decrease with long-term improper grazing (Coupland, 1961; Biondini and Manske, 1996; Derner and Whitman, 2009). Reductions in stocking rates can increase the cover of cool-season midgrasses, although this recovery may take decades (Dormaar and Willms, 1990; Dormaar et al., 1994). Once in the Altered State (2), the site may become unstable and is subject to erosion and solar heating. Broom snakeweed is known to be highly competitive in some habitats and may resist displacement by other species (USDA-NRCS, 2016), but further research is needed.

Phase 2.1: Subshrub/Shortgrass Community Phase
The Subshrub/Shortgrass Community Phase (2.1), occurs when site conditions decline due to long-term drought or improper grazing. Mid-statured grasses such as western wheatgrass and bluebunch wheatgrass have been largely eliminated. Subshrubs such as broom snakeweed and rubber rabbitbrush dominate the plant community. Short-statured grasses such as prairie Junegrass persist due to their low stature, however, vigor is declining due to grazing pressure. Unpalatable forbs such as curlycup gumweed may also be common.

Transition T2A
The Altered State (2) transitions to the Invaded State (3) when non-native grasses or noxious weeds invade the Reference State (1). Exotic plant species dominate the site in terms of cover and production. Site resilience has been substantially reduced. In addition, 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 (1).

Restoration Pathway R2A
A reduction in livestock grazing pressure alone may not be sufficient to return the Altered State (2) to the Reference State (1) (Dormaar and Willms, 1990). Intensive restoration methods may be necessary to reestablish desirable species. Reseeding via conventional methods may not be possible due to the steep topography of this site and specialized reseeding techniques (hydroseeding, straw wattles, etc.) may be necessary. These restoration methods are labor intensive, costly, and may not be practical in all situations. Therefore, returning the Altered State (2) to the Reference State (1) can require considerable cost, energy, and may not be feasible within a reasonable amount of time.

State 3: Invaded State
The Invaded State (3) occurs when invasive plant species invade adjacent native grassland communities. Possible invasive species include Japanese brome, saltlover, halogeton, and noxious weeds. Annual bromes are generally not a significant concern in MLRA 52, however, in the Shallow Clay Moist Grassland ecological site, there could be instances where they do significantly affect the site. Qualitative, non-technical observations of this state have been made, but quantitative documentation has not yet been obtained. This state is considered hypothetical until further investigation of invasive species dynamics can be completed.

State and transition model

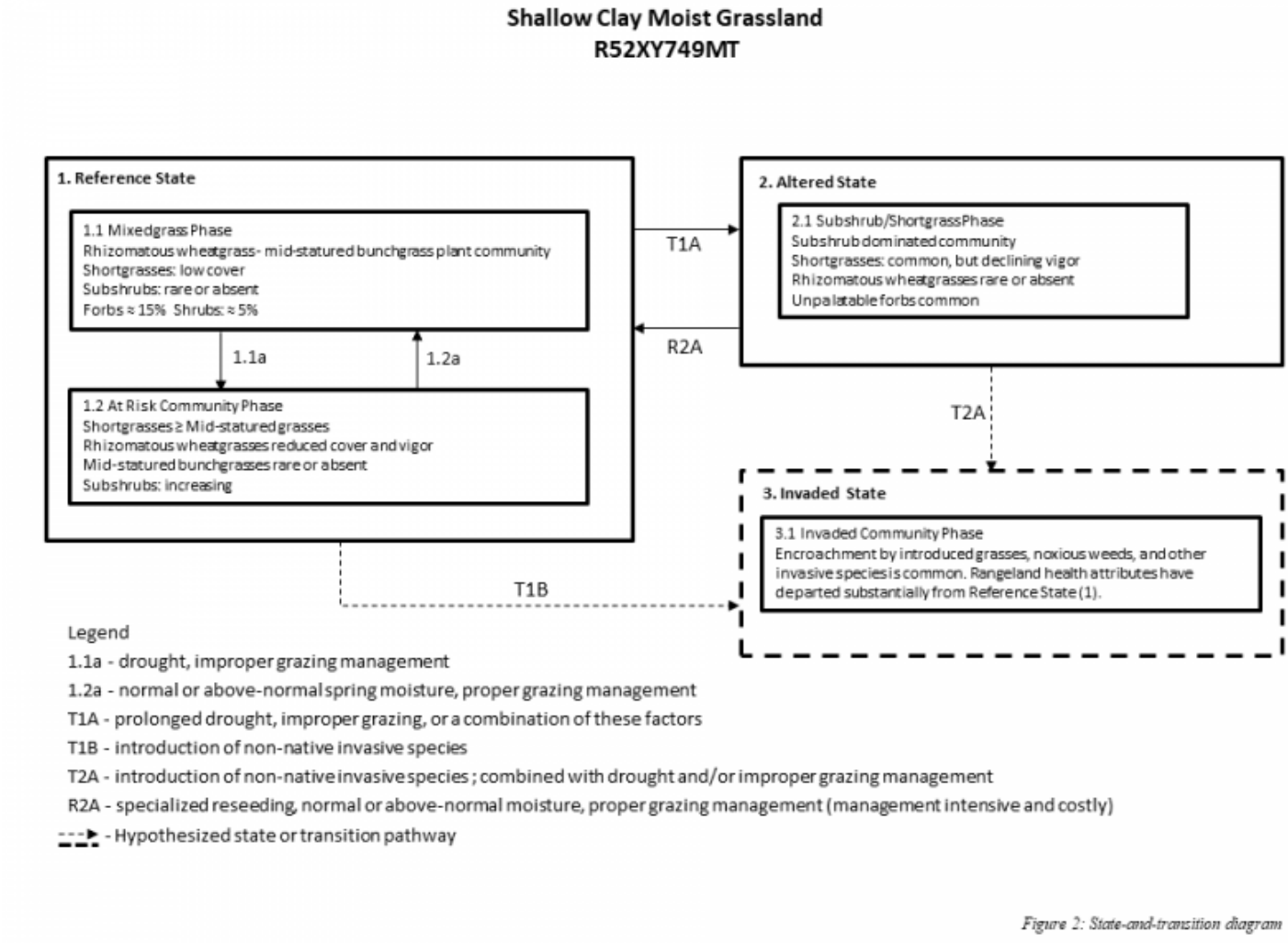

Figure 2: State-and-transition diagram

Inventory data references

One low-intensity plot was available for this provisional ecological site. This plot, in combination with professional experience and a review of the scientific literature, was used to approximate the reference plant community. Information for other states and community phases was obtained from a review of the scientific literature and professional experience. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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Approval

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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	
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:**

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17. **Perennial plant reproductive capability:**
