

Ecological site R052XN086MT

Claypan (Cp)

10-14" p.z.

Last updated: 4/14/2025
Accessed: 09/30/2026

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): 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 sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007) 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, 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. 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 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 Illinoian 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 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 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 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: Dry Shrubland 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: Xeromorphic Woodland, Scrub and Herb Vegetation Class

(3) • Subclass: Cool Semi-Desert Scrub and Grassland Subclass (3.B) • Formation: Cool Semi-Desert Scrub and Grassland Formation (3.B.1) • Division: Cool Semi-Desert Scrub and Grassland Division (3.B.1.Ne) • Macrogroup: Artemisia tridentata - Artemisia tripartita ssp. tripartita - Purshia tridentata Steppe and Shrubland Macrogroup (3.B.1.Ne.3) • Group: Artemisia tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe and Shrubland Group (3.B.1.Ne.3.b) • Alliance: Artemisia tridentata ssp. wyomingensis Mesic Steppe and Shrubland Alliance • Association: Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub 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) and Glaciated Northern Grasslands (42j)

Ecological site concept

The distinguishing characteristic of this site is the presence of a dense, sodium-affected (natric) horizon between depths of 5 to 10 inches from the surface. The natric horizon exhibits columnar structure, is very hard, and severely limits both root penetration and infiltration. Soil surface horizons (0 to 4 inches) are very fine sandy loam to loam, and the natric horizon is clay or clay loam. The root-restrictive natric horizon favors shallower-rooted rhizomatous species, such as western wheatgrass (*Pascopyrum smithii*), over deep-rooted bunchgrasses. Other common grasses include blue grama (*Bouteloua gracilis*), needle and thread (*Hesperostipa comata*), and Sandberg bluegrass (*Poa secunda*). The principal shrub on this site is Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis*).

Associated sites

R052XN162MT	Clayey (Cy) 10-14" p.z. soils >20 inches in depth, higher production, and no hardpan, different species composition R052XC205MT R053AE061MT
R052XN176MT	Shallow to Gravel (SwGr) 10-14" p.z. similar position in landscape, soils with depth restriction that limits available moisture, soils 10-20" deep to sands or loamy sands R052XC216MT
R052XN179MT	Shallow Clay (SwC) 10-14" p.z. soils 10-20" deep to bedrock' soils are clayey over clayey shale R052XC215MT R053AE078MT
R052XN172MT	Dense Clay (DC) 10-14" p.z. has less than 2" of soil over the hard argillic layer, more bare ground, and less production R052XC206MT R053AE073MT
R052XN170MT	Saline Upland (SU) 10-14" p.z. does not have a very hard layer near surface, plant community contains salt- tolerant species; R052XC210MT R053AE071MT

Similar sites

R052XC204MT	Claypan (Cp) 10-14" p.z. May have decrease in total annual production of bluebunch wheatgrass.
R053AE074MT	Claypan (Cp) (Legacy) RRU 53AE May have decrease in total annual production of bluebunch wheatgrass, and an increase in other wheatgrasses and/or needlegrass.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Atriplex nuttallii</i> (2) <i>Sarcobatus vermiculatus</i>
Herbaceous	(1) <i>Pascopyrum smithii</i> (2) <i>Sporobolus airoides</i>

Physiographic features

This ecological site occurs on level to sloping glaciated plains, stream terraces and fans. Slopes vary from 0-15%, but are usually less than 8%. This site occurs on all exposures. Elevations normally vary from 2000 to 4000 feet.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Fan (3) Plain
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	610 – 1,220 m
Slope	0 – 10 %
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	570 – 1,460 m

Slope	0 – 20 %
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Climatic features

A semi-arid, temperate climate characterizes the Glaciated Plains. The predominance of cool season species has evolved to take advantage of the precipitation regime that peaks in late spring-early summer (June). Seventy-five percent of the annual precipitation usually falls as steady, soaking, frontal system rains. Summer rains usually come with thunderstorms. Precipitation is the most important factor influencing production (Heitschmidt et al 2005). Severe drought occurs on average in two out of every ten years (Cooper, et al., 2001).

Table 4 Representative climatic features

Frost-free period (characteristic range)	90-120 days
Freeze-free period (characteristic range)	120-140 days
Precipitation total (characteristic range)	250-360 mm
Frost-free period (average)	90 days
Freeze-free period (average)	130 days
Precipitation total (average)	310 mm

- (1) CHESTER [USC00241692], Chester, MT
- (2) HAVRE CITY CO AP [USW00094012], Havre, MT
- (3) SHELBY [USC00247500], Shelby, MT
- (4) GLASGOW [USW00094008], Glasgow, MT

Influencing water features

This site is not influenced by water from streams.

Wetland description

This site is not influenced by water from wetlands.

Soil features

These deep and very deep, well drained soils formed in glacial till. Soils occupy glacial uplands. The surface layer varies from 2-8" in depth, and has a clay loam to fine sandy loam texture. The B horizon is characterized by a hard argillic horizon (6-10" thick), which restricts root penetration. The argillic layer has strong columnar structure. Salt accumulations are often visible in the lower part of the B horizon. These soils are usually very hard when dry and very sticky when wet.

Permeability is very slow. Soil ph varies from 6.6 – 9.0. This site is characterized by the following soil components: Gerdrum, Archin, Elloam and Thoeny.

Table 5. Representative soil features

Parent material	(1) Till – sedimentary rock (2) Glaciofluvial deposits
Surface texture	(1) Loam (2) Fine sandy loam (3) Clay loam
Family particle size	(1) Clayey (2) Fine
Drainage class	Well drained
Permeability class	Very slow
Depth to restrictive layer	50 – 200 cm
Soil depth	50 – 200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (Depth not specified)	10.16 – 12.7 cm
Calcium carbonate equivalent (Depth not specified)	0 – 10 %
Electrical conductivity (Depth not specified)	0 – 20 mmhos/cm
Sodium adsorption ratio (Depth not specified)	10 – 30
Soil reaction (1:1 water) (Depth not specified)	6.6 – 10

Subsurface fragment volume <=3" (Depth not specified)	10 – 20 %
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research consistently shows that precipitation is the principal factor altering productivity on ecological sites in the Northern Great Plains (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on above ground net primary production varies with timing of grazing and precipitation events, along with the functional and structural composition of the plant community.

It is theorized that these lands burned on a natural interval of 10-12 years (Frost 1998). However, environmental characteristics of this site limit herbage production and subsequent fuel accumulation. Therefore, in comparison to other upland ecological sites, the role of natural fire is probably less significant in the development of this site.

The resultant historic climax plant community (HCPC) is the basis for plant community interpretations. The HCPC has been determined by evaluating rangeland relic areas, and other areas protected from excessive disturbance.

The HCPC is comprised of a mixture of cool and warm season grasses and shrubs. About 85% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 5 and 10%, respectively, to total annual production. Total vegetative production averages 900 lbs/ac in normal years, 500 lbs/ac in "unfavorable" years, and 1200 lbs/ac in "favorable" years.

This site is moderately resilient to disturbance because soil characteristics limit plant growth. Departures from the HCPC generally result from management actions, drought, and/or a change in the natural fire regime. The site is considered fragile in the sense that vegetative vigor and composition will rapidly decline in the absence of prescribed grazing and during prolonged drought. With favorable precipitation and/or prescribed grazing treatments, the plant community can return to the HCPC. However, succession may be slow. Trends in plant community dynamics, states, transitional pathways, and thresholds have been evaluated and determined through experience and research.

Successional pathways of the Clay Pan 10-14" p.z. ecological site cannot be satisfactorily described using traditional theories of plant succession leading to a single climax community (Briske et al. 2005). As the HCPC regresses to an early seral state, it is theorized that a threshold is crossed somewhere within the mid-seral state. Plant communities occurring below this threshold are in a steady state. Succession back to the HCPC does not occur within a reasonable length of time, and/or without a large input of energy.

Three plant communities and the successional pathways that commonly occur within the Reference State (State 1) are shown in the following diagram. In addition, the transition from State 1 to State 2 and a representative plant community in the latter state are also illustrated. Ecological processes are discussed in the plant community descriptions following the diagram.

State and Transition Model Diagram:

State and transition model

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	Rhizomatous Wheatgrasses			202-404	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	101-202	–
	tufted wheatgrass	ELMA7	<i>Elymus macrourus</i>	101-202	–
2	Cool-season Bunchgrasses			252-504	
	green needlegrass	NAVI4	<i>Nassella viridula</i>	101-202	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	101-202	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	50-101	–
3	Warm-season Bunchgrasses			50-101	

	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	50-101	–
4	Miscellaneous Grasses			0-101	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-50	–
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-50	–
	plains reedgrass	CAMO	<i>Calamagrostis montanensis</i>	0-50	–
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	0-50	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0-50	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-50	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-50	–
	Grass, native	2GN	<i>Grass, native</i>	0-50	–
Forb					
5	Dominant Forbs			10-50	
	American vetch	VIAM	<i>Vicia americana</i>	10-50	–
2	Clovers			20-101	
	purple prairie clover	DAPU5	<i>Dalea purpurea</i>	10-50	–
	white prairie clover	DACA7	<i>Dalea candida</i>	10-50	–
7	Miscellaneous Forbs			0-50	
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	0-50	–
	aster	ASTER	<i>Aster</i>	0-50	–
	scurfpea	PSORA2	<i>Psoraleidium</i>	0-50	–
	prairie thermopsis	THRH	<i>Thermopsis rhombifolia</i>	0-50	–
	pussytoes	ANTEN	<i>Antennaria</i>	0-50	–
	bastard toadflax	COUM	<i>Comandra umbellata</i>	0-50	–
	milkvetch	ASTRA	<i>Astragalus</i>	0-50	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	0-50	–
	Forb, native	2FN	<i>Forb, native</i>	0-50	–
Shrub/Vine					
8	Shrubs			6-101	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-50	–
	Nuttall's saltbush	ATNU2	<i>Atriplex nuttallii</i>	6-50	–
	silver sagebrush	ARCA13	<i>Artemisia cana</i>	0-50	–
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0-50	–
	big sagebrush	ARTR2	<i>Artemisia tridentata</i>	1-50	–
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	1-17	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-1	–

Table 7. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Animal community

Livestock Management The Clay Pan 10-14" p.z. ecological site is suited for livestock grazing. However, prescribed grazing management is needed. Forage production is somewhat limited by soil characteristics. Many species occurring in State #1 are palatable to livestock, which makes the communities susceptible to heavy stocking and season long grazing. The cool season medium height grasses are generally selectively grazed, giving the short grasses a competitive advantage. Grazing during early spring may result in soil compaction. Any additional factor reducing infiltration and increasing runoff on this site is a management concern. Shorter grazing periods and adequate periods of rest following grazing are needed to facilitate plant regrowth and accumulate litter. This ecological site has a component of shortgrass species, as do most other sites in the northern mixed prairie. The shortgrasses usually increase with grazing pressure and decrease with deferment or prescribed grazing. However, succession is not guaranteed in the Northern Great Plains. Sampling four-year old ungrazed exclosures and grazed areas with 35% utilization, Vogel and Van Dyne (1966) found essentially the same basal cover of grasses, sedges, forbs, litter and bare soil on protected and grazed sites. They concluded that four years was too short of a time for cover to change significantly. Hofmann and Ries (1989) observed similar results following a four-year study in North Dakota. Even after 41 years of exclosure, changes in species composition can be relatively small when the site is in the dry, low production portion of northern mixed prairie (Brand and Goetz, 1986). They concluded that site characteristics limited the development of potential vegetation with the exclusion of grazing, but the potential impacts of prescribed grazing on succession were not discussed. The Clay Pan 10-14" p.z. ecological site is not as productive as the sites evaluated by Vogel and Van Dyne, Hofmann and Ries, or by Brand and Goetz. Therefore, range managers should recognize the environmental limitations of this site. Prescribed grazing management is always a good recommendation. Furthermore, chiseling of these soils is common in Phillips County and can be very successful given the right conditions. Wildlife Interpretations The HCPC associated with this ecological site provides diverse and valuable wildlife habitat. This site often occurs as a mosaic with other ecological sites, thus creating "ecotones" that serve as a magnet for many species of wildlife. Antelope and mule deer prefer grazing this site because of the Nuttall saltbush and diversity of forage species. However, the landscape does not provide thermal and escape cover. The bare ground limits the potential of the site for upland birds and for ground-nesting birds. This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of either the tall cool season grasses or warm season grass would shorten the length of the "green forage" season. The increase of blue grama, clubmoss, hoods phlox, etc. is also associated with the loss of palatable forbs. These changes tend to adversely impact foraging opportunities for deer, antelope, upland birds, etc. Community C has very little value for most wildlife species because of insufficient vegetative structural diversity, residual grass carry-over and litter cover. Plant Preferences by Animal Kind Refer to NRCS Field Office Technical Guide, Section IIE, General Information, for tables displaying plant preferences by livestock and wildlife.

Hydrological functions

Water is the main factor limiting vegetative production on this site. Soil components in this ecological site are normally classed into Hydrologic Group D. These soils have a medium to very high runoff potential, with hydrologic runoff curves of 89 to 80. Field investigations are needed to adjust the runoff curves when plant communities deteriorate from the HCPC. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides hunting opportunities for upland game species.

Wood products

This site has no significant value for wood products.

Other information

This site ecological site is not highly resistant to disturbances. Species diversity is adversely affected by season long continuous grazing and by heavy stocking. Medium height grasses are replaced by short grasses. The number of structural/functional groups is reduced with regression from the HCPC. The amount of solar energy that is captured and converted to carbohydrates for plant growth is reduced in State 2. A reduction in total vegetative growth results in less potential vegetation that can be transformed into litter. Litter reductions result in less infiltration, and more runoff and soil erosion.

Inventory data references

Data Source Number of Records Sample Period State County SCS-Range-417 (#503) 1 1991 MT Phillips ECS-1 Modified Double Sampling 0 USDA-SCS-MT 1981 Technical Range Site Description

Other references

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Contributors

Kirt Walstad

Approval

Kirt Walstad, 4/14/2025

Acknowledgments

Site Description Revisions The 2005 Clay Pan 10-14" p.z. ecological site description replaces earlier dated versions of Clay Pan 10-14" p.z. descriptions in Rangeland Resource Unit 52XN, located in Section II-E-8 of the NRCS Field Office Technical Guide. This 2005 revision incorporates the State and Transition Model theory, additional data on site productivity, and an improved understanding of many rangeland health indicators. Site Description Approval This ecological site description is approved with the understanding that it is no more than another step in our continual effort to update the NRCS technical guide. In order to facilitate the process, NRCS field personnel are encouraged to forward existing information and/or new data that can be used to improve the utility of this site description. Please forward the information and data to the State Rangeland Management Specialist. Author Date Approval Date Dr. John Lacey 02/23/2005 Loretta J. Metz 03/19/2005 Maxine Rasmussen, Area RMS, Glasgow, MT Jon Siddoway, Area RMS, Great Falls, MT Rick Bandy, Area RSS, Great Falls, MT Greg Snell, Area RSS, Glasgow, MT

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)	Loretta Metz, Maxine Rasmussen, Jon Siddoway
Contact for lead author	Area Rangeland Management Specialist, Glasgow Area Office, MT Reference site used? No
Date	05/04/2005
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present in HCPC. If in plant community A on slopes > 15%, careful examination will yield slight evidence of rills that are less than ½ inch deep, linear, but short in length. If in plant community B on slopes > 15%, rills would be visible, ½ inch deep or more, linear, rarely exceeding 1 foot in length. Distance between rills is irregular.

2. **Presence of water flow patterns:** Water flow patterns should not be observable in HCPC. If in plant community A, careful examination will yield short discontinuous water flow patterns. If in plant community B, water flow patterns would be visible as long (more than 1-foot) and continuous across the landscape.

3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes are nonexistent in HCPC. If in plant community A, careful examination on slopes > 8% yield occasional pedestals approximately ¼ inch above the soil surface. If in plant community B, pedestals are frequent and ½ - ¾ inch above the soil surface.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 10-20% of the soil surface should be bare in HCPC. Bare ground should be less than 2" in diameter. If in plant community A, 20-45% of the soil surface can be exposed. If in plant community B, 45-60% of the soil surface can be exposed.

5. **Number of gullies and erosion associated with gullies:** None.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is not expected with HCPC. If in plant community A, careful examination will yield some fine litter movement for a short distance. If in plant community B, litter, both fine and coarse, movement is visible, especially on slopes > 8%, but the distance moved is less than 1 foot.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class anticipated to be 5 or 6 under plant canopy. Interspaces are between 3-5.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The light gray to grayish brown clay surface layer is 2 - 8" thick. The surface texture ranges from loam, fine sandy loam and clay loam. Soil organic matter is usually 1-3%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** In HCPC, 40-50% plant canopy and 40-70% basal cover with small gaps between plants should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur. Healthy, deep rooted native grasses enhance infiltration and reduce runoff. Infiltration rate is slow. If in plant community A, 15-30% plant canopy and 20-35% basal cover with moderate gaps

between plants will intensify raindrop impact and increase overland flow, causing decreased time for infiltration. If in plant community B, 10-20% plant canopy and 10-20% basal cover with sizeable gaps between plants, amplifies raindrop impact and increases overland flow. The site tends to be more xeric as runoff increases.

11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site): No compaction layer or soil surface crusting should be evident in any of the State 1 plant communities. Restrictive, very hard claypan begins at 2 - 8 inches.
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12. Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):

Dominant:

Sub-dominant:

Other:

Additional: HCPC: Tall and mid-stature, cool season bunch grasses = mid-stature, cool season rhizomatous grasses > short cool season bunch grasses > shrubs > forbs. Plant community A: Mid-stature, cool season rhizomatous grasses > tall and mid-stature, cool season bunch grasses > short stature, warm season rhizomatous > shrubs > forbs. Plant community B: Mid-stature, cool season rhizomatous grasses Short warm season perennial grasses > tall and mid-stature, cool season bunch grasses > forbs > shrubs.

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): Plant mortality and decadence very low in HCPC and Plant community A. In periods of drought, shrubs would exhibit decadence in the state 1 reference communities.
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14. Average percent litter cover (%) and depth (in):
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15. Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production): 500 - 1200 #/acre from Plant community B to HCPC in the State 1 reference community.
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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: Blue grama, prairie junegrass, needleleaf sedge, curly cup gumweed, Sandberg bluegrass, fringed sagewort, plains prickly pear, broom snakeweed, dense clubmoss.
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17. Perennial plant reproductive capability: All species are capable of reproducing in HCPC and Plant community A. In Plant community B, plant seedlings will be weighed in favor of marginal and undesirable species.
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