Ecological site EX044B01A001
Clayey (Cy)
10-14" PZ Frigid

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 044B–Central Rocky Mountain Valleys

Major Land Resource Area (MLRA) 44B, Central Rocky Mountain Valleys, is nearly 3.7 million acres of southwest Montana and borders two MLRAs: 43B Central Rocky Mountains and 46 Northern and Central Rocky Mountain Foothills. The major watersheds of this MLRA are the Missouri and Yellowstone Rivers and their associated headwaters, such as the Beaverhead, Big Hole, Jefferson, Ruby, Madison, Gallatin, and Shields Rivers. These waters allow for extensive irrigation for crop production in an area that would generally only be compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs that supply irrigation water, hydroelectric power, and municipal water. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River. The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay) and some limited mining. Urban development is high, with large expanses of rangeland converted to subdivisions for a rapidly growing population. The MLRA comprises one Land Resource Unit (LRU) and seven climate-based LRU subsets. These subsets are based on Relative Effective Annual Precipitation (REAP) and frost-free days. Each subset expresses a distinct set of plants that differentiate it from other LRU subsets. Annual precipitation ranges from a low of nine inches to a high of nearly 24 inches. The driest areas tend to be in the valley bottoms of southwest Montana in the rain shadow of the mountains. The wettest portions tend to be near the edge of the MLRA at the border with MLRA 43B. Frost-free days vary widely from less than 30 days in the Big Hole Valley to around 110 days in the warm valleys along the Yellowstone and Missouri Rivers. The plant communities of the MRLA are highly variable, but the dominant community is a cool-season grass and shrub-steppe community. Warm-season grasses have a minimal extent in this MLRA. Most subspecies of big sagebrush are present, to some degree, across the MLRA.

LRU notes

MLRA 44B has one LRU that covers the entire MLRA. The LRU comprises seven climate subsets based on Relative Effective Annual Precipitation (REAP) and frost-free days. Combinations of REAP and frost-free days result in a common plant community shared across the LRU subset. Each subset is given a letter designation of A through F for sites that do not receive additional water and Y for sites that receive additional water. LRU 01 Subset A has a REAP of nine to 14 inches (228.6-355.6 mm) with a frost-free days range of 70 to 110. This combination of REAP and frost-free days results in a nearly treeless sagebrush steppe landscape. The soil moisture regime is ustic, dry bordering on aridic, and has a frigid soil temperature regime.

Classification relationships

Grassland and Shrubland Habitat Types of Western Montana. (Mueggler and Stewart, 1980) 1. Agropyron spicatum/Bouteloua gracilis habitat type 2. Artemisia tridentata/Agropyron spicatum habitat type 3. Agropyron spicatum/Agropyron smithii habitat type EPA Ecoregions of North America (U.S. EPA. 2013): Level I: Northwestern Forested Mountains Level II: Western Cordillera Level III: Middle Rockies and Northwestern Great Plains Level IV: Paradise Valley Townsend Basin Dry Intermontane Sagebrush Valleys Shield-Smith Valleys USDA Forest Service National Hierarchical Framework of Ecological Units (Cleland et al., 2007): Domain: Dry Division: M330 – Temperate Steppe Division – Mountain Provinces Province: M332 –Middle Rocky Mountain Steppe – Coniferous Forest – Alpine Meadow Section: M332D – Belt Mountains Section M332E – Beaverhead Mountains Section Subsection: M332Ej – Southwest Montana Intermontane Basins and Valleys M332Dk – Central Montana Broad Valleys

Ecological site concept

The Clayey 10-14" PZ Frigid ecological site is an upland site formed from alluvium or slope alluvium and is on slopes less than 15 percent. The site does not receive additional moisture from a water table or flooding. It has 32 to 45 percent clay in the upper four inches (10 cm) of the mineral surface. It is moderately deep to very deep and has no root-restrictive layers within 20 inches (50 cm). The surface of the site has less than five percent stones and is not skeletal, with less than 35 percent rock fragments in the 10 to 20 inch (25 to 50 cm) depth. The site has no saline or saline-sodic influence and is not strongly or violently effervescent within four inches of the mineral surface. Calcium carbonates may increase with depth.

Associated sites

EX044B01A131	**Shallow Clay (SwC) 10-14" PZ Frigid** The Shallow Clay Ecological Site is often a neighboring site on a higher landscape position. The plant community has a similar species presence. However, overall composition percentages and hydrology are reduced due to shallow bedrock.

Similar sites

EX044B01A032	**Loamy (Lo) 10-14" PZ Frigid** The Loamy Ecological Site has a similar plant community but tends to have higher bluebunch wheatgrass production. It exists in a similar landscape position. The Loamy Ecological Site will express higher production values. The Loamy Ecological Site has reduced clay content in the soil profile compared to the Clayey Ecological Site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Nassella viridula*

Legacy ID

R044BA001MT

Physiographic features

The Clayey 10-14" PZ Frigid ecological site is on nearly level to moderately steep alluvial fans, fan remnants, and hills. This ecological site is on slopes ranging from one to 15 percent. However, the core concept slopes of this ecological site exist in the four to 10 percent range.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Alluvial fan (2) Intermontane basin > Fan remnant (3) Intermontane basin > Hill
Flooding frequency	None
Ponding frequency	None

Elevation	1,220 – 1,980 m
Slope	0 – 10 %
Water table depth	250 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0 – 20 %
Water table depth	Not specified

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. Some of Montana's driest areas are in sheltered mountain valleys due to the rain-shadow effects of the neighboring mountain ranges. The average precipitation for this ecological site is 12 inches (305 mm), and the frost-free period averages 78 days. Fifty to 60 percent of the annual precipitation falls between May and August, and precipitation is highest in May and June.

Table 4 Representative climatic features

Frost-free period (characteristic range)	70-110 days
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	230-360 mm
Frost-free period (actual range)	70-110 days
Freeze-free period (actual range)	110-140 days
Precipitation total (actual range)	230-360 mm
Frost-free period (average)	80 days

Freeze-free period (average)	130 days
Precipitation total (average)	310 mm

- (1) DEER LODGE 3 W [USC00242275], Deer Lodge, MT
- (2) DILLION U OF MONTANA WESTERN [USC00242409], Dillon, MT
- (3) GLEN 2 E [USC00243570], Dillon, MT
- (4) ENNIS [USC00242793], Ennis, MT
- (5) BOULDER [USC00241008], Boulder, MT
- (6) GARDINER [USC00243378], Gardiner, MT
- (7) TOWNSEND [USC00248324], Townsend, MT
- (8) TRIDENT [USC00248363], Three Forks, MT
- (9) TWIN BRIDGES [USC00248430], Sheridan, MT
- (10) WHITE SULPHUR SPRNGS 2 [USC00248930], White Sulphur Springs, MT
- (11) DILLON AP [USW00024138], Dillon, MT
- (12) HELENA RGNL AP [USW00024144], Helena, MT

Influencing water features

The Clayey 10-14" PZ Frigid ecological site is an upland site and is not influenced by water features.

Wetland description

Wetland features do not apply to this ecological site.

Soil features

The soils are moderately deep to very deep, have moderately slow to moderate permeability, and are well drained. The soils are formed from mixed geology alluvium or slope alluvium. Soil surface textures are silty clay loam and clay loam textures. Clay content is 32 to 45 percent of the mineral surface of four inches (10 cm). Common soil series in this ecological site include Sappington, Doolittle, and Dyce. Although representative of this site, these soils may exist across multiple ecological sites because of naturally variable slope, texture, rock fragments, and pH. An on-site soil pit and the most current ecological site key are necessary to classify a site.

Table 5. Representative soil features

Parent material	(1) Alluvium – igneous, metamorphic and sedimentary rock (2) Slope alluvium – igneous, metamorphic and sedimentary rock
Surface texture	(1) Clay loam (2) Silty clay loam
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Very slow to moderate

Depth to restrictive layer	100 cm
Soil depth	150 cm
Surface fragment cover <=3"	0 – 20 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-101.6cm)	12.7 – 17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0 – 20 %
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	6.5 – 8.2
Subsurface fragment volume <=3" (25.4-50.8cm)	0 – 20 %
Subsurface fragment volume >3" (25.4-50.8cm)	0 – 10 %

Ecological dynamics

The Clayey 10-14" PZ Frigid ecological site occurs in a relatively small landscape. However, slight variations within the plant community may exist due to elevation, frost-free days, and relative effective annual precipitation. Bluebunch wheatgrass (Pseudoroegneria spicata), for example, occupies most known combinations of elevation and climate. However, it often shares dominance with needle and thread (Hesperostipa comata) under a drier moisture regime. These warmer, drier sites also exhibit larger populations of warm-season shortgrass, such as blue grama (Bouteloua gracilis).

The reference plant community is dominated by bluebunch wheatgrass (Pseudoroegneria spicata), needle and thread (Hesperostipa comata), and green needlegrass (Nassella viridula). Subdominant species may include western wheatgrass (Pascopyrum smithii), Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis), winterfat (Krascheninnikovia lanata), and dotted blazing star (Liatris punctata). Investigations showed a predominance of perennial grasses on near-pristine range sites (Ross et al., 1973). Shrubs comprise 10 to 15 percent of the community in the Reference state. This shrub percentage tends to be higher than many other ecological sites in this MLRA.

Historically, natural fire was a major ecological driver of this entire ecological site. Fire typically restricted tree and sagebrush growth to small patches, promoting a herbaceous plant community. The natural fire return interval was highly variable (up to 100 years) but was likely shorter than 35 years (Arno and Gruell, 1982). Sagebrush and trees have increased significantly with recent fire suppression.

Shrub dominance may occur in response to improper grazing management, drought, or where big sagebrush increases from a lack of fire. Shrub encroachment by a variety of species, including broom snakeweed (Gutierrezia sarothrae), prairie sagewort (Artemisia frigida), Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis), rubber rabbitbrush (Ericameria nauseosa), yellow rabbitbrush (Chrysothamnus viscidiflorus), and plains prickly pear (Opuntia polyacantha) occurs within this site as the mid-stature bunchgrasses decrease. Shrub dominance and grass loss are associated with soil erosion and, ultimately, thinning of the native soil surface. Subsequent loss of soil could lead to a Degraded state. All states could also lead to the Invaded State when weed prevention and control measures are lacking.

Historical records indicate that elk and bison grazed this ecological site before the introduction of livestock (cattle and sheep) during the late 1800s. Due to bison's nomadic nature and herd structure, grazed areas received periodic grazing pressure. Forage for livestock was noted as minimal in areas recently grazed by bison, suggesting high-intensity grazing utilization (Lesica and Cooper, 1997).

Meriwether Lewis documented that 60 Shoshone warriors met him on horseback in August 1805. The Corps of Discovery was later supplied with horses by the same band of Shoshone. This number of horses suggests that the areas near the modern-day Montana towns of Twin Bridges, Dillon, Grant, and Dell were grazed by an unknown number of horses for nearly 50 years before the large introduction of cattle and sheep. Livestock grazing has occurred on this ecological site for more than 150 years. The gold boom in the 1860s brought the first herds of livestock overland from Texas, and homesteaders began settling the area. During this time, cattle were the primary domestic grazers in the area. In the 1890s, sheep production increased by over 400 percent and dominated the livestock industry until the 1930s. Since the 1930s, cattle production has dominated the livestock industry in the region (Hansen and Wyckoff, 1991).

Because the neutral to slightly alkaline pH of the soils on this site, the potential for dryland farming is high. Hay and small grain production have been the dominant crops to replace native vegetation on this site. Cool-season annual crops (wheat, barley, and oats), perennial introduced grass species, and legumes (e.g., alfalfa) are best adapted. This ecological site has also been converted to pastureland, typically with perennial grasses and legumes for grazing. Cropland, pastureland, and hayland are intensively managed with either annual cultivation or harvesting. The use of herbicides, pesticides, and commercial fertilizers is intended to increase production. Where irrigation water is available, this site is highly productive.

Lesser spikemoss (Selaginella densa) is a minor component of the reference plant community. The conditions that created extensive cover classes of clubmoss on this site point to a history of continuous (yearlong) or moderate spring grazing use (Sturm, 1954). Lesser spikemoss helps reduce erosion and increase site stability. Although lesser spikemoss provides soil stability, some suggest that it competes for the limited water resources in the upper soil profile. However, a study in a similar climate on similar soils indicates that the correlation between reduced plant-available water and lesser spikemoss cover is negligible (Colberg and Romo, 2003). Any correlation between reduced plant production may only be competition for space, though quantitative evidence of that theory is currently unavailable. Dense patches of spikemoss may inhibit seed contact with soil, reducing seedling recruitment (Romo, 2011).

Some of the major invasive species that can be present on this site include (but are not limited to) spotted knapweed (Centaurea stoebe), leafy spurge (Euphorbia esula), sulphur cinquefoil (Potentilla recta), and cheatgrass (Bromus tectorum), field brome (Bromus arvensis), butter and eggs, also known as yellow toadflax, (Linaria vulgaris), dandelion (Taraxacum spp.), Kentucky bluegrass (Poa pratensis). Invasive weeds begin to highly impact this ecological site under grazing mismanagement and urban development.

Plant Communities and Transitions
A state-and-transition model (STM) is depicted below. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field data, field observations, and interpretations by experts. It is likely to change as knowledge increases.

The plant communities within this ecological site will differ slightly across the MLRA due to the naturally occurring weather, soils, and aspect variability. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not full botanical descriptions of all species occurring or potentially occurring on this site. They are intended to cover the core species and the known range of conditions and responses.

Although considerable qualitative experience supports the pathways and transitions within the STM, no quantitative information specifically identifies threshold parameters between grassland types and invaded types in this ecological site.

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				745-1334	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	504-1065	–
	green needlegrass	NAVI4	*Nassella viridula*	106-336	–
	western wheatgrass	PASM	*Pascopyrum smithii*	50-191	–
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	0-191	–
2				106-191	
	Sandberg bluegrass	POSE	*Poa secunda*	22-112	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0-95	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0-95	–
	blue grama	BOGR2	*Bouteloua gracilis*	22-73	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0-56	–
	threadleaf sedge	CAFI	*Carex filifolia*	0-56	–
	Grass-like, perennial	2GLP	*Grass-like, perennial*	0-22	–
	Grass, perennial	2GP	*Grass, perennial*	0-22	–
Forb					
3				54-95	
	American vetch	VIAM	*Vicia americana*	22-95	–
	dotted blazing star	LIPU	*Liatris punctata*	11-90	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	11-90	–
	desertparsley	LOMAT	*Lomatium*	0-56	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	6-45	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0-45	–
	bastard toadflax	COUM	*Comandra umbellata*	0-28	–
	fleabane	ERIGE2	*Erigeron*	0-22	–
	buckwheat	ERIOG	*Eriogonum*	0-22	–
	spiny phlox	PHHO	*Phlox hoodii*	0-22	–
	onion	ALLIU	*Allium*	0-22	–
	Forb, annual	2FA	*Forb, annual*	0-22	–
	Forb, dicot, perennial	2FDP	*Forb, dicot, perennial*	0-22	–
	Drummond's milkvetch	ASDR3	*Astragalus drummondii*	0-22	–
	milkvetch	ASTRA	*Astragalus*	0-22	–
Shrub/Vine					
4				159-286	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	74-179	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	11-135	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0-45	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0-45	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0-22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0-22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0-11	–

Table 7. Community 1.2 plant community composition

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

Table 8. Community 2.1 plant community composition

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

Table 9. Community 2.2 plant community composition

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

Table 10. Community 3.1 plant community composition

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

Table 11. Community 4.1 plant community composition

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

Table 12. Community 5.1 plant community composition

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

Table 13. Community 5.2 plant community composition

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

Table 14. Community 5.3 plant community composition

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

Animal community

The Clayey 10-14" PZ Frigid ecological site provides a various habitat for an array of wildlife species. Prior to the settlement of this area, large herds of antelope, elk, and bison roamed. Though the bison have been replaced, mostly with domesticated livestock, elk and antelope still frequently utilize this largely intact landscape for winter habitat in areas adjacent to forests. The relatively high grass component of the Reference state provides excellent nesting cover for multiple neotropical migratory birds that select for open grasslands, such as the long-billed curlew and McCown’s longspur. Greater sage grouse may be present on sites with suitable habitat, typically requiring a minimum of 15 percent sagebrush canopy cover (Braun et al., 1977). The Bluebunch community is likely to have minimal sage grouse presence given its low sagebrush canopy cover. However, the potentially diverse forb component of the Reference State may provide important early-season (spring) foraging habitat for the greater sage grouse and their broods. Other communities on the site with sufficient sagebrush cover may harbor sage grouse populations, specifically the Mixed Grass and Shrubland community where big sagebrush populations are under a reduced fire regime. Also, as sagebrush canopy cover increases under Altered state and, to a limited extent, under Degraded state, pygmy rabbit, Brewer’s sparrow, and mule deer use may also increase. Managed livestock grazing is suitable on this site due to the potential to produce an abundance of high-quality forage. This is often a preferred site for livestock grazing, and animals tend to congregate in these areas. In order to maintain the site productivity, grazing on adjoining sites with less production must be managed carefully to make sure utilization on this site is not excessive. Management objectives should include maintenance or improvement of the native plant community. Careful management of the timing and duration of grazing is important. Shorter grazing periods and adequate deferment during the growing season are recommended for plant maintenance, health, and recovery. Warm-season defoliation of bluebunch wheatgrass can result in high mortality and reduced vigor in plants (McLean and Wikeem, 1985). They also suggest, based on prior studies, that regrowth is necessary before dormancy to reduce injury of bluebunch. Grazing season has more influence on winterfat than grazing intensity. Late winter or early spring grazing is detrimental. However, early winter grazing may be beneficial (Blaisdell and Holmgren, 1984). Continual non-prescribed grazing of this site will be detrimental, will alter the plant composition and production over time, and will result in the transition to the Altered state. The transition to other states will depend on the duration of poorly managed grazing and other circumstances, such as weather conditions and fire frequency. The Altered state is subject to further degradation to the Degraded state or the Invaded state. Management should focus on grazing management strategies that will prevent further degradation, such as rest rotation, seasonal grazing deferment, or winter grazing where feasible. Communities within this state are still stable under proper management. Forage quantity and quality may be substantially decreased from the Reference state. In the Degraded state, grazing may be possible but is generally not economically or environmentally sustainable. Grazing is possible in the Invaded state. Invasive species are generally less palatable than native grasses. Forage production is typically greatly reduced in this state. Due to the aggressive nature of invasive species, sites in the Invaded state face an increased risk of further degradation by invasive-dominant communities. Grazing must be carefully managed to avoid further soil loss and degradation and possible livestock health issues. Prescriptive grazing can be used to manage invasive species. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or maintain the species composition of invasive species.

Hydrological functions

The hydrologic cycle functions best in the Reference state with good infiltration and deep percolation of rainfall; however, the cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high bunchgrass canopy cover (Thurow et al., 1986). High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sediment transport low. Water leaving the site will have a minimal sediment load, which allows for high water quality in associated streams. High rates of infiltration will allow water to move below the rooting zone during periods of heavy rainfall. The Bluebunch community (1.1) should have no rills or gullies present, and drainage ways should be vegetated and stable. Water flow patterns, if present, will be barely observable. Plant pedestals are essentially nonexistent. Plant litter remains in place and is not moved by wind or water. In the Shortgrass and Shrubland community (2.2), the Degraded state (3) and the Invaded state (4) canopy and ground cover compared to the Reference state (1), which impedes the hydrologic cycle. Infiltration will decrease and runoff will increase due to reduced ground cover, the presence of shallow-rooted species, rainfall splash, soil capping, reduced organic matter, and poor structure. Sparse ground cover and decreased infiltration can increase the frequency and severity of flooding within a watershed. Soil erosion is accelerated, the quality of surface runoff is poor, and sedimentation increases. (McCalla et al., 1984)

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, big game hunting, and upland bird hunting. Some forbs have flowers that appeal to photographers. This site provides valuable open space.

Wood products

none

Other products

none

Inventory data references

The information contained within this ecological site description has been obtained from field observations, historic data, and professional judgement. Inventory sites are located across southwest Montana.

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Approval

Grant Petersen, 5/01/2025

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)	Grant Petersen
Contact for lead author	grant.petersen@usda.gov
Date	08/29/2019
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills: Rills are not present in the reference condition.**

2. **Presence of water flow patterns:** Water flow patterns are not present in the reference condition.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are not evident in the reference condition.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is minimal (0 to 10 percent). It consists of small, randomly scattered patches.

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5. **Number of gullies and erosion associated with gullies:** No gullies are present in the Reference state.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind scoured, blowouts, or depositional areas are present in the Reference state.

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7. **Amount of litter movement (describe size and distance expected to travel):** No litter movement is expected. Herbaceous litter falls within the rain shadow of the plant and does not move.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** The soil surface is stable. Under canopy soil stability rating will be 5 to 6 and non-canopy sites will receive soil stability ratings of 3 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil Structure at the surface is typically weak to medium fine granular. A Horizon should be 4-6 inches thick with color, when wet, typically ranging in Value of 3 or less and Chroma of 3 or less. Local geology may affect color in which it is important to reference the Official Series Description (OSD) for characteristic range.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Evenly distributed across the site, bunchgrasses improve infiltration while rhizomatous grass protects the surface from runoff forces. Infiltration of the Clayey ecological site is well drained but has a slow infiltration rate. An even distribution of mid stature grasses comprising about 60 percent of site production, cool season rhizomatous grasses 25 percent of site production along with a mix of shortgrass, forbs and shrubs (5 to 25 percent).

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Not present, some soils profiles may contain an abrupt transition to an Argillic horizon which can be misinterpreted as compaction however the soil structure will typically be fine to medium subangular blocky whereas a compaction layer will tend to be platy or structureless (massive).

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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: Mid-statured, cool season, perennial bunchgrasses primarily bluebunch wheatgrass and green needlegrass

Sub-dominant: shrubs ? rhizomatous grass = short grass/grasslikes = forbs > subshrubs

Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** **Mortality in herbaceous species is not evident. Species with bunch growth forms may have some natural mortality in centers is 3 percent or less. Shrubs, subshrubs mortality does not exceed 5 percent for any given species.**

14. **Average percent litter cover (%) and depth (in):** **Total litter cover ranges from 40 to 60 percent. Most litter is irregularly distributed on the soil surface and is not readily at a measurable depth.**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** **Production is variable from 950lbs/acre to 1700lbs/acre. Representative value of approximately 1250lbs/acre.**

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:** **Non-native invasive species on this ecological site include (but not limited to): dandelion (Taraxacum spp.), cheatgrass (Bromus tectorum), field brome (Bromus arvensis), spotted knapweed (Centaurea stoebe), butter and eggs (Linaria vulgaris), leafy spurge (Euphorbia esula), and ventenata (Ventenata dubia) Native species with the ability to indicate degradation however species presence alone does not imply degradation: Sandberg bluegrass (Poa secunda), big sagebrush (Artemisia tridentata), blue grama (Bouteloua gracilis), broom snakeweed (Gutierrezia sarothrae), rubber rabbitbrush (Ericameria nauseosa), yellow rabbitbrush (Chrysothamnus viscidiflorus), Rocky Mountain juniper (Juniperus scopulorum), ponderosa pine (Pinus ponderosa) when their populations are significant enough to affect ecological function, indicate site condition departure.**

17. **Perennial plant reproductive capability:** **Capability is very high. Density of plants indicates that plants reproduce at level sufficient to fill available resource. Plants are producing seed, reproductive tillers, or both in order to balance natural mortality with species recruitment.**