Ecological site EX044B01A135
Shallow Limy Droughty (SwLyDr)
10-14" PZ Frigid

Last updated: 2/11/2025
Accessed: 08/09/2026

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): 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 Foothills and 46 Northern and Central Rocky Mountain Foothills. The major watersheds of this MLRA are those of 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), but there is some limited mining. Urban development is high with large expanses of rangeland converted to subdivisions for a rapidly growing population. The MLRA consists of one Land Resource Unit (LRU) and seven climate based LRU subsets. These subsets are based on a combination of 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 9 inches to a high near 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 also 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 an extremely limited 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 has been broken into seven climate subsets based on a combination of Relative Effective Annual Precipitation (REAP) and frost free days. Each combination of REAP and frost free days results in a common plant community that is shared across the subset. Each subset is giving 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 (228.6-355.6mm) with a frost free days range of 70 to 110 days. This combination of REAP and frost free days results in a nearly treeless sagebrush steppe landscape. The soil moisture regime is Ustic, dry that borders on Aridic and has a Frigid soil temperature regime.

Classification relationships

Mueggler and Stewart. 1980. Grassland and Shrubland habitat types of Western Montana 1. Stipa comata/Bouteloua gracilis h.t. 2. Agropyron spicatum/Bouteloua gracilis h.t. 3. Cercocarpus ledifolius/Agropyron spicatum h.t. EPA Ecoregions of Montana, Second Edition: Level I: Northwestern Forested Mountains Level II: Western Cordillera Level III: Middle Rockies & Northern Great Plains Level IV: Paradise Valley Townsend Basin Dry Intermontane Sagebrush Valleys Shield-Smith Valleys National Hierarchical Framework of Ecological Units: 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 Shallow Limy Droughty ecological site is an upland site formed from residuum from limestone. The site slope is less than 45 percent. The site does not receive additional moisture from a water table or flooding. It is a shallow site that has a root-restrictive layers within 20 inches (50cm). The soil surface texture is from loam to silty loam in surface mineral four inches. The surface of the site has less than 15 percent stone cover. The Shallow Limy Droughty ecological site is skeletal, with more than 35 percent rock fragments in the 10 to 20-inch

depth. The site is strongly or violently effervescent within four inches of the mineral surface. Calcium carbonates may increase with depth.

Associated sites

EX044B01A132	**Shallow Limy (SwLy) 10-14" PZ Frigid** The Shallow Limy (SwLy) ecological site is typically adjacent to site and shares similar plant community.

Similar sites

EX044B01A132	**Shallow Limy (SwLy) 10-14" PZ Frigid** Shallow Limy (SwLy) shares a similar plant community and STM, but expresses higher potential for total plant production.

Table 1. Dominant plant species

Tree	(1) *Juniperus scopulorum* (2) *Pinus flexilis*
Shrub	(1) *Cercocarpus ledifolius* (2) *Artemisia nova*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Stenotus acaulis*

Legacy ID

R044BA135MT

Physiographic features

The Shallow Limy Droughty site exists on gentle hillslopes to steep escarpments, hillslopes, or hogbacks. Slopes vary from nearly level to 70 percent, with a core slope generally less than 15 percent.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Hogback (2) Intermontane basin > Hillslope (3) Intermontane basin > Escarpment
Elevation	1,520 – 1,980 m
Slope	0 – 20 %
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Elevation	Not specified
Slope	0 – 70 %

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. Fifty to sixty percent of the annual long-term average total precipitation falls between May and August. Most of the precipitation in the winter is snow on frozen ground. Average precipitation for LRU 01 Subset A is 12 inches (305 mm) and the frost-free period averages 78 days. Precipitation is highest in May and June. Some of Montana's driest areas are located in sheltered mountain valleys, because of the rain-shadow effects on the leeside of some ranges.

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

Influencing water features

This ecological site is an upland site not associated with current water features.

Wetland description

Site is not associated with wetlands

Soil features

These soils are shallow (10 to 20 inches deep to bedrock or a root-restrictive layer), have moderate permeability, and are well drained. These soils are formed from calcareous residuum (often limestone). The most common soil surface textures are loam and silt loam. The site contains greater than 35 percent rock fragments in the 10- to 20-inch control section. Common soil series are Rencot and Pensore. These soils may exist across multiple ecological sites due to natural variations in slope, texture, rock fragments, and pH. An onsite soil pit and the most current ecological site key are required to classify an ecological site.

Table 5. Representative soil features

Parent material	(1) Residuum – calcareous conglomerate (2) Residuum – limestone and dolomite
Surface texture	(1) Very cobbly loam (2) Gravelly loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	50 cm
Soil depth	50 cm
Surface fragment cover <=3"	0 – 20 %
Surface fragment cover >3"	Not specified
Available water capacity (0-50.8cm)	2.79 – 4.06 cm
Soil reaction (1:1 water) (0-50.8cm)	7.4 – 8.4

Subsurface fragment volume <=3" (25.4-50.8cm)	20 – 40 %
Subsurface fragment volume >3" (25.4-50.8cm)	20 – 30 %

Ecological dynamics

The Shallow Limy Droughty ecological site often occurs in a small area with a complex of multiple ecological sites. This site occurs across a relatively small landscape with few variations within the plant community due to aspect, elevation, and relative effective annual precipitation.

The reference plant community is dominated by bluebunch wheatgrass (Pseudoroegneria spicata) and needle and thread (Hesperostipa comata). Subdominant species may include curl-leaf mountain mahogany (Cercocarpus ledifolius), Wyoming big sage (Artemisia tridentata ssp. wyomingensis), black sagebrush (Artemisia nova), winterfat (Krascheninnikovia lanata), and Indian ricegrass (Achnatherum hymenoides). This site's forb production is typically low but diverse. This ecological site has the potential to exhibit extremely limited tree growth, often averaging less than three stems per acre. Tree species that may utilize this site include Rocky Mountain juniper (Juniperus scopulorum), Douglas fir (Pseudotsuga menziesii), and limber pine (Pinus flexilis).

Two species in the genus Sphaeromeria (false sagebrush or chickensage) are unique to the suite of sites born on limestone geology within MLRA 44B (Shallow Limy, Shallow Limy Droughty, and Fractured Rock Limy) in Beaverhead County. The rock daisy (Sphaeromeria capitata) and chickensage (Sphaeromeria argentea) are members of this genus. Rock daisy also exists in a very limited extent in the calcareous soils of the Pryor Mountain Foothills. Both Sphaeromeria species are considered regionally endemic. Chickensage received a State Ranking of S3 or "Potentially at Risk," due to its extremely limited extent (20 known populations) and potential for being limited by one or more activities or agents. Grazing impacts and invasive species are specifically listed by Montana as the two agents posing the highest risk (Montana Field Guide 2019).

The Shallow Limy Droughty community historically was characterized by a 13- to 22-year fire return interval (Arno & Wilson 1986). A shift to the dominance of shrubs may occur in response to improper grazing management, drought, or a lack of fire at the site. As the mid-statured bunchgrasses decline, shrub encroachment by a variety of species such as broom snakeweed (Gutierrezia sarothrae), fringed sagewort (Artemisia frigida), curl-leaf mountain mahogany (Cercocarpus ledifolius), rubber rabbitbrush (Ericameria nauseosa), and yellow rabbitbrush (Chrysothamnus viscidiflorus). Shrub dominance and grass loss can be 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 there is a lack of weed prevention and control measures.

This ecological site is largely intact and is primarily used for livestock grazing. Historical records indicate that, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Grazed areas received periodic high intensity, short duration grazing pressure due to bison's nomadic nature and herd structure. Livestock forage was noted as being minimal in areas recently grazed by bison (Lesica and Cooper 1997). Meriwether Lewis documented that he was met by 60 Shoshone warriors on horseback in August 1805, and the Corps of Discovery was later supplied with horses by the same band of Shoshone. This suggests that the areas near the modern-day Montana towns of Twin Bridges, Dillon, Grant, and Dell were grazed by an untold number of horses for nearly 50 years prior to the large introduction of cattle and sheep. The gold boom of 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 more than 400 percent and dominated the livestock industry until the 1930s. Since then, cattle production has dominated the region's livestock industry (Wyckoff and Hansen 2001).

Some of the primary nonnative invasive species that can occur on this site are cheatgrass (Bromus tectorum), field brome (Bromus arevensis), yellow toadflax (Linaria vulgaris), and dandelion (Taraxicum spp.). Invasive weeds are beginning to have a high impact on this ecological site due to, primarily, human impacts from mismanaged grazing and fire suppression.

Plant Communities and Transitions
A state and transition model (STM) for this ecological site 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 the same ecological site will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. 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 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 there is considerable qualitative experience supporting the pathways and transitions within the state and transition model (STM), no quantitative information exists that specifically identifies threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer et al. (2003), Bestelmeyer et al. (2004), Bestelmeyer and Brown (2005), and Stringham et al. (2003).

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	**Mid-Statured Cool Season bunchgrass**			213-392	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	112-336	20-35
	needle and thread	HECO26	*Hesperostipa comata*	45-73	10-20
	spike fescue	LEKI2	*Leucopoa kingii*	22-73	5-10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	11-28	1-10
2	**Short grasses/Grasslikes**			43-112	
	prairie Junegrass	KOMA	*Koeleria macrantha*	22-34	0-5
	Sandberg bluegrass	POSE	*Poa secunda*	22-34	0-5
	threadleaf sedge	CAFI	*Carex filifolia*	6-17	0-3
	blue grama	BOGR2	*Bouteloua gracilis*	0-17	0-3
3	**Rhizomatous grasses**			43-56	
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	28-45	3-5
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0-11	0-3
Forb					
4	**Forbs**			28-56	
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0-11	0-1
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0-11	0-1
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0-11	0-1
	spiny phlox	PHHO	*Phlox hoodii*	0-11	0-1
	bastard toadflax	COUM	*Comandra umbellata*	0-11	0-1
	desertparsley	LOMAT	*Lomatium*	0-11	0-1
	James' cryptantha	CRCI3	*Cryptantha cinerea*	0-11	0-1
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0-11	0-1
	elkweed	FRSP	*Frasera speciosa*	0-11	0-1
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0-11	0-1
	stemless four-nerve daisy	TEAC	*Tetraneuris acaulis*	0-11	0-1
	Indian paintbrush	CASTI2	*Castilleja*	0-11	0-1
	silver chickensage	SPAR2	*Sphaeromeria argentea*	0-11	0-1
	rock tansy	SPCA8	*Sphaeromeria capitata*	0-6	0-1
	locoweed	OXYTR	*Oxytropis*	0-6	0-1
Shrub/Vine					
5	**Shrubs**			28-84	
	curl-leaf mountain mahogany	CELE3	*Cercocarpus ledifolius*	34-73	5-15
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0-39	0-5
	black sagebrush	ARNO4	*Artemisia nova*	0-34	0-5
	spineless horsebrush	TECA2	*Tetradymia canescens*	0-11	0-1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0-11	0-1

6	**Subshrubs**			0-28	
	winterfat	KRLA2	*Krascheninnikovia lanata*	6-11	1-3
	slender buckwheat	ERMI4	*Eriogonum microthecum*	6-11	1-3
	prairie sagewort	ARFR4	*Artemisia frigida*	0-6	0-1
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0-6	0-1
Tree					
7	**Coniferous Trees**			0-6	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0-6	0-1
	Douglas-fir	PSME	*Pseudotsuga menziesii*	0-6	0-1
	limber pine	PIFL2	*Pinus flexilis*	0-6	0-1

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 3.1 plant community composition

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

Table 10. Community 4.1 plant community composition

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

Table 11. Community 5.1 plant community composition

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

Animal community

This site provides a variety of wildlife habitats for an array of 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. Sites with large quantities of curl-leaf mountain mahogany are considered important winter range for mule deer, elk, and moose. In some areas, it may even be considered critical habitat for dwindling wild ungulate populations. Managed livestock grazing is suitable on this site, however. In order to maintain the productivity of the site, 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. According to McLean et al., early-season defoliation of bluebunch wheatgrass can result in high mortality and reduced vigor in plants. They also suggest, based on prior studies, that the opportunity for regrowth is necessary before dormancy to reduce injury bluebunch. Since needle and thread normally matures earlier than bluebunch wheatgrass and produces a sharp awn, this species is usually avoided after seed set. Changing the grazing season will allow needle and thread to be used more efficiently. Continual non-prescribed grazing of this site will be injurious, 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 as well as other circumstances such as weather conditions and fire frequency. The Altered State can be further degraded to the Degraded or Invaded State. Management should focus on grazing management strategies that will prevent further degradation, such as seasonal grazing deferment or winter grazing where feasible. Communities within this state are still stable and healthy under proper management. Forage quantity and quality may be substantially decreased from the Reference State. 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. Sites infested with invasive species face an increased risk of further degradation due to their aggressive nature. Grazing has to 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. Grazing may be possible in a degraded state, but it is generally not economically or environmentally sustainable.

Hydrological functions

The hydrologic cycle functions best in the Reference State (1) 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. High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sedimentation 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 Wheatgrass 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. Improper grazing management results in a community shift to the Mixed Bunchgrass Community (1.2). This plant community has a similar canopy cover, but the bare ground will be less than 15 percent. Therefore, the hydrologic cycle is functioning at a level similar to the water cycle in the Bluebunch Wheatgrass Community. Compared to the Bluebunch Wheatgrass Community (1.1), infiltration rates are slightly reduced and surface runoff is slightly higher. In the Degraded State (3) and the Invaded State (4), canopy and ground cover are greatly reduced compared to the Bunchgrass 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 combine to increase the frequency and severity of flooding within a watershed. Soil erosion is accelerated, the quality of surface runoff is poor, and sedimentation increases. The hydrology of the Conifer Encroached State (5), however, is highly variable, and studies suggest that an increased tree canopy affects the interception of rainfall as well as reducing available soil moisture for herbaceous vegetation. This can negatively affect infiltration and increase runoff.

Recreational uses

This site is often utilized for photography, hiking, hunting, bird watching, and flower collecting.

Inventory data references

Information presented was derived from the site's Range Site Description (Shallow Limy Droughty 9 –14" P.Z., Northern Rocky Mountain Valleys, South, East of Continental Divide), NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel (i.e., used professional opinion of agency specialists, observations of land managers, and outside scientists).

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Contributors

Petersen
Synergy, Ricketts, Gibbons

Approval

Kirt Walstad, 2/11/2025

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)	G. Petersen
Contact for lead author	grant.petersen@usda.gov
Date	03/15/2019
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** **Rills will primarily be absent on gentle slopes however on the steepest of slopes of this site (greater than 30%) small, short rills (less than 2-3 feet) may be evident after high precipitation events.**

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2. **Presence of water flow patterns:** **Water flow patterns are rare in the reference condition. If present, they are most likely to occur on steeper slopes (15-25%) and are inconspicuous, disconnected, and very short in length.**

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3. **Number and height of erosional pedestals or terracettes:** **Pedestals and terracetts 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 less than 20 percent.**

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5. **Number of gullies and erosion associated with gullies:** **Gullies are not present in the reference condition.**

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6. **Extent of wind scoured, blowouts and/or depositional areas:** **Wind scoured, or depositional areas are not evident in the reference condition.**

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7. **Amount of litter movement (describe size and distance expected to travel):** **Movement of fine herbaceous litter may occur within less than a foot from where it originated.**

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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):** **Soil Surface Stable with Stability Ratings of 4-6 (both under canopy and bare). Biotic crusts, mat forming plants, and or root mats may be present.**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **Structure trends to weak, fine granular. The A horizon is approximately 3 inches thick with wet Munsell colors Value 5 or less, Chroma 3 or less. Dry colors tend to be quite light prior to wetting. Official Series Description (OSD) for characteristic range. https://soilseries.sc.egov.usda.gov/osdname.aspx**

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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. The Shallow Limy Droughty ecological site is well drained and has a high infiltration rate. An even distribution of mid stature grasses, (60-70% of site production), cool season shortgrass (5-15%) with a mix of rhizomatous grasses (5-10%), forbs (1-10%), shrubs (5-10%), subshrubs (0-10%), and tall shrubs/trees (0-Trace)**

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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

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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

    Sub-dominant: perennial shortgrasses/grasslikes ? shrubs = rhizomatous grasses ? forbs > subshrubs >> Tall shrubs/Trees

    Other:

    Additional:

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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.

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14. **Average percent litter cover (%) and depth (in):** Total litter cover ranges from 20 to 30%. Most litter is irregularly distributed on the soil surface and is not at a measurable depth.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Average annual production is 700. Low: 400 High 900 lbs per acre. Production varies based on effective precipitation and natural variability of soil properties for this ecological site.

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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:** Potential invasive (including noxious) species (native and non-native). Invasive species on this ecological site include (but not limited to) annual brome spp., spotted knapweed, yellow toadflax, leafy spurge, ventenata, crested wheatgrass, etc. Native species such as Rocky Mountain juniper, limber pine, broom snakeweed, rabbitbrush spp., blue grama, Sandberg’s bluegrass, etc. when their populations are significant enough to affect ecological function, indicate site condition departure.

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17. **Perennial plant reproductive capability:** In the reference condition, all plants are vigorous enough for reproduction either by seed or rhizomes in order to balance natural mortality with species recruitment. Density of plants indicates that plants reproduce at level sufficient to fill available resource.
