Ecological site EX044B01C131 Shallow Clay (SwC) 15-19" PZ Frigid North

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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. This MLRA borders two other MLRAs: 43B, Central Rocky Mountains and Foothills, 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. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River. These waters allow for extensive irrigation for crop production in an area that is generally only compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs used for irrigation water, hydroelectric power, and municipal water. The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay) with limited mining. Urban development is high, with large expanses of rangeland being converted to subdivisions for a rapidly growing population. MLRA 44B consists of one Land Resource Unit (LRU) and seven climate-based LRU subsets. Annual precipitation ranges from a low of 9 inches to a high of 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 edges of the MLRA, where it borders MLRA 43B. Frost-free periods also vary greatly, with less than 30 days in the Big Hole Valley to approximately 110 days in the warm valleys along the Yellowstone and Missouri Rivers. MLRA 44B's plant communities are highly variable but are dominated by a cool-season grass and shrub-steppe community on the rangeland and a mixed coniferous forest in the mountains. Warm-season grasses occupy an extremely limited extent and number of species in this MLRA. Most subspecies of big sagebrush are present, to some extent, across the MLRA.

LRU notes

LRU 01 Subset C Central Concept: • Moisture Regime: Ustic • Temperature Regime: Frigid • Dominant Cover: rangeland (mixed grassland and sagebrush steppe) • Representative Value (RV) of range of Effective Precipitation: 15 to 19 inches • Representative Value (RV) of range of Frost Free Days: 75 to 105days This LRU subset exists in northern portion of MLRA 44B particularly in Meagher, Powell, Broadwater, Lewis and Clark, Granite, and Deer Lodge Counties.

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. Montana Natural Heritage Program Vegetation Classification 1. Stipa comata - Bouteloua gracilis Herbaceous Vegetation (STICOM – BOUGRA) Needle-and-thread/Blue grama Natural Heritage Conservation Rank-G5 / S5 Edition / Author- 99-11-16 / S.V. Cooper, 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 Level I: Great Plains Level II: West-Central Semi-Arid Prairies Level III: Northwestern Great Plains Level IV: Shield-Smith Valleys Non-calcareous Foothill Grassland

Ecological site concept

Site does not receive any additional water • Soils are o Not saline or saline-sodic. o Shallow (10-20 inches deep to bedrock, lithic, or paralithic root restrictive layer). o Not strongly or violently effervescent (calcareous) in the surface mineral 4 inches. o Not skeletal within 10-20 inches of soil surface (averages less than 35 percent rock fragments in the 10-20 inch layer). o Clay content greater than 32 percent in surface mineral 4 inch (ribbon length greater than 2 inches long). • Parent material is colluvium and residuum from sedimentary rock

Associated sites

EX044B01C136	**Shallow Loamy (SwLo) 15-19" PZ Frigid North** Shallow Loamy ecological site is often a nearby site and shares landscape position
EX044B01C038	**Droughty Steep (DrStp) 15-19" PZ Frigid North** Droughty Steep ecological site is often below this site on the landscape.

Similar sites

EX044B01C138	**Shallow Droughty (SwDr) 15-19" PZ Frigid North** The Shallow Droughty ecological site shares a similar plant community. The Shallow Droughty site does not have a high clay content and had a high rock fragment content in the soil which reduces the water holding capacity.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis* (2) *Rhus aromatica*
Herbaceous	(1) *Festuca campestris* (2) *Pseudoroegneria spicata*

Legacy ID

R044BC131MT

Physiographic features

This ecological site can occur on nearly level to very steep uplands. It often occurs in complexes with other ecological sites, particularly in rougher terrain. This site occurs on all slopes and exposures, and the aspect sometimes becomes significant. Slight variations in plant community composition and production can result due to aspect. The amount of exposed rock outcrop tends to increase as slopes increase. Runoff and the potential for water erosion can be important features of this site.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder
Landforms	(1) Intermontane basin > Escarpment (2) Intermontane basin > Hillside or mountainside (3) Intermontane basin > Knoll
Runoff class	Medium to high

Elevation	1,460 – 1,770 m
Slope	0 – 20 %

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. 50 to 60 percent of the annual long-term average total precipitation falls between May and August with the highest in May and June. Most of the precipitation in the winter is snow on frozen ground. Average precipitation for LRU 01 Subset C is 15 inches, and the frost-free period averages 75 to 105 days.

Table 3 Representative climatic features

Frost-free period (characteristic range)	80-110 days
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	360-430 mm
Frost-free period (actual range)	80-110 days
Freeze-free period (actual range)	110-140 days
Precipitation total (actual range)	330-510 mm
Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	380 mm

- (1) WILSALL 8 ENE [USC00249023], Wilsall, MT
- (2) ANACONDA [USC00240199], Anaconda, MT
- (3) AUSTIN 1 W [USC00240375], Helena, MT
- (4) PHILIPSBURG RS [USC00246472], Philipsburg, MT
- (5) BOZEMAN MONTANA ST U [USC00241044], Bozeman, MT
- (6) LENNEP 5 SW [USC00244954], White Sulphur Springs, MT

Influencing water features

Site is not associated with water features.

Wetland description

Site is not associated with wetlands.

Soil features

These are shallow clayey soils that are 10 to 20 inches deep and have underlying beds of decomposed shale or nearly impervious clays. These soils are formed from alluvium, slope alluvium, and residuum. The site is well drained with slow permeability. Typical soil surface texture is clay loam, with clay content in the top 4 inches of soil greater than 35 percent. The soil series present is almost exclusively Wilsall.

Table 4. Representative soil features

Parent material	(1) Colluvium – sedimentary rock (2) Residuum – sedimentary rock
Surface texture	(1) Clay loam
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Slow
Depth to restrictive layer	50 cm
Soil depth	50 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-50.8cm)	5.33 – 6.6 cm
Soil reaction (1:1 water) (0-50.8cm)	6.6 – 7.8
Subsurface fragment volume <=3" (25.4-50.8cm)	0 – 10 %
Subsurface fragment volume >3" (25.4-50.8cm)	Not specified

Ecological dynamics

The reference plant community is dominated by rough fescue (Festuca campestris), bluebunch wheatgrass (Pseudoroegneria spicata), and western wheatgrass (Pascopyrum smithii). Subdominant species may include green needlegrass (Nassella viridula), Idaho fescue (Festuca idahoensis), needle and thread (Hesperostipa comata), Wyoming big sage (Artemisia tridentata ssp. wyomingensis), sumac (Rhus spp.), and winterfat (Krascheninnikovia lanata). In the reference state, up to two stems per acre of coniferous tree may exist on the landscape, but the core concept of the Reference State is to express no trees.

Wyoming big sagebrush steppe communities historically had low fuel loadings and were characterized by 10- to 70-year interval fires that produced a mosaic of burned and unburned lands (Bunting et al., 1987). A shift to the dominance of shrubs may occur in response to improper grazing management, drought, or where big sagebrush occurs due to a lack of fire. Shrub encroachment by a variety of species, including broom snakeweed (Gutierrezia sarothrae), fringed sagewort (Artemisia frigida), Wyoming big sagebrush, rubber rabbitbrush (Ericameria nauseosa), yellow rabbitbrush (Chrysothamnus viscidiflorus), antelope bitterbrush (Purshia tridentata), and plains prickly pear (Opuntia polyacantha), occurs within this site as the mid-statured bunchgrasses decrease. 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.

Historical records indicate that, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Due to the nomadic nature and herd structure of bison, areas that were grazed received periodic, high-intensity, short-duration grazing pressure. 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, Montana sheep production began to increase (a greater than 400 percent increase) and dominated the livestock industry until the 1930s. Since the 1930s, cattle production has dominated the livestock industry in the region (Wyckoff and Hansen 2001).

Natural fire was a major ecological driver of this entire ecological site. Fire tended to restrict tree and sagebrush growth to small patches and promote an herbaceous plant community. The natural fire return interval was highly variable, ranging up to 100 years; however, it was likely shorter than 35 years (Arno and Gruell 1983). With the historically recent, since 1910, suppression of fire sagebrush and trees has increased significantly.

Some of the major invasive species that can occur on this site include (but are not limited to) spotted knapweed (Centaurea stoebe), leafy spurge (Euphorbia esula), 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.

Plant Communities and Transitions
A state and transition model 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), Stringham et al. (2003).

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-Statured Bunchgrasses**			729-785	
	rough fescue	FECA4	*Festuca campestris*	392-673	15-25
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	392-560	15-25
	green needlegrass	NAVI4	*Nassella viridula*	112-179	3-7
	needle and thread	HECO26	*Hesperostipa comata*	84-112	3-5
2	**Rhizomatous Grasses**			67-84	
	western wheatgrass	PASM	*Pascopyrum smithii*	45-84	3-5
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	0-84	0-5

	plains reedgrass	CAMO	*Calamagrostis montanensis*	22-45	1-3
3	**Shortgrasses**			67-84	
	Idaho fescue	FEID	*Festuca idahoensis*	28-84	3-10
	Sandberg bluegrass	POSE	*Poa secunda*	22-67	1-8
	prairie Junegrass	KOMA	*Koeleria macrantha*	22-67	1-5
	threadleaf sedge	CAFI	*Carex filifolia*	22-67	1-5
	sedge	CAREX	*Carex*	0-45	0-2
	blue grama	BOGR2	*Bouteloua gracilis*	0-11	0-1
Forb					
4	**Forbs**			67-101	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	0-45	0-4
	lupine	LUPIN	*Lupinus*	22-34	1-5
	American vetch	VIAM	*Vicia americana*	22-34	1-3
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	11-22	1-2
	dotted blazing star	LIPU	*Liatris punctata*	0-22	0-1
	spiny phlox	PHHO	*Phlox hoodii*	0-11	0-1
	deathcamas	ZIGAD	*Zigadenus*	0-6	0-1
Shrub/Vine					
5	**Shrubs**			67-101	
	common snowberry	SYAL	*Symphoricarpos albus*	11-112	0-10
	big sagebrush	ARTR2	*Artemisia tridentata*	67-101	3-12
	currant	RIBES	*Ribes*	11-67	0-5
	Woods' rose	ROWO	*Rosa woodsii*	0-56	0-5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0-45	0-3
6	**Subshrubs**			11-34	
	winterfat	KRLA2	*Krascheninnikovia lanata*	11-34	0-2
	prairie sagewort	ARFR4	*Artemisia frigida*	0-11	0-1
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0-11	0-1
Tree					
7	**Coniferous Trees and Tall Shrubs**			0-11	
	ponderosa pine	PIPOS	*Pinus ponderosa var. scopulorum*	0-11	0
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0-11	0
	Douglas-fir	PSME	*Pseudotsuga menziesii*	0-11	0

Table 6. Community 1.2 plant community composition

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

Table 7. Community 2.1 plant community composition

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

Table 8. Community 2.2 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

The Shallow Clay ecological 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. The relatively high grass component of the Reference Community provides excellent nesting cover for multiple neotropical migratory birds that select for open grasslands, such as the long-billed curlew and McCown's longspur. 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 grazing by livestock, and animals tend to congregate in these areas. In order to maintain the productivity of the Shallow Clay site, grazing on adjoining sites with less production must be managed carefully to be 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. Based on previous research, they also believe that regrowth is required before dormancy to reduce bluebunch injury. Since needle-and-thread normally matures earlier than bluebunch wheatgrass and rough fescue and produces a sharp awn, this species is usually avoided after seed set. Changing the grazing season of use will help utilize needle and thread more efficiently while preventing overuse of bluebunch wheatgrass and rough fescue. The grazing season has more influence on winterfat than grazing intensity. Late winter or early spring grazing is detrimental. However, early winter grazing may actually be beneficial (Blaisdell 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. 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 is subject to further degradation to the Degraded State 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/or 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. Due to the aggressive nature of invasive species, sites in the Invaded State face an increased risk of further degradation to the Invaded State. 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. In the Degraded State, grazing may be possible but is generally not economically and/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 Mid-Statured Bunchgrass 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 covered. Therefore, the hydrologic cycle is functioning at a level similar to the water cycle in the Mid-Statured Bunchgrass Community (1.1). Infiltration rates are slightly lower and surface runoff is slightly higher than in the Mid-Statured Bunchgrass Community (1.1). In the Shortgrass Community (2.2), Degraded State (3), and the Invaded State (4), canopy and ground cover are greatly reduced 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 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) is highly variable, but studies suggest that an increased tree canopy affects the interception of rainfall as well as the amount of available soil moisture for herbaceous vegetation. This can negatively affect infiltration and increase runoff.

Recreational uses

This site provides 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

Information presented was derived from the site's Range Site Description, 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

Approval

Grant Petersen, 3/03/2025

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	02/12/2025
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills: Rills will not be evident on lesser sloping Reference Communities. Steeper slopes (greater than 30%) may have rills particularly after extreme weather events however they will remain short**

2. **Presence of water flow patterns: Water flow patterns are not be evident on lesser sloping reference communities however will likely be evident on slopes greater than 30% however they will be short**

3. **Number and height of erosional pedestals or terracettes:** **Steep slopes (greater than 30%) may contain both pedestals and terracettes as a result of slow infiltration and higher run-off. Height of either will not exceed ¾" tall.**

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 25%.**

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** **Wind scoured, or depositional areas are extremely rare in the reference condition.**

7. **Amount of litter movement (describe size and distance expected to travel):** **Litter movement of fine herbaceous material is minimal, distance traveled is less than 1 foot in the reference condition.**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** **The average soil stability rating is 5-6 under plant canopies and 4-6 in plant interspaces. The A horizon is 2-4 inches thick.**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **Soil surface structure will be weak, fine to strong medium granular. A Horizon should be 2-4 inches thick with color, when wet, typically ranging in Value of 5 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. https://soilseries.sc.egov.usda.gov/osdname.aspx**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** **Evenly distributed across the site, deep rooted bunchgrasses improve infiltration while rhizomatous grass protects the surface from runoff forces. Infiltration of the Shallow Clay ecological site is slow but well drained. An even distribution of mid stature bunchgrasses (65-70 percent of site production), cool season rhizomatous grasses (5-10 percent) with a mix of shortgrass (5-10 percent), forbs (1-10 percent) and shrubs (1-10 percent). Trees are rare on this site however may exist as a trace (less than 1 stem per acre)**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** **A compaction layer is not present in the reference condition.**

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: shortgrass/grasslikes = Rhizomatous grass > forbs ? shrubs > subshrubs >> trees/tall shrubs

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 is 3% or less.**

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14. **Average percent litter cover (%) and depth (in):** **Total litter cover ranges from 35 to 45%. 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 1250 pounds per acre (lbs/ac) or 1401 kilograms per hectare (kg/ha) Low: 1050lb/ac (1177 kg/ha) High 1500 (1681 kg/ha) 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, ventenata, crested wheatgrass, Kentucky bluegrass, smooth brome Native species such as rocky mtn Juniper, ponderosa pine, Douglas fir, broom snakeweed, rabbitbrush spp., big sagebrush, blue grama, 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.**
