USDA Natural Resources
Conservation Service

Ecological site R008XY516WA
Shallow Stony South Aspect Columbia Hills

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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): 008X–Columbia Plateau

MLRA 8 encompasses about 50,100 square kilometers mainly in Washington and Oregon, with a small area in Idaho. This MLRA is characterized by loess hills, surrounding scablands, and alluvial deposits. This MLRA consists mostly of Miocene Columbia River Basalt covered with up to 200 feet of loess and volcanic ash. The dominant soil order in this MLRA is Mollisols. Soils in this MLRA dominantly have a mesic temperature regime, a xeric moisture regime, and mixed minerology.

Classification relationships

Major Land Resource Area (MLRA): 8 – Columbia Plateau

LRU – Common Resource Areas (CRA):
8.5 - Moist Yakima Folds

Ecological site concept

Diagnostics:

Shallow stony, south aspect, Columbia Hills is a grassland steppe upland site on the south side of the Columbia Hills in Klickitat Co. It is a sparsely vegetated site occurring on soils that are both shallow (10 to 20 inches deep) AND stony to extremely stony. Soils have a stony or cobbly surface and rock fragments (35 percent or more) throughout the profile. Soil textures loam, silt loam and clay loam are most common. The soil surface is mostly bare soil, soil biotic crust or rock.

Note: due to historic farming and grazing the south side of the Columbia Hills has been heavily disturbed. Shallow Stony is quite stable but the disturbances may have altered some sites.

The south side of the Columbia Hills is a grassland steppe area and has not had sagebrush for more than 50 years and is not expected to have sagebrush. This area does not have sagebrush, nor bitterbrush, and no rabbitbrush except for one small area near the Columbia River.

Perennial bunchgrasses would dominate the reference state. Cool-season bunchgrasses form two distinct layers. Bluebunch wheatgrass is the dominant bunchgrass in the top grass layer, while Sandberg bluegrass is the major grass of the lower grass layer. Native forbs fill the interspaces.

Principle Vegetative Drivers:

The shallow soil depth and stones throughout the profile, and the south aspect drive the vegetative expression of this site. The soil depth limits deep-rooted species, plus the soil depth and stones limit the water holding capacity in the profile. Thus, plant production is quite limited for Shallow stony, south aspect, Columbia Hills sites.

Associated Sites:
Shallow Stony, south aspect, Columbia Hills is associated with other ecological sites in the grassland steppe area on the south side of the Columbia Hills including Loamy and Sands. Very Shallow may also be nearby.

Similar Sites:
Shallow Stony South Aspect Columbia Hills is a sparsely vegetated bluebunch wheatgrass site. Sagebrush is not present and other shrubs are nonexistent to only a trace.

The other sparsely vegetated Shallow Stony sites in MLRA 8 Columbia Plateau, MLRA 7 Columbia Basin and MLRA 6 East Slope of the Cascades all have sagebrush.

Associated sites

R008XY536WA	**Loamy South Aspect Columbia Hills**

Similar sites

R008XY226WA	**Stony Foothills South Aspect bitterbrush**
R008XY120WA	**Stony sagebrush**

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Poa secunda*

Physiographic features

The landscape is part of the Columbia basalt plateau. Shallow stony, south aspect, Columbia Hills sites occur on side-slopes of ridges and plateaus, ridges & benches, foot-slopes and hillslopes, and canyon walls of the Columbia Hills in Klickitat County.

Physiographic Division: Intermontane Plateau
Physiographic Province: Columbia Plateau
Physiographic Sections: Walla Walla Plateau Section

Landscapes: Hills, canyonlands and plateaus
Landform: Sideslopes, shoulders, ridges, summits

Aspect: Dominantly southern aspects, but can occur on all aspects

Table 2. Representative physiographic features

Geomorphic position, hills	(1) Side Slope
Landforms	(1) Hills (2) Canyonlands (3) Plateau (4) Ridge (5) Hillslope
Flooding frequency	None
Ponding frequency	None
Elevation	305–914 m
Slope	10–50%
Water table depth	152 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	244–1,219 m
Slope	0–65%
Water table depth	Not specified

Climatic features

Grasslands do not have shrubs because they receive more spring precipitation especially in March (Daubenmire). The climate is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to the rain shadow effect of the Cascades. Winter fog is variable and often quite localized, as the fog settles on some areas but not others. Compared to the rest of MLRA 8, the south side of the Columbia Hills is dry and hot. Taxonomic soil climate is xeric moisture regime with a mesic temperature regime.

Table 4. Representative climatic features

Frost-free period (characteristic range)	120-150 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	254-356 mm
Frost-free period (actual range)	110-160 days
Freeze-free period (actual range)	
Precipitation total (actual range)	

Influencing water features

A plant’s ability to grow on a site and overall plant production is determined by soil-water-plant relationships
1. Whether rain and melting snow runs off-site or infiltrates into the soil
2. Whether soil condition remain aerobic or become saturated and become anaerobic
3. Water drainage and how quickly the soil reaches wilting point

With adequate cover of live plants and litter, there are no restrictions on this ecological site with water infiltrating into the soil. In some years Shallow stony, south aspect, Columbia Hills sites can become saturated due to the shallow soil depth, but with good drainage would remain anaerobic for only a short period of time. This site has an extremely restricted water holding capacity, so plant production is quite limited.

Soil features

This ecological site components are dominantly Lithic and Typic taxonomic subgroups of Argixerolls great group of the Mollisols taxonomic order. Soils are shallow to moderately deep. Average available water capacity of about 1.5 inches (3.8 cm) in the 0 to 40 inches

(0-100 cm) depth range.

Soil parent material is dominantly loess mixed with colluvium and residuum.

The associated soils are Goodnoe, Horseflat and similar soils.

Dominate soil surface is silt loam.

Dominant particle-size class is loamy-skeletal.

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium (3) Residuum
Surface texture	(1) Silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Depth to restrictive layer	25–102 cm
Soil depth	102 cm
Surface fragment cover <=3"	10%
Surface fragment cover >3"	15%
Available water capacity (0-101.6cm)	3.81 cm
Calcium carbonate equivalent (Depth not specified)	0–5%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (0-25.4cm)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	25%
Subsurface fragment volume >3" (Depth not specified)	20%

Table 6. Representative soil features (actual values)

Drainage class	Not specified

Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	5–25%
Surface fragment cover >3"	5–25%
Available water capacity (0-101.6cm)	2.29–8.64 cm
Calcium carbonate equivalent (Depth not specified)	Not specified
Electrical conductivity (Depth not specified)	Not specified
Sodium adsorption ratio (Depth not specified)	Not specified
Soil reaction (1:1 water) (0-25.4cm)	Not specified
Subsurface fragment volume <=3" (Depth not specified)	5–40%
Subsurface fragment volume >3" (Depth not specified)	10–40%

Ecological dynamics

Shallow stony, south aspect, Columbia Hills produces about 300-600 pounds/acre of biomass annually.

The line between sagebrush steppe and true grasslands has been discussed and debated for many years. Daubenmire states that the line has nothing to do with pre-settlement as native ungulates played no significant role in the evolution of ecotypes. He also says that there is no evidence that the distribution of vegetative types is related to fire. And he also says there is no useful correlation between soil classification and the line between grasslands and sagebrush steppe.

The ecotones between Daubenmire’s vegetation types can be defined on the basis of consistent differences in climate and consistent differences in vegetation. Higher spring precipitation, especially in March, favors grasses over sagebrush. The south side of the Columbia Hills with the influence from the Columbia gorge receives enough spring precipitation that this area is a grassland. So, the grassland on the south side of the Columbia Hills is consistent with Daubenmire’s findings.

Bluebunch wheatgrass is at the core of the Shallow stony, south aspect, Columbia Hills ecological site and warrants a degree of understanding. This perennial is a long-lived, mid-sized bunchgrass with an awned or awnless seed head arranged in a spike. Bluebunch provides a crucial and extensive network of roots to the upper portions (up to 48” deep in

soils with no root-restrictive horizons) of the soil profile. These roots create a massive underground source to stabilize the soils, provide organic matter and nutrients inputs, and help maintain soil pore space for water infiltration and water retention in the soil profile. The extensive rooting system of mid-sized bunchgrasses leave very little soil niche space available for invasion by other species. This drought resistant root can compete with and suppress the spread of exotic weeds.

The stability and resiliency of the reference communities is directly linked to the health and vigor of bluebunch wheatgrass. Research has found that the community remains resistant to medusahead if the site maintains at least 0.8 mid-sized bunchgrass plant/sq. ft. (K. Davies, 2008). It is bluebunch that holds the system together. If we lose the bluebunch the ecosystem crashes or unravels.

Fire: The vegetative cover may be low, but the high winds from the Gorge push the fire across even sparse sites. For any plant, the fire is quick and then out, rarely burning into the crown of the plant.

Grazing: The south side of Columbia Hills are grazed in March when the bunchgrasses are vegetative and prior to the critical period. Deeper, more productive ecological sites are grazed much more intensely.

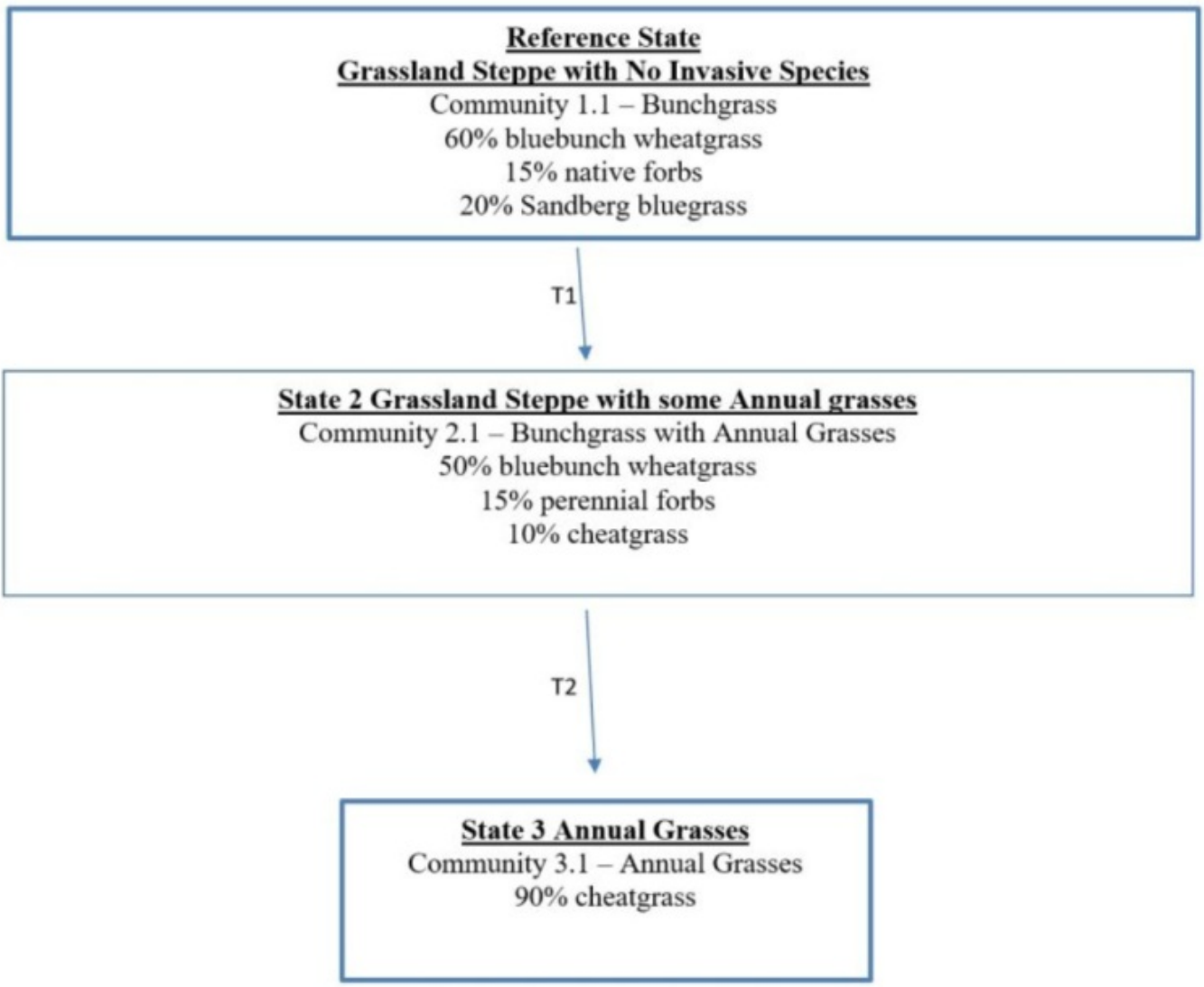
These sites do burn and are grazed, but Shallow stony, south aspect, Columbia Hills sites remain stable as burn severity and grazing pressure is light to moderate.

As grazing pressure increases the plant community unravels in stages:
1. Bluebunch wheatgrass declines while buckwheat species increase
2. As bluebunch wheatgrass continues to decline, invasive species such as cheatgrass and knapweed colonize the site.

For more grazing management information refer to Range Technical Notes found in Section I Reference Lists of NRCS Field Office Technical Guide for Washington State.

In Washington, bluebunch wheatgrass communities provide habitat for a variety of upland wildlife species.

State and transition model



State 1
Historical Reference - Grassland Steppe with No Invasive Species

Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this is not true for Shallow stony, south aspect, Columbia Hills. State 1 Narrative: State 1 represents grassland steppe with no invasive or exotic weed species. Each functional, structural group has one or more native species. Communities with a dominance of annual grasses have never been seen on Shallow Stony, south aspect, Columbia Hills. The south side of the Columbia Hills has no sagebrush or bitterbrush, and except for a spot along the Columbia River, the south side of the Columbia Hills also has no rabbitbrush. The Reference Community 1.1 is dominated by bluebunch wheatgrass with native buckwheat species prominent. Reference State Community Phases: 1.1 Reference Bluebunch wheatgrass-Eriogonum species At-risk Communities: • Any community in the reference state is at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually. • Reference community is quite stable as it receives limited grazing pressure and rarely burns • State 3 has not been seen on Shallow Stony sites in the Columbia Hills

Community 1.1
Reference - Bluebunch Wheatgrass, Sandberg Bluegrass, and Native Forbs

60% bluebunch wheatgrass 15% native forbs 20% Sandberg bluegrass

State 2
Current Potential - Grassland Steppe with Some Annual Grasses

Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this is not true for Shallow Stony, south aspect, Columbia Hills. State 2 Narrative: State 2 represents grassland steppe with minor inclusion of invasive annual grasses such as cheatgrass. All the native functional, structural groups would be represented by one or more species. Cheatgrass will colonize Shallow Stony, south aspect, Columbia Hills sites on the south side of the Columbia Hills, and retain, a presence in the community. In State 2 cheatgrass in a minor component. But once a community has been invaded by cheatgrass the chance of going back to State 1 is small. Community Phases for State 2: 2.1 Bunchgrass Bluebunch wheatgrass Dominate Species in State 2: bluebunch wheatgrass and buckwheat species

Community 2.1
Bluebunch Wheatgrass, Perennial Forbs, and Cheatgrass

50% bluebunch wheatgrass 15% perennial forbs 10% cheatgrass

State 3
Annual Grasses

State 3: Annual Grasses Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this has not been seen for Shallow Stony, south aspect, Columbia Hills. State 3 Narrative: State 3 represents sites that are dominated by invasive annual species and has crossed a biological threshold. State 3 is rare for Shallow stony, south aspect, Columbia Hills sites. The main species include cheatgrass, mustard, prickly lettuce and diffuse knapweed. Community Phases for State 3: 3.1 Annual Grass cheatgrass

Community 3.1
Annual Grasses

Dominant species in State 3: Annual grasses such as cheatgrass. The main species can include Japanese brome, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed.

Transition T1A
State 1 to 2

Result: transition from Reference State to State 2 (grassland steppe w/ a few annuals). The Reference State does not have invasive species. State 2 is the same as Reference State but with minor addition of invasive annual grasses such as cheatgrass. Primary Triggers: A high moisture year causes a micro-burst of cheatgrass and is the principle means of colonization. Loss of soil biological crusts contributes to the invasion. Also, soil disturbances (rodents, badgers) create openings in the community and encourage weed germination. Ecological process: Most sites in the Reference State have cheatgrass seed as the seed blows onto the sites annually. Cheatgrass is a prolific seeder and the seed is waiting for enough moisture to germinate and to compete with the native species for space, light and moisture. When there is more moisture available than the plant community can utilize, even pristine communities in the Reference State are susceptible to colonization by cheatgrass. The addition of cheatgrass to the community is generally a temporary condition on Shallow Stony sites. Indicators: The occurrence of annual grasses on sites where they had been absent.

Restoration pathway R2A
State 2 to 1

State 2 is considered non-reversible. Due to shallow soil depth, surface rock and rock within the soil profile, and the equipment limitations thereof, seeding is not practical for the Shallow Stony ecological site. Restoration of bluebunch wheatgrass, sagebrush, native forbs and the soil biotic crust would be very problematic at best on Shallow Stony. Seeds must germinate. Seedlings and plugged plants need soil moisture and time to become established. In most years, seeds and plugs may not have a chance as site conditions on Shallow Stony can change quickly. Drying winds and bright sun can turn a snowy or muddy site into a hard crust before plants are established. So, the timing of all recovery efforts would have an extremely narrow window of opportunity on Shallow Stony. Perhaps the only avenue for recovery would be to plant plugs of native species which is a very costly and risky proposition.

Transition T2A
State 2 to 3

Result: Shift from State 2 to State 3 which is dominated by annuals. This state is rare and has not been seen on Shallow Stony sites. This transition occurs once there is more invasive species cover than bluebunch wheatgrass cover. Primary Trigger: Chronic heavy grazing, season-long grazing, or late spring grazing causes poor vigor and bluebunch wheatgrass has a significant reduction in cover. Ecological Process: Consistent defoliation pressure to bluebunch wheatgrass causes poor plant vigor, shrinking crowns and mortality. With more and more of the soil surface and upper soil rooting surface open, opportunistic weeds take advantage of the available niche space to colonize and expand. The invasive annual grasses in State 2 communities make a dramatic increase to

dominate the community. Indicators: Decreasing cover of bluebunch wheatgrass and increasing cover of invasive annual species. Increasing distance between perennial species. Decreasing soil organic matter, soil water retention, limited water infiltration and percolation in the soil profile.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs - Minor**			–	
	rock buckwheat	ERSP7	*Eriogonum sphaerocephalum*	–	–
Grass/Grasslike					
2	**Dominant Mid-Size Bunchgrass**			404–	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	–	–
3	**Other Mid-Size Bunchgrasses - Minor**			34–	
	squirreltail	ELEL5	*Elymus elymoides*	–	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	–	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	–	–
4	**Short Grass - Subdominant**			135–	
	Sandberg bluegrass	POSE	*Poa secunda*	–	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	–	–
Forb					
5	**Native Forbs - Subdominant**			112–	
	spiny phlox	PHHO	*Phlox hoodii*	–	–
	granite prickly phlox	LIPU11	*Linanthus pungens*	–	–
	snow buckwheat	ERNI2	*Eriogonum niveum*	–	–
	desertparsley	LOMAT	*Lomatium*	–	–
	fleabane	ERIGE2	*Erigeron*	–	–
	low pussytoes	ANDI2	*Antennaria dimorpha*	–	–
	common yarrow	ACMI2	*Achillea millefolium*	–	–
	Hooker's balsamroot	BAHO	*Balsamorhiza hookeri*	–	–
	narrowleaf mock	NEST5	*Nestotus stenophyllus*	–	–

	goldenweed				
	parsnipflower buckwheat	ERHE2	*Eriogonum heracleoides*	–	–
	onion	ALLIU	*Allium*	–	–
	milkvetch	ASTRA	*Astragalus*	–	–
	woolly plantain	PLPA2	*Plantago patagonica*	–	–
	beardtongue	PENST	*Penstemon*	–	–

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Acknowledgments

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/08/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

   _____

5. **Number of gullies and erosion associated with gullies:**

   _____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

   _____

7. **Amount of litter movement (describe size and distance expected to travel):**

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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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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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:**

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17. **Perennial plant reproductive capability:**
