USDA Natural Resources Conservation Service

Ecological site R047XA505UT
High Mountain Clay (mule-ears)

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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): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The northern half of this area is in the Middle Rocky Mountains Province of the Rocky Mountain System. The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south, and the Uinta Mountains, which trend east and west. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongated shape. Structurally, they consist of a broadly folded anticline that has an erosion-resistant quartzite core. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet (1,495 to 4,115 meters).

The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the footslopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are one of the few ranges in the United States that are oriented west to east. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.

The average precipitation is from 8 to 16 inches (203 to 406 mm) in the valleys and can range up to 73 inches (1854 mm) in the mountains. In the northern and western portions of the MLRA, peak precipitation occurs in the winter months. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees Fahrenheit (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically xeric in the northern part of the MLRA, but grades to ustic in the extreme eastern and southern parts. The mineralogy is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy-skeletal.

LRU notes

Major Land Resource Unit 47A is located in the northern half of the Middle Rocky Mountains Province of the Rocky Mountain System. This MLRA includes the Wasatch Mountains which tend to run north and south. These steeply sloping, precipitous mountains have narrow crests and deep valleys. They are primarily fault blocks that have been

tilted up. The alluvial fans located at the base of these mountains are important recharge zones for valley aquifers.

Ecological site concept

The soils of this site formed mostly in colluvium and residuum from sandstone and shale. Surface soils are loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have very slow to moderately slow permeability. pH is slightly acidic to neutral.. Available water-holding capacity ranges from 5.7 to 7.9 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly xeric and the soil temperature regime is cryic. Precipitation ranges from 22 to 26 inches annually.

Associated sites

R047XA516UT	**High Mountain Loam (mountain big sagebrush)**

Similar sites

R047XA528UT	**High Mountain Stony Clay (slender wheatgrass)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Wyethia amplexicaulis*

Physiographic features

This site is found on valley sides and mountain slopes. It occurs at elevations between 5,600 and 7,500 feet. Slopes on this site are gentle to moderate.

Table 2. Representative physiographic features

Landforms	(1) Valley side (2) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	5,600–7,500 ft
Slope	6–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this site characterized by cold, snowy winters and cool summers. The average annual precipitation ranges from 22 to 26 inches. October thru April, are typically the wettest months with June thru August being the driest. The most reliable sources of moisture for plant growth are the snow that accumulates over the winter and spring rains. Summer thunderstorms are intermittent and sporadic in nature, and thus, are less reliable sources of moisture to support vegetative growth on this site.

Table 3. Representative climatic features

Frost-free period (characteristic range)	80-100 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	22-26 in

Influencing water features

This site is not influenced by water from a wetland or stream.

Wetland description

N/A

Soil features

The soils of this site formed mostly in colluvium and residuum from sandstone and shale. Surface soils are loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have very slow to moderately slow permeability. pH is slightly acidic to neutral. Available water-holding capacity ranges from 5.7 to 7.9 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly xeric and the soil temperature regime is cryic. Precipitation ranges from 22 to 26 inches annually.

Table 4. Representative soil features

Parent material	(1) Colluvium–sandstone and shale (2) Residuum–sandstone and shale
Surface texture	(1) Loam
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	60 in
Soil depth	60 in
Surface fragment cover <=3"	13%
Available water capacity (0-40in)	5.7–7.9 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (0-40in)	13%
Subsurface fragment volume >3" (0-40in)	0%

Ecological dynamics

It is impossible to determine in any quantitative detail the Historic Climax Plant Community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area (Galatowitsch 1990). However, up to the 1870s the Shoshone Indians, prevalent in northern Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long (Parson 1996). Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

The plant communities shown in this State and Transition Model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range and Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

State 1: Reference State
The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information and familiarity with rangeland relict areas where they exist. The least modified plant community would have been co-dominated by a mixture of grass and forb species (1.1), with slender wheatgrass (*Elymus trachycaulus*) and mule-ears (*Wyethia amplexicaulis*) as the primary species. A more complete list of species by lifeform for the Reference State is available in accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this ESD document.

Community Phase 1.1: co-dominant grass-forb mixture/ scattered snowberry & other low shrubs
This plant community would have been characterized by a co-dominance of grass and forb species. Grasses would have included slender wheatgrass, mountain brome (*Bromus marginatus*), basin wildrye (*Leymus cinereus*), sheep fescue (*Festuca ovina*), Columbia needlegrass (*Achnatherum nelsonii*), and Letterman's needlegrass (*Achnatherum lettermanii*). Forb species would have included mule-ears, silvery lupine (*Lupinus argenteus*), showy goldeneye (*Heliomeris multiflora*), and western mountain aster (*Symphyotrichum spathulatum*) among others. Mountain snowberry (*Symphoricarpos oreophilus*) and low sagebrush (*Artemisia arbuscula*) would also have been scattered throughout the site.

Transition T1a: (State 1 to State 2)
The simultaneous introduction of exotic species, both plants and animals, possible extinctions of native flora and fauna, climate change, the advent of heavy continuous season long livestock grazing, and fire prevention has caused State 1 to transition to State 2. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

State 2: Shrub Steppe State
State 2 is a description of the ecological site shortly following Euro-American settlement, which has been influenced by the introduction of several non-native plants and animals, possible extinctions of native species, and a different climate. Historic heavy continuous season long grazing by livestock and the prevention of wildfire also had a major impact on these sites creating a shrub steppe which should now be considered the present potential. Unpalatable species such as mule-ears and native woody species such as mountain snowberry, silver sagebrush (*Artemisia cana*), and low sagebrush increased while the palatable herbaceous species diminished.

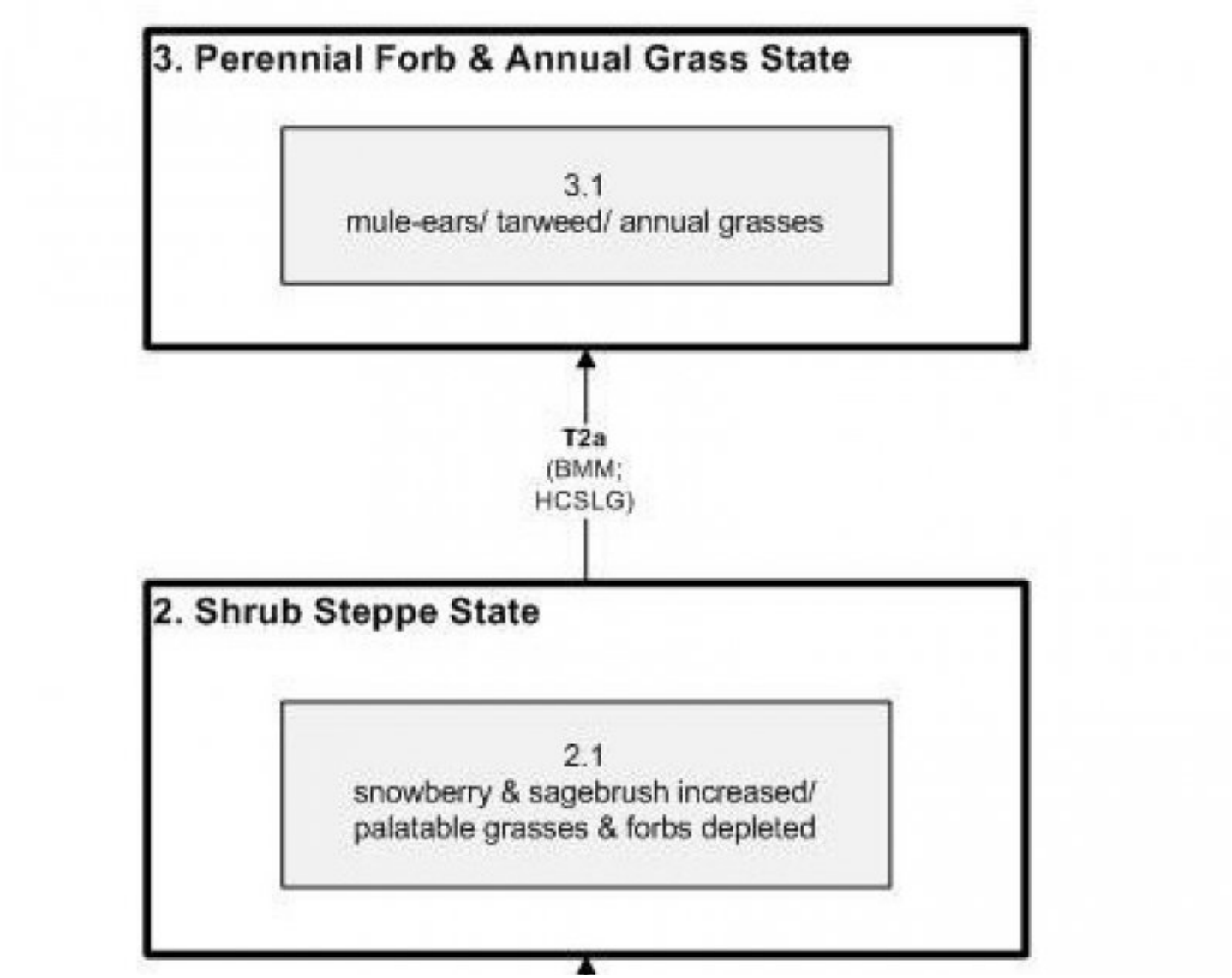
Community Phase 2.1: snowberry & sagebrush increased/ palatable grasses & forbs depleted
This plant community is characterized by a relative increase in native woody species such as snowberry, low sagebrush, and silver sagebrush and unpalatable forbs, particularly mule-ears.

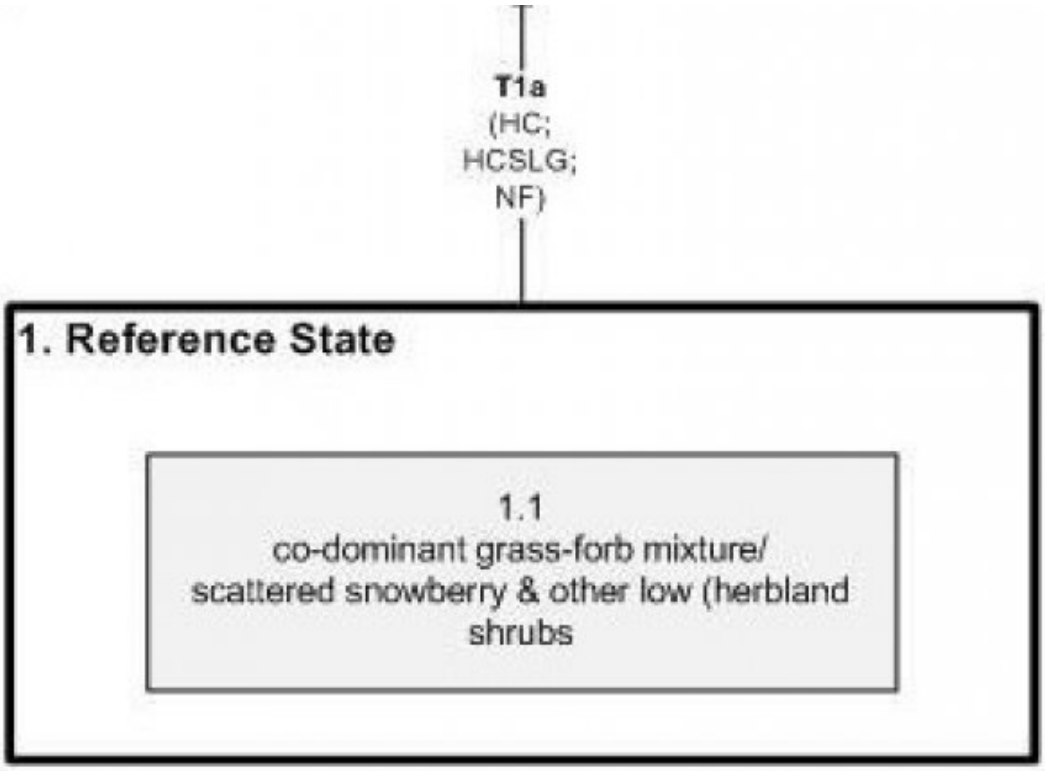
Transition T2a: (State 2 to State 3)
Mechanical disturbance of woody species and continued heavy livestock grazing during the growing season of grasses will cause a transition from State 2 to a perennial forb and annual grass-dominated state (State 3). The churning clay soils naturally favor herbs over woody species, thus shrubs are a temporary occupier of such sites. However both the mechanical and herbivory of interzonal grazing can trigger the shrubs which are moderately palatable, especially to sheep. Mule-ears is however, unpalatable to all animals and its massive root structure allows it to prevail under all treatments except deep plowing and/or herbicides. Reducing livestock grazing has little effect on reducing its competitive hold. The only potential restoration pathway requires massive tillage with subsequent herbicide and re-seeding efforts to convert these sites to perennial grasslands.

State 3: Perennial Forb & Annual Grass State
With continued impacts from heavy livestock grazing and mechanical, herbicidal, or fire removal of native shrubs, the native grass component will markedly decrease or be absent, shrubs will also be reduced to absence, but perennial forbs and annual grasses such as mule-ears, tarweed , (*Madia glomerata*) and cheatgrass (*Bromus tectorum*) will increase.

Community Phase 3.1: mule-ears/ tarweed/ annual grasses
This plant community is characterized by a suite of very grazing-tolerant herbaceous species such as mule-ears, tarweed, and cheatgrass.

State and transition model





BMM	Brush Management Mechanical
HC	Historic Change
HCSLG	Heavy Continuous Season Long Grazing
NF	No Fire

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used.

Other references

Galatowitsch, S.M. 1990. Using the original land survey notes to reconstruct pre-settlement landscapes in the American West. Great Basin Naturalist: 50(2): 181-191. Keywords: [Western U.S., conservation, history, human impact]
Parson, R. E. 1996. A History of Rich County. Utah State Historical Society, County Commission, Rich County, Utah. Keywords: [Rich County, Utah, Historic land use, European settlements]
USDA-NRCS. 2003. National Range and Pasture Handbook. in USDA, editor, USDA-Natural Resources Conservation Service-Grazing Lands Technology Institute. Keywords: [Western US, Federal guidelines, Range pasture management]

Contributors

Tim Watson, David J. Somerville
M. Dean Stacy

Approval

Kendra Moseley, 2/05/2025

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)	V. Keith Wadman (NRCS ret.), Shane A. Green (NRCS)
Contact for lead author	shane.green@ut.usda.gov
Date	06/26/2004
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Very minor rill development in exposed areas. Any rills present should be short on flatter slopes but may become longer (3 to 6 feet) as slope steepens. They should be somewhat widely spaced (4 to 8 feet), and follow the surface micro-features. Old rills should be weathered and muted in appearance. Surface cracking should not be mistaken for rills.

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2. **Presence of water flow patterns:** Flow patterns wind around perennial plant bases and show minor evidence of erosion. They are somewhat short and stable and there is only minor evidence of deposition. Evidence of flow will increase somewhat with slope. Some surface cracking may be evident during dry periods.

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3. **Number and height of erosional pedestals or terracettes:** None. Some minor frost heaving could be evident but should not be mistaken for pedestialing.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 30-40%

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5. **Number of gullies and erosion associated with gullies:** Very rare. Gullies should show only minor signs of active erosion and should be mostly stabilized with vegetation. Gullies may show slightly more indication of erosion as slope steepens.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind caused blowouts and deposition are not present.

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

caused by water. Some litter removal may occur in flow channels with deposition occurring at points of obstruction. Litter movement will increase with slope.

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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):**): 80 to 90% of this site should have an erosion rating of 5 or 6. 10 to 20% may have a rating of 4 to 5.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface varies from 3 to 4 inches. Structure is typically fine granular. Color is typically very dark brown (10YR2/2).

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** When perennial grasses decrease, reducing ground cover and increasing bare ground, runoff will increase and infiltration will be reduced.

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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):** None. Some soils have an increase in clay content at about 20 inches that could be mistaken for a compaction layer.

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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: Perennial bunchgrasses, large perennial forbs, > sprouting shrubs, xeric perennial forbs > invaders such as Tarweed, Coneflower & Annual forbs. Dominants: Slender wheatgrass, Mountain brome, Sheep fescue

    Sub-dominant: Prairie junegrass, Northern mulesears, Bitterbrush.

    Other: The perennial bunchgrass/large perennial forb functioning group is expected on this site.

    Additional: Assumed fire cycle of 40-60 years.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses forbs should be present. Slight decadence in the principle shrubs could occur near the end of the fire cycle.

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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):** 1800-1900 lbs/ac

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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: Northern mulesears, snowberry, Kentucky bluegrass & Xeric perennial forbs.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years.
