USDA Natural Resources
Conservation Service

Ecological site R007XY001WA
Very Shallow

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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): 007X–Columbia Basin

This MLRA is in the Walla Walla Plateau section of the Columbia Plateaus province of the Intermontane Plateaus. The Columbia River flows through this MLRA, and the Snake and Yakima Rivers join the Columbia River within it. This MLRA is almost entirely underlain by Miocene basalt flows. Columbia River Basalt is covered in most areas with as much as 200 feet of eolian, lacustrine, and alluvial deposits. The dominant soil orders in this MLRA are Aridisols and Entisols. The soils in the area dominantly have a mesic temperature regime, an aridic moisture regime, and mixed mineralogy. They generally are moderately deep to very deep and well drained to excessively drained.

Classification relationships

Major Land Resource Area (MLRA): 007X – Columbia Basin

LRU – Common Resource Areas (CRA):
7.1 – Sandy Missoula Flood Deposits
7.2 – Silty Missoula Flood Deposits
7.3 – Dry Loess Islands
7.4 – Dry Yakima Folds
7.5 – Yakima Valley – Pleistocene Lake Basins

Ecological site concept

Diagnostics:
Very Shallow is a sparsely vegetated, low shrub-short grass, upland site on lithosols (very shallow soils generally less than 8 inches deep). Very Shallow sites are often found on windswept ridges and adjacent to exposed rocky ledges. Daubenmire writes that there appears to be no regular difference in either soils or vegetation between lithosols produced by glaciofluvial erosion or those or ridges where only wind and rain could have kept the basalt exposed.

Generally, there are sharp lines on the landscape between Very Shallow and the adjacent ecological site. One can stand with one foot on Very Shallow and the other foot on Stony or some other ecological site.

Occasionally the edge of very shallow is not so abrupt. This has been witnessed several times – less than 8 inches of soil depth has classic very shallow species, while 8to 13 inches is a narrow band of Thurber needlegrass, and greater than 13 inches soil depth is a bluebunch wheatgrass site.

Usually, there are abundant rock and soil biotic crust cover, in the interspaces between plants. The lichen and moss play a critical role in water infiltration and resistance to erosion. On some but not all Very Shallow sites, are a few micro-pockets of taller vegetation in association with bedrock fracturing.

The most common reference community is stiff sagebrush-Sandberg bluegrass. Sandberg bluegrass is the short grass in all instances, but the low shrub component is variable. Stiff sagebrush is the predominant low shrub, but one to several different eriogonum species are present on some sites, instead of, or with stiff sagebrush. While there are minor ecological differences between these low shrubs, they are considered functionally equivalent for the purposes of this ecological site. These low shrubs have been combined into one site for several reasons: (1) the co-dominant short grass is Sandberg bluegrass in all cases, (2) Very Shallow has low plant productivity and extreme site limitations. (3) it is common to find three or more of these low shrub species on the same site, and (4) the hydrologic and watershed characteristics is similar regardless of low shrub.

According to Daubenmire, scabland sagebrush, locally known as stiff sagebrush, occurs on basalts with highly fractured parent material. Eriogonums occupy various parent materials and may dominate on gravelly soils and granitic parent materials.

Principle Vegetative Drivers:
The very shallow soil depth and the fracturing of, or the lack of fracturing in the underlying basalt bedrock drive the vegetative expression of this site. Deep-rooted steppe species do not grow on Very Shallow ecological site because of soil depth limitations. The fracture system accounts for variation in the low shrub component and the occasional mid-stature bunchgrass such as bluebunch wheatgrass or Thurber needlegrass

Edaphic:
The Very Shallow ecological site commonly occurs with rock outcrop, Loamy, and Stony ecological sites. Typical soil surface has about 40 percent rock, 10 to 20 percent bare ground, 10 to 20 percent biotic crust and 30 percent vegetative cover. Sites with less than 10 percent vegetative cover can be considered rock outcrop.

Very Shallow ecological site is sensitive to soil disturbances. When the Very Shallow ecological site is saturated and muddy, physical damage to the site, from vehicle ruts and hoof prints from cows, horses or deer for example, remain intact for many years.

Rocks or plants sitting on pedestals is called pedestaling. Two completely different processes cause the pedestaling. The first process is frost-heaving which pushes the plants upward and is evident across the entire site. The lower part of the soil profile has higher clay content. With winter rain and melting snow, water perches and creates saturated conditions. Freezing weather causes these saturated soils to frost-heave, and then during spring thaw, the site becomes muddy. The second pedestaling process is erosion which washes soil away from plants and rocks but only in water flow patterns.

The degree of pedestaling on the Very Shallow ecological site is quite variable. On many sites the soil surface is smooth and shows little to no evidence of pedestaling. But other sites show a high degree of pedestaling. The difference is presumed to be the amount of clay in the soil and the shrink-swell potential. In some years water runs on the surface and some erosion may occur.

If a site has a high degree pedestaling, the observer must determine whether this process is natural or human-induced (water running off cropland onto the rangeland for example).

Associated sites

R007XY163WA	**Dry Loamy**
R007XY114WA	**Shallow Stony Sand**
R007XY130WA	**Loamy**

Similar sites

R006XY001WA	**Very shallow**
R008XY001WA	**Very shallow**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia rigida*
Herbaceous	(1) *Poa secunda*

Physiographic features

The landscape is part of the Columbia basalt plateau. Very shallow sites occur on ridgetops, shoulders, benches, mesas, and hillslopes.

Geology:
This is almost entirely underlain by Miocene basalt flows. Columbia River basalt is covered in most areas with as much as 200 feet of eolian, lacustrine, and alluvial deposits. This basin generally corresponds to the vast temporary lakes created by floodwaters from glacial Lakes Missoula and Columbia. Most of the fluvial and lacustrine sediments were deposited about 16,000 years ago, when an ice dam on the ancient Columbia River burst and when glacial Lake Missoula periodically emptied, creating catastrophic floods.

Table 2. Representative physiographic features

Landforms	(1) Hills > Hillslope (2) Plateaus or tablelands > Structural bench (3) Hills > Ridge
Elevation	500–2,000 ft
Slope	2–30%
Water table depth	60 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Elevation	500–2,300 ft
Slope	0–60%
Water table depth	Not specified

Climatic features

MLRA 7 is the lowest, driest and hottest portions of the entire Columbia River region and the sagebrush-bluebunch wheatgrass zone.

The climate across MLRA 7 is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to the rain shadow effect of the Cascades. The average annual precipitation is mostly between 4 and 9 inches. Seventy to seventy-five percent of the precipitation comes late October through March as a mixture of rain and snow. Precipitation that comes after March is not as effective for plant growth. June through early October is dry. Freezing temperatures generally occur from late-October through early-April. Temperature extremes are -10 degrees Fahrenheit in winter and 110 degrees Fahrenheit in summer. Winter fog is variable and often quite localized, as the fog settles on some areas but not others.

Soil moisture regime is aridic. Soil temperature regime is mesic.

Table 4. Representative climatic features

Frost-free period (characteristic range)	150-180 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	6-10 in
Frost-free period (actual range)	135-210 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

The lower part of the soil profile of very shallow has high clay content. With winter rain and melting snow, water perches and creates saturated conditions.

In wet years during spring runoff, water runs on the surface of very shallow sites for a short period. Even more water runs beneath the surface to sites below. This increases the effective precipitation to the adjacent sites below.

Wetland description

N/A

Soil features

This ecological site components are dominantly Xeric and Lithic taxonomic subgroup of Haplargids and Torriorthents great groups of the Aridisols and Entisols taxonomic orders. Soils are dominantly very shallow. Average available water capacity of about 0.8 inches (2.0 cm) in the 0 to 40 inches (0 to 100 cm) depth range.

The associated soils are Nevo, Schawana and similar soils.

Saturated Hydraulic Conductivity Class:
0 to 10 inches: Moderately high and high
10 to 20 inches: Moderately high and high

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium
Surface texture	(1) Loamy fine sand (2) Very cobbly loam
Family particle size	(1) Loamy (2) Loamy-skeletal
Drainage class	Well drained to somewhat excessively drained
Depth to restrictive layer	5–15 in
Soil depth	Not specified
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	0.4–1.5 in
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Soil reaction (1:1 water) (0-20in)	6.6–7.8

Subsurface fragment volume <=3" (Depth not specified)	0–40%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Depth to restrictive layer	Not specified
Soil depth	20 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified
Electrical conductivity (Depth not specified)	Not specified
Soil reaction (1:1 water) (0-20in)	Not specified
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

Vegetation Dynamics:
Very Shallow produces about 75 to 200 pounds per acre of biomass annually.

The Very Shallow ecological site in MLRA 7 has at least four different variations on the low shrub-short grass theme for the Reference Community. Sandberg bluegrass is co-dominant in every variation:
1. Scabland sagebrush – Sandberg bluegrass
2. Scabland sagebrush / thymeleaf buckwheat / rock buckwheat – Sandberg bluegrass
3. Thymeleaf buckwheat – Sandberg bluegrass
4. Narrowleaf goldenweed (Stenotus s.) – Sandberg bluegrass

In the spring this site has a rich diversity of native annual and perennial forbs on most sites. Very Shallow ecological site supports edible species that have been an important food source for the Native Americans for many generations. Bitterroot and biscuitroot are the main species harvested for food.

Sandberg bluegrass is a shallow rooted, perennial bunchgrass, perfectly suited to Very Shallow sites. It has short leaves and a green to purplish panicle seed head. On most sites Sandberg is an understory grass, but on the Very Shallow ecological site it is the dominant grass. It begins growth in the fall then grows rapidly in the spring and sets seed before moisture is gone. Sandberg bluegrass is resistant to drought, grazing, trampling and fire.

In most years many bunchgrasses remain dormant in the fall. Sandberg bluegrass, however, greens up every year. And so, from late fall through winter and into early spring these Very Shallow ecological sites provide important green forage for deer, elk and upland birds. But these sites also dry up sooner than adjoining sites due to the very shallow soil depth. Grasses are dry from May through September.

Scabland sagebrush, locally known as stiff sagebrush, is low mounding and strongly scented with the characteristic sage odor. It is low and spreading with a conspicuously woody base. The base is often heaved from the soil by frost action. The trunk is very irregular, spreading above the base in a dense cluster of short, rigid, and rather brittle branches up to sixteen inches in length. Scabland sagebrush leaves are forked into three deep lobes like fingers. Unlike other sagebrush species, the leaves of scabland sagebrush are deciduous, and by fall, all the leaves have dropped. The ground under each plant will have a pile of dead leaves.

Fire: The vegetative cover is too low to carry fires, so these sites rarely burn
Grazing: In many pastures the Very Shallow ecological sites are not attractive to grazing animals and so are rarely if ever grazed.
Based on inherent protection from both fire and grazing, most Very Shallow ecological sites are stable and in excellent condition.

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.

State and Transition Diagram: Very Shallow

This state and transition model (STM), explains the general ecological dynamics for the Very Shallow ecological site. The STM illustrates the common plant communities that can occur on the site. Boxes around each state represent the ecological threshold, which if crossed, is not reversible without human intervention. Arrows within a state represent the pathway between plant communities, while the arrows between states represent the transition or recovery between the states. Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions.

Reference State for Very Shallow Ecological Site

State 1 Narrative:
The Reference State represents non-invaded communities composed of native species. Invasive annual grasses are not present. Very Shallow ecological sites rarely burn, and in most cases, receives minimal grazing. This ecological site is the most stable ecological site on the landscape.

Reference Community 1.1 is the classic Very Shallow, dominated by Sandberg bluegrass with one or more low shrub species. The low shrub component may be scabland sagebrush and one or more Eriogonum low shrub species. Community 1.1 is mostly very stable. remaining in State 1 regardless of climate or management. Similarity Index scores are typically higher on Very Shallow than other ecological sites on the landscape.

Community 1.2 represents the degraded phase which is quite rare in MLRA 7. The species are native, but Sandberg bluegrass has a diminished presence and forbs are more prominent. Community 1.2 still has enough Sandberg bluegrass present, to shift back to reference community 1.1, given the right conditions,

Reference State Community Phases:
1.1 Reference Sandberg bluegrass – low shrub
1.2 Forb – low shrub Native forbs – low shrub

Dominant Reference State Species:
Sandberg bluegrass and scabland sagebrush and other low shrub Eriogonum species

At-risk Communities:
• All communities in the reference state are at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually
• Community 1.1 has a high Sandberg bluegrass cover and is thus, at low risk of moving to State 2, Forb-Annual Grass
• Community 1.2 has low amount of Sandberg bluegrass cover and a high amount of forb cover, and is at considerable risk of moving to State 2

Reference Community 1.1 for Very Shallow:
Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions.

Similarity Index Similarity Index
Dominant Low Shrub/Half Shrub
25% 50 lbs.

ARRI2 stiff sagebrush
ERTH4 thymeleaf buckwheat
ERSP7 rock buckwheat

Other Shrubs / Half Shrubs
2% 4 lbs.

SADOI purple sage
PUTR2 antelope bitterbrush
ERDO Douglas buckwheat
ERHE2 Wyeth buckwheat
ERIOG buckwheat

Dominant Short Grass

POSE Sandberg bluegrass 55% 110 lbs.

Mid-Grasses 3% 6 lbs.

ELEL5 bottlebrush squirreltail
ACTH7 Thurber needlegrass
PSSP6 bluebunch wheatgrass

Annual Grass

VUOC sixweeks fescue 1% 2 lbs.

Most Common Forbs 10% 20 lbs.

NEST5 narrowleaf goldenweed
PHHO spiny phlox
PHLOX phlox
L1PU11 granite gilia
LOMAT lomatium / biscuitroot
BAHO Hooker balsamroot
VITR3 sagebrush violet
ERIGE2 fleabane

Other Forbs 5% 10 lbs.

ERNI2 snow buckwheat
ASPU9 woollypod locoweed
PENI pediocactus
PENST penstemon
NOTR2 weevil microseris
EPILO willow herb
ALLIU wild onion
LERE7 bitterroot

Below Normal Above
Estimated Production (pounds / acre) 75 150 200

1.1a Result: Shift from Reference Community (low shrub – short grass) to Community 1.2 (forb – low shrub). Sandberg bluegrass has been much reduced but remains in the community. The native forb component has increased. There may be a few invasive forbs.

Primary Trigger: heavy spring grazing pressure (heavy to severe grazing intensity) to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses.

Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and mortality. Grass roots begin to die, and this opens the soil for native forbs to increase via seedlings. The hoof action by large ungulates can disturb the soil surface enough to make them vulnerable to annual grass and forb invasion.

Indicators: decreasing Sandberg bluegrass cover and increasing cover of native forbs.

1.2a Result: Shift from forb – low shrub community back to the Reference Community.
Sandberg bluegrass reestablishes dominance over the native annual forb component as it exerts competitive advantage for resources and space. So, Sandberg bluegrass displaces the forbs to become co-dominant with the low shrub component.

Primary Trigger: Defoliation pressures are removed, allowing Sandberg bluegrass to recover and reestablish dominance over the forb component.

Ecological process: With reduced grazing pressure Sandberg bluegrass experiences increased plant vigor and root production, expanding its size and competitive abilities through seedlings and tillering. Soils stabilize with the removal of the hoof action and increased volume of roots.

Indicators: decreased forb cover and increased cover of Sandberg bluegrass.

State 2: Forbs &/or Annual Grass

State 2 Narrative:
This state represents the ecological changes that occur when there is a shift from dominance by perennial native grasses to forbs or annual grass dominance in the herbaceous layer. The shrub components generally remain in the overstory.

Most Very Shallow sites never cross the threshold into State 2 as they are not attractive to grazing animals and rarely burn (limited forage values and surface rocks). The exception being chronic heavy grazing in the spring from migrating elk, feral horses or livestock. As the cover of Sandberg bluegrass significantly declines the site becomes open to invasion by invasive annuals, however.

Invasive annual grasses, which are common & frequently dominant on adjacent Loamy ecological sites, do not often compete as well on Very Shallow sites. However, the cheatgrass seed blows onto Very Shallow sites annually and can become a minor component. In a year with heavy snowfall and early spring rain, such as 2017, the site had far more moisture that the plant community could utilize. This is the perfect opportunity for cheatgrass seed, which is capable of rapid germination and growth to establish in significant amounts across the site. In following years when moisture is normal or below normal, native species will utilize most of the available moisture and cheatgrass seed will not germinate or make viable plants. Therefore, in most cases, these micro-bursts of cheatgrass tend to be episodic and mostly a temporary condition on Very Shallow sites.

A reduction to Sandberg bluegrass cover allows annual grasses the opportunity to colonize and invade on a more permanent basis. Heavy grazing use disrupts the soil surface and the moss-lichen layer via animal hooves, which in turn, causes loss of both soil structure and biological crust. When this happens site resistance to erosional forces are greatly diminished as well.

State 2 may exhibit either a significant decrease in pedestaling due to the lack of bunchgrass cover and heavy use trampling by ungulates, or there will be a significant increase in pedestaling due to increased erosion from water flows around the remaining bunchgrasses.

Community Phases for State 2:

Community Phase 2.1: dominated by native forbs and invasive annual grasses. Forbs which increase in the altered conditions and are competitive with invasive grasses, can include lomatium, fleabane, willow herb, yarrow and onion. Typical invasive grasses may include annual bromes, medusahead and sixweeks fescue.

Transitions
T1 Result: Shift from Reference Community Phase 1.1 to Sate 2 Community Phase 2.1, resulting in the shift in functional groups to forbs and non-native annual grass dominance.

Primary Trigger: Extensive spring grazing with heavy use to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses.

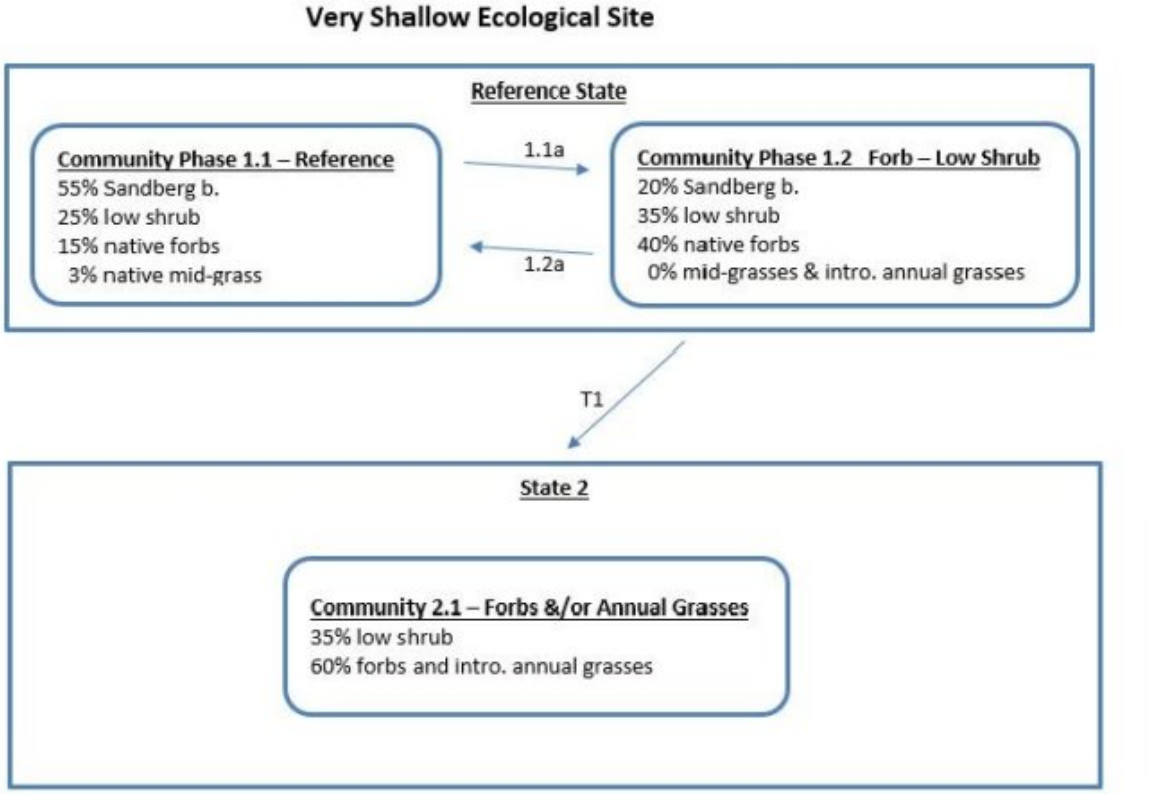
Secondary Trippers: a micro-burst of cheatgrass could put Community 1.2 at risk. The trampling of very shallow soils, displacing and disturbing the surface soil structure by grazing animals could also trigger transition to State 2. A micro-burst of annual grasses could allow even pristine sites to be invaded. Community 1.2 is the community most at risk and is also the pathway for crossing the threshold from State 1 to State 2.

Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and plant mortality. Most or all Sandberg bluegrass plants are lost from the community, and this allows native forbs to increase and invasive annuals (forbs and grasses) to colonize and expand. This facilitates plant community changes from Community 1.2 to Community 2.1.

Indicators: Declining vigor and cover of Sandberg bluegrass, declining soil biotic crust and, increasing gaps between perennial bunchgrasses.

No Recovery
State 2 is considered non-reversible. Restoration of Sandberg bluegrass, the low shrub component, native forbs and the soil biotic crust would be extremely difficult, labor intensive and costly. Seedlings and plugged plants need soil moisture and time to germinate and become established. In most years, seeds and plugs may not have a chance as site conditions on the Very Shallow ecological site can change quickly and the non-native species are much more adaptable under these conditions. Drying winds and bright sun can turn a snowy or muddy site into a hard crust before plants are established. Timing of all recovery efforts would have an extremely narrow window of opportunity on these altered sites.

State and transition model



State 1
Reference

The Reference state represents non-invaded communities composed of native species. Invasive annual grasses are not present. Very Shallow ecological sites rarely burn, and in most cases, receives minimal grazing. This ecological site is the most stable ecological site on the landscape. Reference Community 1.1 is the classic Very Shallow, dominated by Sandberg bluegrass with one or more low shrub species. The low shrub component may be scabland sagebrush and one or more Eriogonum low shrub species. Community 1.1 is mostly very stable. remaining in State 1 regardless of climate or management. Similarity Index scores are typically higher on Very Shallow than other ecological sites on the landscape. Community 1.2 represents the degraded phase which is quite rare in MLRA 7. The species are native, but Sandberg bluegrass has a diminished presence and forbs are more prominent. Community 1.2 still has enough Sandberg bluegrass present, to shift back to reference community 1.1, given the right conditions, Reference State Community Phases: 1.1 Reference Sandberg bluegrass – low shrub 1.2 Forb – low shrub Native forbs – low shrub Dominant Reference State Species: Sandberg bluegrass and scabland sagebrush and other low shrub Eriogonum species At-risk Communities: • All communities in the reference state are at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually • Community 1.1 has a high Sandberg bluegrass cover and is thus, at low risk of moving to State 2, Forb-Annual Grass • Community 1.2 has low amount of Sandberg bluegrass cover and a high amount of forb cover, and is at considerable risk of moving to State 2

Community 1.1
Sandberg Bluegrass and Low Shrubs

Community 1.1 is the classic Very Shallow, dominated by Sandberg bluegrass with one or more low shrub species.

The low shrub component may be scabland sagebrush and one or more Eriogonum low shrub species. Community 1.1 is mostly very stable. remaining in State 1 regardless of climate or management. Similarity Index scores are typically higher on Very Shallow than other ecological sites on the landscape.

Community 1.2
Degraded Native Forbs and Low Shrubs

Community 1.2 represents the degraded phase which is quite rare in MLRA 7. The species are native, but Sandberg bluegrass has a diminished presence and forbs are more prominent. Community 1.2 still has enough Sandberg bluegrass present, to shift back to reference community 1.1, given the right conditions.

Pathway 1.1A
Community 1.1 to 1.2

Result: Shift from Reference Community (low shrub – short grass) to Community 1.2 (forb – low shrub). Sandberg bluegrass has been much reduced but remains in the community. The native forb component has increased. There may be a few invasive forbs. Primary Trigger: heavy spring grazing pressure (heavy to severe grazing intensity) to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses. Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and mortality. Grass roots begin to die, and this opens the soil for native forbs to increase via seedlings. The hoof action by large ungulates can disturb the soil surface enough to make them vulnerable to annual grass and forb invasion. Indicators: decreasing Sandberg bluegrass cover and increasing cover of native forbs.

Pathway 1.2A
Community 1.2 to 1.1

Result: Shift from forb – low shrub community back to the Reference Community. Sandberg bluegrass reestablishes dominance over the native annual forb component as it exerts competitive advantage for resources and space. So, Sandberg bluegrass displaces the forbs to become co-dominant with the low shrub component. Primary Trigger: Defoliation pressures are removed, allowing Sandberg bluegrass to recover and re-establish dominance over the forb component. Ecological process: With reduced grazing pressure Sandberg bluegrass experiences increased plant vigor and root production, expanding its size and competitive abilities through seedlings and tillering. Soils stabilize with the removal of the hoof action and increased volume of roots. Indicators: decreased forb cover and increased cover of Sandberg bluegrass.

State 2
Forbs and Annual Grass

This state represents the ecological changes that occur when there is a shift from dominance by perennial native grasses to forbs or annual grass dominance in the herbaceous layer. The shrub components generally remain in the overstory. Most Very Shallow sites never cross the threshold into State 2 as they are not attractive to grazing animals and rarely burn (limited forage values and surface rocks). The exception being chronic heavy grazing in the spring from migrating elk, feral horses or livestock. As the cover of Sandberg bluegrass significantly declines the site becomes open to invasion by invasive annuals, however. Invasive annual grasses, which are common & frequently dominant on adjacent Loamy ecological sites, do not often compete as well on Very Shallow sites. However, the cheatgrass seed blows onto Very Shallow sites annually and can become a minor component. In a year with heavy snowfall and early spring rain, such as 2017, the site had far more moisture that the plant community could utilize. This is the perfect opportunity for cheatgrass seed, which is capable of rapid germination and growth to establish in significant amounts across the site. In following years when moisture is normal or below normal, native species will utilize most of the available moisture and cheatgrass seed will not germinate or make viable plants. Therefore, in most cases, these micro-bursts of cheatgrass tend to be episodic and mostly a temporary condition on Very Shallow sites. A reduction to Sandberg bluegrass cover allows annual grasses the opportunity to colonize and invade on a more permanent basis. Heavy grazing use disrupts the soil surface and the moss-lichen layer via animal hooves, which in turn, causes loss of both soil structure and biological crust. When this happens site resistance to erosional forces are greatly diminished as well. State 2 may exhibit either a significant decrease in pedestaling due to the lack of bunchgrass cover and heavy use trampling by ungulates, or there will be a significant increase in pedestaling due to increased erosion from water flows around the remaining bunchgrasses.

Community Phases for State 2: Community Phase 2.1: dominated by native forbs and invasive annual grasses. Forbs which increase in the altered conditions and are competitive with invasive grasses, can include lomatium, fleabane, willow herb, yarrow and onion. Typical invasive grasses may include annual bromes, medusahead and sixweeks fescue. No Recovery State 2 is considered non-reversible. Restoration of Sandberg bluegrass, the low shrub component, native forbs and the soil biotic crust would be extremely difficult, labor intensive and costly. Seedlings and plugged plants need soil moisture and time to germinate and become established. In most years, seeds and plugs may not have a chance as site conditions on the Very Shallow ecological site can change quickly and the non-native species are much more adaptable under these conditions. Drying winds and bright sun can turn a snowy or muddy site into a hard crust before plants are established. Timing of all recovery efforts would have an extremely narrow window of opportunity on these altered sites.

Community 2.1
Forbs and Annual Grasses

25% low shrubs 60% forbs and introduced annual grasses

Transition T1A
State 1 to 2

Result: Shift from community 1.1 to sate 2 community 2.1, resulting in the shift in functional groups to forbs and non-native annual grass dominance. Primary Trigger: Extensive spring grazing with heavy use to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses. Secondary Trippers: a micro-burst of cheatgrass could put Community 1.2 at risk. The trampling of very shallow soils, displacing and disturbing the surface soil structure by grazing animals could also trigger transition to State 2. A micro-burst of annual grasses could allow even pristine sites to be invaded. Community 1.2 is the community most at risk and is also the pathway for crossing the threshold from State 1 to State 2. Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and plant mortality. Most or all Sandberg bluegrass plants are lost from the community, and this allows native forbs to increase and invasive annuals (forbs and grasses) to colonize and expand. This facilitates plant community changes from Community 1.2 to Community 2.1. Indicators: Declining vigor and cover of Sandberg bluegrass, declining soil biotic crust and, increasing gaps between perennial bunchgrasses.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Dominant Low Shrubs**			50	
	scabland sagebrush	ARRI2	*Artemisia rigida*	–	–
	thymeleaf buckwheat	ERTH4	*Eriogonum thymoides*	–	–
	rock buckwheat	ERSP7	*Eriogonum sphaerocephalum*	–	–
2	**Other Low Shrubs - Minor**			5	
	purple sage	SADOI	*Salvia dorrii ssp. dorrii var. incana*	–	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	–	–
	Douglas' buckwheat	ERDO	*Eriogonum douglasii*	–	–
	parsnipflower buckwheat	ERHE2	*Eriogonum heracleoides*	–	–
Grass/Grasslike					
3	**Mid-Size Bunchgrasses - Minor**			5	
	squirreltail	ELEL5	*Elymus elymoides*	–	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	–	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	–	–
4	**Dominant Short Grass**			110	
	Sandberg bluegrass	POSE	*Poa secunda*	–	–
5	**Annual Grass - Trace**			0	
	sixweeks fescue	VUOC	*Vulpia octoflora*	–	–
Forb					
6	**Native Forbs - Subdominant**			30	
	narrowleaf mock goldenweed	NEST5	*Nestotus stenophyllus*	–	–
	spiny phlox	PHHO	*Phlox hoodii*	–	–
	phlox	PHLOX	*Phlox*	–	–
	granite prickly phlox	LIPU11	*Linanthus pungens*	–	–
	desertparsley	LOMAT	*Lomatium*	–	–
	Hooker's balsamroot	BAHO	*Balsamorhiza hookeri*	–	–
	sagebrush violet	VIVA	*Viola vallicola*	–	–
	fleabane	ERIGE2	*Erigeron*	–	–
	buckwheat	ERIOG	*Eriogonum*	–	–
	snow buckwheat	ERNI2	*Eriogonum niveum*	–	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	–	–
	snowball cactus	PENI5	*Pediocactus nigrispinus*	–	–
	beardtongue	PENST	*Penstemon*	–	–
	sagebrush false dandelion	NOTR2	*Nothocalais troximoides*	–	–
	willowherb	EPILO	*Epilobium*	–	–
	onion	ALLIU	*Allium*	–	–
	bitter root	LERE7	*Lewisia rediviva*	–	–

Inventory data references

Data to populate Reference Community came from several sources: (1) NRCS ecological sites from 2004, (2) Soil Conservation Service range sites from 1980s and 1990s, (3) Daubenmire's habitat types, and (4) ecological systems from Natural Heritage Program.

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Approval

Kirt Walstad, 2/06/2025

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)	

Contact for lead author	
Date	02/06/2025
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):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:**
