

## Ecological site R048AY449UT Mountain Stony Loam (Black sagebrush)

Last updated: 3/01/2024  
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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.

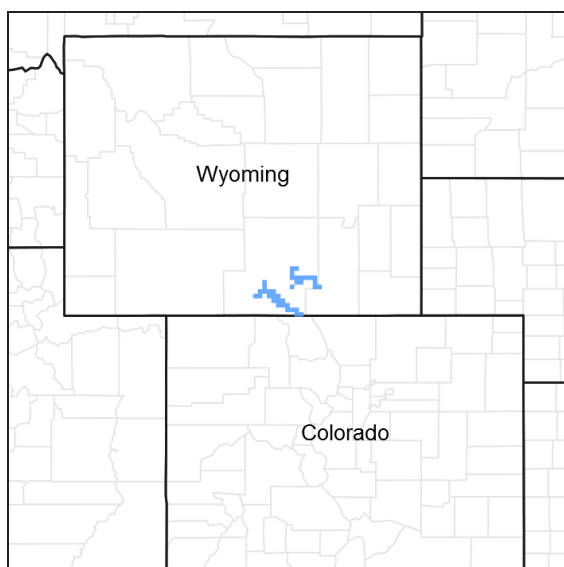


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

### MLRA notes

Major Land Resource Area (MLRA): 048A–Southern Rocky Mountains

MLRA 48A makes up about 45,920 square miles (119,000 square kilometers) and is the southern part of the Rocky Mountains. The Southern Rocky Mountains lies east of the Colorado Plateau, south of the Wyoming Basin, west of the Great Plains, and north of the Rio Grande Rift. It is in western and central Colorado, southeastern Wyoming, eastern Utah, and northern New Mexico. The headwaters of major rivers such as the Colorado, Yampa, Arkansas, Rio Grande, North Platte and South Plate rivers are located here. This MLRA has numerous national forests, including the Medicine Bow National Forest in Wyoming; the Routt, Arapaho, Roosevelt, Pike, San Isabel, White River, Gunnison, Grand Mesa, Uncompahgre, Rio Grande, and San Juan National Forests in Colorado; the Carson National Forest and part of the Santa Fe National Forest in New Mexico. Rocky Mountain National Park also is in this MLRA.

MLRA 48A is the southern Rocky Mountains physiographic region. The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. Several basins, or parks, are between the belts. Some high mesas and plateaus are included. It is characterized by mountain ranges that were uplifted during the Laramide Orogeny and then had periods of glaciation. The ranges include the Sangre de Cristo Mountains, the Laramie Mountains, and the Front Range in the east and the San Juan Mountains and the Sawatch and Park Ranges in the west. The ranges are dissected by many narrow stream valleys having steep gradients. In some areas the upper mountain slopes and broad crests are covered by snowfields and glaciers. Elevation typically

ranges from 6,500 to 14,400 feet (1,980 to 4,390 meters) in this area. The part of this MLRA in central Colorado includes the highest point in the Rockies, Mount Elbert, which reaches an elevation of 14,433 feet (4,400 meters). More than 50 peaks in the part of the MLRA in Colorado are at an elevation of more than 14,000 feet (4,270 meters). Many small glacial lakes are in the high mountains.

The mountains in this area were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. This large MLRA can be subdivided into at least 4 large general divisions. First is the Rockies on the east side of this area are called the "Front Range," which is a fault block that has been tilted up on edge and uplifted and is largely igneous and metamorphic geology. It was tilted up on the east edge, so there is a steep front on the east and the west side is more gently sloping and in the south east there are rocks exposed in the mountains are mostly Precambrian igneous and metamorphic rocks. Second is the tertiary rocks, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are throughout this area (San Juan Mountains Area). The third division is Northwest part of the MLRA is dominantly sedimentary rock from the cretaceous/tertiary and Permian/Pennsylvanian periods. The fourth subset is the long and narrow Sangre de Cristos mountains uplifted in the Cenozoic are between the Rio Grande rift and the great plains. Many of the highest mountain ranges were reshaped by glaciation during the Pleistocene. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. They also are important sources of sand and gravel.

The average annual precipitation ranges predominantly from 12 to 63 inches. Summer rainfall commonly occurs as high-intensity, convective thunderstorms. About half of the annual precipitation occurs as snow in winter; this proportion increases with elevation. In the mountains, deep snowpacks accumulate throughout the winter and generally persist into spring or early summer, depending on elevation. Some permanent snowfields and small glaciers are on the highest mountain peaks. In the valleys at the lower elevations, snowfall is lighter and snowpacks can be intermittent. The average annual temperature is 26 to 54 degrees F (-3 to 12 degrees C). The freeze-free period averages 135 days and ranges from 45 to 230 days, decreasing in length with elevation. The climate of this area is strongly dependent upon elevation; precipitation is greater, and temperatures are cooler at the higher elevations. The plant communities vary with elevation, aspect and change in latitudes due to changing in precipitation kind and timing and temperature.

The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an ustic or udic soil moisture regime. Mineralogy is typically mixed, smectitic, or paramicaceous. In areas with granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on mountain slopes. Dystrocryepts (Leighcan and Mummy series) formed on mountain slopes and summits at the higher elevations. In areas of andesite and rhyolite bedrock, Dystrocryepts (Endlich and Whitecross series) formed in colluvium on mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on mountain slopes at low elevations and with low precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on mountain slopes at high elevations.

## Ecological site concept

The soil is moderately deep to deep and well drained. It formed in mixed alluvium derived mainly from sedimentary and igneous parent materials. The soil is loamy-skeletal with over 50 percent coarse fragments throughout the profile. Soils have a moderately slow to moderate permeability. It is generally strongly to moderately calcareous to the surface. Surface textures are generally gravelly loam, gravelly sandy loam to sandy loam over very cobbly loam within 20 inches. pH is neutral to slightly alkaline and available water-holding capacity ranges from 3 to 5 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 16 to 22 inches annually.

## Associated sites

R048AY448UT	Mountain Stony Loam (Mountain Big Sagebrush)
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## Similar sites

R048AY448UT	Mountain Stony Loam (Mountain Big Sagebrush)
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**Table 1. Dominant plant species**

Tree	Not specified
Shrub	(1) <i>Artemisia nova</i>
Herbaceous	(1) <i>Pseudoroegneria spicata</i>

## Physiographic features

This ecological site typically is on fan remnants and mountain slopes. Sites are located between 7,000 to 8,400 feet in elevation. Slopes normally range from 1 to 45 percent.

**Table 2. Representative physiographic features**

Landforms	(1) Fan remnant (2) Mountain slope
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	2,134–2,560 m
Slope	1–45%
Ponding depth	Not specified
Water table depth	Not specified

## Climatic features

Average annual precipitation is 16 to 22 inches. Approximately 55 percent occurs as rain from May through October. On the average, November through June are the driest months and July through October are the wettest months. Cool temperatures and length of growing season are important environmental factors in this site. In average years, plants begin growth around April 20 and end growth around September 30.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	60-90 days
Precipitation total (characteristic range)	406-559 mm

## Influencing water features

Due to its landscape position, this site is not influenced by streams or wetlands.

## Wetland description

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## Soil features

The soil is moderately deep to deep and well drained. It formed in mixed alluvium derived mainly from sedimentary and igneous parent materials. The soil is loamy-skeletal with over 50 percent coarse fragments throughout the profile. Soils have a moderately slow to moderate permeability. It is generally strongly to moderately calcareous to the surface. Surface textures are generally gravelly loam, gravelly sandy loam to sandy loam over very cobbly loam within 20 inches. pH is neutral to slightly alkaline and available water-holding capacity ranges from 3 to 5 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 16-22 inches annually.

Modal Soil: Guber GR-L – loamy-skeletal mixed Typic Calciborolls

**Table 4. Representative soil features**

Parent material	(1) Alluvium–igneous and sedimentary rock (2) Residuum–igneous and sedimentary rock
Surface texture	(1) Gravelly loam (2) Gravelly sandy loam (3) Sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	51–152 cm
Soil depth	51–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	7.62–12.7 cm
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	7–7.6
Subsurface fragment volume <=3" (Depth not specified)	36–43%
Subsurface fragment volume >3" (Depth not specified)	0–37%

## 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 as the proportion of browse 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, and/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 & 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 (1.1) within the Reference State would have been a black sagebrush-dominated (*Artemisia nova*) stand and associated bunch grasses as well as common forb species. The generally shallow and stony soils would have accentuated the effects of drought and reduced the chances of fire altering this state. The reference plant community (1.1) would have been relatively stable with occasional use by wildlife. However, heavy utilization by bison, elk, and Native American horses on these sites (1.1a) would have depleted the grasses creating a near monoculture of black sagebrush (1.2). Heavy browsing by deer during the dormant season of black sagebrush (1.1b) would have created an herbaceous variant (1.3). Occasional very wet years during El Nino-Southern Oscillation periods could have caused temporary soil anoxia (West 2000) (1.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (1.3). Infestation of some insects and pathogens on sagebrush (1.1c) could have led to a similar result where the herbaceous species become temporarily dominant (1.3). The interaction of an unusually dry period and heavy utilization by all grazers (e.g. deer, bison, elk, and horses used by native American) (1.1d) would have removed the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), , and phlox to predominate (1.4). The depauperate black sagebrush (*Artemisia nova*) community (1.2) could have also shifted to the unpalatable short-lived shrub community phase (1.4) in areas that have sustained heavy browsing by deer (1.2b). Relatively rocky sites such as these typically would not have declined in overall cover or productivity. However, the portion that is palatable may have changed appreciably. Similarly, these soils would have been more resistant to erosion than other stone-free soils. Each of the phases within State 1 could have returned to Community Phase 1.1 if climate conditions were within the normal range of variability and there was a release from heavy grazing and/or browsing pressure (1.2a, 1.3a, 1.4a).

The least modified plant community within the Reference State would have been a black sagebrush-dominated stand and associated bunch grasses and commonly associated forbs.

#### Community Phase Pathway 1.1a

Heavy continuous season-long grazing by bison, elk, and Native American horses would have converted the Reference State to a depauperate black sagebrush community.

#### Community Phase Pathway 1.1b

Heavy browsing by deer would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and subsequent anoxic soil conditions would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. The same result would occur following a sudden insect (or other pathogen) outbreak on sagebrush.

#### Community Phase Pathway 1.1c

The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing by all grazers including deer, bison, elk, and Native American horses, would have converted the Reference State to an unpalatable short-lived shrub & perennial forb plant community.

### Community Phase 1.2: Depauperate black sagebrush

This plant community would have developed under heavy continuous season-long grazing by bison, elk, and Native American horses. Heavy utilization of grasses would have created a near monoculture of black sagebrush.

#### Community Phase Pathway 1.2a

The absence of grazing would have allowed the native bunchgrasses and perennial forbs to return to the system converting it back to the Community Phase 1.1.

#### Community Phase Pathway 1.2b

Heavy browsing by deer would have converted the depauperate black sagebrush community to an unpalatable short-lived shrub community phase.

### Community Phase 1.3: Bunch grasses & Perennial Forbs/Sparse black sagebrush

There are several environmental conditions that would have produced this plant community. Heavy browsing by deer would have resulted in an herbaceous-dominated variant because of the utilization of black sagebrush during the dormant season. Under the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could have developed (West 2000), killing the sagebrush and allowing the forbs and grasses to dominate for a short time. A similar plant community would have also developed following an outbreak of insects and pathogens where sagebrush was the dominant host.

#### Community Phase Pathway 1.3a

A return to normal climate conditions and the absence of heavy browsing would have allowed black sagebrush to re-establish and convert back to the Community Phase 1.1.

### Community Phase 1.4: Short-lived Shrubs/Perennial Forbs

This plant community would have developed under the combined effect of unusual drought conditions and heavy grazing by all grazers including deer, bison, elk, and Native American horses. Focused utilization would have reduced the palatable species while allowing the noxious, unpalatable, and shorter-lived species such as yellow rabbitbrush, and phlox to predominate.

#### Community Phase Pathway 1.4a

A return to normal climate conditions followed by a prolonged reduction in grazing pressure would have allowed black sagebrush and native bunchgrasses to re-establish returning to the reference plant community (1.1).

### Transition 1a

The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, will cause State 1 to transition to State 2. A return pathway back to State 1 would be impracticable because of these issues.

### State 2: Black Sagebrush/ Introduced Non-natives State

State 2 is identical to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, and a different climate. State 2 is a description of the ecological site shortly following Euro-American settlement, which can be regarded as the current potential. The least modified plant community (2.1) within State 2 is a black sagebrush-dominated stand and associated bunch grasses such as bluebunch wheatgrass, muttongrass, and Salina Wildrye and Columbia needlegrass. Forbs such as Phlox, stonecrop and rock goldenrod are common. The generally shallow and stony soils accentuate the effect of drought and reduce the chances of fires altering this state. This plant community is relatively stable under mixed use by wildlife and livestock. However, heavy utilization by bison, elk, horses, and domestic cattle on these sites during the growing season (2.1a) would deplete the grasses creating a near monoculture of black sagebrush (2.2). Heavy browsing by deer and sheep (2.1b) would create an herbaceous variant (2.3) because of year-round utilization of black sagebrush. Occasionally very wet years during El Nino-Southern Oscillation periods can cause temporary soil anoxia (West 2000) (2.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (2.3). Some insects and pathogens on sagebrush (2.1c) can lead to a similar result where the herbaceous species become temporarily dominant (2.3). The interaction of an unusually dry period and heavy utilization of grasses by bison, elk, horses, and domestic cattle (2.1d) would remove the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush, and phlox to predominate. Species composition does not change, just their abundance (2.4). The depauperate black sagebrush community (2.2) may

also shift to the unpalatable short-lived shrub community phase (2.4) with heavy utilization of browse by deer and sheep (2.2b). Relatively rocky sites such as these typically do not decline in overall cover or productivity, however, the portion that is palatable may change appreciably. Similarly, these soils are more resistant to erosion than associated stone-free soils. Each of the phases within State 2 can return to Community Phase 2.1 when climate conditions are within the normal range of variability and grazing pressure is moderated (2.2a, 2.3a, 2.4a).

#### Community Phase 2.1: Black sagebrush/Sparse bunchgrasses & Perennial forbs

The least modified plant community within the Black Sagebrush/ Introduced Non-natives State is a black sagebrush-dominated stand and associated bunch grasses such as bluebunch wheatgrass, muttongrass, and Salina Wildrye and Columbia needlegrass. Phlox, stonecrop and rock goldenrod are commonly associated forbs.

##### Community Phase Pathway 2.1a

Heavy continuous season-long grazing by bison, elk, horses, and cattle would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a depauperate black sagebrush community.

##### Community Phase Pathway 2.1b

Heavy browsing by deer and sheep would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and subsequent anoxic soil conditions would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. The same result would be seen following a sudden insect (or other pathogen) outbreak on sagebrush.

##### Community Phase Pathway 2.1c

The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing by all grazers would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to an unpalatable short-lived shrub and perennial forb plant community.

#### Community Phase 2.2: Depauperate Black sagebrush

This plant community is developed under heavy continuous season-long grazing by bison, elk, cattle, and horses. Heavy utilization of grasses creates a near monoculture of black sagebrush.

##### Community Phase Pathway 2.2a

This plant community can move back towards the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase when grazing management, particularly of sheep, and use by deer, take place only during the non-growing season of the herbaceous component, along with broadcast re-seeding with native perennial forbs and grasses.

##### Community Phase Pathway 2.2b

Heavy browsing by deer and sheep would convert the depauperate black sagebrush phase to the unpalatable short-lived shrub and perennial forb community

#### Community Phase 2.3: Bunch grasses & perennial forbs/ Sparse black sagebrush

There are several environmental conditions that would produce this plant community. Heavy year-round browsing by deer and sheep would result in an herbaceous-dominated variant because of the utilization of black sagebrush. Following the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could develop, (West 2000) killing the sagebrush and allowing the forbs and grasses to dominate for a short time. A similar plant community would also develop following an outbreak of insects and pathogens where sagebrush is the dominant host.

##### Community Phase Pathway 2.3a

This plant community can move back to the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase with a return to normal climate conditions and when grazing by both livestock and wildlife is concentrated during the spring to put pressure on the herbaceous component, allowing the native woody component to re-establish.

#### Community Phase 2.4: Short-lived shrubs/perennial forbs

This plant community is developed under extreme drought conditions combined with heavy continuous season-long grazing. Such disturbances will reduce the palatable species and allow the unpalatable, shorter-lived species such

as yellow rabbitbrush, and phlox to predominate. Because of the prevalence of historic unrestricted ungulate grazing, this is the most likely of the phases within State 2 to transition to States 3 or 4.

#### Community Phase Pathway 2.4a

A return to the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase is possible with a return to normal (or wetter) climate conditions and high intensity short duration grazing management to allow the native woody component to re-establish and decrease the competition by herbaceous species.

#### Transition 2a

The Black Sagebrush/ Introduced Non-natives State will transition to the Introduced Annuals/Biennials State following a sustained period of eutrophication caused by excessive year-long livestock grazing, trampling and bedding, especially by large flocks of domestic sheep. Sheep bedding, salting, watering, and handling locations involve intensive trampling, urination, defecation, and consequent eutrophication, which can be influential in this type of transition. It is also common to see accelerated soil erosion in such locations.

#### Transition 2b

The Black Sagebrush/ Introduced Non-natives State will transition to the Cushion Plant State under conditions marked by accelerated soil erosion and soil compaction caused by mechanical damage from trail and road development, excessive trail/foot traffic, and/or jeep/ATV impacts resulting in permanent reduction of plant cover.

#### State 3: Introduced Annuals/Biennials State

Invasive annuals and biennial forbs such as cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola tragus*), knapweeds (*Centaurea* spp.), and horehound (*Marrubium vulgare*) are favored by an increase in nutrient build-up in old, eutrophicated sheep bedgrounds. Where fire return intervals are frequent (3.2a) annuals such as cheatgrass and Russian thistle will predominate (3.1). Longer intervals between fire events (3.1a) will result in a plant community dominated by biennial forbs (3.2). The soil profiles of the plant communities within this state are mainly intact.

Although there have been previous attempts to apply tillage and chemicals to improve the composition and productivity in areas where the ESD has developed into this state (see files in the State Range Conservationist Office for details), the biological responses may be too low to justify the economic investment. Therefore, currently available rangeland manipulations are not recommended.

#### Community Phase 3.1: Annual grass/annual forb

This plant community will develop where fire return intervals are frequent and annual species such as cheatgrass and Russian thistle predominate.

#### Community Phase Pathway 3.1a

When intervals between fire events are prolonged, biennial forbs will dominate the plant community.

#### Community Phase 3.2: Annual forb/biennial forb

This plant community will develop when intervals between fires are longer, allowing biennial species such as knapweeds, tumbled mustard (*Sisymbrium altissimum*), and Dyer's woad (*Isatis tinctoria*) to become established.

#### Community Phase Pathway 3.2a

When fire return intervals are frequent, annual forbs and grasses will dominate the plant community.

#### State 4: Cushion Plant State

Curlycup gumweed (*Grindelia squarrosa*) and other cushion plants such as spiny phlox (*Phlox hoodii*), pricklyphlox (*Leptodactylon* spp.), etc. are found on highly eroded sites, where accelerated soil erosion and soil compaction caused by mechanical damage has removed the fine soil particles and compacted the soils leaving a rocky self-armored surface (4.1).

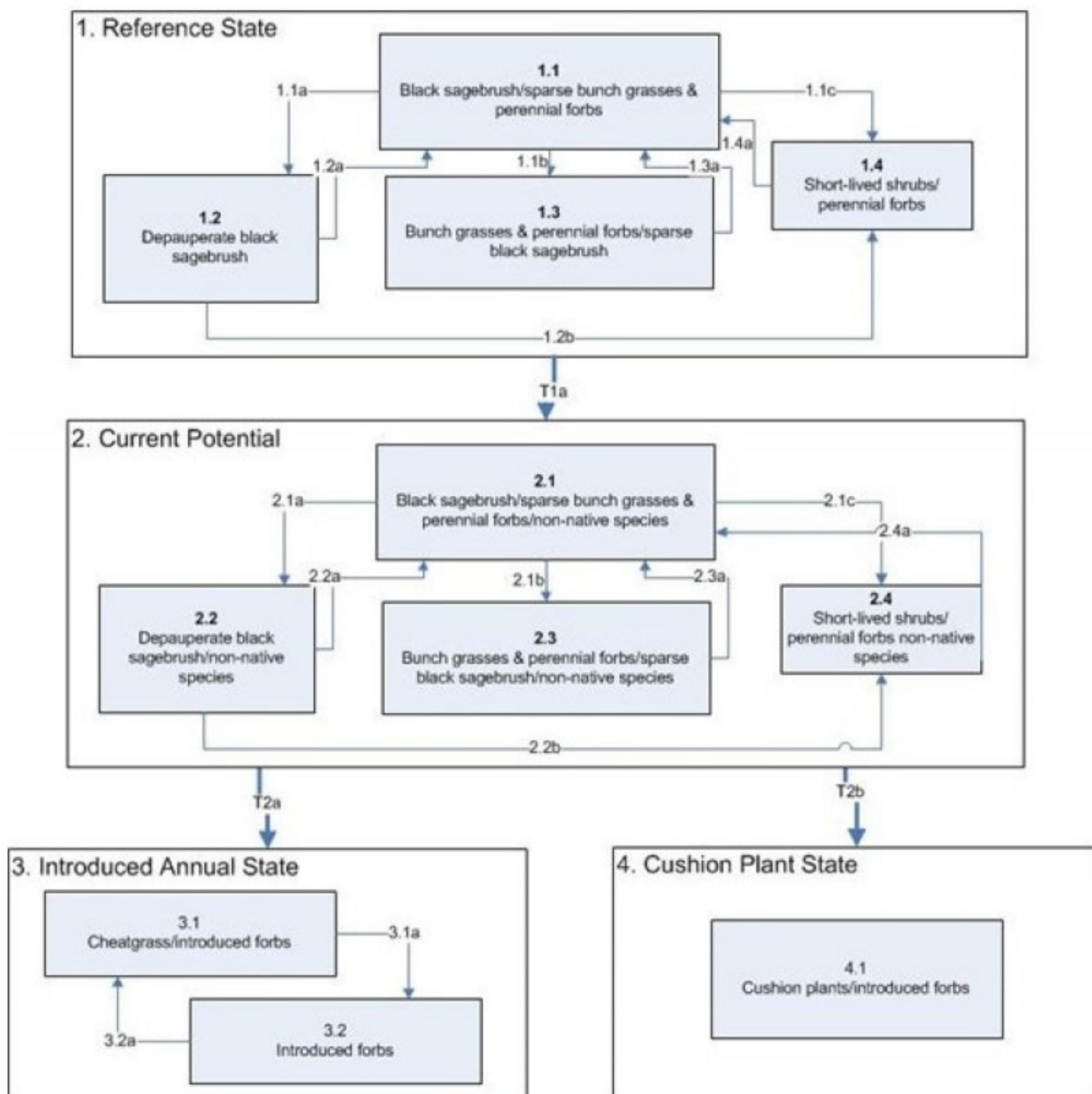
As with State 3, although there have been previous attempts to apply tillage and chemicals to improve the composition and productivity in areas where the ESD has developed into this state (see files in the State Range Conservationist Office for details), the biological responses may be too low to justify the economic investment. Therefore, currently available rangeland manipulations are not recommended.



## Community Phase 4.1: Cushion Plant/annual forb

his plant community will develop following prolonged mechanical damage caused by trail and road development, excessive trail/foot traffic, and/or jeep/ATV impacts resulting in permanent reduction of plant cover. The only plants remaining are those tolerant of drought, infertile soil, and mechanical disturbances.

### State and transition model



Community Phase Pathway 1.1a  
Heavy continuous season-long grazing by bison, elk, and Native American horses.

Community Phase Pathway 1.1b  
Heavy browsing by deer.

Community Phase Pathway 1.1c  
The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing.

Community Phase Pathway 1.2a  
The absence of grazing .

Community Phase Pathway 1.2b  
Heavy browsing by deer.

Community Phase Pathway 1.3a  
A return to normal climate conditions and the absence of heavy browsing.

Community Phase Pathway 1.4a  
A return to normal climate conditions followed by a prolonged reduction in grazing pressure.

Transition 1a  
Introduction of exotic species.

Community Phase Pathway 2.1a  
Heavy continuous season-long grazing by bison, elk, horses, and cattle.

Community Phase Pathway 2.1b  
Heavy browsing by deer and sheep.

Community Phase Pathway 2.1c  
The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing.

Community Phase Pathway 2.2a  
Grazing management.

Community Phase Pathway 2.2b  
Heavy browsing by deer and sheep.

Community Phase Pathway 2.3a  
Return to normal climatic conditions and grazing management.

Community Phase Pathway 2.4a  
Return to normal climatic conditions and grazing management.

Transition 2a  
Sustained period of eutrophication

Transition 2b  
Accelerated soil erosion and soil compaction.

Community Phase Pathway 3.1a  
When intervals between fire events are prolonged.

Community Phase Pathway 3.2a  
When fire return intervals are frequent.

## State 1

### Reference State

## Community 1.1

### Reference Plant Community

The general view of this site is black sagebrush and grass. The composition by air-dry weight is approximately 40 percent perennial grasses, 10 percent forbs, and 50 percent shrubs.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	252	392	532
Grass/Grasslike	202	314	426
Forb	50	78	106
<b>Total</b>	<b>504</b>	<b>784</b>	<b>1064</b>

**Table 6. Ground cover**

Tree foliar cover	0%
Shrub/vine/liana foliar cover	34-36%
Grass/grasslike foliar cover	24-26%
Forb foliar cover	4-6%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

**Table 7. Canopy structure (% cover)**

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	—	—	—	—
>0.15 <= 0.3	—	—	—	4-6%
>0.3 <= 0.6	—	34-36%	24-26%	—
>0.6 <= 1.4	—	—	—	—
>1.4 <= 4	—	—	—	—
>4 <= 12	—	—	—	—
>12 <= 24	—	—	—	—
>24 <= 37	—	—	—	—
>37	—	—	—	—

## Additional community tables

**Table 8. Community 1.1 plant community composition**

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Shrub/Vine</b>					
0	<b>Dominant Shrubs</b>			303–381	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	252–295	—
	yellow rabbitbrush	CHVIV4	<i>Chrysothamnus viscidiflorus</i> ssp. <i>viscidiflorus</i> var. <i>viscidiflorus</i>	26–43	—
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	26–43	—
3	<b>Sub-Dominant Shrubs</b>			87–213	

	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	43–84	–
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	9–26	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	9–26	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</i>	9–26	–
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	9–26	–
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis</i> var. <i>acaulis</i>	9–26	–
<b>Grass/Grasslike</b>					
0	<b>Dominant Grasses</b>			135–252	
	muttongrass	POFE	<i>Poa fendleriana</i>	43–84	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	43–84	–
	Columbia needlegrass	ACNE9	<i>Achnatherum nelsonii</i>	26–43	–
	saline wildrye	LESAS	<i>Leymus salinus</i> ssp. <i>salinus</i>	26–43	–
1	<b>Sub-Dominant Grasses</b>			118–230	
	Grass, annual	2GA	<i>Grass, annual</i>	84–127	–
	Grass, perennial	2GP	<i>Grass, perennial</i>	84–127	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	9–26	–
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	9–26	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	9–26	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	9–26	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	9–26	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	9–26	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	9–26	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	9–26	–
<b>Forb</b>					
2	<b>Sub-Dominant Forbs</b>			78–185	
	Forb, annual	2FA	<i>Forb, annual</i>	43–84	–
	Forb, perennial	2FP	<i>Forb, perennial</i>	43–84	–
	Wyoming Indian paintbrush	CALI4	<i>Castilleja linariifolia</i>	9–26	–
	wavyleaf thistle	CIUN	<i>Cirsium undulatum</i>	9–26	–
	tapertip hawksbeard	CRAC2	<i>Crepis acuminata</i>	9–26	–
	rock goldenrod	PEPU7	<i>Petradoria pumila</i>	9–26	–
	oneside penstemon	PEUN	<i>Penstemon unilateralis</i>	9–26	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	9–26	–
	spearleaf stonecrop	SELA	<i>Sedum lanceolatum</i>	9–26	–
	Pacific aster	SYCHC	<i>Symphyotrichum chilense</i> var. <i>chilense</i>	9–26	–

## Animal community

This site provides proper grazing for cattle and sheep during spring, summer, and fall.

This site produces food and limited cover for wildlife. Wildlife using this site include elk, mule deer, rabbit, sage

grouse, and coyote.

## Hydrological functions

The soil series is in hydrologic groups B, C, and D. The hydrologic curve numbers are 61, 74, and 80 when the vegetation is in good condition.

## Recreational uses

Hiking and hunting

## Wood products

None

## Inventory data references

Type Location: See Soil Survey Report

## Contributors

George Cook, David Somerville

## Approval

Kirt Walstad, 3/01/2024

## 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	03/13/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

- Number and extent of rills:** Some rills present. Rill development may increase following large storm events, but should begin to heal during the following growing season. Frost heaving will accelerate recovery. Rill development may increase when run inflow enters site from other sites that produce large amounts of runoff (i.e. steeper sites, slickrock, rock outcrop).
- Presence of water flow patterns:** Water flow patterns will be short (2-5') and meandering; interrupted by plants and exposed rocks. Some evidence of erosion or deposition associated with flow patterns. Where slopes exceed 5%, water

flow patterns may be longer (5–10').

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3. **Number and height of erosional pedestals or terracettes:** Plants may have small pedestals (1-3") where they are adjacent to water flow patterns, but without exposed roots. Terracettes should be few and stable. Terracettes should be small (1-3") and show little sign of active erosion. Some plants may appear to have a pedestal but rather than be formed by erosion, they are the result of litter and soil accumulating at plant bases, forming the appearance of a pedestal.
4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 30-40% bare ground (soil with no protection from raindrop impact). Very few if any bare spaces of greater than 1 square foot. In general, bare ground increases as production decreases. As species composition of shrubs relative to grasses increases, bare ground is likely to increase. Poorly developed biological soil crust that is susceptible to erosion from raindrop impact should be recorded as bare ground.
5. **Number of gullies and erosion associated with gullies:** No gullies present.
6. **Extent of wind scoured, blowouts and/or depositional areas:** Very minor evidence of active wind-generated soil movement. Wind scoured (blowouts) and depositional areas are rarely present. If present they have muted features and are mostly stabilized with vegetation and/or biological crust.
7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water and wind movement. Very minor litter removal may occur in water flow paths with deposition occurring at points of obstruction. Where litter movement does occur, litter accumulates at plant bases. Some leaves, stems, and small twigs may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move.
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have an erosion rating of 4 to 5 under plant canopies and a rating of 3 to 4 in the interspaces with an average rating of 4 using the soil stability kit test.
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** We should say ?this indicator will be revised when additional information becomes available?
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Bunchgrasses and shrubs are equally important for increasing infiltration and reducing runoff. Plant litter and canopy cover from all functional groups intercept rainfall and prevent splash erosion. Bunchgrasses contribute organic matter directly to soil through root decay, and organic matter helps stabilize soil aggregates and maintain soil porosity. Shrubs hold snow and slow wind evaporation. Bunchgrass bases intercept litter and soil in water flow paths, reducing runoff. Biological soil crusts (where present) are resistant to raindrop impact and splash erosion. Spatial distribution of vascular plants and well-developed biological soil crusts (where present) provides detention storage and surface roughness that slows runoff allowing time for infiltration. Interspaces between plants and any well-developed biological soil crusts (where present) may serve as water flow patterns during episodic runoff events,

with natural erosion expected in severe storms.

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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):** A compaction layer is not expected.
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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: Dominant: Non-sprouting shrub (black sagebrush)

Sub-dominant: Sub-dominant: Perennial cool-season bunchgrasses (muttongrass, bluebunch wheatgrass) > sprouting shrubs (yellow rabbitbrush, antelope bitterbrush)

Other: Other: Other perennial grasses > perennial forbs = other shrubs

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** During years with average to above average precipitation, there should be very little recent mortality or decadence apparent in either the shrubs or grasses. Some mortality of bunchgrass and other shrubs may occur during very severe (long-term) droughts. Long-lived species dominate the site. Open spaces from disturbance are quickly filled by new plants through seedlings and asexual reproduction (tillering).
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14. **Average percent litter cover (%) and depth ( in):** Litter cover includes litter under plants. Most litter will be fine (herbaceous) litter. Almost all litter is concentrated under plant canopies. Litter between plant canopies is very sparse. Average litter cover is 5-15% and average litter depth is 0.25-0.5 inches.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 650-750 lbs/acre.  
Even the most stable communities exhibit a range of production values. Production will vary between communities and across the MRLA. Refer to the community descriptions in the ESD. Production 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.
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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:** Invasive species unlikely because of high elevation
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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce sexually or asexually, except in drought years. Density of plants indicates that plants reproduce at level sufficient to fill available resource.

Within capability of site there are no restrictions on seed or vegetative reproductive capacity.

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