USDA Natural Resources
Conservation Service

Ecological site R048AA245CO
Mountain Swale Gunnison Basin LRU

Last updated: 3/05/2024
Accessed: 04/20/2024

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): 048A–Southern Rocky Mountains

MLRA 48A makes up about 45,920 square miles (119 000 square kilometers). It is in the Southern Rocky Mountains province, which is east of the Colorado Plateau, south of the Wyoming Basin, west of the Great Plains, and north of the Rio Grande rift. MLRA 48A is in western and central Colorado, southeastern Wyoming, eastern Utah, and northern New Mexico. The headwaters of major rivers, including the Colorado, Yampa, Arkansas, Rio Grande, North Platte, and South Platte Rivers are in this MLRA. It 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; and 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 in 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. The mountains were uplifted during the Laramide orogeny and then were subject to periods of glaciation. The ranges include the Sangre de Cristo Mountains, Laramie Mountains, and Front Range in the east and the San Juan Mountains and Sawatch and Park Ranges in the west. The ranges are dissected by many narrow stream valleys that have steep gradients. In some areas, the upper mountain slopes and broad crests are covered by snowfields and glaciers. Elevation of the MLRA typically is 6,500 to 14,400 feet (1980 to 4390 meters). The part of the MLRA in central Colorado includes the highest point in the Rocky Mountains, Mount Elbert, which reaches an elevation of 14,433 feet (4400 meters). More than 50 peaks in this part of the MLRA are at an elevation of more than 14,000 feet (4270 meters). Many small glacial lakes are in the high mountains.

The mountains in this MLRA were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. This large MLRA can be subdivided into at least four general divisions. The first division includes the Rocky Mountains in the eastern part of this area, called the Front Range. This range is a fault block that has been tilted on edge and uplifted and is dominantly igneous and metamorphic rock. It was tilted on the east edge, so a steep front is on the east side and more gentle slopes are on the west side. In the southeast part, the exposed rock is mostly Precambrian igneous and metamorphic. The second division is the tertiary rock, primarily basalt and andesitic lava flows, tuff, breccia, and conglomerate, throughout the San Juan Mountains area. The third division is the northwest part of the MLRA, which is dominantly sedimentary rock from the Cretaceous and Tertiary periods and the Permian and Pennsylvanian periods. The fourth division is the long, narrow Sangre de Cristo Mountains uplifted during the Cenozoic era 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 and are an important source of sand and gravel.

The average annual precipitation is dominantly 12 to 63 inches. Summer rainfall commonly occurs as high-intensity, convective thunderstorms. About one-half of the annual precipitation is received as snow in winter; the proportion increases as elevation increases. In the mountains, deep snowpack accumulates in winter and generally persists until spring or early in 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 snowpack may be intermittent. The average annual temperature is 26 to 54 degrees F (-3 to 12 degrees C). The freeze-free period averages 135 days, but it ranges from 45 to 230 days, decreasing in length as elevation increases. The climate of this MLRA varies according to the elevation. Precipitation is higher and temperatures are cooler at the higher elevations. The plant communities vary according to elevation, aspect, and latitude due to variations in the kind and timing of the precipitation and the 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 typically is mixed, smectitic, or paramicaceous. In areas of granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on the mountain slopes and 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 the mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on the mountain slopes at low elevations that receive a low amount of precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on the mountain slopes at high elevations

LRU notes

This site occurs only in the Gunnison Basin Land Resource Unit. The Gunnison Basin is a valley with hills that occurs along the frigid/cryic temperature break and the aridic bordering on ustic/typic ustic climate break. Gunnison Basin has 5 dominant ecological sites.

The lower elevations are in the dry mountain ecological site climate zone and the upper elevations are in the mountain ecological site climate zone. Aspect and wind directions further complicates where plant communities occur in the basin. Southern aspects tend to be dry and warmer and Dry Mountain Loam (R048AA231CO) usually can be found on these aspects at middle elevations in the basin. Mountain Loam (R048AA228CO) occurs on the Northern and eastern aspects and depression areas were the wind blows the snow too. Thus, creating a higher effective precipitation at lower and middle elevations in the Basin. Dry exposure (R048AA235CO) is found on the southern most aspects and landscape positions where it is windswept from moisture that is received. Mountain Swale and Mountain Meadows occur in the draws where the snow is deposited during the winter. Mountain Swale (R048AY245CO) received extra water only during snow melt and large precipitation events. Mountain Meadows (R048AA241CO) has a water table year-round.

Classification relationships

Natural Resources Conservation Service (NRCS):
Major Land Resource Area 48A, Southern Rocky Mountains (USDA-NRCS, 2006).

U.S. Forest Service (USFS):
M331G – South-Central Highlands Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331H – North-Central Highlands and Rocky Mountain Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331I – Northern Parks and Ranges Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

Environmental Protection Agency (EPA):
21b–Crystalline Subalpine Forests, 21c–Crystalline Mid-Elevations Forests, 21d–Foothill Shrublands, 21f–Sedimentary Mid-Elevation Forests, and 21h–Volcanic Mid-Elevation Forests < 21 Southern Rockies < 6.2 Western Cordillera < 6 Northwestern Forested Mountains North American Deserts (Griffith, 2006).

U.S. Geological Survey (USGS):
Southern Rocky Mountain Province

Ecological site concept

This description of the Mountain Swale Gunnison Basin LRU ecological site was drafted from the description of the Mountain Swale range site (R048AY245CO, February 1976). The original concept was expanded based on the soil temperature and moisture regimes and the climate in western Colorado. The site is in areas that receive water and fine sediment from the surrounding uplands. After large precipitation events or during the spring snowmelt the channel may run for short periods. This site spreads the water out across the site. The soils are very deep, loamy Mollisols that have a high water-holding capacity. Buried A horizons and a very low content of rock fragments characterize the soil profile. The soil moisture regime is aridic ustic to typic ustic and the soil temperature regime is cool, frigid to borderline cryic. The historic climax plant community consists dominantly of basin wildrye (Leymus cinereus), and Woods' rose (Rosa woodsii).

Associated sites

R048AA228CO	**Mountain Loam Gunnison Basin LRU** Mountain Loam occurs mainly hills, hillsides, mountainside, or mountain slopes. Slopes average between 3 and 25% but can range up to 45% in some areas. Soils are moderately deep to deep (20-60+ inches); fine-loamy soils derived from colluvium derived from rhyolite; slopes alluvium derived from rhyolite; colluvium derived from volcanic and sedimentary rock or igneous and metamorphic rock; residuum weathered from schist; or old alluvium derived from basalt and/or glacial till from basalt. Surface textures are loam, sandy loam, gravelly sandy loam, or sandy clay loam with subsurface clay content ranging from 25 to 45% clay. It is a Mountain Big Sagebrush -Arizona Fescue-needlegrass community. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.
R048AA231CO	**Dry Mountain Loam Gunnison Basin LRU** Dry Mountain Loam occurs mainly hillsides. Slopes average between 5 and 25% but can range up to 45% in some areas. Soils are moderately deep (20-40 inches); fine-loamy soils derived from slope alluvium derived from rhyolite and/or sedimentary rock or residuum from granite and rhyolite. Surface textures are fine sandy loam or gravelly sandy loam with loamy subsurface with an average of 20-30% clay. It is a Wyoming Big Sagebrush - Indian Ricegrass community. It has an aridic ustic moisture regime. The effective precipitation ranges from 12 to 16 inches.
R048AA241CO	**Mountain Meadow Gunnison Basin LRU**
R048AA235CO	**Dry Exposure Gunnison Basin LRU** Dry Exposure Loam occurs mainly ridgetops, hills, and hillsides. Slopes average between 5 and 45%. Soils are shallow (10-20 inches); loamy soils derived from slope alluvium derived from rhyolite and/or or residuum from granite, gneiss, or rhyolite. Surface textures are gravelly loam with loamy subsurface with an average of 20-30% clay. It is a Black Sagebrush – Muttongrass - Squirreltail community. It has an aridic ustic moisture regime. The effective precipitation ranges from 12 to 16 inches.

Similar sites

R048AY245CO	**Mountain Swale** This site was originally written for the entire Southern Rocky Mountains of Colorado. This site has similar effective precipitation, but it does not recognize the difference in understory that can occur from north to south in MLRA 48A. Precipitation in the northern part is received mainly in winter, and precipitation in the south-central part is received in winter and as monsoonal rain in summer.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Rosa woodsii* (2) *Symphoricarpos oreophilus*
Herbaceous	(1) *Leymus cinereus* (2) *Elymus trachycaulus*

Physiographic features

This site is in swales, flood plains, small fans, draws, and the bottom of narrow, winding valleys along intermittent streams, Elevation is about 7,200 to 8,700 feet. Generally, the slopes are 1 to 15 percent. Slopes may be steeper in some areas, which will impact water movement and plant growth. Landscape position is an important factor for this site.

Due to differences in the depth to bedrock and water table, width of the valley, and slope, this site commonly has small inclusions of the Mountain Meadow ecological site (R048AA241CO). The Mountain Meadow site has a high water table year round, and the Mountain Swale site receives intermittent run-in from adjacent sites. The surrounding uplands commonly support the Mountain Loam (R048AA228CO) and Dry Mountain Loam (R048AA231CO) sites.

Table 2. Representative physiographic features

Landforms	(1) Swale (2) Drainageway (3) Flood plain
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	7,200–8,700 ft
Slope	1–15%
Water table depth	60–80 in
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 10 to 18 inches, of which 50 percent or more is received as snow. The average total snowfall is 49.7 inches at the Gunnison 1 N climate station. The highest annual snowfall, 104.9 inches, was recorded at the Gunnison 1 N climate station in 2008. This site is on south and west aspects, which are drier because of solar radiation and the prevailing winds.

The optimum growing season for native plants is late in spring through midsummer. The frost-free period is 55 to 75 days. The last frost in spring occurs sometime in the middle of June to the first week of July, and the first frost in fall is as early as the middle of August to the first week of September. The average monthly air temperature typically ranges from 80.7 to -7.4 degrees F throughout the year, but the mean annual air temperature is 37.7 degrees F. The coldest temperature in winter, -47 degrees F, was recorded on December 10, 1939, and the coldest temperature in summer, 15 degrees F, was recorded on June 1, 1919. Associated with this site are areas in which wind exposure limits the height and growth of plants. Climate data are from the Western Regional Climate Center, Cochetopa and Gunnison 1 N climate stations (2012).

Table 3. Representative climatic features

Frost-free period (characteristic range)	35-47 days
Freeze-free period (characteristic range)	82 days
Precipitation total (characteristic range)	10-18 in
Frost-free period (actual range)	32-50 days
Freeze-free period (actual range)	82 days
Precipitation total (actual range)	10-18 in
Frost-free period (average)	41 days
Freeze-free period (average)	82 days
Precipitation total (average)	14 in

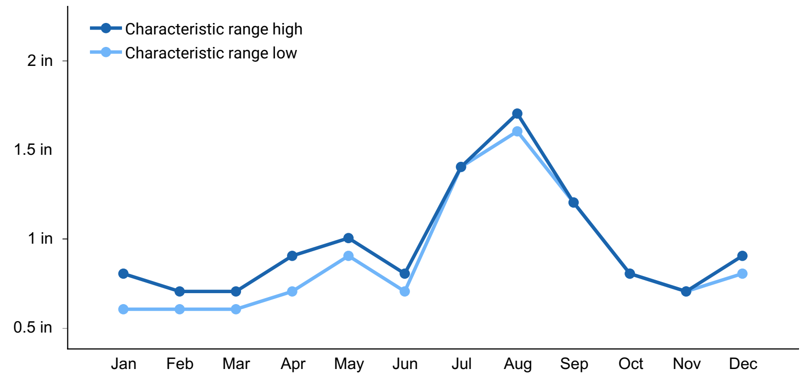


Figure 1. Monthly precipitation range

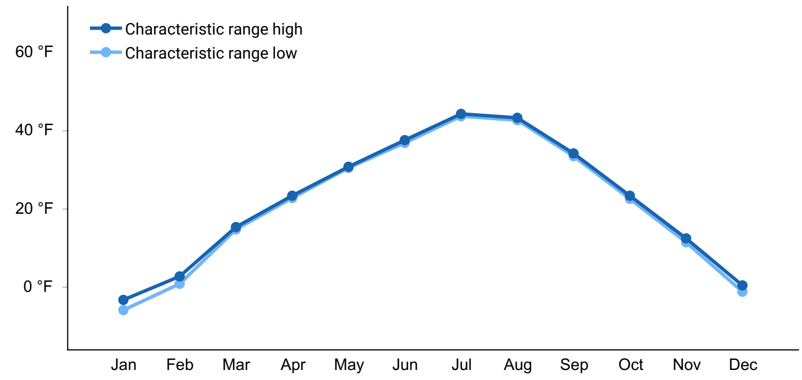


Figure 2. Monthly minimum temperature range

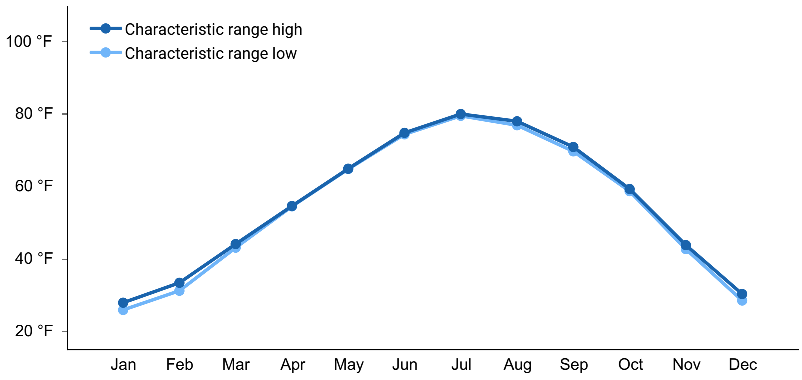


Figure 3. Monthly maximum temperature range

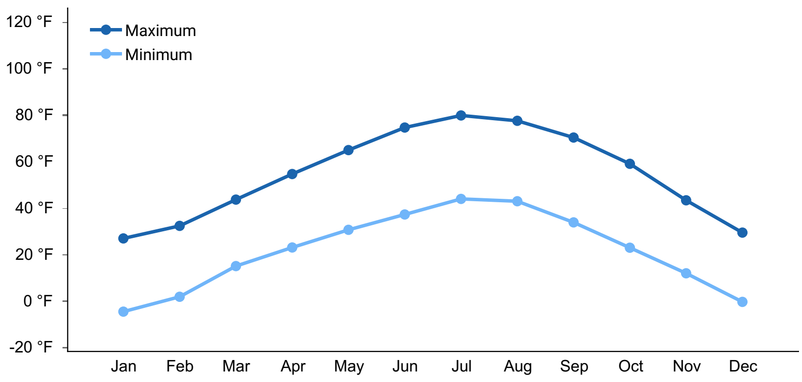


Figure 4. Monthly average minimum and maximum temperature

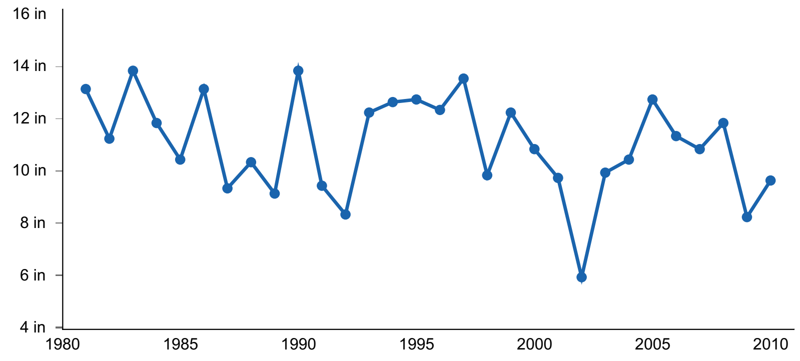


Figure 5. Annual precipitation pattern

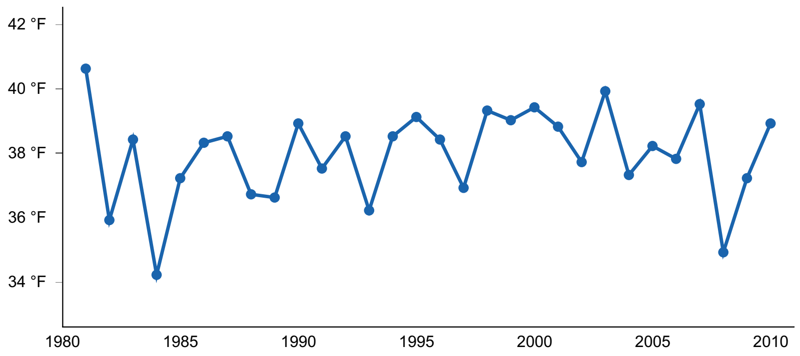


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GUNNISON 3SW [USC00053662], Gunnison, CO
- (2) COCHETOPA CREEK [USC00051713], Gunnison, CO

Influencing water features

Water features do not influence the Mountain Swale site. It is not riparian; it is associated with intermittent ephemeral drainage. The site slows the movement of and absorbs overland and subterranean flow from uplands. Most of the water movement is subterranean. After large precipitation events or during spring snowmelt, water may flow in channels for short periods. Normally, water spreads out across the site rather than flowing in channels.

Soil features

The soils associated with this site are deep to very deep (60 inches or more), and they have a high water-holding capacity. The soils have a mollic epipedon (thick dark upper layer that has a high content of organic matter). The content of clay is about 15 to 25 percent in the surface layer. Common surface textures range are fine sandy loam, loam and silt loam.

Commonly, the profile is fine-loamy throughout, but the uplands surrounding the drainageways and the parent material influence the textures. The subsurface layers commonly are loam, gravelly loam. silt loam, sandy clay loam or clay loam. The wide range in textures is due to the stratification of the soils. Layers that have gravel and cobbles (as much as 25 percent rock fragments) and carbonates may be present, depending on the properties of the soils in adjacent areas that washed onto this site during a large precipitation event.

The soils receive periodic overflow and sediment from adjacent areas. Little pedogenic (in situ) soil development occurs because of the frequent deposition and transient, intermittent flow in channels. The soils in areas that have not been degraded or drained by gullies may have multiple buried A horizons. No apparent water table is present during the growing season. Present-day redoximorphic features may be below a depth of 36 inches, which is indicative of an elevated water table for short periods outside of the growing season. The soils and landscape position help to slow runoff and allow water to infiltrate, minimize flooding, and prolong the availability of water throughout the dry season.

This site is associated with the Ad–Alluvial land map unit in the Soil Survey of the Gunnison Area, Colorado (1975). Alluvial land is a miscellaneous land type; thus, a soil series was not assigned to this map unit when the Gunnison Area was mapped. Soil data in this section are from that soil survey report, but the data are being updated from more recent fieldwork conducted in 2009 to 2020.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Sandy loam (3) Silt loam
Family particle size	(1) Fine-loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderate to moderately rapid
Soil depth	40–100 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–1%
Available water capacity (Depth not specified)	6–9 in
Soil reaction (1:1 water) (Depth not specified)	6.8–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

The description of this site is based on the description of the Mountain Swale (R048XY245CO) range site (USDA-SCS, February 1976). The original concept included all of MLRA 48A, which covers the mountainous areas of Colorado. This ecological site describes data collected primarily for the high mountain areas of the Gunnison Basin. The soil moisture regime is typic ustic, and the soil temperature regime is cool frigid bordering on warm cryic. This site is in draws, on the bottom of small valleys, and in drainageways of high mountain valleys in MLRA 48A. Herbivory and fire are the dominant disturbance factors in the sagebrush biome (Boyd et al., 2014). Absence or repeated incidences of these disturbances may result in a shift in the ecological dynamics. The ecological dynamics of the associated uplands also influence the dynamics of this site. Excessive runoff and erosion from degraded uplands can increase the concentrated flow and potential for formation of gullies. Frequent fires remove brush and help to maintain the grassland.

The Gunnison Basin is in a climatic zone where pinyon (*Pinus edulis*) and juniper (*Juniperus osteosperma*) normally occur; however, the basin generally does not support these species because of its unique ecological characteristics. The basin does support intergradations of Wyoming big sagebrush and mountain big sagebrush. The Gunnison Basin is recognized for its unusual ecological characteristics, including absence of certain plants and vertebrates. Pinyon pine is rare in the basin, and western rattlesnake is absent. Winters are extremely cold, and the cold air settles into the basin. Also, this area is drier than other regions at similar elevations. It is thought that the temperature, moisture, and topography are responsible for the sagebrush-dominant plant communities in the Upper Gunnison Basin (Emslie et al., 2005). Black sagebrush has a taproot and wide-spreading lateral roots. The shallow soils associated with this site prevent development of deep roots; thus, they support plants that have more fibrous roots than does big sagebrush (Fryer, 2009). The shallow soils also prevent deep-rooted trees from invading the site, which allows black sagebrush to remain dominant.

The Gunnison Basin is in the transition zone from Wyoming big sagebrush to mountain big sagebrush. Wyoming big sagebrush generally is in areas that receive 7 to 12 inches of precipitation and are at an elevation of 1,000 to

6,000 feet, but in Colorado it may be in areas of well drained soils at an elevation of as high as 8,000 feet. Mountain big sagebrush is at an elevation of 6,800 to 8,500 feet. Bonneville big sagebrush, a hybrid of Wyoming big sagebrush and mountain big sagebrush, has been observed at the head of Long Gulch near Gunnison, Colorado, at an elevation of about 8,000 feet (between the boundaries of Wyoming big sagebrush and mountain big sagebrush; Winward, 2004). Ultraviolet fluorescent tests showed intergradations between the two subspecies in areas that receive 8 to 15 inches of precipitation (Goodrich et al., 1999). This ecological site is in areas that receive 12 to 16 inches of effective precipitation and are at an elevation of 7,200 to 8,200 feet; thus, both the subspecies and the hybrid may be in this site, depending on elevation and aspect. Mountain big sagebrush may grow in areas with Wyoming big sagebrush (Johnson, 2000).

The soils, topographic location, climate, and periodic drought and fire influence the stability of the reference state. The reference state is presumed to be the community encountered by European settlers in the early 1800's that developed under the prevailing climate over time. Grazing and browsing by wildlife also influenced the plant community. The resulting plant community is a cool-season bunchgrass/shrub community. Sagebrush communities in Colorado above an elevation of 8,500 feet are in relatively good condition and appear to be recovering slowly from the impacts of settlement in the west. Sagebrush communities below an elevation of 8,500 feet have been slower to recover (Winward, 2004). This site supports mountain big sagebrush, Wyoming big sagebrush, and Bonneville big sagebrush; therefore, the big sagebrush (ARTR2) in the “Plant Community Composition” table includes all three species.

Natural fire plays an important role in the function of most sites in high mountain valleys, especially the sagebrush communities. Fire stimulates growth of grasses such as needlegrasses and bluegrasses. It also helps to keep sagebrush stands from becoming too dense and invigorates other sprouting shrubs such as serviceberry and snowberry. Fire helps to maintain a balance among grasses, forbs, and shrubs. The dynamics of a plant community are improved by opening the canopy and stimulating growth of forbs, creating a mosaic of different age classes of species and a diverse composition of species in the communities. Other than Wyoming big sagebrush, the deep-rooted species that grow on the site are not easily damaged by fire (BLM, 2002). Shrubs that resprout, such as yellow rabbitbrush and spineless horsebrush, are suppressed for a period. This allows grasses to become dominant. If periodic fires or other methods of brush control are not used, sagebrush slowly increases in abundance and can become dominant.

Wyoming big sagebrush plant communities have lower productivity and fuel loads, less ground cover, lower crown cover of shrubs, and less diversity in species and structure than do mountain big sagebrush plant communities (Goodrich et al., 1999; West and Hassan, 1985; Evers, et al., 2011; Johnson, 2000). Wyoming big sagebrush communities are less prone to fire than are mountain big sagebrush communities. The fire return interval for Wyoming big sagebrush communities in the western United States is 10 to 115 years (West and Hassan, 1985; Evers, et al., 2011; Johnson, 2000). The fire return interval for Wyoming big sagebrush varies greatly depending on differences in precipitation and temperature; it is about 10 to 70 years in the uplands of the Gunnison Basin. Big sagebrush in mesic habitats is subject to more frequent fires. The fire return interval for mountain big sagebrush in mesic habitats is 12 to 25 years (Boyd et al., 2014).

Prior to 1850, the fires typically consisted of a large number of small- to medium-sized mosaic burns. Since 1980, the fires typically consist of a few very large burns caused by human activity (Evers et al., 2011). The change in the fire return interval and intensity of fires is a result of fire suppression and reduced fine fuel from livestock grazing in the late 1800’s and early 1900’s. Other shrub management practices may be needed to help keep the community in balance. The response to treatment varies among sites due to differences in the composition and abundance of vegetation, soils, elevation, aspect, slope, and climate (McIver, et al, 2010).

Several sagebrush taxa have been subject to die-off in the past 10 to 15 years. The dominant factors are disease (pathogens) and drought. Disease and stem and root pathogens have caused die-off dominantly in dense, over-mature sagebrush stands throughout the west. Drought and heavy browsing in conjunction with pathogens have caused complete die-off in other areas.

Water may accumulate in narrow, small valley bottoms. These areas may support willows, sedges, and rushes and communities of the Mountain Meadow ecological site. Narrowleaf cottonwood may be in these areas (USDA-SCS, 1976). Narrowleaf cottonwood is a facultative wetland species that is tolerant of frequent, prolonged periods of flooding and is not resistant to drought (Simonin, 2001). Typically, this site is too dry to sustain cottonwood.

Variability in climate, soils, aspect, and complex biological processes results in differing plant communities. The composition and relative productivity of species may fluctuate from year to year, depending on precipitation and other climatic factors. The species listed in this description are representative; not all occurring or potentially occurring species are listed. The species listed do not cover the full range of conditions and responses of the site. The state-and-transition model is based on available research, field observations, and interpretations by experts; changes may be needed as knowledge increases. The reference plant community is the interpretive community. This plant community evolved as a result of grazing, fire, and other disturbances such as drought. This community is well suited to grazing by domestic livestock and wildlife, and it is in areas that are properly managed by prescribed grazing.

State and transition model

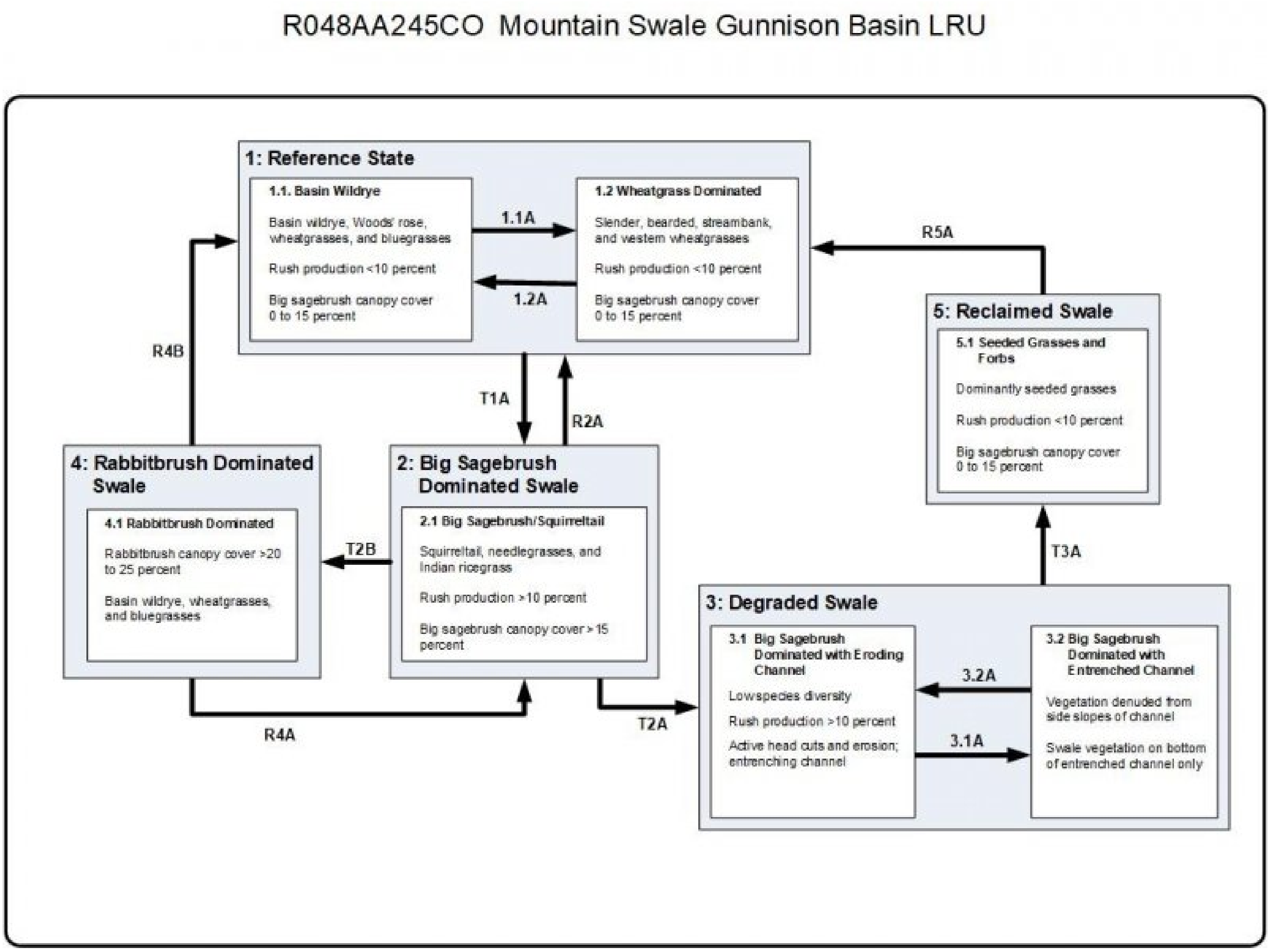


Figure 7. S & T Model

Legend

1.2A, 3.2A, T1A – Lack of fire, period without disturbance, extended improper grazing, extended drought, lack of insect or pathogen outbreak, lack of run-in water from adjacent uplands

1.1A, 3.1A, R2A – Fire, proper grazing, wet climatic cycle, vegetative treatment, small-scale insect or pathogen outbreak

T2A – Extended drought, lack of fire, extended improper grazing, lack of insect or pathogen outbreak, large flow event

T2B – Repeated fire, vegetative treatment of sagebrush

T3A – Time-, resource-, and energy-intensive input; restoration of water table in entire swale; possible installation of erosion control structure

R4A, R4B – Period without disturbance, re-establishment of sagebrush, treatment of rabbitbrush, seeding, proper grazing

R5A – Time-, resource-, and energy-intensive input; seeding; vegetative treatment; period without disturbance; proper grazing

Figure 8. Legend

State 1
Reference State

This state is on gently sloping valley bottoms that receive excess runoff from well-managed surrounding uplands. The plant community is very productive because of the extended growing season as compared to the uplands. An ephemeral channel that is not entrenched or downcutting is typical. The reference state is stable and has properly functioning hydrology. The reference state consists of grassland that has minor amounts of forbs and shrubs. The dominant grasses are basin wildrye, slender wheatgrass, western wheatgrass, Letterman's needlegrass, pine needlegrass, and sedges. Forbs include geranium, herbaceous cinquefoil, American bistort, and yarrow. Minor amounts of big sagebrush and rabbitbrush are present, but they may become more dominant as the site begins to deteriorate (USDA-SCS, 1976). Notable patch dynamics influence pockets of vegetation. For example, a greater dominance of western wheatgrass and basin wildrye is near the toeslopes of the hills and in high areas. Western wheatgrass is dominant in drier areas associated with finer textured soils. Basin wildrye is not suited to saturated soils; it commonly is best suited to well drained soils that are subject to periodic water events throughout the growing season. Bunch bluegrasses, bromes, and other wheatgrasses increase in prevalence closer to the channel. Forbs and preferred shrubby species such as snowberry, Woods' rose, and willows also increase. The high diversity of species in this state allows plants to adapt to periods of additional moisture or drought.

Community 1.1
Basin Wildrye

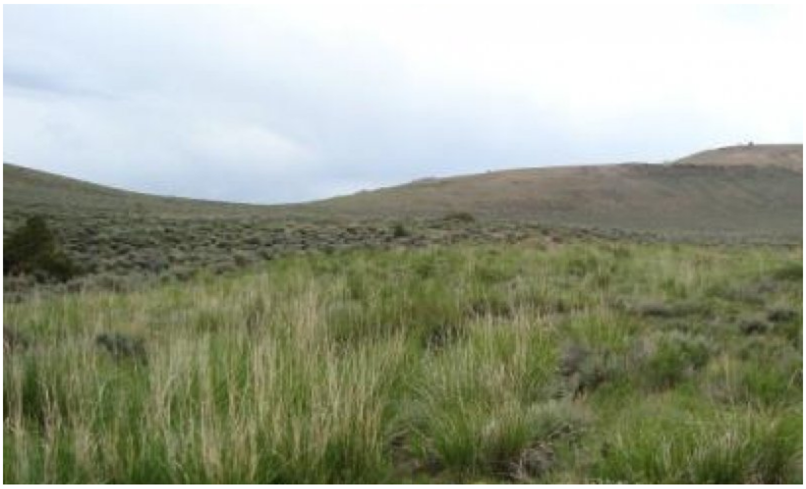


Figure 9. Typical area of community 1.1.

Figure 10. Typical area of community 1.1.

Figure 11. Typical area of community 1.1.

Figure 12. Typical area of community 1.1.

This community phase typically consists dominantly of basin wildrye, western wheatgrass, streambank wheatgrass (thickspike wheatgrass [AGRI3]), slender wheatgrass (Trachycaulus ssp. [ELTRT]), bearded wheatgrass (Subsecundus ssp. [ELTRS]), and bunch bluegrasses. Generally, grasses and rushes make up 60 to 75 percent of the total annual production, forbs 15 to 25 percent, and shrubs 10 to 20 percent. In a normal year, the annual production is 2,000 to 3,000 pounds. The diverse community consists of 15 to 20 species or more, which help to stabilize it. A decrease in the diversity of species is one of the first indicators of site deterioration. Key species that indicate a pristine, well-functioning system include nodding brome (Porter's brome [BRPO2]), mountain brome, western needlegrass, and occasionally meadow barley, snowberry, geranium, and alumroot. Species that increase in abundance under disturbance and indicate deterioration of the site include rush, big sagebrush, fleabane, herbaceous cinquefoil, bottlebrush squirreltail, foxtail barley, horsetail, Rocky Mountain iris, and rabbitbrush. The canopy cover of big sagebrush is less than 15 percent, and the annual production of rush is less than 10 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1300	1625	1950
Shrub/Vine	400	500	600
Forb	300	375	450
Total	**2000**	**2500**	**3000**

Table 6. Ground cover

Tree foliar cover	0-1%
Shrub/vine/liana foliar cover	1-20%
Grass/grasslike foliar cover	50-70%
Forb foliar cover	5-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	20-50%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0-1%
Bare ground	0-10%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	15-20%	1-5%
>0.5 <= 1	–	1-2%	25-35%	5-15%
>1 <= 2	0-1%	1-2%	20-40%	1-3%
>2 <= 4.5	0-1%	0-5%	1-10%	–
>4.5 <= 13	0-1%	0-5%	–	–
>13 <= 40	0-1%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

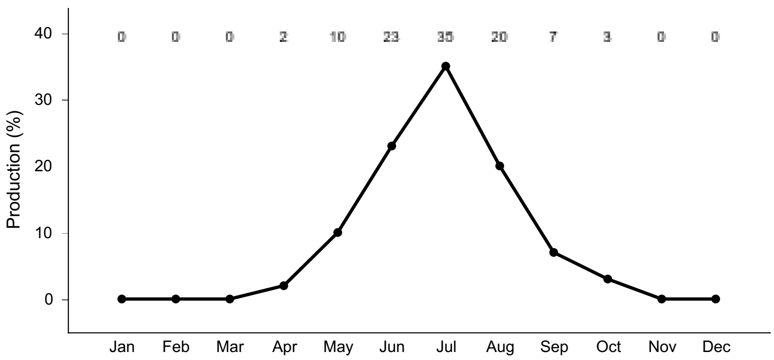


Figure 14. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

Community 1.2
Wheatgrass Dominated Swale

Figure 15. Wheatgrass dominated community.

This community phase is a result of continuous grazing by domestic livestock. Wheatgrasses, commonly western wheatgrass, provide more than 50 percent of the production in this community. Most of the production is from four or five plant species. The annual production is about 2,000 to 3,000 pounds per acre, which is similar to that of the reference community. This community phase is moderately stable. It is somewhat vulnerable to erosion due to the bare ground between the plants. The biotic integrity of the plant community commonly is intact, and the watershed commonly is functioning. The community can be at risk if the canopy cover of big sagebrush or the amount of bare ground increases.

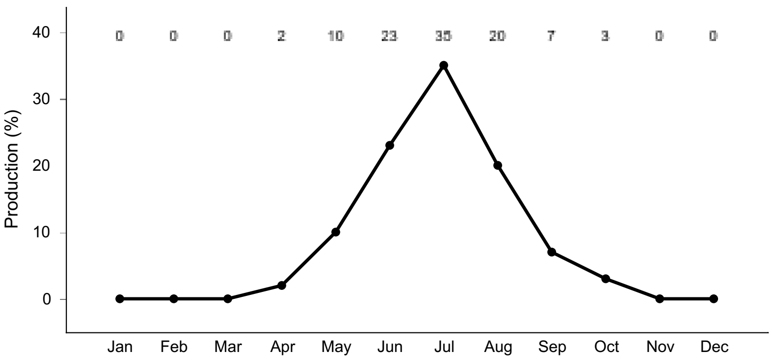


Figure 16. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

Pathway 1.1A
Community 1.1 to 1.2

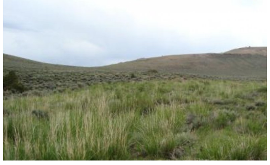
Basin Wildrye

Wheatgrass Dominated Swale

Disturbances such as fire and improper grazing use by wildlife and domestic livestock can cause a shift to a less diverse community that is dominantly wheatgrasses. Under improper grazing, cool-season bunchgrasses, such as basin wildrye, decrease in abundance and production.

Pathway 1.2A
Community 1.2 to 1.1

Wheatgrass Dominated Swale



Basin Wildrye

Proper grazing use, presence of favorable propagules, and time allow for the wheatgrass-dominated community to transition to the more diverse reference plant community. Brush management practices may be needed if the abundance of sagebrush and the amount of bare ground have increased. Care should be taken when planning these practices to consider the value of wildlife habitat.

State 2
Big Sagebrush Dominated Swale

Rush, big sagebrush, fleabane, herbaceous cinquefoil, bottlebrush squirreltail, foxtail barley, horsetail, and rabbitbrush are dominant in this state. The hydrologic function of this community is intact throughout the swale; no benches or entrenched channels are present. The water has access to the entire swale, which helps to dissipate the energy and minimize the effects of flooding. This state is unstable and at the edge of a major threshold. If it is left untreated, it likely will transition to a degraded state and a high flow event could permanently alter the hydrologic function. Degradation of upland areas influences the transition of this site from a functioning hydrology and preferred plant communities to this highly unstable community. Upland areas that develop a dense, old stand of sagebrush and minimal understory dewater swales by increasing the overland flow and loss through evaporation and decreasing the ability to capture and store water. Removal of grasses and herbaceous litter from the soil surface increases the rate of the flow of water and decreases infiltration. Water that could have been transported, infiltrated, stored, and moved to the swale at a later time is added to the already erosive overland flow; thus, larger amounts of water and sediment are flowing into the swale more rapidly and in a shorter period. Minor changes in the microclimate, especially at the periphery of swales, allow sagebrush and other obligate upland species to advance into the swales, which further dries them out.

Community 2.1
Big Sagebrush/Squirreltail

The annual production of big sagebrush makes up 15 to 20 percent of the total production of this community, and the canopy cover of big sagebrush makes up 35 percent or more of the plant community. The diversity of this community is similar to that of the reference plant community; it commonly supports 15 to 20 species. Unlike the reference plant community, however, a larger proportion of the plants are upland species that have invaded the swales. Species such as bottlebrush squirreltail, Letterman’s needlegrass, pine needlegrass, muttongrass, and upland sedges commonly indicate a transition to an altered hydrologic function. Because rush grows mainly early in spring when moisture is available and does not need sustained moisture throughout the growing season, it becomes a dominant species. Treatment may be needed if the production of rush is more than 10 percent of the total production of the community. Total production of this community is 1,200 to 1,600 pounds per acre. The dominant plants have changed from grasses to big sagebrush. This reduces the amount of fine organic material on the surface that helps to protect the soil from erosion and reduces organic matter content in the soil. Moderate and large flows can result in excessive erosion. The swales are at risk for developing deeply eroded channels and contributing higher sediment loads in streams.

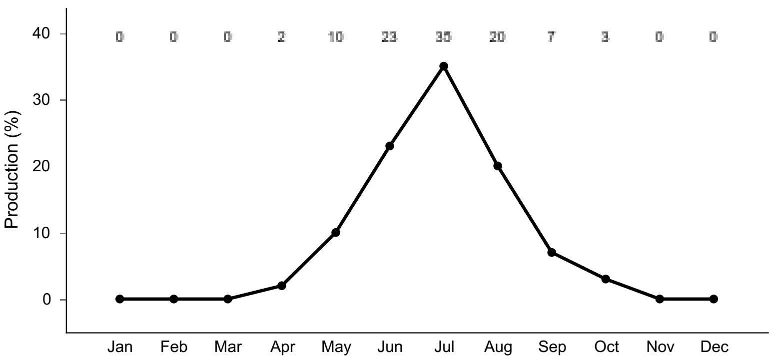


Figure 17. Plant community growth curve (percent production by month).

State 3
Degraded Swale

This state is degraded, and the hydrology is altered. The plant community and surface debris are insufficient to slow runoff and dissipate the erosive energy of the water. During flow events, the amount of fine organic material on the surface is not sufficient to stabilize the soil, slow the flow of water, and allow for infiltration. Water from the uplands builds energy as it collects in the swales and forms channels. The swales cannot dissipate the energy; thus, channelization increases and head cuts form. The channel also begins to drain subterranean water, further dewatering the system in a self-perpetuating loop. Soils in these areas may have a thinner A horizon (7 inches or less). Due to the dewatering of swales that support dominantly sagebrush, production is drastically reduced to 500 to 700 pounds per acre. Diversity of the plant community is limited to three or four species, and rush is one of the major components. The amount of bare ground is 10 to 15 percent or more. This state has two fluctuating phases. Both phases have an entrenched channel, and water has no access to the flood plain of the swales. The plant community in the channel may be similar to that of the reference state, but the majority of the swale supports a degraded sagebrush community that produces a fraction of its original potential. The least stable fluctuating community phase is subject to excessive erosion during a flow event. No vegetation is on the sidewalls or bottom of the channel. It has a distinctly V-shaped channel that widens and deepens during each flow event. In the other fluctuating community phase, the bottom of the channel is revegetated. The vegetation is similar to that of the reference community. Since the water is consolidated in a smaller area, the soils have a higher potential for exhibiting gleying and redoximorphic features. This is indicative of the low levels of oxygen associated with a water table. Common plants in the channel are those that are tolerant of flooding; thus, the abundance of obligate and facultative wetland species is higher as compared to the reference plant community. The vegetation helps to stabilize the channel during periods of minor or moderate flooding and prevent further degradation. Commonly, the channel in this phase is U-shaped.

Community 3.1
Big Sagebrush Dominated Eroding Channel

Figure 18. Big sagebrush dominated swale that has an actively eroding channel.

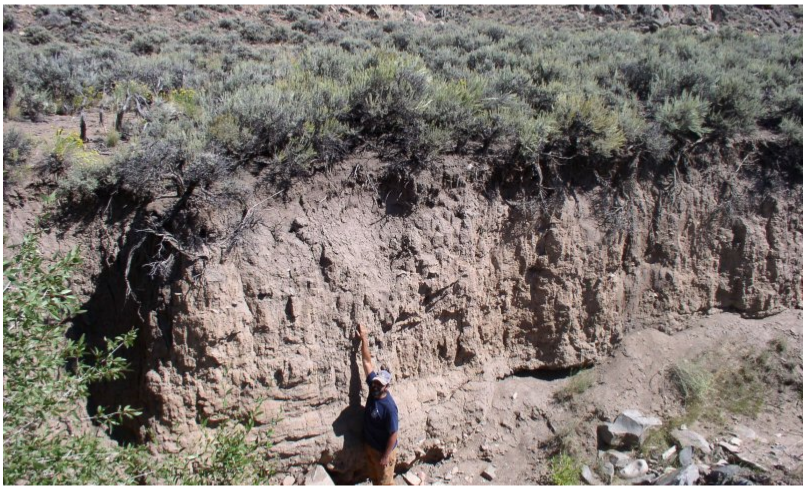


Figure 19. Big sagebrush dominated swale that has an actively eroding channel.

This community is the least stable in this state. It has an actively eroding channel and active head cuts at the top of the channel. Excessive erosion occurs during flow events due to the lack of vegetation on the sidewalls and bottom of the channel. The channel commonly is V-shaped, and it widens and deepens during each flow event. The amount of bare ground is increased. The herbaceous production is 500 to 700 pounds per acre. Rush makes up more than 10 percent of the total production of the community. The diversity of the community is very low, and few forbs are present. Eventually, the partially abandoned swale will look like a dry sagebrush “bench” above a narrow channel.

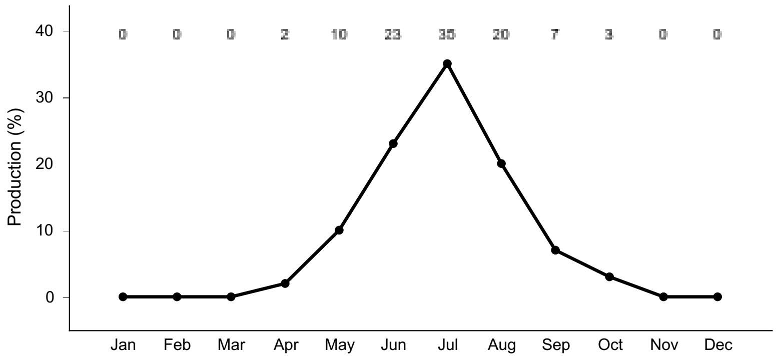


Figure 20. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

Community 3.2
Big Sagebrush Dominated with Incised Channel

Figure 21. Big sagebrush dominated swale that is not subject to active erosion.

In this community phase, the bottom of the channel is revegetated with plants similar to those in the reference community. Since the water is consolidated in a smaller area, the soils have a higher potential for exhibiting gleying and redoximorphic features. This is indicative of the low levels of oxygen associated with a water table. Common plants in the channel are those that are tolerant of prolonged periods of flooding; thus, the abundance of obligate and facultative wetland species is higher as compared to the reference plant community. The vegetation helps to stabilize the channel during periods of minor or moderate flooding. Commonly, the channel in this phase is U-shaped. The side slopes are denuded and subject to erosion. A sagebrush “bench” (elevated top slopes that have relict reference state vegetation) may be along a narrow, entrenched channel.

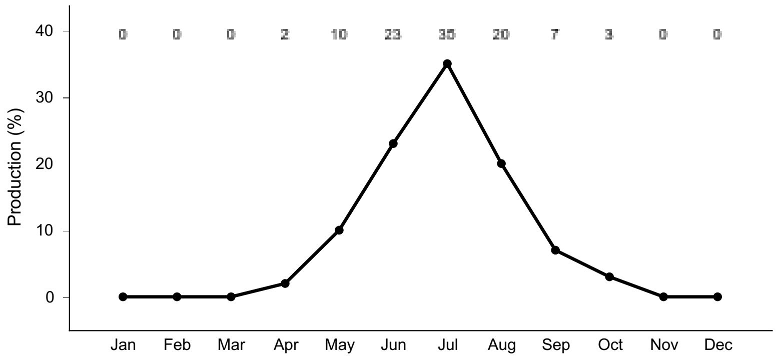


Figure 22. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

Pathway 3.1A
Community 3.1 to 3.2

Big Sagebrush Dominated Eroding Channel

Big Sagebrush Dominated with Incised Channel

Stabilizing the actively eroding areas of the swale with vegetation and ground cover helps to prevent further deterioration. Practices that promote growth of vegetation aid in this pathway.

Pathway 3.2A
Community 3.2 to 3.1

Big Sagebrush Dominated with Incised Channel

Big Sagebrush Dominated Eroding Channel

Seasonal drought, improper grazing use, fire, and large flow events may contribute to further degradation of the swale.

State 4
Rabbitbrush Dominated Swale

If sagebrush is removed by chemical treatment, mowing, or fire, resprouting rabbitbrush will become dominant.

Community 4.1
Rabbitbrush Dominated Swale

Rabbitbrush production makes up 15 to 20 percent of the annual production of the community. Rabbitbrush commonly sprouts vigorously after the above-ground biomass is removed. Although this is not the preferred community, rabbitbrush does not restrict the production of grasses and forbs as does sagebrush. It may take several years of chemical treatment to return this community to the reference plant community.

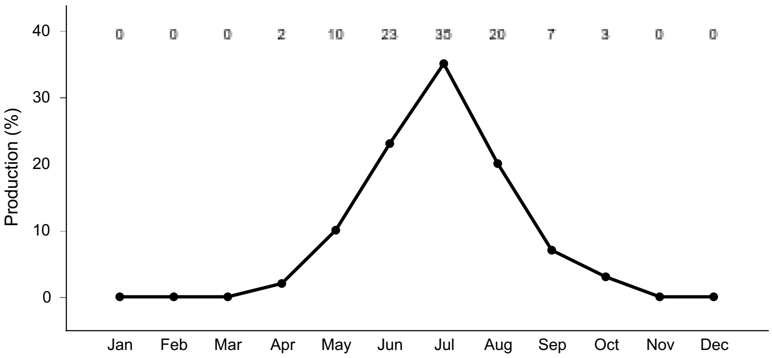


Figure 23. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

State 5
Reclaimed Swale

This community is a man-made community. Intensive inputs of time, energy, and resources are needed to restore the level of the water table to the floor of the swale instead of the bottom of the channel.

Community 5.1
Reclaimed Swale

This community phase is characterized by restoration of the level of the water table to the floor of the swale. Commonly, a large amount of site work is needed. Site work may include soil movement, brush removal, and installation of check dams to reclaim the community, but it may never be restored to the reference plant community. Areas directly behind the check dams commonly have a higher water table, which promotes growth of facultative and obligate wetland species. Areas directly below the structures do not receive the subterranean flow that was present in the original swale; thus, they are drier. This promotes invasion of upland species that typically are not in the reference plant community. Buildup of sediment in the check dams needs to be monitored. Seeding is needed to help stabilize the community.

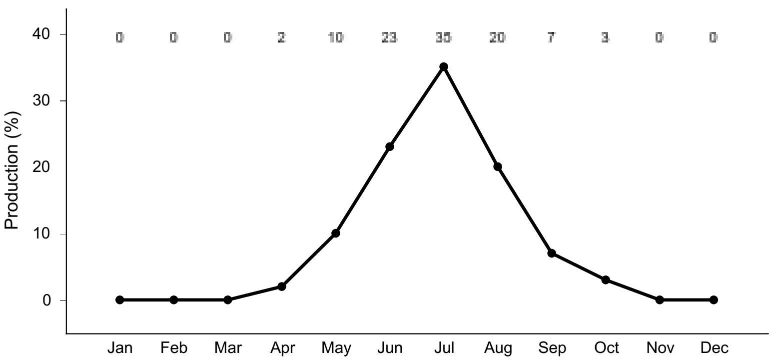


Figure 24. Plant community growth curve (percent production by month). CO4802, MLRA 48A- Mt Swale . Extended moisture availability in mid-summer.

Transition T1A
State 1 to 2

Sagebrush encroachment from adjacent upland communities as a result of prolonged drought, lack of fire, and improper grazing can alter the plant community, leaving the soils subject to erosion and altering the hydrological function. The mean fire return interval is 12 to 25 years in mesic habitats (Boyd et al., 2014). Lack of wet periods may shift the community from a grass-dominant state (State 1) to a sagebrush-dominant state (State 2).

Restoration pathway R2A
State 2 to 1

State 2 can be restored to the reference state (State 1) by removing sagebrush with fire or other treatments and applying proper grazing use by domestic livestock and wildlife. Management practices that restore the health of the upland community are critical to return the community to the reference state. Suitable practices include prescribed fire, shrub management, and proper grazing management. Several consecutive wet years also can decrease the abundance of big sagebrush because its roots are not tolerant of wetness for extended periods.

Transition T2A
State 2 to 3

Due to a lack of protection on the soil surface, large flow events quickly destabilize the site and the hydrological function is altered (State 3). Practices that further reduce the ground cover, such as improper grazing, and prolonged periods of drought can speed up this transition. Fire suppression and lack of shrub management in uplands areas that support decadent sagebrush communities promote alteration of the hydrologic function and destabilization of the swale. State 3 is an unstable community that affects soil health and the hydrologic function as it becomes invaded by big sagebrush. Gullies and head cuts form due to the lack of adequate herbaceous cover to dissipate the velocity of the water flow and encourage infiltration.

Transition T2B
State 2 to 4

Repetitive burning of big sagebrush favors growth of rabbitbrush and perennial grasses, especially basin wildrye. Mechanical and chemical removal of sagebrush encourages growth of rabbitbrush. This may be affected by the timing of treatment or the weather patterns in years following treatment.

Transition T3A
State 3 to 5

Restoring either of the community phases in State 3 to the reference plant community would require intensive inputs of time, resources, and energy. The level of the water table needs to be returned to the floor of the swale instead of the bottom of the channel. Commonly, a large amount site work is needed to reclaim the community. The site work may include soil movement, brush removal, and installation of check dams. Check dams help to minimize development of head cuts, slow the movement of water, and trap sediment. This helps to raise the channel and the water table, which allows floodwater to cover the entire swale and restores the hydrologic function. Reclaiming these areas also requires management practices that improve the upland communities. The health and restoration of the communities in swales is directly related to the health and function of the surrounding uplands.

Transition R4B
State 4 to 1

Repetitive chemical treatment of rabbitbrush may be needed to restore this community to the reference plant community.

Transition R4A
State 4 to 2

Continued sagebrush encroachment from untreated uplands and improper grazing use can contribute to the transitioning of this rabbitbrush state to that of one dominated by sagebrush.

Transition R5A
State 5 to 1

This pathway requires intensive inputs. Restoration of small areas over very long periods may be possible, but large areas commonly cannot be restored fully. This transition requires continued sedimentation, proper grazing use, and proper hydrologic contributions. The hydrological function of the reference state may be restored if the upland areas provide the hydrologic contributions.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Native Perennial Bunchgrass**			450–900	
	basin wildrye	LECI4	*Leymus cinereus*	450–900	–
2	**Subdominant Native Perennial Bunchgrasses**			400–700	
	slender wheatgrass	ELTRS	*Elymus trachycaulus ssp. subsecundus*	100–300	–
	slender wheatgrass	ELTRT	*Elymus trachycaulus ssp. trachycaulus*	100–300	–
	muttongrass	POFE	*Poa fendleriana*	100–200	–
	Sandberg bluegrass	POSE	*Poa secunda*	50–200	–
3	**Subdominant Native Perennial Rhizomatous**			200–400	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	100–400	–
	western wheatgrass	PASM	*Pascopyrum smithii*	100–400	–
4	**Subdominant Perennial Cool Season Grass-likes**			150–225	
	Northwest Territory sedge	CAUT	*Carex utriculata*	25–50	–
	sedge	CAREX	*Carex*	0–25	–
5	**Occasional Native Perennial Cool Season Bunchgrass**			100–200	
	Grass, perennial	2GP	*Grass, perennial*	50–125	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	0–125	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	25–125	–
	pine needlegrass	ACPI2	*Achnatherum pinetorum*	0–125	–
	mountain brome	BRMA4	*Bromus marginatus*	25–125	–
	Porter brome	BRPO2	*Bromus porteri*	0–125	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–50	–
	squirreltail	ELEL5	*Elymus elymoides*	0–50	–
	meadow barley	HOBR2	*Hordeum brachyantherum*	0–50	–
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–50	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–50	–
Forb					
6	**Dominant Native Perennial Forbs**			210–375	
	common yarrow	ACMI2	*Achillea millefolium*	85–125	–
	Rocky Mountain iris	IRMI	*Iris missouriensis*	50–100	–
	cinquefoil	POTEN	*Potentilla*	50–75	–
	horsetail	EQUIS	*Equisetum*	25–75	–
7	**Occasional Native Perennial Forbs**			85–125	
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–75	–
	Forb, perennial	2FP	*Forb, perennial*	30–50	–
	pale agoseris	AGGL	*Agoseris glauca*	5–25	–
	onion	ALLIU	*Allium*	0–25	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	5–25	–

	milkvetch	ASTRA	*Astragalus*	0–25	–
	Gunnison's mariposa lily	CAGU	*Calochortus gunnisonii*	0–25	–
	Indian paintbrush	CASTI2	*Castilleja*	0–25	–
	aspen fleabane	ERSP4	*Erigeron speciosus*	0–25	–
	Richardson's geranium	GERI	*Geranium richardsonii*	0–25	–
	littleflower alumroot	HEPA10	*Heuchera parviflora*	5–25	–
	silvery lupine	LUAR3	*Lupinus argenteus*	5–25	–
	American vetch	VIAM	*Vicia americana*	5–25	–
Shrub/Vine					
8	**Dominant Native Non-sprouting Shrubs**			150–225	
	Woods' rose	ROWO	*Rosa woodsii*	135–175	–
	big sagebrush	ARTR2	*Artemisia tridentata*	25–75	–
9	**Subdominant Native Re-Sprouting Shrubs**			150–225	
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	135–150	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	35–75	–
	willow	SALIX	*Salix*	0–25	–
10	**Occasional Native Cool non-sprouting Shrubs**			50–125	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	15–50	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	10–50	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	10–40	–
	shrubby cinquefoil	DAFR6	*Dasiphora fruticosa*	10–35	–
	skunkbush sumac	RHTR	*Rhus trilobata*	5–35	–
	wax currant	RICE	*Ribes cereum*	5–25	–

Animal community

This ecological site provides important habitat for wild animals and domestic livestock. It is highly productive and provides cover, food, and access to water. Due to the extended period of available water, the vegetation commonly is palatable for longer periods as compared to the surrounding uplands. Animals commonly congregate in areas of this site.

Hydrological functions

Soils originally were assigned to hydrologic soil groups based on measured rainfall, runoff, and infiltrometer data (Musgrave, 1955). Since the initial work was done to establish these groupings, assignment of soils to hydrologic soil groups has been based on the judgment of soil scientists. Assignments are made based on comparison of the characteristics of unclassified soil profiles with profiles of soils already placed into hydrologic soil groups. Most of the groupings are based on the premise that soils in a specific climatic region will have a similar runoff response if the depth to a restrictive layer or water table, the transmission rate of water, texture, structure, and the degree of swelling when saturated are similar. Four hydrologic soil groups are recognized (A, B, C, and D). For specific definitions of each group, see the National Engineering Handbook, Chapter 7, Part 630, Hydrology (http://policy.nrcs.usda.gov/OpenNonWebContent.aspx? content=22526.wba).

The hydrologic soil groups are based on the following factors:
—intake and transmission of water under maximum yearly wetness (thoroughly wet),
—unfrozen soil,
—bare soil surface, and
—maximum swelling of expansive clays.

The slope of the soil surface is not considered when assigning hydrologic soil groups. In its simplest form, the hydrologic soil group is determined by the water-transmitting soil layer that has the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present) (Caudle et al., 2013). The runoff curve numbers are determined by field investigations using the hydrologic cover conditions and hydrologic soil groups.

Hydrologic group of areas associated with this site:
Ad - Alluvial land—Group A

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission (Soil Survey Staff, 2014).

Recreational uses

The cool summers make this site desirable for a wide range of outdoor activities such as picnicking, sightseeing, photographing, wildlife watching, hiking, and camping.

Wood products

No harvestable wood products are produced in this site.

Other products

None.

Inventory data references

This ecological site occurs in the Gunnison, and Montrose field offices in the Gunnison Basin.

Other references

Boyd, C.S., J.L. Beck, and J.A. Tanaka. 2014. Livestock grazing and sage grouse habitat: Impacts and opportunities. Journal of Rangeland Applications. Volume 1, pages 58-77.

Chapman, S.S., G.E. Griffith, J.M. Omernik, A.B. Price, J. Freeouf, and D.L. Schrupp. 2006. Ecoregions of Colorado. (2-sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. Map scale 1:1,200,000.

Cleland, D.T.; J.A. Freeouf; J.E. Keys, Jr.; G.J. Nowacki; C.A. Carpenter; and W.H. McNab. 2007. Ecological subregions: Sections and subsections of the conterminous United States. Map scale 1:3,500,000. A.M. Sloan, cartographer. U.S. Department of Agriculture, Forest Service, General Technical Report WO-76. Washington, D.C.

Emslie, S.D., M. Stiger, and E. Wambach. 2005. Packrat middens and late Holocene environmental change in southwestern Colorado. The Southwestern Naturalist 50(2): 209-215.

Evers, L., R.F. Miller, M. Hemstrom, J. Merzenich, and R. Neilson. 2011. Estimating historical sage-grouse habitat abundance using state-and-transition model. Natural Resources and Environmental Issues. Volume 17, Article 16. Pages 1-13.

Goodrich, S., E.D. McArthur, and A.H. Winward. 1999. Sagebrush ecotones and average annual precipitation. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station Proceedings RMRS-P-11.

Howard, Janet L. 1999. Artemisia tridentata subsp. wyomingensis. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at https://www.feis-crs.org/feis/ (accessed 18 July, 2012).

Johnson, Kathleen A. 2000. Artemisia tridentata subsp. vaseyana. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at https://www.feis-crs.org/feis/ (accessed 28 February, 2012).

McIver, J.D., M. Brunson, S.C. Bunting, and others. 2010. The sagebrush steppe treatment evaluation project (SageSTEP): A test of state-and-transition theory. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-237. Fort Collins, Colorado.

Simonin, Kevin A. 2001. Populus angustifolia. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at https://www.feis-crs.org/feis/ (accessed 12 August, 2013).

United States Department of Agriculture, Natural Resources Conservation Service. Web Soil Survey. Available at http://websoilsurvey.nrcs.usda.gov/ (accessed 30 July, 2014).

United States Department of Agriculture, Soil Conservation Service. 1976. Range site description for Mountain Swale (245). Denver, Colorado.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, Soil Conservation Service. 1975. Soil survey of Gunnison Area, Colorado, Parts of Gunnison, Hinsdale, and Saguache Counties.

United States Department of the Interior, Bureau of Land Management. 2002. Management considerations for sagebrush (Artemisia) in the western United States: A selective summary of current information about ecology and biology of woody North American sagebrush taxa. Washington, D.C.

West, N.E., and M.A. Hassan. 1985. Recovery of sagebrush-grass vegetation following wildfire. Journal of Range Management 38(2): 131-134.

Western Regional Climate Center. Data retrieved from http://www.wrcc.dri.edu/summary/Climsmco.html on 10 May, 2012.

Winward, A.H. 2004. Sagebrush of Colorado: Taxonomy, distribution, ecology, and management. Colorado Division of Wildlife. Denver, Colorado.

Contributors

Elizabeth With
Suzanne Mayne-Kinney

Approval

Kirt Walstad, 3/05/2024

Acknowledgments

Project Staff:
Suzanne Mayne-Kinney, ecological site specialist, NRCS-MLRA, Grand Junction Soil Survey Office
Chuck Peacock, MLRA soil survey leader, NRCS-MLRA, Grand Junction Soil Survey Office

Program Support:
Rachel Murph, State rangeland management specialist, NRCS, Denver, CO
Scott Woodhall, MLRA ecological site specialist (quality assurance), NRCS, Phoenix, AZ
Eva Muller, regional director, Rocky Mountain Region, Bozeman, MT
B.J. Shoup, State soil scientist, NRCS, Denver, CO
Eugene Backhaus, State resource conservationist, NRCS, Denver, CO

Partners/Contributors:
Those involved in developing earlier versions of this site description include Bob Rayer, retired NRCS soil scientist, and Herman Garcia, retired State rangeland management specialist and MLRA ecological site specialist (quality assurance).

Site Development and Testing:
Future work is needed to validate and further refine the information in this provisional ecological site description (pESD). This will include field activities to collect low-, medium-, and high-intensity samples, soil correlation, and analysis of data.

Additional information and data are required to refine the plant production and annual production data in the tables for this ecological site. The extent of MLRA 48A requires further investigation.

Field testing of the information in this pESD is required. As this pESD progresses to the approved level, reviews will be conducted by the technical team, quality control and quality assurance staff, and peers.

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)	J. Murray, C. Holcomb, L. Santana, F. Cummings, A. Jones, P. Billig, S. Jaouen Revised May 2010: E. With, L. Santana, P. Billig, S. Jaouen, B. Saunders Updated By Suzanne Mayne-Kinney 7/27/2018
Contact for lead author	
Date	07/27/2018
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** No rills present. Very minor rill development may occur in sparsely vegetated areas. If rills were present, they likely would be widely spaced and not connected. Rill development may increase following large storm events, but the site should begin to heal during the following growing season. Frost heaving will accelerate recovery. Rill development may increase when run-in enters the site from adjacent areas that produce large amounts of runoff (i.e., steeper sites, rock outcroppings). The site is essentially level, and rills do not form.

2. **Presence of water flow patterns:** Vegetation should be persistent in the channel. Flow patterns meander around rocks, litter, and perennial plant bases. They should exhibit only minor evidence of deposition. This site is periodically inundated with runoff water due to its physiographic location.

3. **Number and height of erosional pedestals or terracettes:** Plants may have small pedestals (<1 inch) in areas adjacent to water flow patterns, but they do not have exposed roots. Terracettes should be few in number and small (3 to 6 inches). They are stable and exhibit little evidence of active erosion. Some plants may appear to have a pedestal as a

result of litter accumulating and soil collecting at the base of the plants. This appearance of a pedestal is not the result of erosion.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect <10 percent bare ground. Herbaceous communities are most likely to have less bare ground. As the species composition of shrubs increases, the amount of bare ground likely will increase. Very few, if any, bare spaces of more than 1 square foot are present. Sagebrush invasion commonly causes decreased ground cover; thus, it is an indicator of declining health. Keeping vegetation and litter on the soil surface is key to maintaining the functioning ecosystem.

---

5. **Number of gullies and erosion associated with gullies:** None; however, one main ephemeral channel may be present. If present, the channel should be highly mobile and exhibit little entrenchment and sinuousness. If influences offsite cause gullying to begin or continue, it is an indication that the site cannot stop the erosion and is in an unhealthy condition.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** No evidence of active wind-generated soil movement. Wind-scoured areas (blowouts) and depositional areas are very rare. If present, they have muted features and are mostly stabilized by vegetation or a biological crust.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter remains in place, but some redistribution is caused by water and wind movement. Very minor movement of litter may occur in flow patterns and rills with deposition at points of obstruction and plant bases. During major flooding, this site slows water and captures litter and sediment; thus, large amounts of litter movement are uncommon.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** The stability class rating expected to range from 2 to 6. Commonly, the soil surface is not very stable because of frequent deposition and weak soil formation. Litter and vegetation maintain the stability of the soil. This site should have a soil stability rating of 5 or 6 under a canopy of plants.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The soils are deep and moderately well drained or well drained. The surface layer is fine-loamy, and it has granular structure. A thick, dark surface layer that is high in content of organic matter (mollic epipedon) is standard in a functioning site. The soils in areas that have never been degraded or drained by gullies may have multiple buried A horizons to a depth of more than than 60 inches. The soils in areas where degradation has occurred may have a drastically reduced A horizon (7 inches or less).

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Because this site is on alluvial bottoms, drainageways, and flood plains, it accumulates runoff minimize the impact of raindrops, slow overland flow, and allow for increased infiltration. When perennial grasses decrease in abundance, which reduces the ground cover and increases the amount of bare ground, runoff is expected to increase and infiltration to decrease.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Naturally occurring soil horizons may be harder than the surface, but they should not be considered compaction layers.

---

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 Native Perennial Bunchgrass >= Subdominant Native Perennial Bunchgrasses > Subdominant Native Perennial Rhizomatous >= Occasional Native Perennial Cool Season Bunchgrass >>

    Sub-dominant: Dominant Native Perennial Forbs >> Subdominant Native Re-Sprouting Shrubs >=Dominant Native Non-sprouting Shrubs >= Subdominant Perennial Cool Season Grass-likes

    Other: > Occasional Native Cool non-sprouting Shrubs >= Occasional Native Perennial Forbs

    Additional: Rhizomatous grasses and bunchgrasses tend to be equally prominent in patches throughout the site. Rushes are also a fairly major component and should be considered subdominant. Shrubs and forbs combined make up about 10 to 15 percent of the production. Sedges may be present, but a water table commonly is not present during the growing season to support them; thus, they are a minor component.

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** During years of average or above-average precipitation, very little recent mortality or decadence should be apparent in the shrubs and grasses. Some mortality of bunchgrasses and other shrubs may occur during a very severe (long-term) drought. Partial mortality of individual bunchgrasses and shrubs may occur during a less severe drought.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover includes the litter under the plant canopy. Most is fine litter. Excess litter may accumulate in the absence of disturbances. Vegetative production may be reduced if the litter cover exceeds 40 percent. Litter may be reduced during a drought.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000 pounds per acre in low precipitation years; 2,500 pounds per acre in average precipitation years; and 3,000 pounds per acre in above-average precipitation years. After extended drought, production may be reduced by 500 to 1,000 pounds per acre or more.

---

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:** Kentucky bluegrass, Canada thistle, and dandelion

---

17. **Perennial plant reproductive capability:** All plants have the ability to reproduce. Limitations may be related to weather, wildfire, natural disease, interspecies competition, wildlife, excessive litter, and insects. Any of these limitations might temporarily reduce the reproductive capability of plants.