USDA Natural Resources Conservation Service

Ecological site R048AY285CO
Foothill Swale

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 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.

LRU notes

Foothill Swale ecological site occupies the roan plateau and Piceance Basin areas in MLRA 48A. Verification of this ecological site concept in other areas of the MLRA is needed before it is correlated to those areas.

Classification relationships

NRCS:
Major Land Resource Area 48A, Southern Rocky Mountains (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:

M331F- Southern Parks and Rocky Mountain Range Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331G – South Central Highlands Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

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

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

M341B – Tavaputs Plateau Section M341 Nevada-Utah Mountains Semi-Desert - Coniferous Forest - Alpine Meadow (Cleland, et al., 2007).

EPA:

21a – Alpine Zone, 21b – Crystalline Subalpine Forests, 21c – Crystalline Mid-Elevations Forests, 21d -Foothill Shrublands, 21e – Sedimentary Subalpine Forests, 21f – Sedimentary Mid-Elevation Forests, 21g – Volcanic Subalpine Forests, and 21h – Volcanic Mid-Elevation Forests < 21 Southern Rockies < 6.2 Western Cordillera < 6 Northwestern Forested Mountains North American Deserts (Griffith, 2006).
20c – Semiarid Benchlands and Canyonlands and 20e - Escarpements < 20 Colorado Plateau < 10.1 Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS: Southern Rocky Mountain Province and the southern part of Unita Basin Section Colorado Plateaus Province

Ecological site concept

The 48AY Foothill Swale was drafted from the existing Foothill Swale Range Site #285 (August, 1975). The concept was expanded upon based on soil temperature and moisture regimes, and climate and The original range site was used in MLRA 48A and 34A. The site occurs in the watershed in areas that receive extra water and fine sediment from surrounding uplands. The soils are deep and loamy in texture with high water-holding capacity. Buried surface horizons and very little rock characterize the soil profile. The soil moisture regime is aridic ustic and the soil temperature regime is frigid.

The aspect of this site is a valley grassland plant community with a rather sparse stand of shrubs. Basin wildrye, western and thickspike wheatgrasses, Indian ricegrass, squirreltail, and Sandburg bluegrass are the dominant grasses. Shrubs include basin big sagebrush, and rubber rabbitbrush.

Associated sites

R034AY298CO	**Rolling Loam** Rolling loam has medium to moderately coarse textured soils. This site is a grassland - Wyoming big sagebrush site. The dominant grasses are wheatgrass (mostly likely thickspike), needleandthread, Sandberg bluegrass, bluebunch wheatgrass and Indian ricegrass. This site was originally written for MLRA 34A & 48A in the 12 to 15 inch precipitation zone.
R034AY303CO	**Loamy Slopes** Loamy Slopes occurs on alluvial fans, terraces, hills mountains and mountainsides. Slopes is between 25 to 65%. Soils are moderately deep to deep (20 to 60+ inches). Soils are derived from alluvium from sandstone and siltstone or sandstone; residuum or colluvium from sandstone or outwash from basalt. Soil surface texture is cobbly sandy loam or cobbly, very flaggy or channery loam with loamy-skeletal textured subsurface. It is a mountain mahogany – Indian ricegrass community. It has an aridic ustic moisture regime and frigid temperature. The effective precipitation ranges from 12 to 18 inches.
R048AY307CO	**Shallow Slopes** Shallow Slopes occurs on hillsides, ridges, mountainside and canyon walls. Soils are shallow (less than 20 inches) loamy textured soils derived from residuum from sandstone and limestone. Soil surface textures are generally sandy loam or gravelly sandy loam. It is a Black sagebrush –western wheatgrass community. It has an aridic ustic moisture regime and frigid temperature regime. The effective precipitation ranges from 12 to 16 inches.

Similar sites

R048AA245CO	**Mountain Swale Gunnison Basin LRU** Mountain Swale - Mountain Valley occurs in a similar precipitation zone in the lower valley of MLRA 48A on the western slope. This site is located in the run-in position at the bottom of the hills. Characteristic plants are Basin Wildrye and Big Sagebrush.
R048AY245CO	**Mountain Swale** Mountain Swale occurs flood plains, alluvial fans, swales, stream terraces, and valley floors. Slopes is between 0 to 12%. Soils are deep (60+ inches) in depth. Soils are derived from alluvium. Soil surface texture is loam, with a fine-loamy subsurface. It is a basin wildrye-western wheatgrass community. It has a typic ustic moisture. The effective precipitation ranges from 16 to 20 inches. It receives extra moisture from surrounding uplands that drain into the area. These areas are sloped themselves and drain into perennially wet areas. They have well drained soils and ephemeral streams.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. tridentata* (2) *Chrysothamnus nauseosus*
Herbaceous	(1) *Leymus cinereus* (2) *Elymus lanceolatus*

Physiographic features

This ecological site occurs in swales, valley bottoms, stream terraces, flood plains, small drainages and along

intermittent streams which receives run-in from adjacent uplands. Elevations for this site generally occur between 6000 feet to 7400 feet above sea level. Most common slopes occur between 1-12 percent.

Typically, due to differences in the depth to bedrock and the water table, valley width, and slope, this site often has small inclusions of Swale Meadow or Mountain Meadow at upper elevations will have year round water table rather intermittent run-in from adjacent sites. Surrounding upland sites are stony foothill (R048AY287CO), loamy slopes (R048AY303CO), clayey foothill (R048AY289CO) and Pinyon-Juniper (F048AY909CO) ecological sites.

Table 2. Representative physiographic features

Landforms	(1) Swale (2) Drainageway (3) Valley floor (4) Alluvial fan (5) Flood plain (6) Stream terrace
Runoff class	Low
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,829–2,256 m
Slope	0–12%
Aspect	Aspect is not a significant factor

Climatic features

This site may receive anywhere from 12-18 inches of water (precipitation and run-in) throughout the year with about 50-60% coming as snow. Run-in is defined as significant amounts of upland runoff from snow melt and periodic precipitation events that adds extra water to this site. Foothill swales may have ephemeral streams and subsurface flows that can sustain the system most of the spring and early summer but generally dry in the late summer to early fall. They have a lengthened growing season when compared to surrounding uplands that can extend into early August as long as moisture remains available. During the winter months, plants are protected from extreme cold with continuous snow cover. The average total snowfall is 70.8 inches at the Meeker-climate station. The highest snowfall recorded at Meeker was 117.6 inches which occurred in 1955. Optimum growing season for native plants is late spring through the middle of the summer. The frost-free period ranges from 90 to 110 days. The last spring frost is the end of May to middle of June and the first frost can be as early as the middle of September to the first week of October. Mean annual temperatures range from 85 to 6 ºF. The coldest winter temperature recorded was -43ºF on January 7, 1913 and the coldest summer temperature was 20ºF recorded on June 1, 1922. Mean annual air temperature is ranges from 43 to 47 ºF. Climate data is from the Western Regional Climate Center (2015).

This site has frigid temperature regime and a aridic ustic/typic ustic moisture regime.

Table 3. Representative climatic features

Frost-free period (characteristic range)	74-84 days
Freeze-free period (characteristic range)	101-112 days
Precipitation total (characteristic range)	432 mm
Frost-free period (actual range)	71-87 days
Freeze-free period (actual range)	98-115 days
Precipitation total (actual range)	432 mm
Frost-free period (average)	79 days
Freeze-free period (average)	107 days

Precipitation total (average)	432 mm

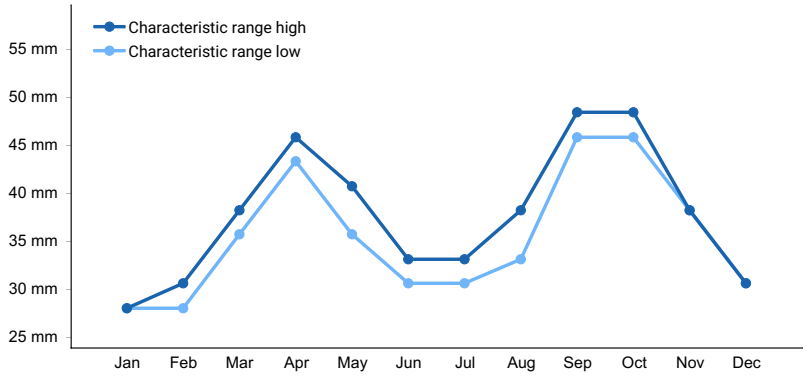


Figure 1. Monthly precipitation range

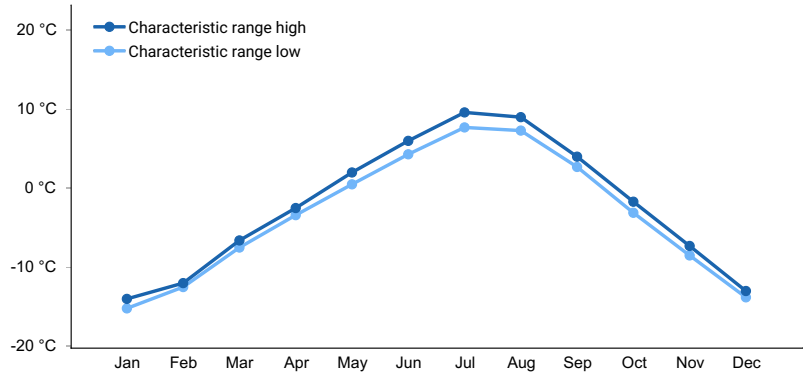


Figure 2. Monthly minimum temperature range

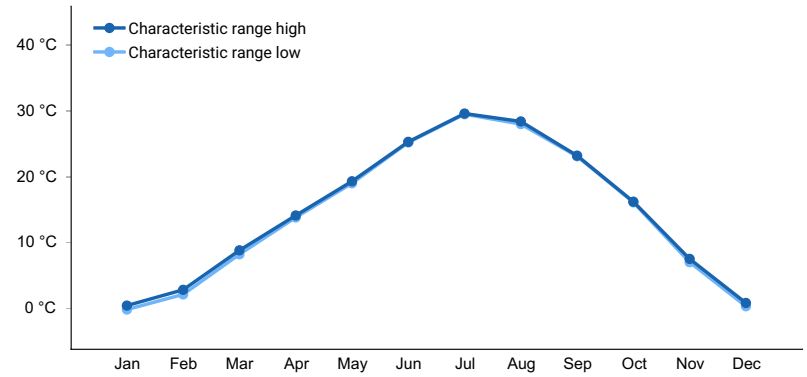


Figure 3. Monthly maximum temperature range

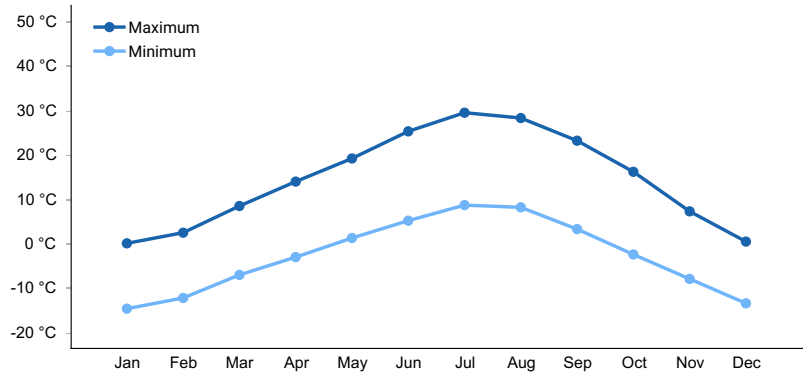


Figure 4. Monthly average minimum and maximum temperature

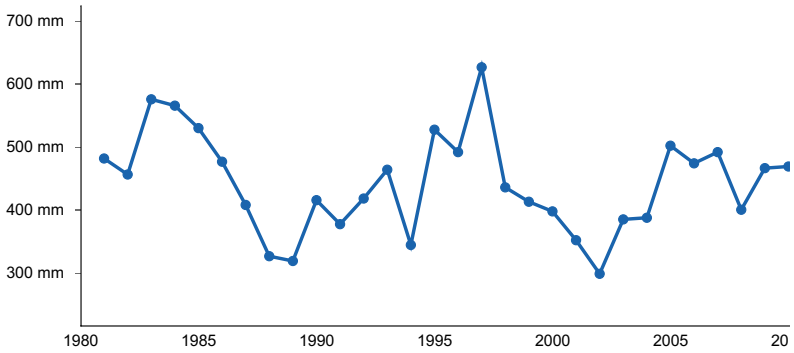


Figure 5. Annual precipitation pattern

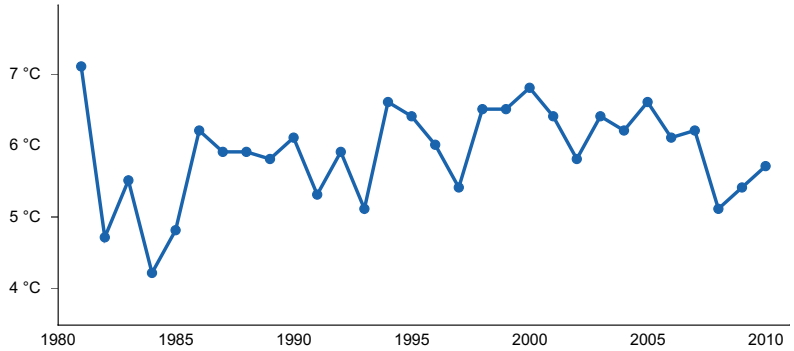


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MEEKER [USC00055484], Meeker, CO
- (2) CRAIG 4 SW [USC00051932], Hamilton, CO

Influencing water features

This ecological site is located in swales and valleys. It receives extra moisture from surrounding uplands that drain into the area. These areas are sloped themselves and drain into perennially wet areas. They have well drained soils and ephemeral streams. The water table is usually greater than 60 inches. Periodic flooding is not unusual as long as it is less than 14 days. Gleying and mottles are often present in lower portions of the profile.

Soil features

Soils are deep to very deep (60+) soils that have a high water holding capacity. The soil surface textures are usually a sandy loam and loam. Clay percentage ranges from 10 to 25% on the surface and from approximately 15 to 35% in the subsurface. Often, the profile is loamy throughout but the uplands surrounding the drainage and parent materials are highly influential on the swale's soil profile's textures. Subsurface textures normally found are sandy loam, loam and silt loam. There can be a wide range of subsurface textures due to the layer stratification in the soil on this site. Occasionally, there can be layers of gravels and cobbles (up 20% rock fragments) and /or carbonates depending on adjacent sites soil properties that washed onto this site during a previous large precipitation event.

The soils receive periodic overflow and sometimes sediment from the adjacent slopes. There is little pedogenic (in-situ) soil development because of the frequent deposition and a transient, intermittent channels making soil subsurface highly stratified. Soils in areas that have never been degraded or drained by gullies may have multiple buried A horizons (soil surface layers). There is no apparent water table during the growing season. Present-day redoximorphic features may be present below 36 inches that may indicate the presence of an elevated water table for short durations outside of the growing season. The soils and landscape position play an important hydrological function in slowing runoff and allowing water to infiltrate. They help to reduce flooding and prolong water availability throughout the dry season.

Soils in this site include: Havre loam and Glendive fine sandy loam.

Soil data in this section are from the Soil Survey Rio Blanco County Area (1982) and updated from more recent field work collected between the years of 2009 to 2013. Soil mapunit components need to be updated in this area to reflect the mesic/frigid temperature differences.

Table 4. Representative soil features

Parent material	(1) Alluvium–shale (2) Alluvium–sandstone and shale
Surface texture	(1) Fine sandy loam (2) Loam (3) Clay loam (4) Gravelly sandy clay loam
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–10%
Available water capacity (Depth not specified)	8.13–19.05 cm
Calcium carbonate equivalent (Depth not specified)	0–5%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Soil reaction (1:1 water) (Depth not specified)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–25%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

This site is based on the range site Foothill Swale - R048XY245CO/R034XY285CO) from August 1975. (SCS, 1975). This original site concept was written for the two MLRAs 48A (mountainous ares of Colorado) and 34A in the Piceance Basin. This ecological site is described and data was collected primarily in the Piceance basin with an Aridic Ustic soil moisture phase and frigid temperature regime. This ecological site is located in draws, small valley bottoms and drainage-ways in Piceance Basin. Herbivory and fire are the dominant disturbance factors in the sagebrush biome (Boyd et. al., 2014). Removal or repeatedly detrimental application of either of these disturbances on the system and/or the landscape can result in a shift of the ecological dynamics of this system. The ecological dynamics of the associated uplands are influential to the dynamics of this site. Excessive runoff and erosion from degraded uplands can increase concentrated flow and increased potential erosion towards gully formation. This site is located in the bottoms where fire occurred more frequently, removing brush and keeping it in a grassland state.

The plant community on this site is very productive and relatively resilient compared to its surrounding uplands. It has deep soils with good water holding capacity that receive a large amount of moisture from run-in and overflow water. Because of these factors many of these sites are now or once were cleared and converted to agricultural lands depending on their accessibility.

This site is dominated by perennial grasses but shrub species are present with Basin Big Sagebrush being the most abundant Although this site evolved with grazing and is relatively durable, it will be affected negatively with continuous heavy grazing pressure. Livestock are attracted to these sites because they are so productive and these sites lie in low areas with gentle slopes. Proper distribution of livestock is critical. Appropriate placement of fencing,

water, and salt/supplement is necessary. Heavy grazing combined with drought and/or lack of fire, will cause this site to become shrub dominant. As shrubs increase and perennials are weakened due to heavy grazing and/or drought, undesirable annuals such as cheatgrass may invade the site.

As perennial grasses with fibrous root systems are replaced by weaker annuals, erosion may occur more rapidly. Runoff from the uplands can cause channels to form and incise dropping the water table. As soils dry out, greasewood may begin to invade into these sites. This seems to occur more frequently at lower elevations.

A Greasewood state occurs in the similar foothill swale ecological site in MLRA 34B where the temperature regime is mesic and not frigid. The 2 foothill swale sites have not been broken out in published soil survey and this will be need to be done in the future. Greasewood invades and can eventually dominate foothill swale sites when adjacent to salty ecological sites when dewatered. This typically occurs in the lower ends of the drainages, possibly because of salt accumulations from upstream or salt layers that are exposed through erosion and where the landscape has transitioned to mesic temperature regime.

Soils, topographic location, climate, periodic droughts and fire influenced the stabilization of the Reference State on this site as was the case on most high mountain valley ecological sites. The Reference State is presumed to be as found by European settlers in the early 1800's developed under the prevailing climate over time along with the soils in their topographic location. Grazing and/or browsing by wildlife influenced the plant community as well. The resulting plant community was a cool season bunchgrass/shrub community. Sagebrush below 8500 feet has been slower to recover from settlement of the west (Winward, 2004). This site has been found to have basin big sagebrush.

Natural fire played an important role in the function of most high mountain valley sites, especially the sagebrush communities. Grasses such as needlegrasses and blue grasses were dependent upon fire to stimulate them. Fire also kept sagebrush stands from getting too dense, while invigorating other sprouting shrubs. Fire helped to keep a balance between the grasses, forbs and shrubs. Plant community dynamics were improved by opening up canopies and stimulating forb growth creating a mosaic of different age classes and species composition. Other than Wyoming big sagebrush, the deep rooted species that grow on the site are not easily damaged by fire (BLM, 2002). Shrubs which re-sprout (yellow rabbitbrush, rubber rabbitbrush), are suppressed for a time allowing grasses to dominate. If periodic fire or some other method of brush control is not used, then sagebrush will slowly increase and can begin to dominate the site.

Fire size prior to 1850 were most likely a large number of small to medium size mosaic burns and since 1980 can be typified by a few very large fires due to human caused changes (Evers, et al, 2011). This change in fire return intervals and intensities was cause by fire suppression and reduced fine-fuels from livestock grazing practices around the late 1800’s and early 1900’s. Since fire is not always available to be applied, then other shrub management may necessary from time to time to help keep the community in balance. Treatment response will vary among sites due to differences in vegetation composition and abundance, soils, elevation, aspect, slope and climate (McIver, et al, 2010).

There has been shrub die-off in several sagebrush taxa in the past 10-15 years due to several factors. The two dominant factors are disease/pathogens and drought. Die-off due to disease/pathogens is believed to be tied to disease or stem/root pathogens occurring in dense over-mature sagebrush stands throughout the west. While in some areas, when the factors of drought and heavy browsing occurring in conjunction with disease/pathogens complete areas are dying.

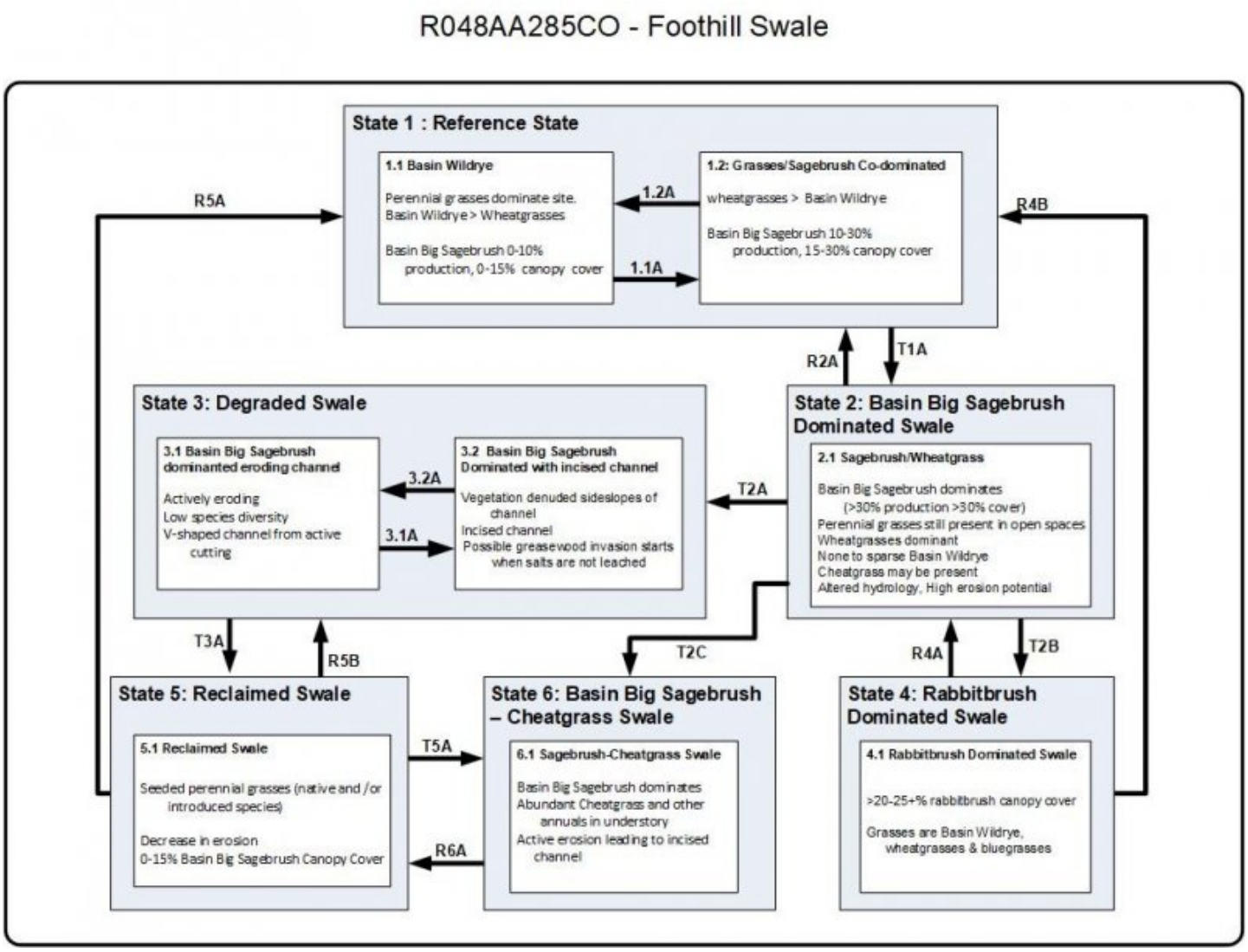
Small wet areas can occur occasionally when the bottoms are very narrow and small, allowing for more water accumulation. This may support willows, sedges and rushes and may be a small inclusion of a mountain meadow or swale meadow ecological site. Narrowleaf cottonwoods can occasionally be found in these inclusion areas. Narrowleaf cottonwood are reported to be a facultative wetland species which are tolerant of frequent and prolonged flooding and are not drought resistant (Simonin, 2001). This site is typically too dry to sustain cottonwoods.

A weedy community that has not been depicted on the model can arise if domestic grazing is completely excluded or if there is repetitive, season-long, heavy domestic or wild ungulate use. With grazing exclusion, a thick thatch of residual litter build-up results in shading and a reduction of health, vigor and production of all plants. Improper domestic and wild ungulate grazing use results in preferred species being repeatedly clipped which decreases their

health, vigor and production. Both make a site susceptible to invasion by noxious and/ unsuited species.

Variability in climate, soils and aspect and complex biological processes will cause the plant communities to differ. Fluctuations in species composition and relative production may change from year to year depending upon precipitation and other climatic factors. The species lists provided within this document are not a complete list of all occurring or potentially occurring species on this site. These species lists are not intended to cover the full range of conditions, species and responses of the site. The State & Transition model depicted for this site is based on available research, field observations and interpretations by experts and could change as knowledge increases. This is the interpretive plant community and is considered to be the Reference State. This plant community evolved with grazing, fire, and other disturbances such as drought. This site is well suited for grazing by domestic livestock and wildlife and can be found on areas that are properly managed prescribed grazing.

State and transition model



Legend

1.1A, 3.1A, T1A – lack of fire, time without disturbance, extended improper grazing, extended drought, lack of insect or pathogen outbreaks and/or lack of run-in water from adjacent uplands
1.2A, 3.2A, R2A – Fire, proper grazing, wet climatic cycles, vegetative treatments, and/or small scale insect/ pathogen outbreaks
T2A, R5B – extended drought, lack of fire, extended improper grazing, lack of insect or pathogen outbreaks and/or large flow event(s)
T2B – repeated fires, and vegetative treatment of sagebrush
T2C, T5A – introduced of invasive annual grasses and forbs, prolonged drought, lack of fire, improper grazing, and or surface disturbances,
T3A – time, resource and energy intensive inputs, water table restored to entire swale, erosion control structure may be necessary
R4A, R4B – time without disturbance, sagebrush re-establishment, treatment of rabbitbrush, seedings, and/or proper grazing
R5A – time, resource and energy intensive, seedings, vegetative treatments, time with out disturbances and/or proper grazing.
R6A – time, resource and energy intensive inputs, sagebrush removal, treatments of invasive species, seedings, and/or proper grazing

State 1
Reference

This state consists of two major plant communities, 1) Basin Wildrye with low Basin big sagebrush shrub cover and 2) Wheatgrasses/Basin Wildrye with basin big sagebrush. In community 1.1, the grasses are the dominant component. In community 1.2, grasses may be dominant or co-dominant with basin big sagebrush.

Community 1.1
Basin Wildrye

Figure 7. Basin Wildrye Community

This plant community is dominated by cool season grasses with shrub species being a minor component. Probable vegetation for this state is estimated to be 70-75% grass and grasslike plants, 5-10% forbs, and 10-20% shrubs. The dominant grass found on this site is basin wildrye. The subdominant grasses are western and thickspike wheatgrass. Other common grasses found on this site are wheatgrass, needle and thread and sandberg bluegrass. Sand dropseed is the lone warm season grass that has been infrequently observed on this site (take out and mention when present have changes to 34B site). Principal forbs are yarrow, fleabane, globemallow, phlox, Louisiana sagewort, and wild buckwheat. The dominant shrub found on this site is basin big sagebrush with rabbitbrush species being subdominant. A typical plant composition based on air-dry weight for this state consists of 40-55% basin wildrye, 15-45% rhizomatous wheatgrasses, 0-5% , Sandburg bluegrass, 0-5% needle and thread. 15-20% makeup the other grasses. Scarlet globemallow, and western yarrow make up around 0-3% of the annual

forb production. Shrubs consist of 10-15% basin big sagebrush, 5-10% other woody species. The total annual production (air-dry weight) of this state is around 2000 lbs. per acre but it can range from around 1000 lbs. on unfavorable years to over 3000 lbs. in years when there is high precipitation that falls during the growing season. The percentage of shrubs in this state will fluctuate depending on frequency and intensity of disturbances such as fire, or grazing. Typically the sage brush increases until fire is introduced to the system. Following the fire rabbitbrush and annual forbs will increase creating a rabbitbrush/weedy state that will be phased out as perennial grasses and sagebrush reestablish themselves. In a normal year, this site, is capable of producing 2000 to 3000 pounds per acre annually and is a very diverse community with 15-20 or more species present throughout the site. This diversity adds to a site's stability. Often, decreasing diversity can be one of the first indicators of site deterioration. Key species that indicate a pristine and functioning system include:. Species that often act as increasers with disturbance and indicate a deteriorating site include: basin big sagebrush, fleabane, herbaceous cinquefoil, bottlebrush squirreltail, foxtail barley, and rabbitbrush. This site has less than 15% big sagebrush canopy cover.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	785	1681	2578
Shrub/Vine	224	336	448
Forb	112	224	336
Total	**1121**	**2241**	**3362**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	5-8%
Grass/grasslike basal cover	55-65%
Forb basal cover	1-3%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-70%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	5-10%

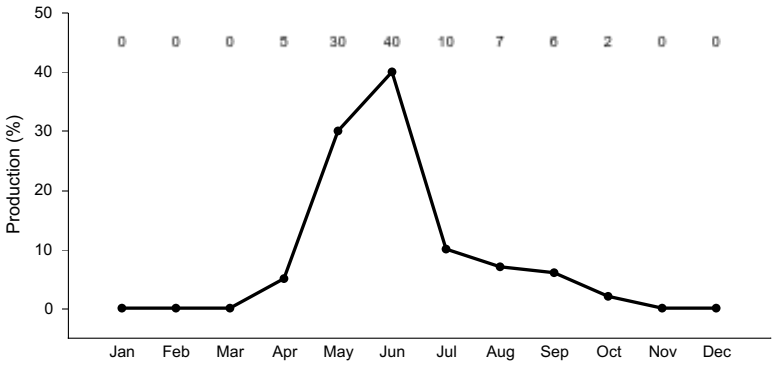


Figure 9. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

Community 1.2

Grasses/Sagebrush Co-dominated

Figure 10. Wheatgrass Plant Community

This state occurs when there are low frequencies of fire coupled with heavy grazing, and/or drought. The rabbitbrush increases due to the disturbance and decrease of competition from the grasses and then is phased out by basin big sage brush. The basin big sagebrush continues to increase as perennial grasses are weakened by drought or improper grazing. The grasses remain dominant, however their composition does change. Streambank wheatgrass increases to become dominant or co-dominant with basin wildrye. Streambank wheatgrass is more tolerant to grazing than basin wildrye which has elevated growing points. If grazed consistently heavy in the spring and early summer when basin wildrye is palatable, it will decline. Streambank wheatgrass can handle periodic flooding as well as drought conditions fairly well. This state is moderately stable, although susceptible to erosion due to the increase of bare ground under and around sagebrush canopy. If fire is not introduced to this system it may begin to cross a threshold to a sagebrush dominated state. During this phase Kentucky bluegrass and small amounts of cheatgrass and lambsquarters may begin to invade the site. The plant community evolved under continuous grazing by domestic livestock. This community is a reflection of a disturbance. It is dominated by wheatgrasses, often western wheatgrass, which can be greater than 50% of this community phase's herbaceous (grass and forb) production. The diversity of this phase is limited with the vast majority of the production coming from only 4 to 5 species. The state is moderately stable and somewhat vulnerable to erosion due to more bareground between the plants. The biotic integrity of this plant community is usually intact. The watershed is usually functioning. However, it can become at risk when canopy cover of big sagebrush and/or bare ground increases.

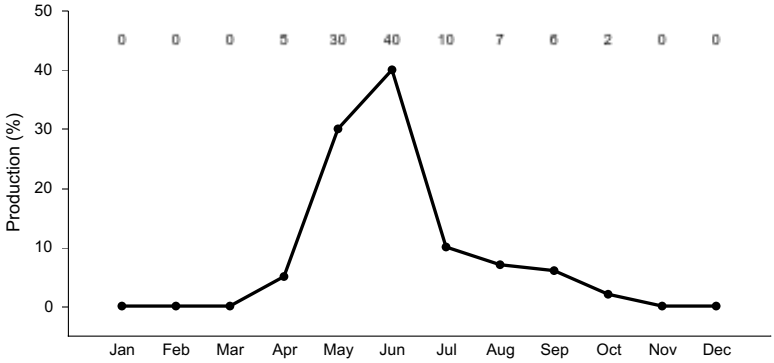
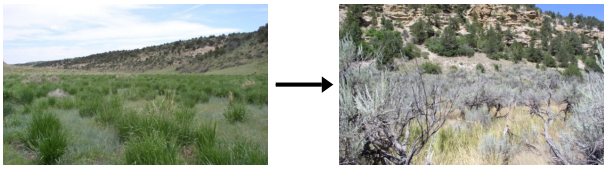


Figure 11. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

Pathway 1.1A
Community 1.1 to 1.2



Basin Wildrye

Grasses/Sagebrush Co-dominated

Lack of disturbances, lack of fire, insect and pathogen outbreaks, and improper grazing use by both wildlife and domestic grazers can cause this community to shift to a less diverse community dominated by wheatgrasses and basin big sagebrush. Cool season bunchgrasses such as basin wildrye will decrease in frequency and production with improper grazing.

Pathway 1.2A
Community 1.2 to 1.1

Grasses/Sagebrush Co-dominated

Basin Wildrye

Proper grazing use, fire, wet climatic cycles, insect or pathogen outbreaks, and/or vegetation treatments should allow this sagebrush dominated community to transition to the more diverse Basin Wildrye plant community. Brush management practices may be necessary if the sagebrush and bareground has increased. Care should be taken when planning brush management practices to consider wildlife habitat and edge values.

State 2
Basin Big Sagebrush Dominated

This state occurs when there are low frequencies of fire coupled with heavy grazing, and/or drought. The rabbit brush increases due to the disturbance and decrease of competition from the grasses and then is phased out by basin big sagebrush. The basin big sagebrush continues to increase as perennial grasses are weakened by drought or improper grazing. The grasses remain dominant, however their composition does change. Streambank wheatgrass increases to become dominant or co-dominant with basin wildrye. Streambank wheatgrass is more tolerant to grazing than basin wildrye which has elevated growing points. If grazed consistently heavy in the spring and early summer when basin wildrye is palatable, it will decline. Streambank wheatgrass can handle periodic flooding as well as drought conditions fairly well. This state is moderately stable, although susceptible to erosion due to the increase of bare ground under and around sagebrush canopy. The plant composition of this state is 50-65% perennial grasses, 5-10% forbs and 20-35% shrubs. The annual production drops to around 1500 pounds an acre in an average year. If fire is not introduced to this system it may begin to cross a threshold to a sagebrush dominated state. During this phase Kentucky bluegrass and small amounts of cheatgrass and lambsquarters may begin to invade the site. This state arises when there has been prolonged fire suppression along with heavy grazing and/or drought. Basin big sagebrush is now the dominant species contributing over 35% of the production of the site. Streambank wheatgrass and western wheatgrass are the major grasses in this scenario, along with sandberg bluegrass, bottlebrush squirreltail, and Indian ricegrass. These are all grasses that are favored as soils are drying. There is little to no basin wildrye left in this community. Kentucky bluegrass and cheatgrass may invade as native grasses are weakened due to heavy grazing and increased competition by basin big sagebrush. The hydrology of the site is beginning to be altered as the water table lowers due to the lack of grasses. This state's annual production may be around 800-1200 pounds an acre in an average year. If heavy grazing continues to occur shrubs will continue to increase and perennial grasses will begin to be replaced by annuals such as cheatgrass. This state may return to the reference state through Prescribed fire or brush management by chemical or mechanical means followed by reseeding. A prescribed grazing plan should be applied which should include a deferment period of 2 to 3 years or more depending on the site to allow. Rush, big sagebrush, fleabane, herbaceous cinquefoil, bottlebrush squirreltail, foxtail barley, equisetum - horsetail, and rabbitbrush have increase and become dominant plants in this state. The hydrologic function of this community is still intact throughout the entirety of the swale. Meaning, there is no bench or entrenched channel. The water has access to the entirety of the swale for flooding and energy dissipation purposes. This state is a very unstable state at the edge of a very major threshold and this would be the latest time to treat the site, with the least amount of energy, and expect to restore it to the reference plant community. Without treatment there is high probability of a transition to a greatly degraded state with a high flow event that could permanently alter the hydrologic function of the site. Upland site degradation is a huge influence in allowing the progression of the transition from a site with functioning hydrology and preferred plant communities to this highly unstable community. Uplands that develop dense, aged sagebrush stands with little understory dewater a swale by increasing overland flow and evaporative loss and decreasing a site's ability to capture and store water.

The removal of grasses and herbaceous litter from the soil surface decreases the site's ability to slow water and allow for infiltration. Thus, water that once could have been safely transported, infiltrated, stored and moved to the swale at a later period is now added to the already erosive overland flow at the same time. Meaning, larger amounts of water and sediment are running onto the swale more rapidly in a shorter period of time. These minor changes in the microclimate, especially on the periphery of the swale, are enough to allow for the sagebrush to continue advancing into the swale along with other obligate upland species and further perpetuating the drying.

Community 2.1
Basin Big Sagebrush Dominated Swale

Figure 12. Sagebrush Dominated Community

The total annual production from big sagebrush is 15-20% of the community phase total. Big sagebrush canopy cover will have increased to 35% or greater of the plant community. This community, like the reference plant community, is diverse often with 15-20 species. However, unlike the reference plant community, a larger proportion of the diversity comes from upland plants invading the drying swale. Species like bottlebrush squirreltail, Letterman's/pine needlegrass, muttongrass and upland sedges often indicate that the system is transitioning into a site with altered hydrologic function. Rush, only a minor component in other communities begins to increase in the sagebrush understory as the dominate species to greater than 10% of the annual production. This is due to the fact that rush plants tend to grow mainly in early spring when moisture is available and does not need sustained moisture throughout the growing season. Rush production greater than 10% should be an indicator to managers that closer evaluation and treatment may be needed. Production is 1200 to 1600 pounds per acre. The dominate plants have changed from grasses to big sagebrush. There is a reduction of fine organic material to protect soil from erosion leading to organic matter depletion. Moderate and large flow events can result in immense amounts of erosion. A swale that was once a depositional zone prior to sagebrush invasion can become at risk for developing deeply eroded channels and contribute to higher stream sediment loads.

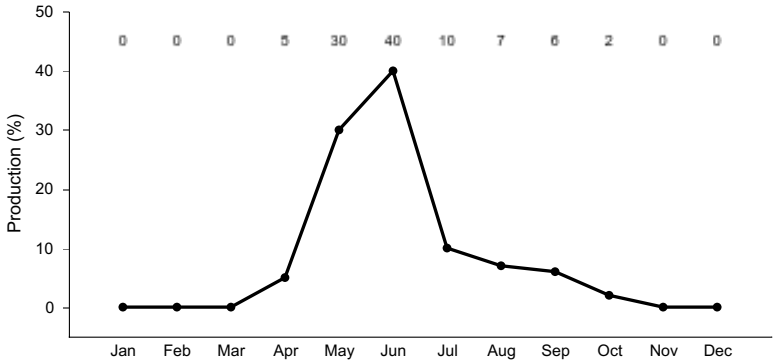


Figure 13. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

State 3
Degraded

This is a degraded state and the hydrology of this site has been altered. The plant community and surface debris

are no longer capable of slowing runoff and dissipating the water's erosive energy. In flow events, fine organic materials are not present to stabilize soil, slow water and allow infiltration. Instead, water from the uplands builds energy as it collects in the swale and begins to form a channel. As the water becomes more channelized, the swale becomes even less capable of dissipating the energy and channelization increases moving down the system and a head-cut start moving up the system. The channel also begins to drain subterranean water, further dewatering the system in a self-perpetuating feedback loop. Soils in these areas may see drastically reduced A horizons (7" or less). Due to the dewatering trend that has occurred in the sagebrush dominated swale State 2, production of this altered community is drastically reduced to 500-700 pounds per acre. Diversity is severely restricted to three or four different species with rush being one of the major components. The bare ground is also increased to 10-15%, or higher. With the lower water availability this allows greasewood to possible invaded in this state. More research is needed into the greasewood plant community in this area. This state has two fluctuating phases. Both phases have an entrenched channel where water has no access to the swale floodplain and although vegetation in the channel may return to a community similar to the original reference state (if not a little wetter), the majority of the swale remains in the degraded sagebrush dominated state producing only a fraction of its original potential. The first community is the least stable with high levels of erosion occurring with any flow event. There is no vegetation on the sidewalls or the bottom of the channel. It has a distinctly V shaped channel profile that widens and deepens with every flow event. The second community is where healing is occurring and he bottom of the channel has become re-vegetated. The vegetation is similar to that of the reference community with some exception. Since there is the same amount of water consolidated to a smaller are, the soils have a greater potential to show gleying and redoximorphic features that indicate low oxygen environments that are associated with the presence of a water table. Thus, plants that often inhabit the channel are those that have a greater tolerance for flooding. This means that often the amount of obligate and facultative wetland species are increased beyond that of the reference plant community. The channel vegetation helps to hold the channel in minor to moderate flooding events and prevent further degradation. Often sites in this phase develop U shaped profiles.

Community 3.1
Basin Big Sagebrush Dominated eroding Channel

This community is the least stable community within this state. This state has actively eroding channel with active head-cuts at the top of the eroding channel. There are high levels of erosion occurring with any flow event due to the lack of vegetation on the sidewalls and the bottom of the channel. Often there is a distinctly V shaped channel that widens and deepens with every flow event. Bareground has increased and herbaceous production has been reduced to 500-700 pounds per acre. The rush production has increased proportionally to greater than 10% of the sites total production. There is very low species diversity and a majority of the forbs are gone from the community. The site is eroding to create a partially abandoned swale that will look like a drier sagebrush bench above a narrower channel (swale).

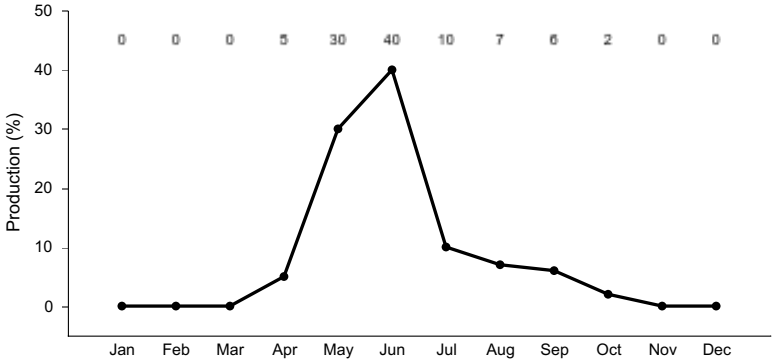


Figure 14. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

Community 3.2
Basin Big Sagebrush Dominated incised channel

This phase is where healing is occurring and he bottom of the channel has become re-vegetated. The vegetation is similar to that of the reference community with some exception. Since there is the same amount of water consolidated to a smaller are, the soils have a greater potential to show gleying and redoximorphic features that indicate low oxygen environments that are associated with the presence of a water table. Thus, plants that often

inhabit the channel are those that have a greater tolerance for flooding. This means that often the amount of obligate and facultative wetland species are increased beyond that of the reference plant community. The channel vegetation helps to hold the channel in minor to moderate flooding events and prevent further degradation. Often sites in this phase develop U shaped profiles.

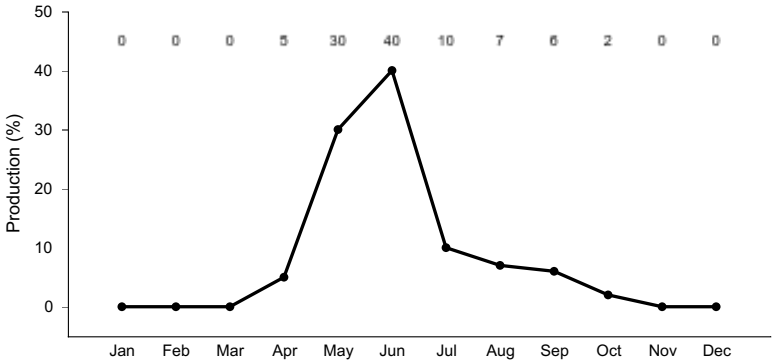


Figure 15. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

Pathway 3.1A
Community 3.1 to 3.2

By stabilizing actively eroding areas with vegetation and ground cover the swale can begin to heal and further deterioration can be reduced. Any practice that promotes vegetation will aid in this transition. possible mechanisms of transition are lack of fire, time without disturbance, extended, improper grazing, extended drought, lack of insect or pathogen outbreaks

Pathway 3.2A
Community 3.2 to 3.1

Possible mechanisms of transition are fire, proper grazing, wet climatic cycles, vegetative treatments, and/or small scale insect/ pathogen outbreaks

State 4
Rabbitbrush Dominated

A system dominated by rabbitbrush is a system in which the vegetation has been removed by chemical treatment, physical means (mowing) or fire often in attempted to remove invading sagebrush. Rabbitbrush is a re-sprouter and will increase after disturbance.

Community 4.1
Rabbitbrush Dominated Swale

Rabbitbrush production is 15-20% of the annual production. Rabbitbrush is a re-sprouter that often vigorously sprouts after removal of the aboveground biomass. Although this is not a preferred state, it is often better than sagebrush dominated swale because the rabbitbrush does not restrict grass and forb production. However it can be difficult to move this community back to the reference plant community often taking several years of chemical treatment.

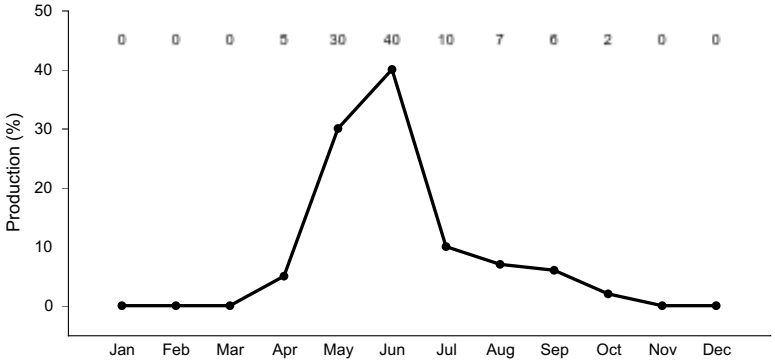


Figure 16. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

State 5
Reclaimed

This community is a man-made community. To get to this state requires a lot of inputs and hard work, but it can be done. Time, energy and resources are needed to restore the water table to the floor of the swale and not the bottom of the channel.

Community 5.1
Reclaimed Swale

Figure 17. Recalimed Plant Community

This is the community phase after the work is done to restore the water table to the floor of the swale. Often a large amount of dirt work, brush removal and the installation of check dams are required to reclaim the swale community. Even then, the community may never be that of the reference plant community. Areas directly behind the check structures often have a higher water table and promote facultative and obligate wetland species. Areas directly below the structures are not getting the subterranean flow that was present in the original swale and thus are drier and promote invasion by upland species that are not typical in the reference plant community. This site will need to be monitored to see if additional work will need to be done once original check dams fill up with sediment. This site could need to be seeded to help stabilize it.

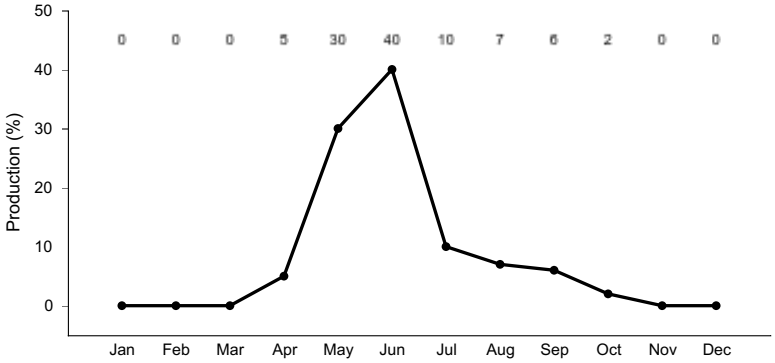


Figure 18. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

State 6
Basin Big Sagebrush - Cheatgrass

With Basin big sagebrush increasing and sagebrush decadence increasing, cover changes in this communities can brought on by prolonged drought, lack of fire, surface disturbances, (i.e. road and pipeline development and off road vehicle (OHV) use), and improper grazing use can create alterations in the plant community that can leave the soils at risk for erosion and alter the hydrological function. Improper grazing of perennial grasses during growth has favored non-native invasive species, primarily cheatgrass and/or Russian thistle, to co-dominate the understory. Few remnant plants may still persist under shrubs, but re-establishment and dominance by perennial grasses will not occur following a fire, or with the removal of grazing animals in the natural time frame.

Community 6.1
Basin Big Sagebrush - Cheatgrass Swale

Figure 19. Sagebrush - Cheatgrass Community

This state will occur following the Big Sagebrush/Streambank Wheatgrass state if it is heavily grazed. As perennial grasses disappear due to improper grazing and competition from basin big sagebrush, annual plants such as cheatgrass fill the void. As this happens the hydrology of the site is altered. There is accelerated erosion that can lead to increased channelization in flow areas. If channels continue to erode and become incised, the water table will drop farther and the site may then move into the Greasewood/cheatgrass state. This state will consist mainly of basin big sagebrush with annuals and bare ground in the understory. The production for this state drops significantly to around 500 to 800 pounds per acre. To restore the site to the Reference state extreme inputs are necessary. There would most likely be a reclamation state that would have to occur in between this state and the Reference state. This would include erosion control structures, brush removal, and reseeding.

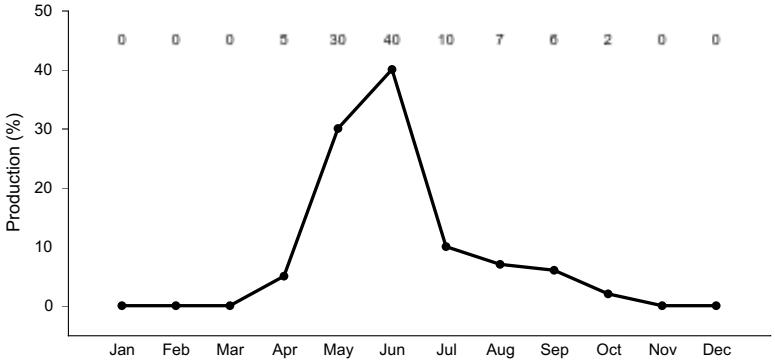


Figure 20. Plant community growth curve (percent production by month). CO0104, MLRA 48A & 34A - Foothill Frigid. MLRA 48A & 34A.

Transition T1A
State 1 to 2

Sagebrush encroachment with increasing sagebrush decadence and cover in adjacent upland communities brought on by prolonged drought, lack of fire, and improper grazing use can create alterations in the plant community that can leave the soils at risk for erosion and alter the hydrological function. The mean fire return interval (FRI) is 12 -25 years for mesic habitats (Boyd et. al., 2014) Also, lack of wet periods to drown out Big sagebrush can cause this shift from State 1 - Reference State to State 2 - Basin Big Sagebrush Dominated Swale.

Restoration pathway R2A
State 2 to 1

State 1 can be restored from the sagebrush dominated swale through fire or some kind of sagebrush removal and proper grazing use by both domestic animal and wildlife use. Management practices that restore upland community health and functioning are critical to restoring a sagebrush dominated swale to the reference state as well as those done in the swale itself. Such practices can include prescribed fire and/or shrub management. This needs to be used in conjunction with proper grazing management. Several wet years in a row can also decrease big sagebrush, as big sagebrush does not like to have it roots in water for extended periods of time.

Transition T2A
State 2 to 3

This is a very quick transition. Due to the lack of soil protection large flow events quickly destabilize the site and it transitions to the state with altered hydrological function (3). Anything that further reduces ground cover, like improper grazing use and continued drought, has potential to quicken this transition. Fire suppression and lack of shrub management in decadent sagebrush uplands continue to promote altered hydrologic function and also aid in destabilizing the swale. This community becomes unstable, affects soil health and the hydrologic function as it is invaded by big sagebrush. The lack of adequate herbaceous cover to dissipate water velocity and encourage infiltration result in the formation of gullies and head-cuts.

Transition T2B
State 2 to 4

Repetitive burning of big sagebrush favors rabbitbrush and perennial grasses, especially Basin wildrye. Mechanical and chemical removal of sagebrush can often release rabbitbrush on this site. This may be a timing of treatment issue or one related to the weather patterns in years surrounding the treatment.

Transition T2C
State 2 to 6

The introduction of annual grasses (cheatgrass) and forbs to the site.

Transition T3A

State 3 to 5

Returning to the reference state from either of the two communities phase in State 3 would be time, resource, and energy intensive. The water table needs to be restored to the floor of the swale and not the bottom of the channel. Often a large amount of dirt work, brush removal and the installation of check dams are required to reclaim the swale community. Check dam structures are used in an attempt to stop head-cuts, slow water, and catch sediments all in hopes of raising both the channel and the water table to allow for flooding access to the entire swale and returning the hydrologic function. Reclaiming these swale sites, also, include fixing all the problems that initially contribute to the degradation, including management practices that improve the contributing upland communities. A swale cannot be restored by only changing problems within the site itself. The swale's health and success in restoring the functioning is directly tied the health and function of the surrounding uplands.

Restoration pathway R4B
State 4 to 1

Often the only way to transition from this state to a preferred functioning community (reference community) that is not dominated by sagebrush is by means of chemical treatment of the rabbitbrush. Repetitive treatment is often needed.

Restoration pathway 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.

Restoration pathway R5A
State 5 to 1

This restorative pathway from the State 5 to the State 1 is very intensive. Often successful on small scales over very long periods of time, large scale restoration projects are not often able to be fully restored. This pathway would require continued sedimentation, proper grazing use, and proper hydrologic contributions. This community may reestablish the same hydrological function as in the reference state if the contributing upland sites provide the hydrologic contributions.

Restoration pathway R5B
State 5 to 3

This community becomes unstable, affects soil health and the hydrologic function as it is invaded by big sagebrush. The lack of adequate herbaceous cover to dissipate water velocity and encourage infiltration result in the formation of gullies and head-cuts. This is a very quick transition. Due to the lack of soil protection large flow events quickly destabilize the site and it transitions to the state with altered hydrological function (3). Anything that further reduces ground cover, like improper grazing use and continued drought, has potential to quicken this transition. Fire suppression and lack of shrub management in decadent sagebrush uplands continue to promote altered hydrologic function and also aid in destabilizing the bottom.

Transition T5A
State 5 to 6

Sagebrush encroachment with increasing sagebrush decadence and cover in adjacent upland communities brought on by prolonged drought, lack of fire, and improper grazing use can create alterations in the plant community that can leave the soils at risk for erosion and alter the hydrological function.

Restoration pathway R6A
State 6 to 5

To restore the site to the current potential state extreme inputs are necessary. This transition is from a big sagebrush dominated state, to a state that has been seeded with introduced or native perennial grasses. High energy inputs are needed for this transition. Sagebrush will need to be removed with vegetation treatment

techniques (I.e. chemical, mechanical, or fire) and introduced or native species that are adapted to the area and adapted to management needs have been seeded and become established. Proper grazing use by both domestic animal and wildlife needs to occur. Often successful on small scales over very long periods of time, large scale restoration projects are not often able to be fully restored. This pathway would require continued sedimentation, proper grazing use, and proper hydrologic contributions. Management practices that restore upland community health and functioning are critical to restoring a sagebrush dominated bottom to the current potential state. Such practices can include shrub management, and reseeding. Erosion control structures may be necessary. This needs to be used in conjunction with proper grazing management. Several wet years in a row can also decrease big sagebrush, as big sagebrush does not like to have it roots in water for extended periods of time.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Native Cool Season Bunchgrass**			897–1233	
	basin wildrye	LECI4	*Leymus cinereus*	897–1233	–
2	**Subdominant Cool Season Rhizomatous Grasses**			336–673	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	336–673	–
	western wheatgrass	PASM	*Pascopyrum smithii*	336–673	–
3	**Occasional Native Cool Season Bunchgrasses**			28–224	
	Sandberg bluegrass	POSE	*Poa secunda*	11–112	–
	squirreltail	ELEL5	*Elymus elymoides*	11–67	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–45	–
	muttongrass	POFE	*Poa fendleriana*	0–45	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–45	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–45	–
Forb					
4	**Dominant Native Perennial Forbs**			56–224	
	yarrow	ACHIL	*Achillea*	11–67	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	11–67	–
	globemallow	SPHAE	*Sphaeralcea*	11–67	–
	Indian paintbrush	CASTI2	*Castilleja*	0–45	–
	fleabane	ERIGE2	*Erigeron*	11–45	–
	buckwheat	ERIOG	*Eriogonum*	11–45	–
	bladderpod	LESQU	*Lesquerella*	0–45	–
5	**Occasional Native Perennial Forbs**			17–84	
	agoseris	AGOSE	*Agoseris*	6–34	–
	povertyweed	IVAX	*Iva axillaris*	0–22	–
	phlox	PHLOX	*Phlox*	6–22	–
	goldenrod	SOLID	*Solidago*	0–22	–
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	6–22	–
6	**Occasional Annual Native Forbs**			0–22	

	goosefoot	CHENO	*Chenopodium*	0–22	–
	bird's-beak	CORDY	*Cordylanthus*	0–22	–
Shrub/Vine					
7	**Dominant Native non-sprouting Shrub**			224–336	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	56–314	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	22–157	–
8	**Dominant Native Sprouting Shrub**			22–179	
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	22–179	–
9	**Occasional Native Sprouting Shrub**			0–22	
	snowberry	SYMPH	*Symphoricarpos*	0–22	–

Animal community

WILDLIFE INTERPRETATIONS:

This site offers a high value rating for deer, cottontail, and upland game birds. It offers a medium value rating for antelope, bison, elk, and waterfowl.

GRAZING INTERPRETATIONS:

This site offers a high value ratng for sheep. It offers a medium value rating for cattle and horses.

Hydrological functions

Soils were originally 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 found within a climatic region that are similar in depth to a restrictive layer or water table, transmission rate of water, texture, structure, and degree of swelling when saturated, will have similar runoff responses. Four (4) Hydrologic Soil Groups are recognized (A-D). For specific definitions of each hydrologic soil group see the National Engineering Handbook, Chapter 7, Part 630 Hydrology, or visit: 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 the conditions of maximum yearly wetness (thoroughly wet)
- soil not frozen
- bare soil surface
- maximum swelling of expansive clays

The slope of the soil surface is not considered when assigning hydrologic soil groups. In its simplest form, hydrologic soil group is determined by the water transmitting soil layer with 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 hydrologic cover conditions and hydrologic soil groups.

Soil Series Hydrologic Group
Havre B

Glendive B

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission (Soil Survey Staff, 2015).

Recreational uses

This site has a cool summer climate that makes it very desirable for a wide range of outdoor activities such as picnicking, sightseeing, photography, wildlife watching, hiking, and camping.

Wood products

None.

Other information

Rare, Threatened or Endangered Plants and Animals:
None identified at this time.

Location of Typical Example of the Site:
Major drainages in the Piceance Basin, Rio Blanco County.

Field Offices in Colorado where the site occurs:

Glenwood Springs
Grand Junction
Meeker

Type locality

Location 1: Rio Blanco County, CO	
General legal description	Major dranages in the Piceance Basin, Rio Blanco County.

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Approval

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--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 48A must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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)	Original written by J. Murray, C. Holcomb, L. Santana, F. Cummings, S. Jaouen on 1/19/2005 revised and updated by Suzanne Mayne-Kinney June 23, 2015
Contact for lead author	
Date	12/08/2014
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 are present, they should be widely spaced and not connected. 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 adjacent sites that produce large amounts of runoff (i.e. steeper sites, rock outcrop). Site is essentially level and rills do not form.

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

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3. **Number and height of erosional pedestals or terracettes:** Plants may have small pedestals (<1”) where they are adjacent to water flow patterns, but without exposed roots. Terracettes should be few and stable. Terracettes should be small (3-6”) and show little sign of active erosion. Some plants may appear to have a pedestal but rather than be formed by erosion, the only place litter accumulates and soil collects is at plant bases forming the appearance of a pedestal.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect 5-10% bare ground. Extended drought can cause bare ground to increase. Herbaceous communities are most likely to have lower values. As species composition by shrubs increases, bare ground is likely to increase. Very few if any bare spaces of greater than 1 square foot. Sagebrush invasion is often one of the causes of decreased ground cover and is defiantly an indicator of declining health. Keeping vegetation/litter on the soil surface is the key to maintaining this ecosystem in a functioning condition.

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5. **Number of gullies and erosion associated with gullies:** None. But, there may be one main ephemeral channel. If present, the channel should be highly mobile with little entrenchment and sinuous. If there are influences offsite that are causing the gullying to begin or continue, the fact that the site cannot stop the erosion indicates a health problem.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Typically slight, Most litter resides in place with some redistribution caused by water and wind movement. Very minor litter movement may occur in flow patterns and rills with deposition occurring at points of obstruction and plant bases. However during major flooding events this site slows water and capture litter and sediment and thus large amounts of litter movement is not uncommon after large flow events.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating anticipated to be "2-5". Often the soil surface is not very stable because of frequent deposition and weak soil formation. Litter and vegetation are what maintain soil stability. This site should typically have a soil stability rating of 4-5 at the soil surface.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soils are typically deep and well drained. Surface texture ranges from silty clay loam to loam. The A horizon can range from 0-20 inches with a light brownish gray to grayish brown. Surface structure is weak coarse platy to moderate fine granular. Soils in areas that have never been degraded or drained by gullies may have multiple buried A horizons to a depth greater than 60 inches. However, soils in areas where degradation has occurred may see drastically reduced A horizons (7” or less).

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** With the topographic location of the site being in alluvial bottoms, drainage ways, and flood plains this site is one of the accumulation sites for runoff water. Diverse grass, sedge, rushes, and shrub functional/ structural groups with diverse root structures and patterns reduce raindrop impact, slow overland flow, and provide increased time for infiltration. When perennial grasses decrease, reducing ground cover and increasing bare ground, runoff is expected to increase and any associated infiltration reduced.

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

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 Cool Season Bunchgrasses > Subdominant Cool Season Rhizomatous Grasses >>

    Sub-dominant: Dominant Native Non-sprouting Shrubs > Occasional Native Cool Season Bunchgrasses > Dominant Native Perennial Forbs >> Dominant Native Sprouting Shrub >

    Other: Occasional Native Perennial Forbs > Occasional Native Annual Forbs > Occasional Native Sprouting Shrub

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal. 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. There may be partial mortality of individual bunchgrasses and shrubs during less severe drought.

14. **Average percent litter cover (%) and depth (in):** 30-40% litter cover and ranges from 0.50 inches in depth. Litter cover declines during and following extended drought. Litter cover includes litter under plants. Most litter is fine litter. Excess litter may accumulate in absence of disturbance. Vegetative production may be reduced if litter cover exceeds 40%. Litter may decline due to drought but it is a major factor preventing erosion and site degradation and thus if depleted, even due to drought, rangeland health should reflect the vulnerability.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1000 lbs/ac low precip years; 2000 lbs/ac average precip years; 3000 lbs/ac above precip years. After extended drought production may be reduced by 500-1000 lbs/ac 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, dandelion, and other noxious weeds.

17. **Perennial plant reproductive capability:** All plants have the ability to reproduce. The limitations can be weather, wildfire, natural disease, inter-species competition, wildlife, excessive litter, or insect related. Any of these might temporarily reduce plant reproductive capability.