USDA Natural Resources Conservation Service

Ecological site R048AY251CO
Shallow Subalpine

Last updated: 3/05/2024
Accessed: 05/17/2024

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) 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.

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

Shallow subalpine occurs on hills, mesas, plateau, mountain-slope, and structural benches. Slopes is between 0 to 30 percent. Soils are very shallow to shallow (4 to 20 inches) in depth. Soils are derived from slope alluvium, colluvium, or residuum from sandstone and shale; colluvium, slope alluvium, or residuum from basalt; colluvium from

tuff breccia, rhyolite or andesite; or residuum from andesite, rhyolite or tuff breccia. Soil surface texture is loam, channery loam, sandy loam, gravelly silt loam, gravelly loam or extremely stony loam, with a loamy or loamy-skeletal subsurface. If soil is loamy-skeletal, the majority rock fragments that make it skeletal are below 20-24 inches in depth. It is a mountain big sagebrush – Columbia wheatgrass community. It has an ustic udic/typic udic moisture regime and cryic temperature regime. The effective precipitation ranges from 20 to 30 inches

Associated sites

R048AY253CO	**Wet Subalpine** Wet Subalpine occurs on swales, valleys, and mesas. Slopes is between 0 to 25%. Soils are moderately deep to very deep (20 to 60+ inches). Soils are derived from till from basalt, andesite, tuff or non-volcanic breccia; slope alluvium from tuff, alluvium from tuff; mixed eolian deposits from basalt; or residuum from basalt. Soil surface texture is loam, gravelly loam, or very cobbly loam with loamy-skeletal or clayey skeletal textured subsurface. It is slender wheatgrass – Nodding Brome. It has an ustic udic/typic udic moisture regime and cryic temperature regime. The effective precipitation ranges from 30 to 40 inches.
R048AY250CO	**Subalpine Loam** Subalpine Loam occurs on hills, mountain-slopes, and mountains. Slopes is between 1 to 30%. Soils are deep to very deep (20 to 60+ inches). Soils are derived from colluvium and alluvium from volcanic rock; complex landslide deposits from igneous, metamorphic, and sedimentary rock; and slope alluvium, colluvium, residuum, alluvium or complex landslide deposits from sandstone and shale or shale. Soil surface texture is loam with loamy textured subsurface. It is a mountain big sagebrush – Thurber's Fescue community. It has an ustic udic/typic udic moisture regime and cryic temperature regime. The effective precipitation ranges from 20 to 30 inches.
R048AY228CO	**Mountain Loam** Mountain Loam occurs mainly alluvial fans, mountain slopes, benches, terraces, or hills. Slopes average between 5 and 10% but can range from 0 to 30%. Soils are moderately deep to deep (20-60 inches) loamy soils derived from residuum from igneous and metamorphic rocks or sandstone and shale; slope alluvium from sandstone and shale, or igneous and metamorphic rocks; colluvium from igneous and metamorphic rocks or sandstone and shale, and/or alluvium from igneous and metamorphic rocks. Soil surface texture are loam, sandy loam or silt loam with loamy subsurface. It is a Mountain Big Sagebrush - Arizona Fescue community. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.

Similar sites

R048AY218CO	**Dry Shallow Pine** Shallow Pine occurs on mountains, hills, and mountainside. Slopes is between 5 to 35%. Soils are shallow (10 to 20 inches) in depth. Soils are derived from slope alluvium from monzonite or gneiss or from residuum from granite, gneiss or granodiorite. Soil surface texture is very gravelly sandy loam with a loamy skeletal subsurface. It is a Gambel's oak – Mountain muhly community. It has an typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.
R048AY230CO	**Shallow Loam** Shallow Loam occurs on mountains, and hills. Soils are very shallow to shallow (less than 20 inches) loamy-skeletal soils derived from slope alluvium from trachyte, volcanic breccia, gneiss, granite and/or sandstone; residuum from weathered volcanic breccia, tuff, igneous rock, sandstone or sandstone and shale. Soils surface textures are gravelly to very gravelly loam, gravelly to very gravelly sandy loam, cobbly loam. Or very cobbly sandy loam. It is an Arizona Fescue-Mountain Muhly community with scattered mountain mahogany, snowberry and current. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.
R048AY240CO	**Shallow Pine** Shallow Pine occurs on mountains and mountainsides. Slopes are 5 to 50%. Soils are shallow (10 to 20 inches). Soils are derived from slope alluvium from volcanic breccia, gneiss, granite, or sandstone and/or residuum from granite, granodiorite and/or gneiss. Soil surface texture is a gravelly to very gravelly sandy loam or very gravelly loam with loamy-skeletal subsurface. It is a Ponderosa Pine - Arizona Fescue – Mountain Muhly community. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Achnatherum nelsonii* (2) *Achnatherum lettermanii*

Physiographic features

Landscape characteristics are those of hills, mountainous slopes and the edges of high mesas where parent rock is intermittently exposed. Slope is generally 0 to 15 percent, but can range up to 30 percent.

The elevation is principally between 8500 and 10000 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mesa (3) Plateau (4) Mountain slope (5) Structural bench
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,591–3,048 m
Slope	0–15%
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation is about 20 to 30 inches. Of this, approximately 65-75% falls as snow, and 25-35% falls as rain between middle of June to and the middle of September 1. Summer moisture is mostly from thundershowers in July, August and September. May to June is the driest period of the year with the driest month being June. December thru March is the wettest period and the wettest month is usually January. The average annual total snowfall is 198.5 inches. The snow depth usually ranges from 4 to 35 inches during November thru April. The highest winter snowfall record in this area is 354.5 inches which occurred in 1964-1965. The lowest snowfall record is 68.5 inches during the 1914-1915 winter. The frost-free period typically ranges from 25 to 90 days. The last spring frost is typically the end of June to the middle of July. The first fall frost is the first week of August to the first week of September. Mean daily annual air temperature is about 17.9ºF to 51.5ºF, averaging about 13.6ºF for the winter and 54.9ºF in the summer. Summer high temperatures of 70ºF to mid-70ºF are not unusual. The coldest winter temperature recorded was -47ºF on February 6, 1982 and the warmest winter temperature recorded was 13.6ºF on December 18, 1917. The coldest summer temperature recorded was 15ºF on June 20, 1920 and the warmest was 95 ºF on July 17, 1949. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2018) for Crested Butte, Colorado Climate Station.

This zone in MLRA 48 will need to be broken up into at least 7 land resources zones in future projects based on current knowledge of precipitation and temperature patterns.

West Central Zone Stations: use in write up above. Driest month is June and wettest months are December thru March.

Northwest Zone Climate Stations: Marvine Ranch, Pyramid, Vail and Winter Park. Driest month is June and the wettest period is October thru April.

Southwest Zone Climate Stations (Precambrian sedimentary and igneous): Cascade, Electra Lake, Rico, Silverton, Telluride 4 WNW and Trout Lake. This area has driest month as June and the wettest months are July and August.

Southwest Volcanics: Platoro and Rio Grande Reservoir. The driest month is June and the Wettest are August and March.

Northeast (Front Range Igneous and Metamorphic): Allen's Park 2 NNW, Allen's Park NNW, Breckenridge, Climax, Jones Pass 2E, and Squaw Mountain. April, May, July and August are the wettest months. February, December, November and October are the driest.

Southeast (Sangre de Cristo Mtns): North Lake – This is the only climate station in this zone. It driest months are December and January with July being the wettest. So, this area receives more summer precipitation than other zones in this climate zone.

Frigid high elevation valleys: Aspen 1 SW, Ouray, Tacoma, Gross Reservoir, Coal Creek Canyon, Steamboat Springs, Marvine, and Buckskin Mtn 1 E. These areas have longer growing seasons by 20 to 40 days over the cryic stations.

Table 3. Representative climatic features

Frost-free period (characteristic range)	5-36 days
Freeze-free period (characteristic range)	40-76 days
Precipitation total (characteristic range)	584-660 mm
Frost-free period (actual range)	3-46 days
Freeze-free period (actual range)	32-88 days
Precipitation total (actual range)	533-686 mm
Frost-free period (average)	19 days
Freeze-free period (average)	56 days
Precipitation total (average)	610 mm

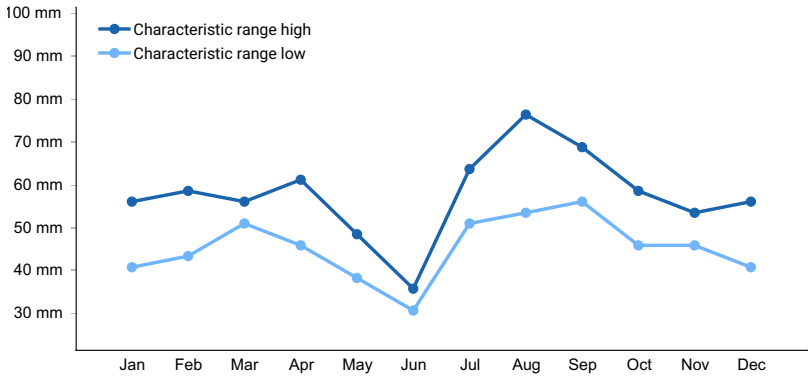


Figure 1. Monthly precipitation range

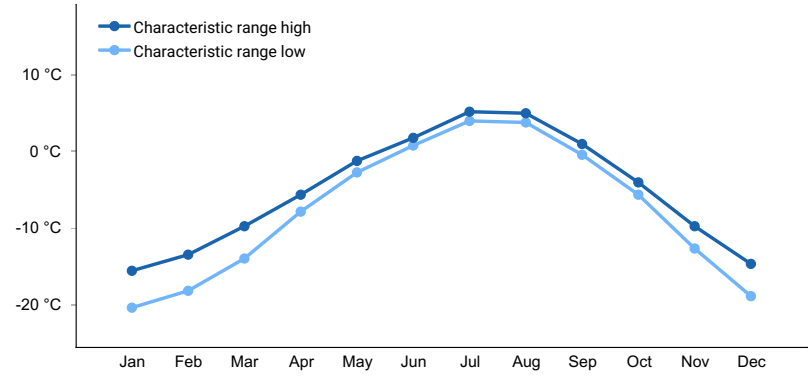


Figure 2. Monthly minimum temperature range

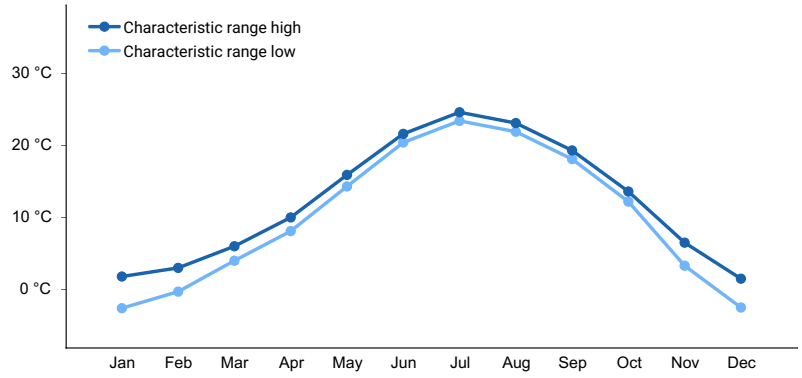


Figure 3. Monthly maximum temperature range

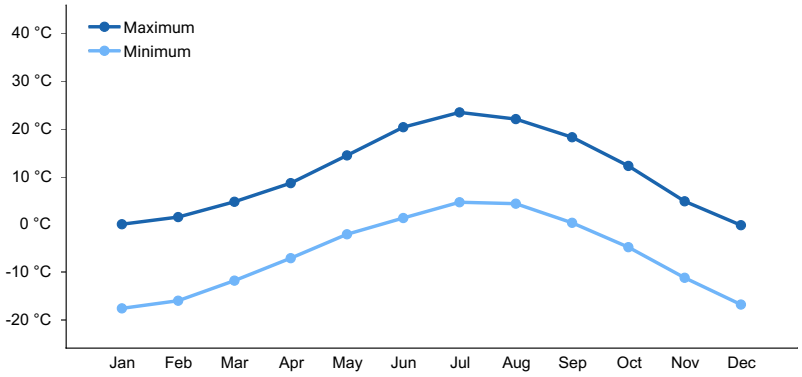


Figure 4. Monthly average minimum and maximum temperature

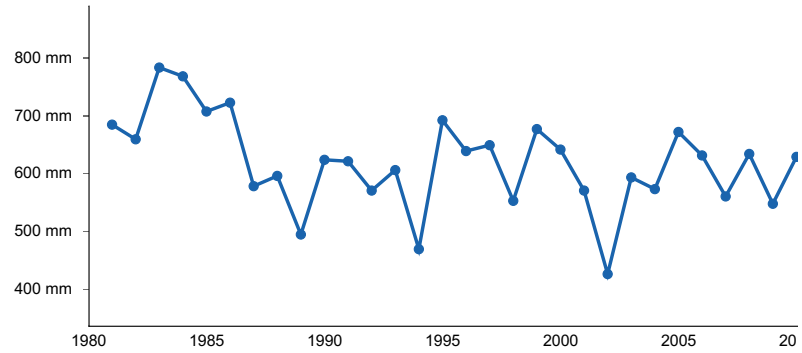


Figure 5. Annual precipitation pattern

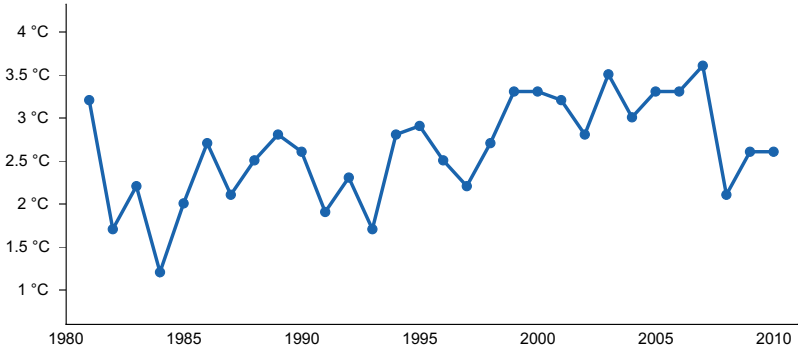


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CLIMAX [USC00051660], Leadville, CO
- (2) RICO [USC00057017], Cahone, CO
- (3) SILVERTON [USC00057656], Silverton, CO

- (4) TELLURIDE 4WNW [USC00058204], Telluride, CO
- (5) CRESTED BUTTE [USC00051959], Crested Butte, CO
- (6) MARVINE RCH [USC00055414], Meeker, CO
- (7) RIO GRANDE RSVR [USC00057050], Lake City, CO
- (8) VAIL [USC00058575], Vail, CO

Influencing water features

None

Soil features

Very shallow to shallow less than 20 inches) very dark brown loams, underlain by igneous, basalt, limestone, or sandstone parent rock characterize the soils of this site. Usually neutral to acid in reaction. Permeability is moderate to underlying parent rock. Water-holding capacity is strongly limited because of the shallow soil. Plant growth is greatly reduced by this soil characteristic despite favorable precipitation.

Table 4. Representative soil features

Parent material	(1) Slope alluvium–sandstone and shale (2) Colluvium–sandstone and shale (3) Colluvium–basalt (4) Slope alluvium–basalt (5) Residuum–basalt (6) Residuum–sandstone and shale (7) Colluvium–andesite (8) Colluvium–tuff breccia (9) Colluvium–rhyolite (10) Residuum–andesite (11) Residuum–rhyolite (12) Residuum–tuff breccia
Surface texture	(1) Loam (2) Channery loam (3) Sandy loam (4) Extremely stony loam (5) Gravelly silt loam (6) Gravelly loam
Family particle size	(1) Loamy (2) Loamy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to moderately rapid
Soil depth	10–51 cm
Surface fragment cover <=3"	0–30%
Surface fragment cover >3"	0–10%
Available water capacity (Depth not specified)	1.27–7.62 cm
Soil reaction (1:1 water) (Depth not specified)	5.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–20%

Ecological dynamics

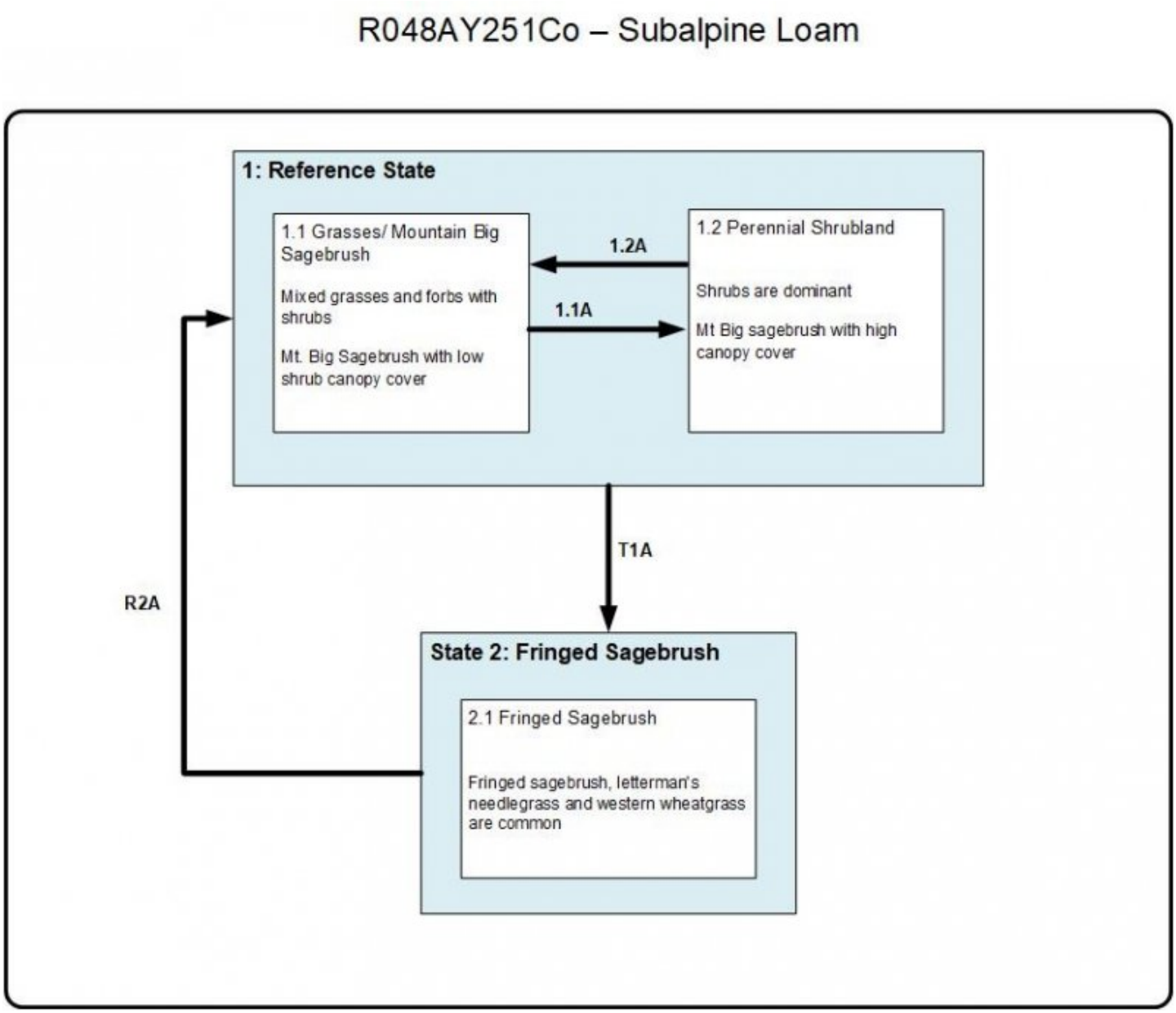
This plant community is formed by a mixture of shrubs and forbs interspersed within a grassland that is interrupted

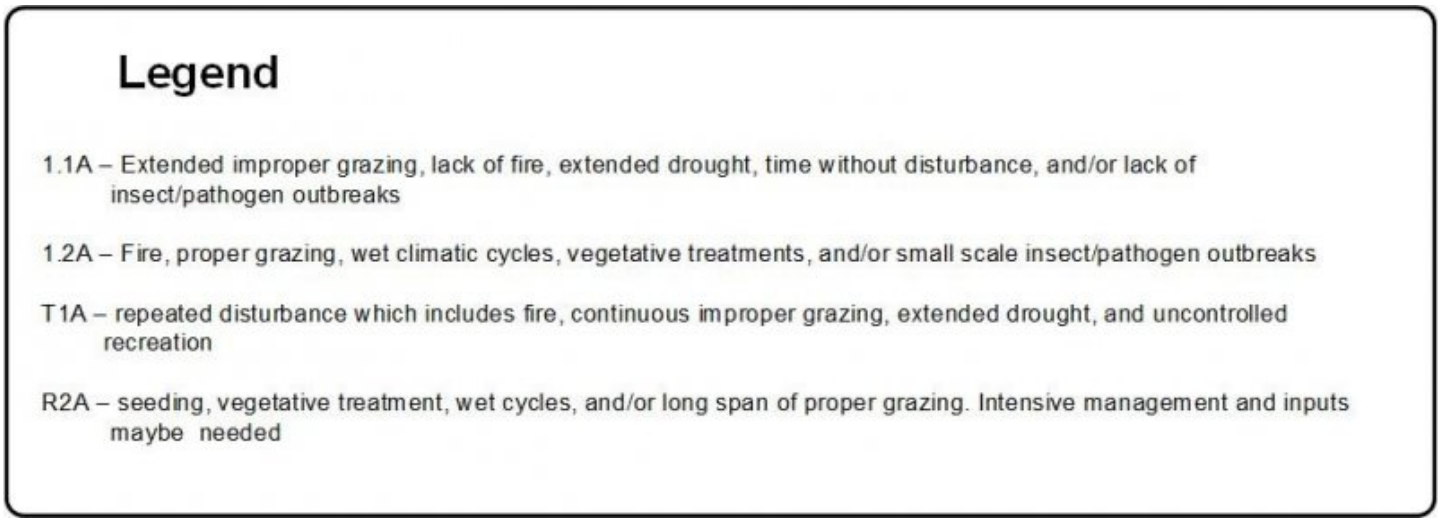
by rock outcrops. The main grasses are Letterman needlegrass, Columbia needlegrass, nodding brome, mountain brome, bluebunch wheatgrass, slender wheatgrass, western wheatgrass, mountain muhly, muttongrass, Arizona/Idaho and Thurber fescue, alpine timothy, blue wildrye, Parry oatgrass, spike trisetum, purple reedgrass, and Junegrass. Some of the more frequent and conspicuous forbs in the community are ligusticum, larkspur, geranium, lupine, American vetch, paintbrush, hairy goldaster, penstemon, aspen fleabane, sulfur buckwheat, and rose pussytoes. Silver sagebrush, mountain big sagebrush, gooseberry, fringed sage, shrubby potentilla, and currant are common shrubs. The site itself is treeless but is in the aspen, spruce-fir zone. Ground cover (not counting the areas of bare rock) approximates 30%.

Plants not a part of the potential plant community tha are most likely to invade when the cover deteriorates are blue grama, slimstem muhly, Colorado rubberweed, snakeweed and introduced species.

The State and Transition model is a basic model made for the provisional ecological site instruction.

State and transition model





State 1
Reference State

Community 1.1
Reference State

Ground cover (not counting the areas of bare rock) approximates 30%. Plants not a part of the potential plant community that are most likely to invade when the cover deteriorates are blue grama, slimstem muhly, Colorado rubberweed, snakeweed, and introduced species. Total annual production Favorable years 2500 pounds per acre air dry Median years 1000 pounds per acre air dry Unfavorable years 775 pounds per acre air dry

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	432	560	2074
Shrub/Vine	219	308	420
Forb	219	252	308
Total	**870**	**1120**	**2802**

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			448–673	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	56–168	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	112–168	–
	mountain brome	BRMA4	*Bromus marginatus*	56–112	–
	muttongrass	POFE	*Poa fendleriana*	56–112	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	56–112	–
	Arizona fescue	FEAR2	*Festuca arizonica*	56–112	–
	Idaho fescue	FEID	*Festuca idahoensis*	56–112	–
	Thurber's fescue	FETH	*Festuca thurberi*	56–112	–
	Junegrass	KOELE	*Koeleria*	34–56	–
	mountain muhly	MUMO	*Muhlenbergia montana*	34–56	–
	western wheatgrass	PASM	*Pascopyrum smithii*	34–56	–
	alpine timothy	PHAL2	*Phleum alpinum*	34–56	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	34–56	–
	spike trisetum	TRSP2	*Trisetum spicatum*	34–56	–
	purple reedgrass	CAPU	*Calamagrostis purpurascens*	34–56	–
	Parry's oatgrass	DAPA2	*Danthonia parryi*	34–56	–
	blue wildrye	ELGL	*Elymus glaucus*	34–56	–
	nodding brome	BRAN	*Bromus anomalus*	34–56	–
Forb					
2	**Forbs**			224–280	
	Porter's licorice-root	LIPO	*Ligusticum porteri*	112–168	–
	lupine	LUPIN	*Lupinus*	56–112	–
	larkspur	DELPH	*Delphinium*	56–112	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	56–112	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	56–78	–
	Indian paintbrush	CASTI2	*Castilleja*	34–56	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	34–56	–
	beardtongue	PENST	*Penstemon*	34–56	–
	American vetch	VIAM	*Vicia americana*	34–56	–
Shrub/Vine					
3	**Shrubs**			224–392	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	112–168	–
	silver sagebrush	ARCA13	*Artemisia cana*	56–112	–
	prairie sagewort	ARFR4	*Artemisia frigida*	56–112	–
	wax currant	RICE	*Ribes cereum*	56–112	–
	whitestem gooseberry	RIIN2	*Ribes inerme*	56–112	–

Animal community

INTERPRETATIONS FOR GRAZING ANIMALS:
This site offers a high value rating for sheep and medium for cattle and horses.

INTERPRETATIONS FOR WILDLIFE:
The site offers a high value rating for deer and elk while offering a medium rating for upland game birds. It offers a low value rating for antelope and bison. The site is not used by cottontail, jackrabbit, and waterfowl.

Hydrological functions

The site offers a medium value rating for watershed.

Recreational uses

Recreation and Natural Beauty:
The site offers a high rating for recreation and natural beauty.

Wood products

No wood products are produced on this site.

Other information

Rare, Threatened or Endangered Plants and Animals
(To be added when known)

Field Offices in Colorado where the site occurs:
Canon City, Colorado Springs, Cripple Creek, Delta, Eagle, Glenwood Springs, Grand Junction, Gunnison, Kremmling, Meeker, Montrose, Norwood, Steamboar Springs, Walden, and Westcliffe.

Type locality

Location 1: Garfield County, CO	
Township/Range/Section	TT4S RR89W S34
General legal description	One quarter mile south of Haypress Lake on Canyon Creek drainage Sec 34 T4S, R89W, Garfield County.
Location 2: Gunnison County, CO	
General legal description	About 6 miles north and 3 miles east of Cathedral near the Gunnison-Saguache County line in Rock Creek Park.

Other references

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Approval

Kirt Walstad, 3/05/2024

Acknowledgments

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Those involved in developing earlier versions of this site description include: Bob Rayer, retired NRCS Soil Scientist; Herman Garcia, retired CO State RMS and NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ.

--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)	
Contact for lead author	
Date	05/17/2024
Approved by	Kirt Walstad
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

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

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

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

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

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
