Ecological site F048AY919CO
Subalpine Fir/Blueberry/Twinflower

Last updated: 3/05/2024
Accessed: 05/10/2025

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

This site is found mostly commonly on landslides on mountain slopes. Soils are very deep (> 60+ inches). Soil surface textures are very stony ashy loam. Subsurface textures can be loamy-skeletal. It is usually typic udic and cryic. It is a Subalpine Fir – Blueberry – Fringed Brome – Twinflower plant community. The effective precipitation ranges from 20 to 40 inches.

Associated sites

F048AY915CO	**Engelmann Spruce – Whortleberry– Jacob's-Ladder** This site is found mostly commonly on mountain slopes. Soils are very deep (> 60+ inches). Soil surface textures are cobbly ashy loam, or cobbly ashy silt loam. Subsurface textures can be loamy-skeletal. It is usually ustic udic or typic udic and cryic. It is an Engelmann Spruce – whortleberry– Jacob's-ladder community. The effective precipitation ranges from 20 to 40 inches.
F048AY917CO	**Abies lasiocarpa/Paxistima myrsinites/Erigeron eximius** This site is found mostly commonly on mountain slopes. Soils are very deep (> 60+ inches). Soil surface textures are stony loam, cobbly ashy loam or stony ashy loam. Subsurface textures can be loamy-skeletal. It is usually typic udic and cryic. It is a Subalpine Fir – Oregon boxleaf – Sprucefir Fleabane. The effective precipitation ranges from 20 to 40 inches.

Similar sites

F048AY449CO	**Aspen Woodland** Aspen Woodland is a permanent type aspen stand in Western Colorado. This site is found mostly commonly on mountain slopes, hills, and complex landslides. Soils are moderately deep to very deep (20 to 60+ inches), dark and high in organic matter. Soil surface textures are loam, stony loam, very stony loam, cobbly loam, gravelly loam or very cobbly loam. Subsurface textures can be fine-loamy, loamy-skeletal, clayey-skeletal or fine. It is usually ustic udic and can be frigid or cryic. It is a Aspen – Wood's Rose – Slender Wheatgrass community. It Precipitation ranges from 20 to 30 inches, but on favorable north and east aspect it can be found as low as 18
F048AY908CO	**Mixed Conifer** This site is found mostly commonly on mountain slopes. Soils are moderately deep to very deep (20 to 60+ inches). Soil surface textures are loam, very gravelly sandy loam, very stony sandy loam, stony sandy loam, stony loam, very stony loam, very cobbly loam or gravelly fine sandy loam. Subsurface textures can be loamy-skeletal or sometimes fine-loamy. It is usually ustic udic or typic udic and cryic. It is a Mixed Conifer community with subalpine fir, white fir, and Douglas fir intermixed. The effective precipitation ranges from 20 to 40 inches.
F048AY912CO	**Lodgepole Pine** This site is found mostly commonly on mountain slopes. Soils are shallow to very deep (10 to 60+ inches). Soil surface textures are very gravelly loam, cobbly sandy loam or fine sandy loam. Subsurface textures can be loamy-skeletal or clayey-skeletal. It is usually ustic udic and cryic. . It is a Lodgepole pine – Common Juniper – Elk Sedge community. The effective precipitation ranges from 20 to 30 inches.
F048AY915CO	**Engelmann Spruce – Whortleberry– Jacob's-Ladder** This site is found mostly commonly on mountain slopes. Soils are very deep (> 60+ inches). Soil surface textures are cobbly ashy loam, or cobbly ashy silt loam. Subsurface textures can be loamy-skeletal. It is usually ustic udic or typic udic and cryic. It is an Engelmann Spruce – whortleberry– Jacob's-ladder community. The effective precipitation ranges from 20 to 40 inches.
F048AY917CO	**Abies lasiocarpa/Paxistima myrsinites/Erigeron eximius** This site is found mostly commonly on mountain slopes. Soils are very deep (> 60+ inches). Soil surface textures are stony loam, cobbly ashy loam or stony ashy loam. Subsurface textures can be loamy-skeletal. It is usually typic udic and cryic. It is a Subalpine Fir – Oregon boxleaf – Sprucefir Fleabane. The effective precipitation ranges from 20 to 40 inches.
F048AY918CO	**Spruce-Fir Woodland** This site is found mostly commonly on mountain slopes, complex landslides, and mesas. Soils are moderately deep to very deep (20 to 60+ inches). Soil surface textures are loam, cobbly loam, gravelly loam, very cobbly sandy loam, very gravelly sandy loam, very stony sandy loam, very cobbly fine sandy loam, or stony fine sandy loam. Subsurface textures can be loamy-skeletal, or clayey-skeletal. It is usually ustic udic or typic udic and cryic. It is a Engelmann Spruce – Subalpine Fir – Elk Sedge – Slender Wheatgrass plant community. The effective precipitation ranges from 20 to 40 inches.
F048AY921CO	**White Fir/Snowberry** This site is found mostly commonly on mountain slopes. Soils are moderately deep to very deep (20 to 60+ inches). Soil surface texture is stony ashy loam. Subsurface textures can be loamy-skeletal. It is usually ustic udic or typic udic and cryic. It is a White Fir – Snowberry – Ross′ Sedge plant community. The effective precipitation ranges from 20 to 40 inches.

Table 1. Dominant plant species

Tree	(1) *Abies lasiocarpa*
Shrub	(1) *Linnaea borealis*
Herbaceous	(1) *Bromopsis ciliata*

Physiographic features

This site is found on landslides on mountain slopes.

Table 2. Representative physiographic features

Landforms	(1) Landslide (2) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	8,900–10,500 ft
Slope	5–60%

Climatic features

Average annual precipitation is about 20 to 40 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)	20-40 in
Frost-free period (actual range)	3-46 days
Freeze-free period (actual range)	32-88 days
Precipitation total (actual range)	20-40 in
Frost-free period (average)	19 days
Freeze-free period (average)	56 days
Precipitation total (average)	30 in

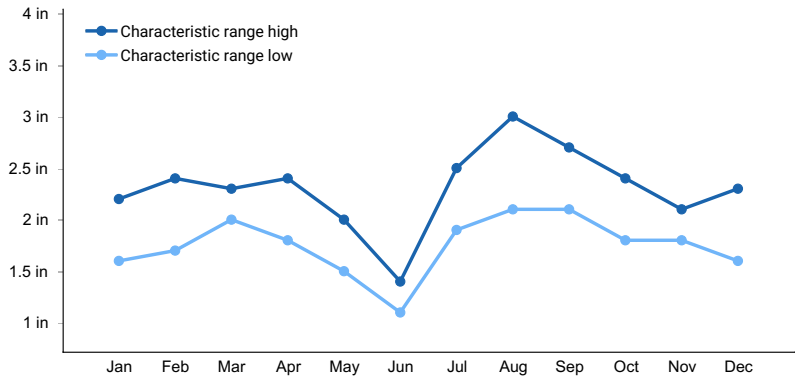


Figure 1. Monthly precipitation range

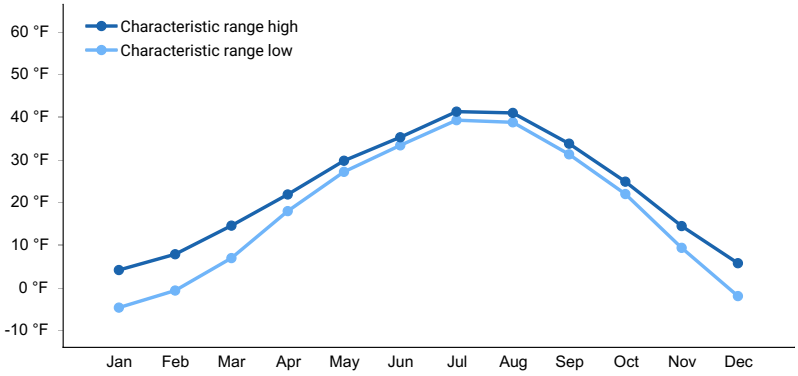


Figure 2. Monthly minimum temperature range

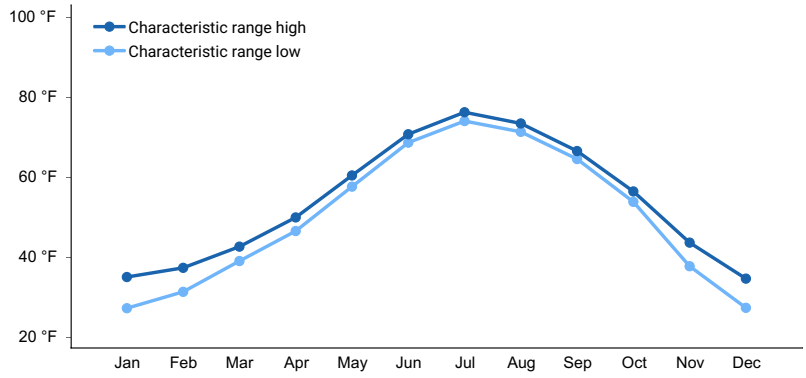


Figure 3. Monthly maximum temperature range

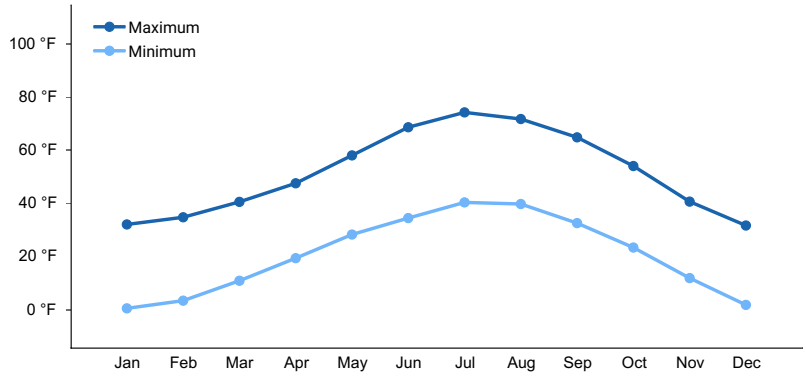


Figure 4. Monthly average minimum and maximum temperature

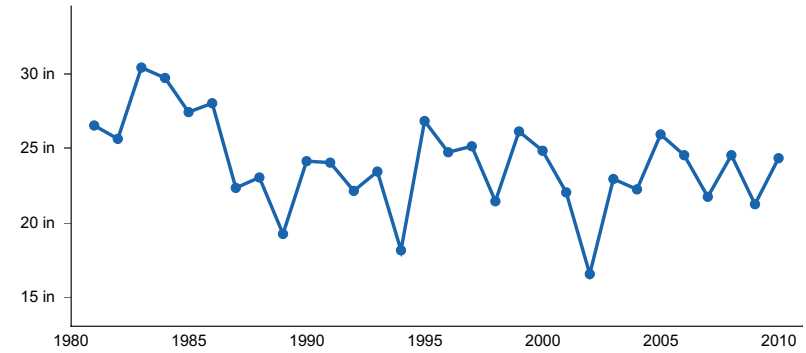


Figure 5. Annual precipitation pattern

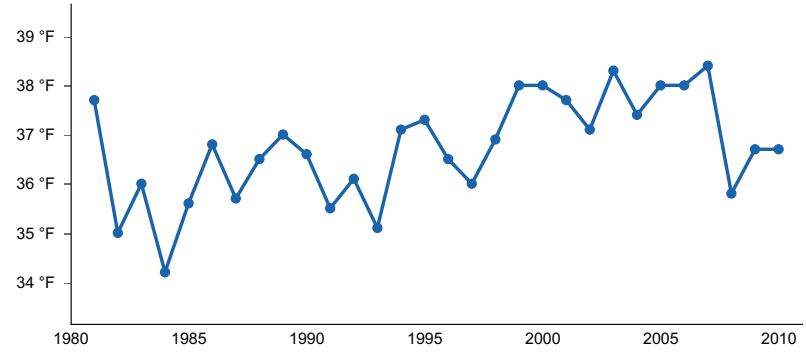


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CLIMAX [USC00051660], Leadville, CO
- (2) CRESTED BUTTE [USC00051959], Crested Butte, CO
- (3) MARVINE RCH [USC00055414], Meeker, CO

- (4) RICO [USC00057017], Cahone, CO
- (5) RIO GRANDE RSVR [USC00057050], Lake City, CO
- (6) SILVERTON [USC00057656], Silverton, CO
- (7) TELLURIDE 4WNW [USC00058204], Telluride, CO
- (8) VAIL [USC00058575], Vail, CO

Influencing water features

None

Soil features

The soil surface texture is very stony ashy loam.

Table 4. Representative soil features

Parent material	(1) Slope alluvium–volcanic breccia
Surface texture	(1) Ashy, very stony loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to slow
Soil depth	60–100 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	3–5 in
Subsurface fragment volume <=3" (Depth not specified)	26–36%
Subsurface fragment volume >3" (Depth not specified)	22–32%

Ecological dynamics

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include tree harvest, grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, and kinds and times of timber harvest, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram.

The plant communities shown in this State and Transition Model may not represent every possibility but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, and/or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range & Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

This site provides poor grazing for livestock because of the short growing season, limited numbers of forage species, and low productivity resulting from shade associated with the generally continuous tree canopy. However,

it does provide valuable summer range for big game.

State 1 Reference State
The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. At the time of European colonization, what would have been observed on these sites would have primarily depended on the time elapsed since the last wildfire occurred. Had the site been relatively undisturbed (i.e. without fire) for approximately 400 years or longer, the late seral climax of subalpine fir would have been found (1.1). The understory would have been relatively sparse due to tree competition, overstory shading, and duff accumulation. Wildfire (1.1a) would have replaced these stands with diverse herb-dominated vegetation (1.2). In the absence of any major disturbance (1.2a, 1.3a, 1.4a, 1.5a), the vegetation would have progressed into more of a shrub-herb co-dominance (1.3), followed by aspen (*Populus tremuloides*) (1.4), then would have become a mixed age stand of subalpine fir (*Abies lasiocarpa*) (1.5). Ultimately the site would have been mature stand of subalpine fir with scattered other conifers (1.1). Wildfire (1.1a, 1.5b) would have been the primary disturbance factor prior to colonization. Livestock grazing and fire exclusion can accelerate natural succession of woody species.

Community Phase 1.1: Mature Subalpine Fir
Subalpine fir is the climax overstory. Douglas fir and aspen occur as seral trees in some stands. The understory would be sparse consisting of shade-tolerant herbs. This community would have existed approximately 400 years post fire.

Community Pathway 1.1a:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Selective timber harvesting opens the forest canopy, allowing shrubs and herbs to flourish for 20 to 30 years.

Community Phase 1.2: herb-dominated meadow
This plant community will develop within the first 5 years following the last fire or complete tree removal. This would have been dominated by shade-intolerant forbs and grasses.

Community Pathway 1.2a:
After about 5 years, shrubs will establish, and the understory will diminish due to natural succession. Heavy season-long livestock grazing will accelerate woody plant recovery and diminish the understory.

Community Phase 1.3: shrub-herb
Between 5 and 30 years after fire, shrubs and herbs would co-dominate the site. Twinflower and fringed brome would have been beginning to be present in the understory.

Community Pathway 1.3a:
Woody plant recovery continue to occur due to natural succession. Heavy season-long sheep grazing, deer and elk grazing, and fire exclusion will accelerate woody plant recovery and diminish the understory. About 30 years after fire, aspen would have become established in the site.

Community Phase 1.4: aspen
This plant community would have been dominated by aspen, a seral species. Understorys are forb-rich beneath early successional aspen canopies. Subalpine fir would have been present only as an understory species at this time. Aspen would have dominated these sites for approximately 30 to 100 years following the last fire. The understory would have had a mixture of shrubs and herbaceous species.

Community Pathway 1.4a:
With approximately another century without fire, subalpine fir would have out competed the aspen to become the dominant overstory species at the site. Heavy season-long livestock grazing, and fire exclusion will accelerate woody plant recovery and diminish the understory.

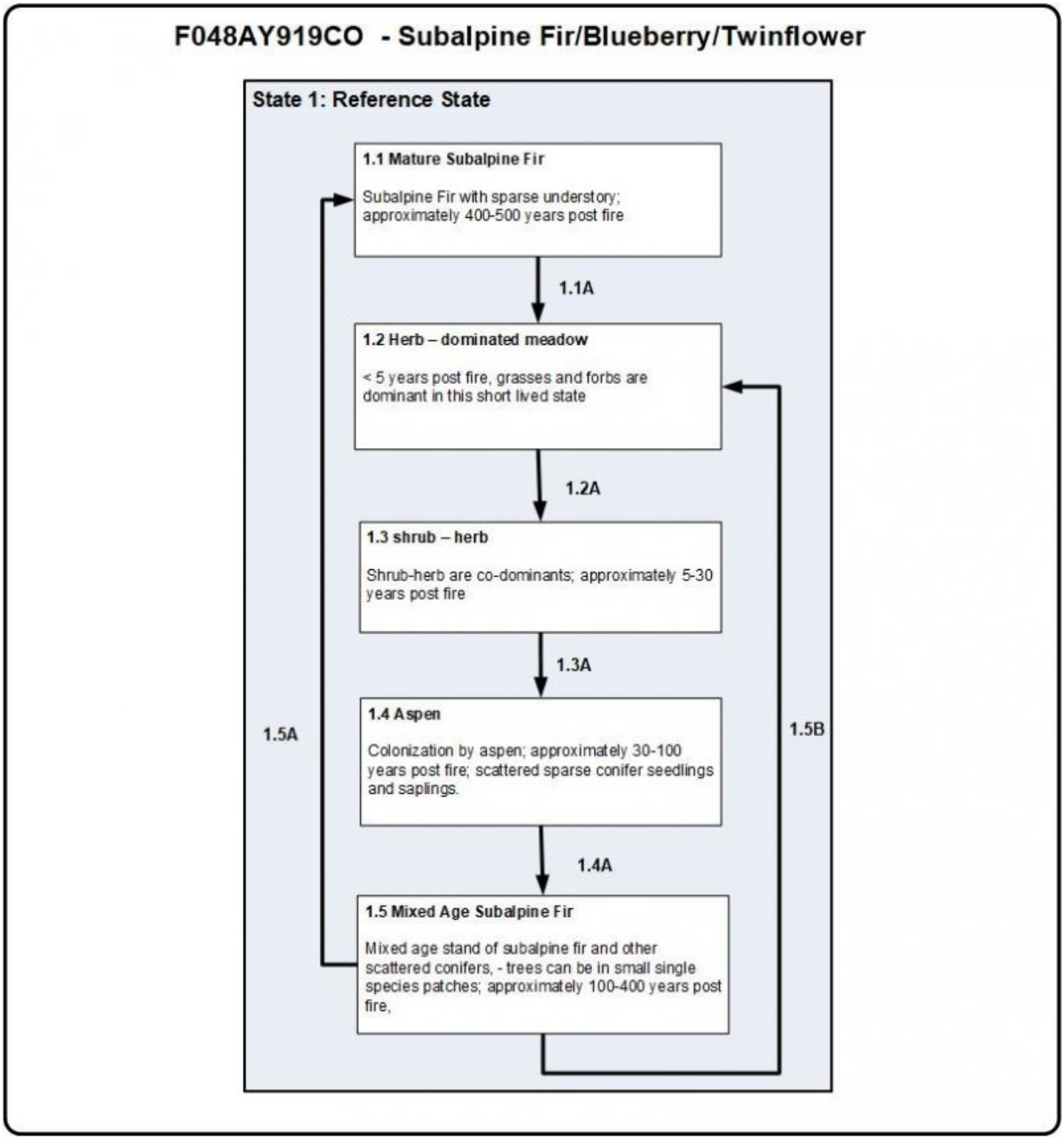
Community Phase 1.5: mixed age subalpine fir
A stand of mature aspen with an inter-mixing of subalpine fir, and Douglas fir will develop approximately 100 to 400 years following fire or complete tree removal. Only shade-tolerant understory species would have been present.

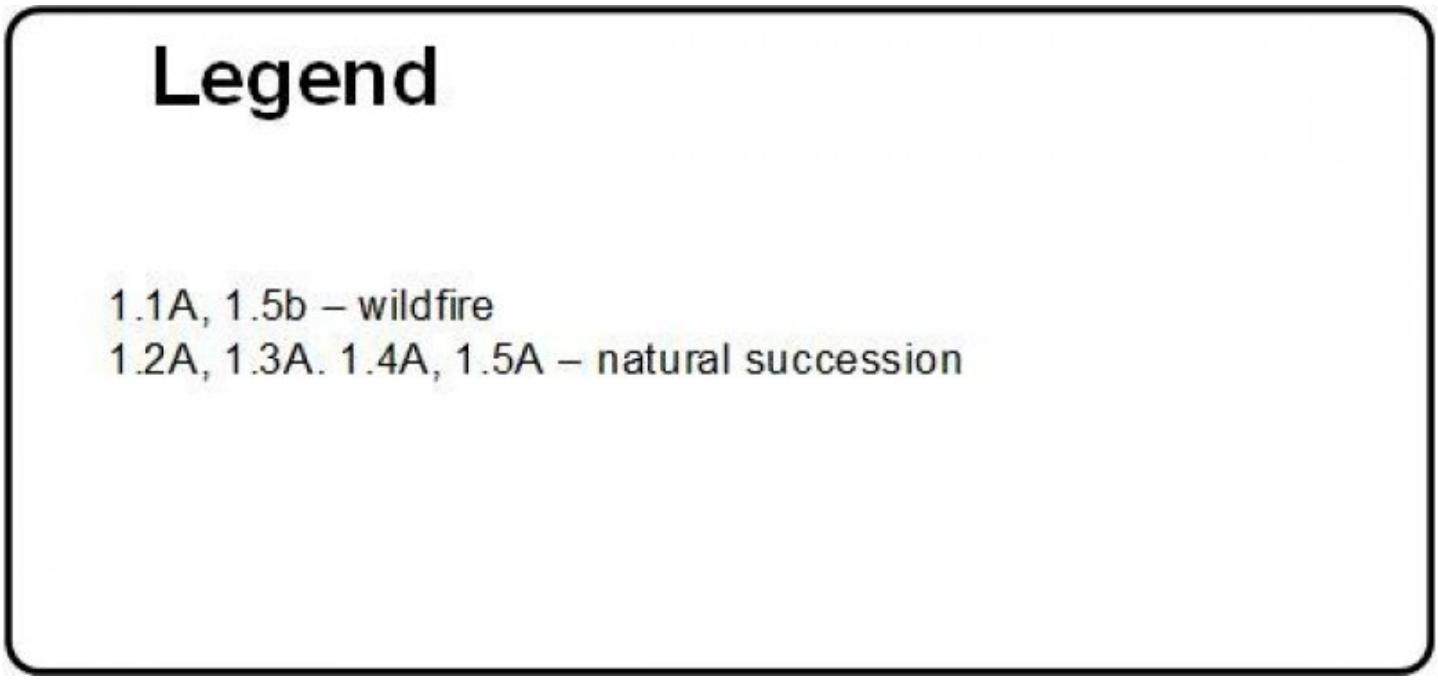
Community Pathway 1.5a:
After approximately 400 years following the last wildfire, subalpine would have out-competed other conifers to

become the dominant overstory species at the site. Fire exclusion will accelerate woody plant recovery and diminish the understory.

Community Pathway 1.5b:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral shade-intolerant herb-dominated phase. Logging opens up the forest canopy allowing shrubs and herbs to flourish for 20 to 30 years.

State and transition model





State 1
Reference State

Total annual air-dry production on an unfavorable year is 200 lbs/acre, an average year 400 lbs/acre and 600 lbs/acre on a favorable year.

Other references

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

Cleland, D.T.; Freeouf, J.A.; Keys, J.E.; Nowacki, G.J.; Carpenter, C.A.; and McNab, W.H. 2007. Ecological Subregions: Sections and Subsections for the conterminous United States. Gen. Tech. Report WO-76D [Map on CD-ROM] (A.M. Sloan, cartographer). Washington, DC: U.S. Department of Agriculture, Forest Service, presentation scale 1:3,500,000; colored.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Western Regional Climate Center. Retrieved from http://www.wrcc.dri.edu/summary/Climsmco.html on December 10, 2018

Contributors

Scott Woodall
Suzanne Mayne-Kinney

Approval

Kirt Walstad, 3/05/2024

Acknowledgments

Project Staff:
Suzanne Mayne-Kinney, Ecological Site Specialist, NRCS MLRA, Grand Junction SSO
Chuck Peacock, MLRA Soil Survey Leader, NRCS MLRA Grand Junction SSO

Program Support:
Rachel Murph, NRCS CO State Rangeland Management Specialist, Denver
Scott Woodhall, NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ
Eva Muller, Regional Director, Rocky Mountain Regional Soil Survey Office, Bozeman, MT
B.J. Shoup, CO State Soil Scientist, Denver
Eugene Backhaus, CO State Resource Conservationist, Denver

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	05/10/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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:**

---

17. **Perennial plant reproductive capability:**
