USDA Natural Resources Conservation Service

# Ecological site F047XA610UT
# Subalpine Gravelly Loam (subalpine fir/Engelmann spruce)

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Accessed: 05/14/2024

## 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.

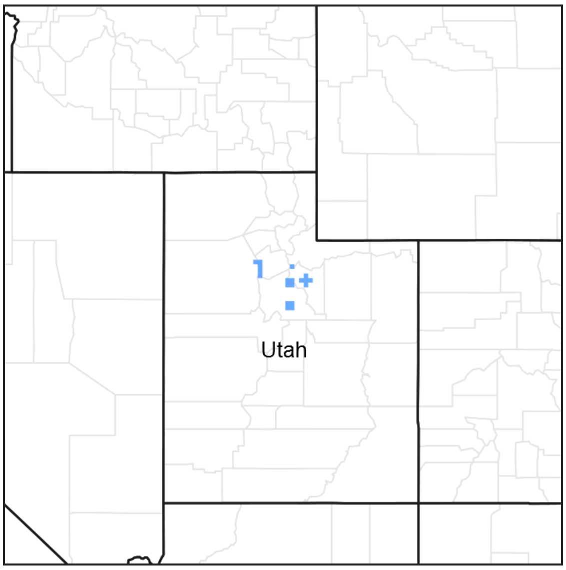


**Figure 1. Mapped extent**

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

## MLRA notes

Major Land Resource Area (MLRA): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The northern half of this area is in the Middle Rocky Mountains Province of the Rocky Mountain System. The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south, and the Unita Mountains, which trend east and west. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongated shape. Structurally, they consist of a broadly folded anticline that has an erosion-resistant quartzite core. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet (1,495 to 4,115 meters).
The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the footslopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are one of the few ranges in the United States that are oriented west to east. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.

The average precipitation is from 8 to 16 inches (203 to 406 mm) in the valleys and can range up to 73 inches (1854 mm) in the mountains. In the northern and western portions of the MLRA, peak precipitation occurs in the winter months. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees F (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.
The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically xeric in the northern part of the MLRA, but grades to ustic in the extreme eastern and southern parts. The minerology is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy –skeletal.

## Ecological site concept

The soils of this site are typically deep and well-drained. They formed in colluvium, alluvium and till derived mainly from limestone, sandstone, shale, and quartzite. This site is correlated to rocky soils, therefore rock fragments may occur on the soil surface and throughout the soil profile in some cases. pH is slightly acidic to neutral and available water-holding capacity ranges from 2.8 to 4.6 inches of water in the upper 40 inches of soil. The soil moisture regime for this site have been mapped as udic and the soil temperature regimes is cryic

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Abies lasiocarpa*<br>(2) *Picea engelmannii* |
| Shrub | (1) *Vaccinium scoparium* |
| Herbaceous | (1) *Carex rossii* |

## Physiographic features

Mountain Sideslopes, Glacial Till, and Moraine

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Mountain slope<br>(2) Canyon<br>(3) Moraine |
| Runoff class | High |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 2,286–2,743 m |
| Slope | 25–70% |

## Climatic features

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 60 days |
| Freeze-free period (average) | 0 days |
| Precipitation total (average) | 1,016 mm |

## Influencing water features

## Soil features

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Colluvium–metamorphic and sedimentary rock<br>(2) Residuum–metamorphic and sedimentary rock<br>(3) Till–metamorphic rock |
| Surface texture | (1) Gravelly loam<br>(2) Gravelly silt loam |
| Family particle size | (1) Loamy-skeletal |
| Drainage class | Well drained to somewhat excessively drained |
| Permeability class | Moderate to moderately rapid |
| Depth to restrictive layer | 102–152 cm |
| Soil depth | 102–152 cm |
| Surface fragment cover <=3" | 10–25% |
| Surface fragment cover >3" | 5–15% |
| Available water capacity (0-101.6cm) | 7.62–10.16 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0% |
| Electrical conductivity (0-101.6cm) | 0–2 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 0 |
| Soil reaction (1:1 water) (0-101.6cm) | 6.1–7 |
| Subsurface fragment volume <=3" (0-101.6cm) | 15–45% |
| Subsurface fragment volume >3" (0-101.6cm) | 10–20% |

## Ecological dynamics

It is impossible to determine in any quantitative detail the historic climax plant community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area (Galatowitsch 1990). However, up to the 1870s the Shoshone Indians, prevalent in northern Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long (Parson 1996). Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include 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 transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

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

## State and transition model

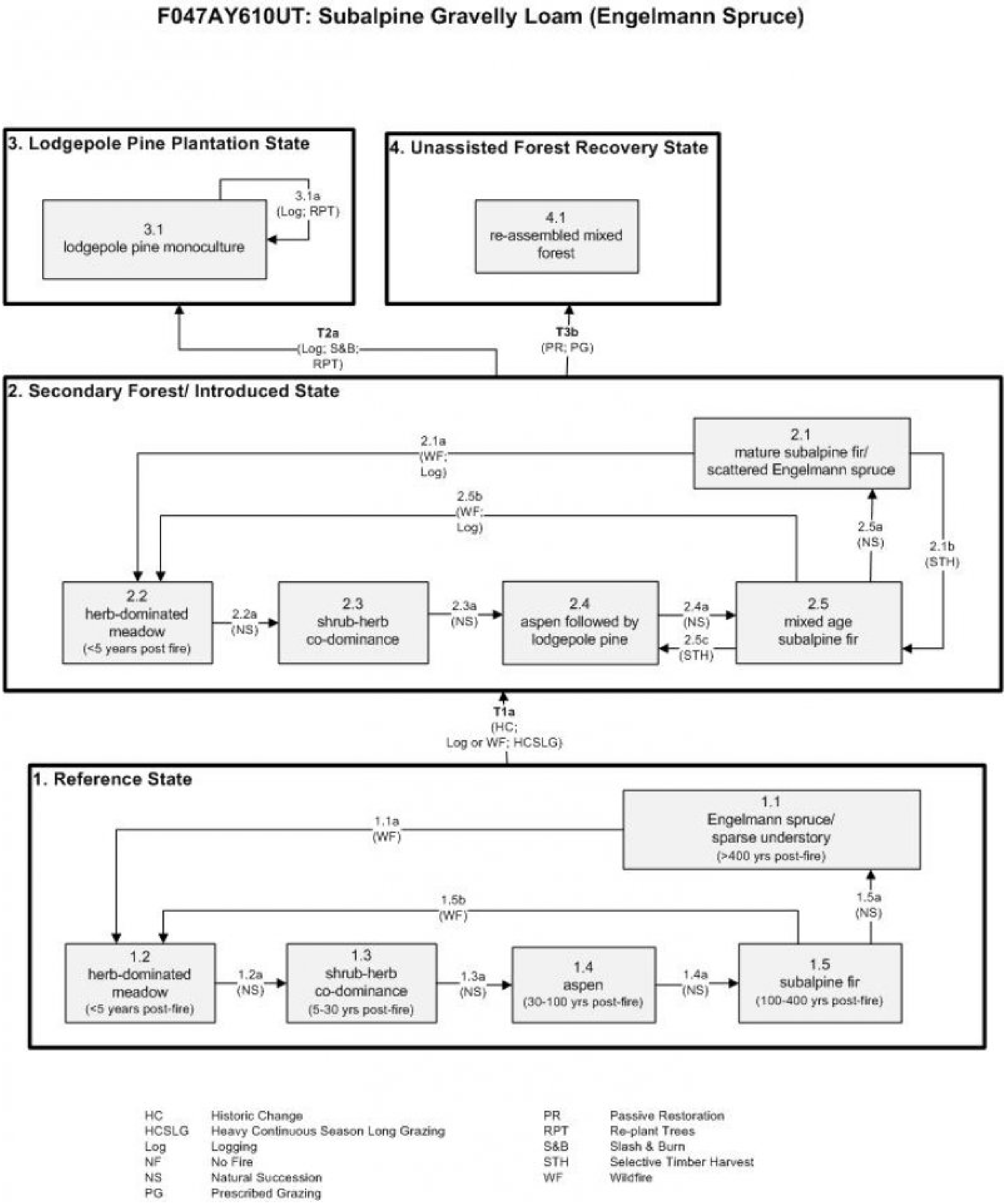


**Figure 3. State and Transition Model**

## State 1
## Reference State

The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information and familiarity with rangeland relict areas where they exist. 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 an Engelmann spruce (*Picea engelmannii*) -dominated forest 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 mature stand of subalpine fir (*Abies lasiocarpa*) (1.5). Ultimately the site would have been reinvaded by Engelmann spruce (1.1). A more complete list of species by lifeform for the Reference State is available in accompanying tables in the "Plant Community Composition by Weight and Percentage" section of this document. Wildfire (1.1a, 1.5b) would have been the primary disturbance factor prior to colonization.

## Community 1.1
## Reference State

Community Phase 1.1: Engelmann spruce/ sparse understory This plant community (1.1) would have been characterized by a dense-canopied stand of mature Engelmann spruce with a sparse understory of shade-tolerant herbs such as heartleaf arnica (*Arnica cordifolia*), Geyer's sedge (*Carex geyeri*), Ross' sedge (*Carex rossii*), and spike trisetum (*Trisetum spicatum*). This community would have existed approximately 400 years post fire. Community Pathway 1.1a: Wildfire would have removed the trees, allowing herbs to flourish briefly. Community Phase 1.2: herb-dominated meadow This plant community would have developed within the first 5 years since the last fire. This would have been dominated by shade-intolerant forbs and grasses. Community Pathway 1.2a: After about 5 years, shrubs would begin to establish in the site. Community Phase 1.3: shrub-herb co-dominance Between 5 and 30 years after fire, shrubs and herbs would co-dominate the site. The Increasing shrub component would have included common juniper (*Juniperus communis*), grouse whortleberry ( *Vaccinium scoparium*), gooseberry currant (*Ribes montigenum*), and Oregon boxleaf (*Paxistima myrsinites*). Geyer's and Ross' sedges, spike trisetum, thickspike wheatgrass, heartleaf arnica, and Fendler's meadow-rue would have been beginning to be present in the understory. Community Pathway 1.3a: 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. 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. Community Phase 1.5: subalpine fir Subalpine fir would have been temporarily dominant at these sites for approximately 100 to 400 years following the last wildfire. Only shade-tolerant understory species would have been present. During this time, Engelmann spruce would become established in the understory. Community Pathway 1.5a: After approximately 400 years following the last wildfire, Engelmann spruce would have out-competed subalpine fir to become the dominant overstory species at the site. Community Pathway 1.5b: Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly. Transition T1a: from State 1 to State 2 (Reference State to Secondary Forest/ Introduced State) The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, has caused State 1 to transition to State 2. Although the earliest use of climax Engelmann spruce forests by Europeans was for trapping of fur beavers, this had little impact on the vegetation. Similarly, early livestock grazing had little impact on these lands in climax forests. Instead, the major European influences were from logging (T1a). The first cycle of logging in these forests was for the large spruce trees for building farms, ranches, and city buildings. Continued impacts could prevent the recovery toward potential conifer dominance (State 2, various phases). Spruce establishment dates back to the colder, wetter little Ice Age, thus it is not likely that the slow growing spruce will re-establish under the altered climate of the present day. The reversal of these changes (i.e. a return pathway) back to State 1 is not practical.

**Table 5. Annual production by plant type**

| **Plant Type** | **Low (Kg/Hectare)** | **Representative Value (Kg/Hectare)** | **High (Kg/Hectare)** |
|---|---|---|---|
| Forb | 252 | 353 | 454 |
| Shrub/Vine | 168 | 235 | 303 |
| Grass/Grasslike | 140 | 196 | 252 |
| **Total** | **560** | **784** | **1009** |

## State 2
## Secondary Forest/ Introduced State

### Community 2.1
### Secondary Forest/ Introduced State

State 2 is similar to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, a different climate, and a secondary stand of trees. State 2 is a description of the ecological site shortly following Euro-American settlement. This state can be regarded as the current potential. With the large spruce trees being targeted during the first rounds of logging, what was left of these trees was minimal to none. Instead, sites that would have been dominated by Engelmann spruce became more often dominated by subalpine fir with only a scattering of Engelmann spruce (2.1). As with the Reference State, time elapsed since last wildfire or logging event remains the key factor in determining what vegetation will be encountered on these sites. Logging effects, along with associated mechanical and fire disturbances, open up the canopy and allow for the expansion of the herbaceous understory (2.1a, 2.5b). In the absence of any major disturbance (2.2a, 2.3a, 2.4a, 2.5a), the vegetation will progress through shrub-herb co-dominance (2.3), followed by aspen and lodgepole pine (*Pinus contorta*) (2.4), and ultimately by mature subalpine fir (2.1). The resiliency of this State is encouraged by the presence of self-armoring gravelly soils. Livestock grazing and fire exclusion accelerate natural succession of woody species. Community Phase 2.1: subalpine fir/ scattered Engelmann spruce This plant community (2.1) is characterized by a stand of mature subalpine fir with a scattering of Engelmann spruce. The understory is sparse and made up of Geyer’s and Ross’ sedges, slender wheatgrass, and heartleaf arnica. Community Pathway 2.1a: A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy, allowing shrubs and herbs to flourish for 20 to 30 years. Community Pathway 2.1b: Selective timber cutting of mature subalpine fir and remaining Engelmann spruce (i.e. “high grading” - which consists of the harvesting of most valuable trees) will leave a mixed age subalpine fir forest (i.e. “jungled up forest” or “dog-hair stand” - a super dense stand of small trees). Community Phase 2.2: herb-dominated meadow This plant community will develop within the first 5 years following the last fire or complete tree removal. The site will be dominated by various shade-intolerant herbs and graminoids and by Fendler’s meadow-rue (*Thalictrum fendleri*) (Reese 1980). A small component of introduced species may be present. Community Pathway 2.2a: Shrubs will become more common 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 2.3: shrub-herb co-dominance A plant community co-dominated by shrubs and herbs will develop approximately 5 to 30 years post-fire. A small component of introduced species may be present. Community Pathway 2.3a: Woody plant recovery will 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. Community Phase 2.4: aspen followed by lodgepole pine Aspen will establish in the site 30 to 100 years after the last fire or complete tree removal. Lodgepole pine will become established following aspen. Community Pathway 2.4a: Aspen recovery followed by the establishment of lodgepole pine will occur due to natural succession. Heavy season-long livestock grazing and fire exclusion will accelerate woody plant recovery and diminish the understory. Community Phase 2.5: mixed age subalpine fir A stand of mature aspen and/or lodgepole pine with an inter-mixing of subalpine fir, white fir (*Abies concolor*), and Engelmann spruce will develop approximately 100 to 400 years following fire or complete tree removal. Community Pathway 2.5a: Through natural succession, subalpine fir will dominate the site 400 years or more years following the last fire or complete tree removal. Fire exclusion will accelerate woody plant recovery and diminish the understory. Community Pathway 2.5b: 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. Community Pathway 2.5c: Selective timber harvest of subalpine fir will allow aspen or lodgepole pine to regain temporary dominance. Transition T2a: from State 2 to State 3 (Secondary Forest/ Introduced State to Lodgepole Pine Plantation State) Sites that have had the most intense logging pressure have also had greatest degree of forest soil erosion and soil compaction. Once the forest reaches a certain level of degradation, managers often decide to focus on favoring one tree, usually lodgepole pine because of its greater growth rate and merchantability. This requires a clear cut and slash disposal followed by planting. Transition T2b: from State 2 to State 4 (Secondary Forest/ Introduced State to Unassisted Forest Recovery State) A less costly alternative compared to logging/slashing/replanting is to defer logging and control livestock grazing to allow whatever self-regenerating trees that occur on the site to recover. This process could, however, be thwarted by heavy game usage (i.e. elk utilization of aspen, or snowshoe hare utilization of subalpine fir). The Forest Service calls this “passive restoration.” Recovery of Engelmann spruce may not occur if climates continue with current warming trends. The pre-settlement spruce forest establishment may have been a product of the cooler, wetter Little Ice Age (AD 1450-1850).

### State 3
### Lodgepole Pine Plantation State

### Community 3.1
### Lodgepole Pine Plantation State

State 3 is plantation forest of lodgepole pine planted specifically to replace previously degraded forests and to increase productivity of the site for economic profitability. Subsequent harvests and replanting will take place at maximum wood accumulation. Thinning to reduce insect or pathogen outbreaks will help maintain the resiliency of this State. Conversely, no management action may reduce the resiliency of this State. Community Phase 3.1: lodgepole pine monoculture This plant community is a monoculture of lodgepole pine managed specifically for growth rate and harvestability. Community Pathway 3.1a: Maintenance of the Lodgepole Pine Plantation State requires subsequent harvests at maximum accumulated wood followed by replanting.

### State 4
### Unassisted Forest Recovery State

### Community 4.1
### Unassisted Forest Recovery State

This state is achieved through “passive restoration”, allowing whatever self-regenerating trees that occur on the site to recover naturally. Thinning to reduce insect or pathogen outbreaks will help maintain the resiliency of this State. Conversely, no management action may reduce the resiliency of this State. Community Phase 4.1: re-assembled mixed forest The trees likely to occur in this phase include aspen and subalpine fir.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Shrub** | | | 168–303 | |
| **Grass/Grasslike** | | | | | |
| 0 | **Grasses** | | | 140–252 | |
| **Forb** | | | | | |
| 0 | **Forbs** | | | 252–454 | |

## Animal community

a. Livestock Grazing

This site is suited to cattle and sheep grazing during the summer and fall. Livestock will often concentrate on this site taking advantage of the shade and shelter offered by the tree overstory. Many areas are not used because of steep slopes or lack of adequate water. Attentive grazing management is required due to steep slopes and erosion hazards. Harvesting trees under a sound management program can open up the tree canopy to allow increased production of understory species desirable for grazing.

b. Initial Stocking Rates

Stocking rates vary in accordance with such factors as kind and class of grazing animal, season of use, and fluctuation in climate. Actual use records for individual sites, together with a determination of the degree to which the sites have been grazed and an evaluation of trend in site condition, offer the most reliable basis for developing initial stocking rates.

Selection of initial stocking rates for given grazed units is a planning decision. This decision should be made only after careful consideration of the total resources available, evaluation of alternatives for use and treatment, and establishment of objectives by the decisionmaker.

Wildlife species seeking food and cover in this forest site include moose, elk, mule deer, bear, porcupine, snowshoe hare, owl, and woodpecker.

## Wood products

6. Silvicultural Practices

a. Harvest cut selectively or in small patches (size dependent upon site conditions) to enhance forage production.

1. Thinning and improvement cutting – removal of poorly formed, diseased, and low vigor trees of little.

2. Harvest cutting – selectively harvest surplus trees to achieve desired spacing. Save large, healthy, full-crowned trees. Do not select only “high grade” trees during harvest.

b. Prescription burning program may be used to maintain desired canopy cover and manage site reproduction.

c. Selective tree removal on suitable sites to enhance forage production and manage site reproduction.

d. Pest Control – use necessary and approved control for specific pests or diseases.

e. Fire hazard – fire is usually not a problem in mature grazed stands. Install firebreaks or firelines as necessary.

## Other information

4. Limitations and Considerations

a. Potential for sheet and rill erosion is moderate to severe depending on slope.

b. Moderate to severe equipment limitations on steeper slopes and on sites having extreme surface stoniness.

c. Proper spacing is the key to a well managed multiple use and multi-product forest.

5. Essential Requirements

a. Adequately protect from uncontrolled burning.

b. Protect soils from accelerated erosion.

c. Apply proper grazing management practices (see management guides)

**Table 7. Representative site productivity**

| Common Name | Symbol | Site Index Low | Site Index High | CMAI Low | CMAI High | Age Of CMAI | Site Index Curve Code | Site Index Curve Basis | Citation |
|---|---|---|---|---|---|---|---|---|---|
| subalpine fir | *ABLA* | 28 | 33 | 34 | 39 | – | – | – | |

## Other references


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### Contributors

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### Approval

Scott Woodall, 9/19/2019

### 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 | |
| Approved by | |
| 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:**