

Ecological site R047XA408UT

Mountain Gravelly Loam (Douglas-fir)

Last updated: 2/05/2025
Accessed: 08/29/2026

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): 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 Uinta 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.

LRU notes

Major Land Resource Unit 47A is located in the northern half of the Middle Rocky Mountains Province of the Rocky Mountain System. This MLRA includes the Wasatch Mountains which tend to run north and south. These steeply sloping, precipitous mountains have narrow crests and deep valleys. They are primarily fault blocks that have been tilted up. The alluvial fans located at the base of these mountains are important recharge zones for valley aquifers.

Ecological site concept

The soils of this site formed mostly in alluvium/slope alluvium or colluvium over residuum derived from limestone, sandstone and shale. Surface soils are gravelly loam to loam in texture. Rock fragments may be present on the soil surface and throughout the profile, and make up more than 35 percent of the soil volume. These soils are moderately deep to deep, well-drained, and have moderately slow to moderate permeability. pH is slightly acidic to moderately alkaline. Available water-holding capacity ranges from 3.0 to 6.0 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly xeric and the soil temperature regime is frigid. Precipitation ranges from 16-22 inches annually.

Associated sites

R047XA410UT	Mountain Gravelly Loam (oak) Sites often occur adjacent to each other.
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Similar sites

F047XA512UT	High Mountain Loam (Douglas-fir) Similar floristic characteristics, however this site falls in a higher precipitation regime.
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Table 1. Dominant plant species

Tree	(1) <i>Pseudotsuga menziesii</i>
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This ecological site typically occurs on mountain sides and strath terraces. Slopes normally range from 0 to 70 percent but may occasionally be steeper. Slope steepness, aspect and elevation will influence the vegetative floristics of this site. Sites are typically located between 7,000 to 10,000 feet in elevation. Runoff is low to high.

Table 2. Representative physiographic features

Landforms	(1) Mountainside (2) Strath terrace
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	1,980 – 2,800 m
Slope	0 – 70 %
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The climate of this site characterized by cold, snowy winters and cool summers. The average annual precipitation ranges from 16-22 inches. March thru May and August, are typically the wettest months with June and July being the driest. The most reliable sources of moisture for plant growth are the snow that accumulates over the winter, and spring rains. Summer thunderstorms are intermittent and sporadic in nature, and thus, are less reliable sources of moisture to support vegetative growth on this site.

Table 3 Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	410-560 mm

Influencing water features

Due to its landscape position, this site is not influenced by streams or wetlands.

Soil features

The soils of this site formed mostly in alluvium/slope alluvium or colluvium over residuum derived from limestone, sandstone and shale. Surface soils are gravelly loam to loam in texture. Rock fragments may be present on the soil surface and throughout the profile, and make up more than 35 percent of the soil volume. These soils are moderately deep to deep, well-drained, and have moderately slow to moderate permeability. pH is slightly acidic to moderately alkaline. Available water-holding capacity ranges from 3.0 to 6.0 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly xeric and the soil temperature regime is frigid. Precipitation ranges from 16-22 inches annually.

Table 4. Representative soil features

Parent material	(1) Alluvium – limestone, sandstone, and shale (2) Slope alluvium – limestone, sandstone, and shale (3) Residuum – limestone, sandstone, and shale
Surface texture	(1) Gravelly loam (2) Loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	100 – 150 cm
Soil depth	100 – 150 cm

Surface fragment cover <=3"	0 – 20 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (Depth not specified)	7.62 – 15.24 cm
Calcium carbonate equivalent (Depth not specified)	0 – 10 %
Electrical conductivity (Depth not specified)	Not specified
Sodium adsorption ratio (Depth not specified)	Not specified
Soil reaction (1:1 water) (Depth not specified)	6.1 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	20 – 30 %
Subsurface fragment volume >3" (Depth not specified)	0 – 20 %

Ecological dynamics

It is impossible to determine in any quantitative detail the reference state 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. 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. In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long. Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram that illustrates 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 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.

Community 1.1

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 depended primarily on the time since the last wildfire occurred. If the site had not experienced fire for about 100 years, Douglas-fir (*Pseudotsuga menziesii*) would have been the dominant species occupying the site with a sparse understory (1.1) due to tree competition, overstory shading, and duff accumulation. Douglas-fir replaces itself without wildfire and would have been the climax dominant. Wildfire (1.1a) would have replaced these stands with a rich herb-dominated vegetation (1.2). In the absence of any major disturbance (1.2a, 1.3a, 1.4a, 1.5a), the re-sprouting vegetation including quaking aspen (*Populus tremuloides*), bigtooth maple (*Acer grandidentatum*), and/or Gambel oak (*Quercus gambelii*) would have reclaimed the site (1.3), followed by the increasing presence of aspen (*Populus tremuloides*), first as saplings (1.4), and later as mature aspen with Douglas-fir seedlings (1.5), ultimately to where aspen would have been outcompeted by Douglas-fir returning to the climax vegetation (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 Phase 1.1: densely canopied Douglas-fir/ sparse understory

This plant community (1.1) would have been characterized by a stand of mature Douglas-fir with a sparse understory of Geyer’s sedge (*Carex geyeri*), bluegrass (*Poa* spp.), chokecherry (*Prunus virginiana*), Fendler’s meadow-rue (*Thalictrum fendleri*), and creeping barberry (*Mahonia repens*).

Community Pathway 1.1a:

Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly.

Community Phase 1.2: herb-dominated

This plant community would have developed within the first 5 years since the last fire, with Geyer’s sedge, bluegrass, slender wheatgrass (*Elymus trachycaulus*), heartleaf arnica (*Arnica cordifolia*) and feathery false lily of the valley (*Maianthemum racemosum* ssp. *racemosum*) being the dominant understory species.

Community Pathway 1.2a:

After about 5 years, shrubs would begin to establish in the site.

Community Phase 1.3: re-sprouting aspen, maple, oak/ herbaceous understory

For a period of about 5 to 60 years post fire, a mixture of re-sprouting shrubs would have been dominant on the site, including, quaking aspen, bigtooth maple, and Gambel oak. Other prominent shrubs would have been mountain snowberry (*Symphoricarpos oreophilus*), chokecherry (*Prunus virginiana*), Saskatoon serviceberry (*Amelanchier alnifolia*), and Oregon boxleaf (*Paxistima myrsinites*), among others. The herbaceous understory would also have been fairly intact.

Community Pathway 1.3a:

About 60 years after fire, aspen would become established in the site.

Community Phase 1.4: immature aspen

This plant community would have been dominated by a stand of immature aspen, which is a seral species while Douglas-fir begins to establish itself under other nurse species. A stand of immature aspen would have existed approximately 60 to 80 years since last fire.

Community Pathway 1.4a:

Aspen would have continued to mature while Douglas-fir would have become well established in the understory.

Community Phase 1.5: mature aspen/ Douglas-fir

A stand of mature aspen intermixed with Douglas-fir saplings would have been encountered approximately 80 to 100 years post fire.

Community Pathway 1.5a:

After about 100 years following the last fire, Douglas-fir would become mature, shading out aspen and the shade-intolerant shrub and

herb species in the understory.

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. Europeans further altered this vegetation largely through logging, livestock grazing, trapping of fur beaver and changing the fire regime. Continued impacts could prevent the recovery toward potential conifer dominance (State 2, various phases). The reversal of these changes (i.e. a return pathway) back to State 1 is not practical.

a. Nature of Forest Community

The overstory tree canopy cover is 30 to 40 percent. Common understory plants are Geyer sedge, wheeler bluegrass, heartleaf arnica, chokecherry, canyon maple, and creeping Oregon grape. Understory composition by air-dry weight is about 25 percent perennial grasses and grasslike plants, 10 percent forbs, and 65 percent shrubs. Understory production ranges from 500 pounds per acre in favorable years to about 100 pounds per acre in unfavorable years. Understory production includes the total annual production of all species within 4 ½ feet of the ground surface.

State 2

Secondary Forest/ Introduced State

Community 2.2

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 least amount of disturbance or manipulation of fire regime (Alexander 1985; 1988), a mature stand of Douglas-fir with a sparse understory component is expected at this site (2.1). As with the Reference State, time since last wildfire remains the key factor in determining what vegetation would be encountered here. Wildfire, particularly crown fires, or complete harvesting of the forest (2.1b, 2.5b) will replace these stands with a rich herb-dominated vegetation. (2.2). In the absence of any major disturbance (2.2a, 2.3a, 2.4a, 2.5a), the vegetation will progress into more of a shrub-herb co-dominance (2.3), followed by the increasing presence of aspen first as saplings (2.4), and later as mature aspen with Douglas-fir (2.5), ultimately to where Douglas-fir will outcompete aspen returning to the climax vegetation (2.1). Because soils on this site are rocky they are considered "self-armoring," thus making the site resistant to the effects of erosion. Heavy livestock grazing and tree harvests will reduce the stability of this site, while a reduction in livestock use and tree harvests will maintain stability.

Community Phase 2.1: densely canopied Douglas-fir/ sparse understory

This plant community (2.1) is characterized by a stand of mature Douglas-fir with a sparse understory of Geyer's sedge, and bluegrass may be present.

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 more understory for 20 to 30 years.

Community Pathway 2.1b:

The removal of only the mature Douglas-fir will allow some aspen to return and the immature Douglas-fir to continue growing.

Community Phase 2.2: herb-dominated

This plant community will develop within the first 5 years since the last fire. Dominant grasses are Geyer's sedge, bluegrass, and slender wheatgrass with heartleaf arnica and feathery false lily of the valley as common forbs. A small component of introduced species may also be present.

Community Pathway 2.2a:

The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant (shrub) establishment and diminish the herbaceous understory.

Community Phase 2.3: re-sprouting aspen, maple, oak/ herbaceous understory

A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years post fire. A small component of introduced species may be present.

Community Pathway 2.3a:

The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the herbaceous understory.

Community Pathway 2.3b:

Heavy browsing will lead to Phase 2.1, a densely canopied Douglas-fir community with a sparse understory.

Community Phase 2.4: immature aspen

Aspen will establish in the site 60 to 80 years after the last fire or complete tree removal.

Community Pathway 2.4a:

The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Phase 2.5: mature aspen/ Douglas-fir

A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years following fire or complete tree removal.

Community Pathway 2.5a:

The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Pathway 2.5b:

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 more understory for 20 to 30 years.

Community Pathway 2.5c:

The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

Transition T2a: from State 2 to State 3 (Secondary Forest/ Introduced State to Tertiary Forest/ Degraded State)

The Secondary Forest/ Introduced State will transition to the Tertiary Forest/ Degraded State following a second cycle of timber harvest or stand replacing wildfire, and further impacts from heavy continuous season-long grazing. Logging opens up the forest canopy allowing shade tolerant understory for 20 to 30 years. Secondary and tertiary disturbances produce an assemblage of vegetation from degraded temporary meadows to further simplified forests. A key indicator of the approach to this transition the presence of dominant trees that have reached the size required for commercial harvest. The trigger is a management decision. The second cycle of cutting typically is a clearcut, where all stems are downed, slash piled and burned.

State 3

Tertiary Forest/ Degraded State

Community 3.3

Tertiary Forest/ Degraded State

State 3 is characterized by tertiary forests that are further degraded in both understory and remnant tree layers. Active fire suppression speeds up the recovery of dominance by woody plants. Less predictable changes in the vegetation of State 3 will ensue due to global climate changes.

Community Phase 3.1: densely canopied Douglas-fir/ sparse understory

This plant community (3.1) is characterized by a stand of mature Douglas-fir. A sparse understory of Geyer's sedge and bluegrass may be present.

Community Pathway 3.1a:

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 shade-intolerant grasses, forbs, and shrubs to flourish for 20 to 30 years.

Community Pathway 3.1b:

The removal of only the mature Douglas-fir will allow aspen to return and the immature Douglas-fir to continue growing.

Community Phase 3.2: herb-dominated

This plant community will develop within the first 5 years since the last fire. Dominant grasses are Geyer's sedge, bluegrass, and slender wheatgrass. A small component of introduced species may be present.

Community Pathway 3.2a:

After about 5 years, shrubs will begin to establish in the site.

Community Phase 3.3: re-sprouting aspen, maple, oak/ herbaceous understory

A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years after fire or complete tree removal. A small component of introduced species may be present.

Community Pathway 3.3a:

Aspen will become established at the site after 60-80 years following the last wildfire or complete tree removal.

Community Phase 3.4: immature aspen

Immature aspen dominate the stand 60 to 80 years following the last fire or complete tree removal.

Community Pathway 3.4a:

Aspen matures and immature Douglas-fir become well established in the understory 80 years after the last fire or complete tree removal.

Community Phase 3.5: mature aspen/ Douglas-fir

A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years after the last fire or complete tree removal.

Community Pathway 3.5a:

After about 100 years following the last fire, Douglas-fir will become mature, shading out aspen and the shade-intolerant shrub and herb species in the understory.

Community Pathway 3.5b:

A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase clearcut. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 3.5c:

The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

State and transition model

Additional community tables

Contributors

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Approval

Kendra Moseley, 2/05/2025

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	08/29/2026
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:
