USDA Natural Resources
Conservation Service

Ecological site R228XY705AK
White spruce/alder scrub unstable slopes

Last updated: 6/12/2025
Accessed: 04/10/2026

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): 228X–Interior Alaska Mountains

Physiography
The Interior Alaska Mountains Major Land Resource Area (MLRA) (228X) includes portions of the high mountain slopes, hills, and plains of the Alaska Range, Talkeetna Mountains, Chugach Mountains, Wrangell Mountains and the northern Aleutian Range. This MLRA comprises 54,205 square miles and consists of rugged, high mountains and low, rounded hills and extended footslopes along the base of the mountains. Most of the area is undeveloped wildland and includes true alpine and subalpine life zones. Geology consists of sedimentary, metamorphic, and igneous bedrock. Climate is considered continental subarctic.

MLRA boundaries
MLRA 228X is expansive and therefore shares a boundary with many MLRAs. Boundaries with other mountainous MLRAs such as 222X (Southern Alaska Coastal mountains), 223X (Cook Inlet Mountains), and 225X (Southern Alaska Peninsula Mountains) result from orogenic differences (225X,223X) or variation in climate (222X). Other MLRAs such as 236X (Bristol-Bay-Northern Alaska Peninsula Lowlands), 227X (Copper River Basin), 229X (Interior Alaska Lowlands), and 230X (Yukon-Kuskokwim Highlands) have distinct physiographic boundaries where steep mountains meet lowlands, basins, and floodplains.

Waterways
Encompassed within the Pacific Mountain system, the mountains of MLRA 228X are dissected by high-gradient valleys with braided floodplains in the valley bottoms. Glaciers, snowfields, and ice fields make up 15 percent of the area and elevations range from about 1,500 feet in the Copper River Basin to 20,320 feet at the summit of Denali. The major

rivers of this MLRA include the Tanana, Kuskokwim, and Copper, and drain into the Bering Sea (Tanana, Kuskokwim), and the Gulf of Alaska (Copper). The headwaters of the Susitna River are part of this MLRA and drain into Cook Inlet through the Cook Inlet Mountains, and Cook inlet Lowlands (MLRA 223X and 224X, respectively). This MLRA is in the zone of discontinuous permafrost, where permafrost mostly occurs in fine-textured soils on gently sloping landforms and/or on northerly aspects.

Geology
Except for the highest peaks and upper ridges, all of this area was glaciated during the late Pleistocene. Glacial deposits have mostly eroded or have been buried by colluvium and alluvium throughout the Holocene, yet some highly modified glacial deposits remain at lower elevations on low mountain slopes and valleys. Loess also occurs at lower elevations, and most valley bottoms have been buried by recent alluvial deposits. Bedrock geology is comprised of sedimentary, metamorphic, igneous, and volcanic rock, and gold mining does take place in this MLRA.

Soils
The dominant soil orders in MLRA 228X are Gelisols, Inceptisols, Spodosols, and Entisols. The Gelisols are shallow or moderately deep to permafrost, occur on finer textured sediments, and are poorly drained or very poorly drained. Common Gelisol suborders are Histels, Orthels, and Turbels. The Histels have thick accumulations of surface organic material and occur in depressions and peat plateau. The Orthels and Turbels have comparably thinner surface organic material and occur on drainageways, stream terraces, and outwash plains. The Inceptisols, Spodosols, and Entisols lack permafrost in the soil profile. Spodosols are formed from weathering processes that strip organic matter combined with aluminum from upper horizons and deposit them into lower horizons. Entisols and Inceptisols are characteristically undeveloped, with Inceptisols exhibiting only moderate weathering and development while Entisols exhibit little to no evidence of development at all. Soils have a subgelic or cryic temperature regime with aquic or udic moisture regime and mixed minerology. Miscellaneous areas make up 58 percent of this MLRA and are classified as rock outcrop, rubble land, and glaciers.

Climate
The climate of this area is characterized by brief, cool summer, and long, cold winters, but extreme variation in elevation results in a wide range of climatic conditions. Average annual precipitation ranges from 15 to 20 inches at lower elevations to 100 inches at high elevations. Rainfall is generally highest in July, August, and early September. The average annual snowfall ranges from 70 to 400 inches, and the average annual temperature at Denali Park headquarters is 27 degrees F. Freeze-free period ranges from 50 to 80 days, but at higher elevations, freezing temperatures can occur at any point throughout the year.

Vegetation
The Interior Mountains MLRA is defined by subalpine and alpine life zones; therefore, true forested communities do not occur and are restricted to surrounding lowland MLRAs. Black and white spruce trees do occur in the subalpine zone, but are often sporadic, and

exhibit Krummholz (stunted and/or crooked) growth forms and do not produce viable seed. Subalpine vegetation is characterized by birch-willow scrublands or spruce-scrub woodlands on loamy, stable mountain slopes. Unstable, colluvial slopes are typically dominated by alder scrub communities which can, on occasion, include scattered black and white spruce. Willow typically dominates drainages, while wet, poorly to very poorly drained swales are comprised of tussock sedge-scrub species. Low birch-ericaceous scrub communities climb up mountain slopes until they are replaced by dryas-ericaceous dwarf scrub communities in the true alpine zone. Lichen also plays an important role in skeletal and bedrock-controlled high elevation mountain slopes, ridges, and summits. There is generally little to no plant growth at elevations above 7,500 feet (USDA, 2022).

LRU notes

This area supports two life zones defined by the physiological limits of plant communities along an elevational gradient: subalpine, and alpine. In this area, the boreal life zone occurs below 2500 feet elevation on average, and is relegated to surrounding, lowland MLRAs. The subalpine zone is typically a narrow transitional band between the boreal and the alpine life zones, and is characterized by sparse, stunted trees. In the subalpine, certain types of birch and willow shrub species grow at over one meter in height (commonly Betula glandulosa and Salix pulchra). In the alpine, trees no longer occur, and all shrubs are dwarf or lay prostrate on the ground. The transition between boreal and alpine vegetation can occur within a range of elevations, and is highly dependent on slope, aspect, and shading from adjacent mountains.

Within each life zone, there are plant assemblages that are typically associated with cold slopes and warms slopes. Cold slopes and warm slopes are created by the combination of the steepness of the slope, the aspect, and shading from surrounding ridges and mountains. Warm slope positions typically occur on southeast to west facing slopes that are moderate to very steep (over 10 percent slope) and are not shaded by the surrounding landscape. Cold slopes typically occur on northwest to east facing slopes, occur in shaded slope positions, or occur in low-lying areas that are cold air sinks. Examples of shaded positions include head slopes, low relief backslopes of hills, and the base of hills and mountains shaded by adjacent mountain peaks. These warm and cold slopes can shift the elevation at which life zones occur. Warm slopes can allow communities to persist at higher elevations, while cold slopes can restrict these same communities to lower elevations.

Classification relationships

Alaska Vegetation Classification
Tall closed alder scrub (II.B.1.b. – level IV)
(Viereck et al. 1992)

Circumboreal Vegetation Map – Alaska-Yukon Region
Southern Alaska Alder-Willow-Dwarf Birch Scrub

(Jorgensen and Meidinger, 2015)

LANDFIRE Biophysical Settings
7416090 - Alaska Sub-boreal Mesic Subalpine Alder Shrubland
(LANDFIRE biophysical settings, 2009)

Ecological site concept

• Ecological site R228XY705AK is a subalpine white spruce/alder/horsetail scrub community on mountain slopes, hillslopes, and glacial landforms
• Unstable, well drained soils formed in loess over glacial till or colluvium
• Elevations range from 2460 to 3940 feet
• Vegetation is influenced by harsh growing conditions, persistent snowpack, and unstable soils that can lead to soil creep and mass movement events
• The representative plant community (1.1) is a tall closed alder scrub community

Associated sites

R228XY706AK	**White spruce/willow-birch scrub dry slopes** Ecological site R228XY706AK occurs on dry stable slopes, adjacent to ecological site R228XY705AK and supports a willow-birch subalpine community, rather than the alder-dominated community supported on unstable slopes.

Similar sites

R228XY714AK	**Mixed spruce/birch-ericaceous scrub woodland mesic slopes** Ecological site R228XY714AK occurs adjacent to ecological site R228705AK on stable, mesic slopes in the subalpine zone. A similar plant community is supported, but is dominated by a willow, birch, and alder, rather than alder, exclusively.

Table 1. Dominant plant species

Tree	(1) *Picea glauca*
Shrub	(1) *Alnus viridis ssp. fruticosa* (2) *Salix pulchra*
Herbaceous	(1) *Equisetum arvense* (2) *Geocaulon lividum*

Physiographic features

Ecological site R228XY705AK occurs in the subalpine zone on unstable, colluvial mountain slopes, hill slopes, and glacial deposits. Elevation ranges from 2460 to 3940 feet on slopes ranging from 10 to 75 percent on all aspects.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Mountains > Hillslope (3) Mountains > Moraine
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	2,460–3,940 ft
Slope	10–75%
Water table depth	60 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	1,100–5,940 ft
Slope	0–80%
Water table depth	39–60 in

Climatic features

The climate of this high-elevation area is characterized by short growing season, cool summers, and long winters. Mean annual precipitation is around 15 inches at lower elevations but can reach much higher totals at higher elevations. June, July, and August are the wettest months of the year, while February, March, and April are the driest. On average, there are 17 frost free days per year, but at high elevations, freezing temperatures can occur any month of the year. The mean maximum temperature is 67 degrees Fahrenheit in July, while the mean low temperature is -9 degrees Fahrenheit in January. At higher elevations, this temperature range will be greatly skewed towards colder temperatures.

Table 4. Representative climatic features

Frost-free period (characteristic range)	5-30 days
Freeze-free period (characteristic range)	63-77 days
Precipitation total (characteristic range)	12-17 in

Frost-free period (actual range)	1-41 days
Freeze-free period (actual range)	50-84 days
Precipitation total (actual range)	12-18 in
Frost-free period (average)	17 days
Freeze-free period (average)	69 days
Precipitation total (average)	15 in

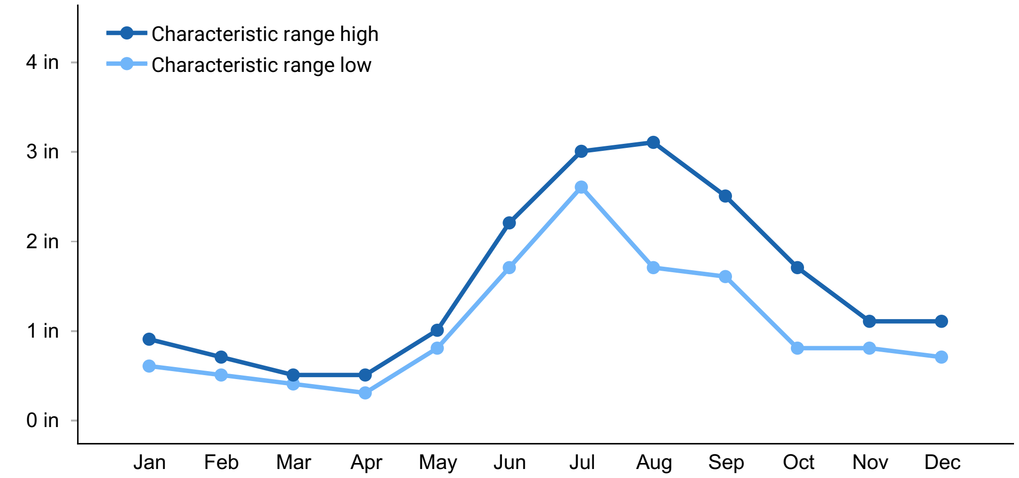


Figure 1. Monthly precipitation range

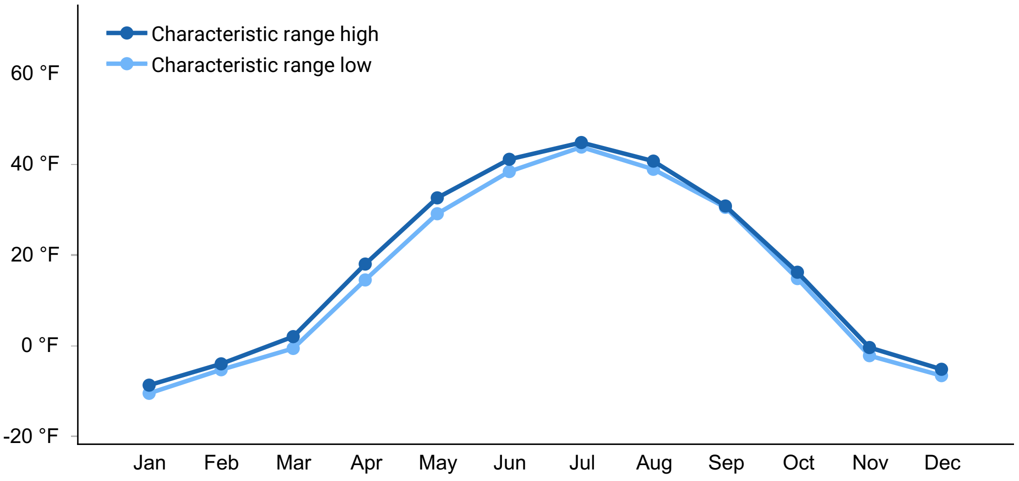


Figure 2. Monthly minimum temperature range

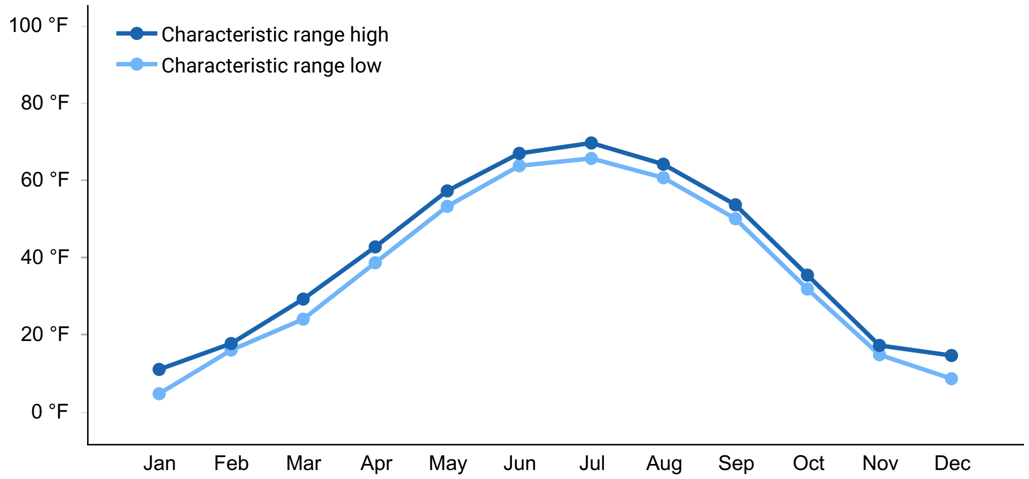


Figure 3. Monthly maximum temperature range

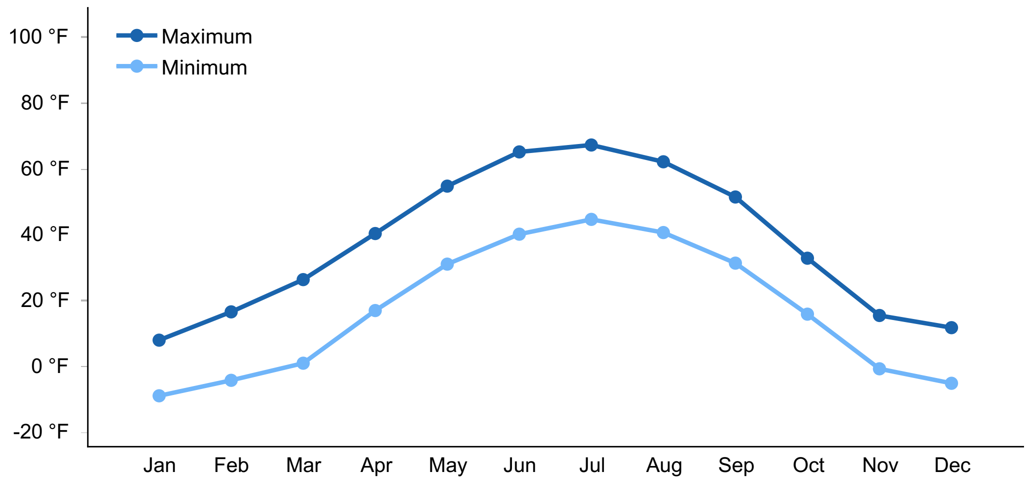


Figure 4. Monthly average minimum and maximum temperature

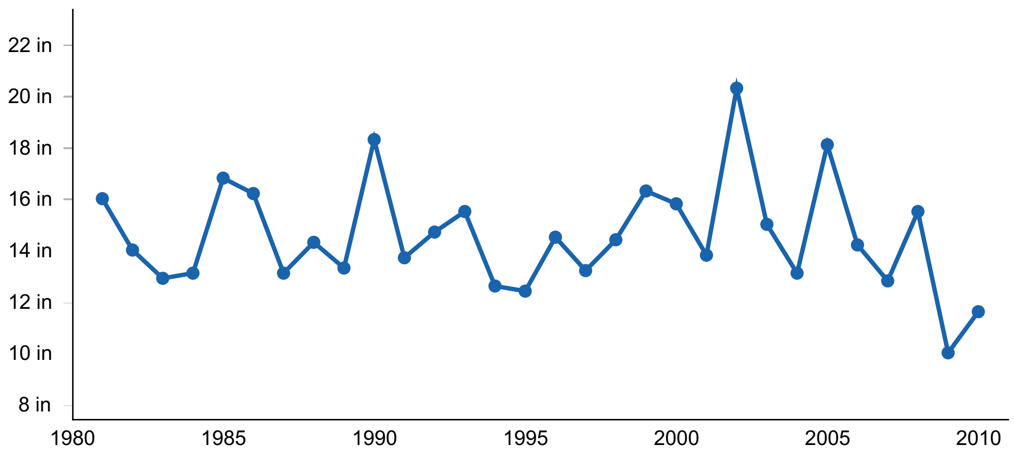


Figure 5. Annual precipitation pattern

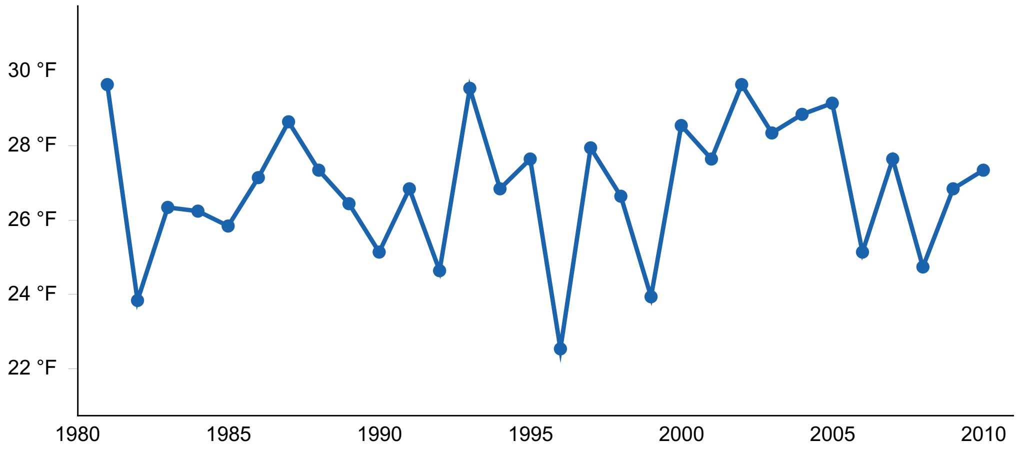


Figure 6. Annual average temperature pattern

Climate stations used

- (1) TONSINA [USC00509385], Copper Center, AK
- (2) NABESNA [USC00506147], Gakona, AK
- (3) PAXSON [USC00507097], Copper Center, AK
- (4) CANTWELL 2 E [USC00501243], Cantwell, AK
- (5) MCKINLEY PARK [USC00505778], Healy, AK
- (6) FAREWELL LAKE [USC00503009], Mc Grath, AK

Influencing water features

Due to topographic position, no water features or wetlands are associated with this ecological site.

Wetland description

Not a wetland.

Soil features

Soils formed in organic material and loess over gravelly colluvium and glacial till. Surface fragments are not common, and surface textures are silt loams. The mineral soil is considered loamy-skeletal and forms in aeolian silts over gravelly colluvium and glacial till. Strongly contrasting textural stratifications is a common restrictive layer at very shallow to moderate depths. Soil depth is controlled by lithic contact which typically occurs at deep and very deep depths. Soils are well drained. Soil pH varies dependent upon parent material minerology and range from acidic to basic.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Loess (3) Colluvium (4) Till
Surface texture	(1) Silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	7–35 in
Soil depth	59–60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-10in)	0.4–4.2 in
Clay content (0-20in)	3–16%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–3
Soil reaction (1:1 water) (0-40in)	3.6–8.4
Subsurface fragment volume <=3" (0-60in)	0–21%
Subsurface fragment volume >3" (0-60in)	0–24%

Table 6. Representative soil features (actual values)

Drainage class	Poorly drained to somewhat excessively drained
Permeability class	Not specified
Depth to restrictive layer	7–72 in
Soil depth	36–72 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-10in)	0.3–5.5 in

Clay content (0-20in)	Not specified
Electrical conductivity (0-40in)	Not specified
Sodium adsorption ratio (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (0-60in)	0–78%
Subsurface fragment volume >3" (0-60in)	0–90%

Ecological dynamics

Growing conditions

Located in the subalpine life zone, ecological site R228XY705AK is exposed to a variety of harsh conditions including high winds, persistent snowpack, and extremely cold temperatures. Persistent snowpack and cold temperatures reduce the growing season in the alpine, when compared to lower elevations. These harsh climate conditions result in stunted vegetative growth forms, inhibiting growth of tree species and causing shrubby vegetation to be diminished in growth form.

Disturbance

Although fire plays an important role in shaping plant communities across Alaska, fire frequency in high elevation communities is largely unstudied, when compared to interior forest stands. Most wildfires in Alaska are caused by lightning strikes which tend to occur near tree line, decreasing in frequency into the subalpine and alpine zones (Dewilde et al, 2006). Despite the propensity of fires to move from boreal stands upslope into higher life zones, it is likely a general lack of fuel in scrub communities that accounts for diminished fire frequency (Kasischke et al. 2002, Dewild et al. 2006). The disturbance regime in this community is likely driven by avalanche, rockslides, and other mass movement events associated with eroding, unstable mountain slopes coupled with substantial snowfall.

Unstable slopes

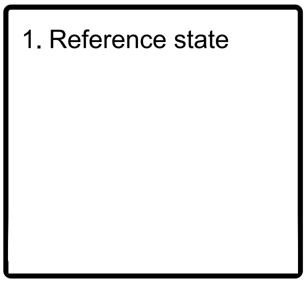
Soil creep and mass movements are the driving force behind this ecological site. This site exists on a variety of landforms, but the unifying abiotic factor is unstable soil. This can manifest in a variety of ways, be it steep slopes, presence of volcanic ash, or soils high in angular coarse fragments. This instability can lead to soil creep, which is slow, constant, downhill movement over time. In addition to soil creep, these unstable slopes can experience mass movement events in which, rather than moving slowly over time, soils move all at once. Both scenarios can make it difficult for plants to establish, given a substrate that is constantly in flux. It is in this constant state of flux that alder thrives. Once established, their high seed output and ability to reproduce through sprouting rhizomes can lead to expansive thickets. These thickets, once canopy closure occurs, can shade out competing plants, preventing establishment. This prolific colonization in conjunction with highly acidic leaf material allows alder to establish quickly, and out-compete other shrub species on these unstable slopes.

Reference community 1.1

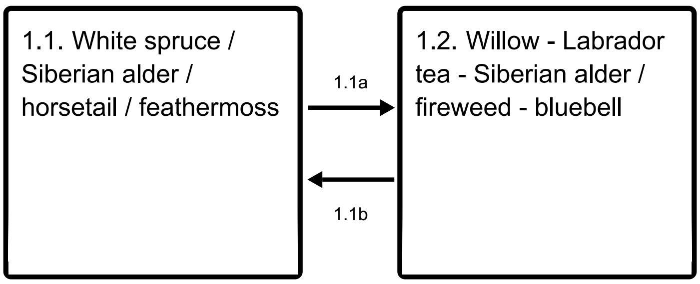
Field data suggest that a single state exists on this ecological site. The reference plant community (1.1) is characterized by a tall, closed alder scrub community (Viereck et al. 1992). White spruce is common in this community but does not exceed 25 percent cover. Many trees that exist in subalpine communities exhibit Krummholz growth forms and do not produce viable seed. For these reasons, subalpine trees in this community are at the edge of their range, decreasing in abundance as elevation increases. Notable plant species in this community include Siberian alder (*Alnus viridis* ssp. fruticosa), field horsetail (*Equisetum arvense*), several willow (Salix spp.) species, and feather mosses such as splendid feather moss (*Hylocomium splendens*) and Schreber's big redstem moss (*Pleurozium schreberi*).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1a - Fire or mass movement

1.1b - Time without disturbance

State 1

Reference state

The reference state includes two plant community phases. The reference plant community (1.1) is characterized by a tall closed alder scrub community (Viereck et al., 1992) where white spruce does not exceed 25 percent, and feather mosses, bluebells, and horsetail are abundant in the shaded slopes beneath the alder canopy. Community 1.2 is an early-mid stage successional community that is dominated by herbaceous and low shrub species that colonize this ecological site after fire or following a mass movement event. Although fire is less abundant in subalpine communities, tall, closed alder scrub carries a heavy fuel load necessary for a stand-replacing fire. In addition to fire, the unstable slopes associated with this ecological site are more likely to slide than adjacent stable slopes. Either disturbance mechanism will result in exposed mineral soil that will be colonized by forbs, and low shrub species before eventually being dominated by alder once more.

Dominant plant species

- white spruce (*Picea glauca*), tree
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- Richardson's willow (*Salix richardsonii*), shrub
- grayleaf willow (*Salix glauca*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- false toadflax (*Geocaulon lividum*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous
- field horsetail (*Equisetum arvense*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous

Community 1.1
White spruce / Siberian alder / horsetail / feathermoss

Community 1.1 is characterized by a tall closed alder scrub community (Viereck et al., 1992). White spruce is common, but does not exceed 25 percent and cover decreases with elevation. Feathermosses and horse tail are common in the understory along with various forbs such as bluebells and fireweed where sunlight is able to penetrate the closed canopy.

Dominant plant species

- white spruce (*Picea glauca*), tree
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Community 1.2
Willow - Labrador tea - Siberian alder / fireweed - bluebell

Community 1.2 is an early-mid succession community that colonizes this ecological site following disturbance by fire or mass movement events. Exposed mineral soil is initially colonized by herbaceous species such as fireweed and bluebells. Then, low willows, Labrador tea, and Siberian alder begin to establish. Eventually Siberian alder overshadows the low willow and herbaceous species, and once canopy closure occurs, this community reverts back to the reference community 1.1. Siberian alder's ability to resprout and produce abundant seed allow it to dominate these unstable slopes.

Dominant plant species

- bog Labrador tea (*Ledum groenlandicum*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- grayleaf willow (*Salix glauca*), shrub
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- tall bluebells (*Mertensia paniculata*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.2

Wildfire or mass movement event exposes mineral soil and resets succession.

Pathway 1.1b
Community 1.2 to 1.1

Time without disturbance allows alder to dominate, leading to canopy closure. This closed canopy creates ample shade, prohibiting competitors from establishing in the understory.

Additional community tables

Inventory data references

The vegetation modeled for this site has limited data and is considered provisional. The associated model was largely developed from NRCS staff with working knowledge of the area and literature review.

Plant community composition is largely based on ecological sites from AK638: Soil Survey of Cantwell Area, Alaska.

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Contributors

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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	04/10/2026
Approved by	Blaine Spellman
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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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:**
