Ecological site R229XY002AK
Boreal Tussock Peat Frozen Depressions

Last updated: 6/12/2025
Accessed: 03/13/2026

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): 229X–Interior Alaska Lowlands

The Interior Alaska Lowlands MLRA includes the flood plains and terraces along the upper reaches of the Tanana and Kuskokwim Rivers and the middle reaches of the Yukon River. This area makes up 39,065 square miles. The northern portion of this area that contains the cities of Fairbanks and North Pole are the second most densely populated lands in Alaska. Other towns along the road system include Nenana, Delta Junction, and Tok; and parts of Fort Wainwright and Fort Greely, the two largest military reservations in Alaska. Elsewhere, the area is mostly undeveloped wild land and is sparsely populated. In the western part of the area, the communities of Tanana, Galena, and McGrath are accessible only by air or by river. Parts of the Denali National Park and Preserve and Tetlin National Wildlife Refuge are in this area. The Trans-Alaska Pipeline parallels the Alaska Highway from Delta Junction to Fairbanks.

This area is on broad, nearly level, braided to meandering flood plains, stream terraces, and outwash plains. In many places, shallow basins and undulating stream terraces are dotted with hundreds of small and medium size lakes and interconnecting wetlands. Sloughs, oxbow lakes, and escarpments along river channels are features associated with the flood plains, terraces, and basins. Isolated bedrock-controlled hills and low- to moderate-relief mountains are in scattered places throughout the area. Extended footslopes are common at the base of hills and mountains and along the boundaries with adjoining mountainous MLRAs. Elevation ranges from about 100 feet in the southwestern part of the area, along the lower Yukon River, to about 1,900 feet in the upper Tanana Valley.

Geology and Soils

Although never glaciated, this area is filled with a deep layer of Pleistocene glaciofluvial deposits. Additional fluvial sediments from the Alaska Range and the northern Aleutian Range accumulated along the Tanana and Kuskokwim Rivers during the Holocene Epoch. The Koyukuk and lower Yukon River drainages have undergone several periods of deposition followed by erosion. In some places old terraces are 33 to 250 feet above the flood plain. Quaternary glaciofluvial and fluvial sediments are estimated to be as much as 330 to 660 feet thick throughout the area. Much of the MLRA, particularly along the Tanana and Kuskokwim Rivers, is mantled with a layer of silty micaceous loess originating from the unvegetated flood plains and outwash plains along the Alaska Range. Thick eolian deposits, including loess dunes, sand dunes, and sand sheets, make up about 12 percent of the area. Inclusions of glacial moraines and drift are near the mountains. Unconsolidated sediments bury the bedrock geology, except for structural hills in some places.

This area is in the zone of discontinuous permafrost. Permafrost is close to the surface in lands with finer textured silty sediments on stream terraces, plains, and the more gently sloping footslopes and hills throughout the area. Isolated masses of ground ice occur on terraces and the lower side slopes of hills. Permafrost does not generally occur on floodplains, soils with sandy and gravelly parent material, and in areas near lakes and other water bodies.

The dominant soil orders in this area are Gelisols, Entisols, Inceptisols, and Spodosols. 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. Two important factors that prevent permafrost aggradation are groundwater connectivity and thick bands of sandy and/or gravelly soil horizons. Entisols most commonly occur on the floodplain with the most common suborder being Fluvents. Inceptisols and Spodosols occurs on streams terraces and slopes of hills and outwash plains. Dry soils on these landforms support soil suborders related to Cryods and Cryepts, while wet soils support Aquepts. Miscellaneous (non-soil) areas make up about 19 percent of this MLRA. The most common are riverwash and water.

For Gelisols, wildfires disturb the insulating organic material at the soil surface and can change the presence and/or depth of permafrost in the soil profile. These fire related changes to permafrost can also change the depth and presence of perched water tables. Gelisols that burn in this area can change soil taxonomic classification. For instance, depending on fire-severity, Histels may change to Orthels and Orthels may change to Inceptisols. Depending on the frequency and intensity of fires, landform position, and soil texture, the soils may or may not revert back to their original taxonomic classification.

Climate

Short, warm summers and long, very cold winters characterize the continental subarctic climate of the area. The average annual precipitation for this area ranges from 11 to 17 inches. The maximum precipitation occurs in late summer, mainly during thunderstorms. The average annual snowfall ranges from 30 to 80 inches. The average annual temperature for this area ranges from about 23 to 30 degrees Fahrenheit. The freeze-free period averages about 90 to 110 days. The temperature usually remains above freezing from June through early-September.

Vegetation

Much of the soil in this area supports forested communities in some stage of post-fire recovery. Mesic to dry soils in the uplands support mixed forests of black spruce, white spruce, paper birch, and quaking aspen. White spruce and white spruce-balsam poplar forests occur on occasionally to rarely flooded portions of the floodplain-step. Black spruce woodlands occur on stream terraces and other places with wet soils and/or shallow permafrost. On permafrost-affected alluvial flats, tamarack occurs in association with black spruce. Lightning-caused wildfires are common. Many thousands of acres are often burned during a single fire. Following wildfires, willow, shrub birch, and ericaceous shrub scrub invade most previously forested ecological sites until they eventually are replaced by forest vegetation. After fire, resin birch is common on wet and mesic soils and quaking aspen on dry soils. On all forest and woodland ecological sites, post-fire succession leads to a relatively rapid accumulation of organic matter and mosses on the surface. This accumulation results in decreases in soil temperature, biologic activity, and nutrient availability and a gradual decrease in site productivity.

Frequently flooded and continuously ponded soils lack forested communities. Non-forested soils include shrub birch, ericaceous shrub scrub, and tussock tundra in peat areas and in drainageways. Wet sedge meadows, sedge-moss bog meadows, and sedge-grass meadows are along the margins of lakes and on continuously ponded sites such as fens. Low to tall willow and alder scrub are on low flood plains.

Classification relationships

Landfire BPS - 16170 - Western North American Boreal Shrub and Herbaceous Floodplain Wetland (Landfire 2009)

Ecological site concept

- Occurs on depressions of flood plains, stream terraces, and alluvial flats with flooding ranging from none to occasional.
- Soils formed in organic material over alluvium. Peat layers are 12 to 28 inches or more thick.
- Soils pond frequently to occasionally for long durations of time. Soils have a water table

at 0 to 10 inches for much of the growing season and are considered very poorly to poorly drained.
- Soils are considered very deep but have permafrost at shallow to moderate depth.
- The reference plant community is mixed shrub-sedge tussock bog (Viereck et al. 1992) with dwarf birch, tealeaf willow, and tussock cottongrass commonly observed plants. Two plant communities have been identified within the reference state related to fire.

Associated sites

F229XY012AK	**Boreal Woodland Loamy High Floodplain** Occurs on the highest levels of the floodplain step. Soils are very wet and lack permafrost. Associated with stunted tamarack and black spruce woodlands.
F229XY013AK	**Boreal Forest Loamy Frozen High Floodplain** Occurs on the highest levels of the floodplains step. Soils are wet and have permafrost. Associated with black spruce and white spruce open forests.
F229XY020AK	**Boreal Woodland Loamy Frozen Slopes** Occurs on wet stream terraces and slopes of hills and plains. Soils are wet and have permafrost. Associated with black spruce forests.
F229XY021AK	**Boreal Peat Terraces and Slopes Complex** Occurs on very wet stream terraces and slopes of hills and plains. Associated with stunted black spruce peatlands and thermokarst pits.

Similar sites

XA232X01Y209	**Boreal Tussock Loamy Frozen Terraces** Ecological site 209 shares similar site and soil properties but occurs to the North in the Yukon Flats Lowlands MLRA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Betula nana* (2) *Salix pulchra*
Herbaceous	(1) *Eriophorum vaginatum*

Physiographic features

- Occurs on depressions of flood plains, depressions of stream terraces, and depressions of alluvial flats.
- Elevation occurs between 100 and 1150 feet
- Slope is nearly level and occurs on all aspects
- Flooding is occasional on floodplains and does not occur on stream terraces.
- Ponding is occasional to frequent and occurs for long durations of time. Ponding depth ranges between 4 and 12 inches.

- A water table occurs between 0 and 10 inches of the soil profile throughout much of the growing season.
- Associated with negligible amounts of runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Landforms	(1) Alluvial plain > Flood plain (2) Alluvial plain > Stream terrace (3) Alluvial plain > Alluvial flat (4) Alluvial plain > Depression
Runoff class	Negligible
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	30–351 m
Slope	0–2%
Ponding depth	10–30 cm
Water table depth	0–25 cm
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding duration	Not specified
Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–8%
Ponding depth	Not specified
Water table depth	0–51 cm

Climatic features

Short, warm summers and long, very cold winters characterize the subarctic continental climate associated with this ecological site. The mean annual temperature for Interior Alaska Lowlands area ranges from 23 to 31 degrees Fahrenheit. The warmest months span May through August with mean temperatures ranging from 60 to 71 degrees

Fahrenheit. The coldest months span December through February with mean temperatures ranging from -15 to -10 degrees Fahrenheit. The freeze-free period ranges between 96 and 115 days and typically lasts from late May through early-September.

The average annual precipitation across the Interior Alaska Lowlands area ranges between 11 and 17 inches. July through September are the wettest months with approximately 60 percent of the annual precipitation occurring, and thunderstorms are common. The average annual snowfall ranges from 30 to 80 inches (USDA 2022). The ground is consistently covered with snow from November through March.

Table 4. Representative climatic features

Frost-free period (characteristic range)	68-84 days
Freeze-free period (characteristic range)	96-115 days
Precipitation total (characteristic range)	305-356 mm
Frost-free period (actual range)	56-94 days
Freeze-free period (actual range)	88-120 days
Precipitation total (actual range)	279-432 mm
Frost-free period (average)	75 days
Freeze-free period (average)	105 days
Precipitation total (average)	330 mm

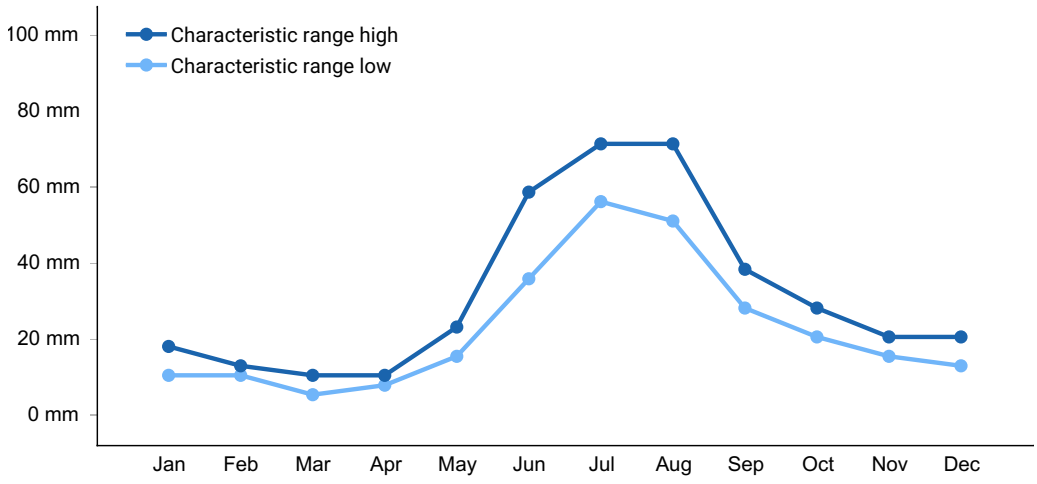


Figure 1. Monthly precipitation range

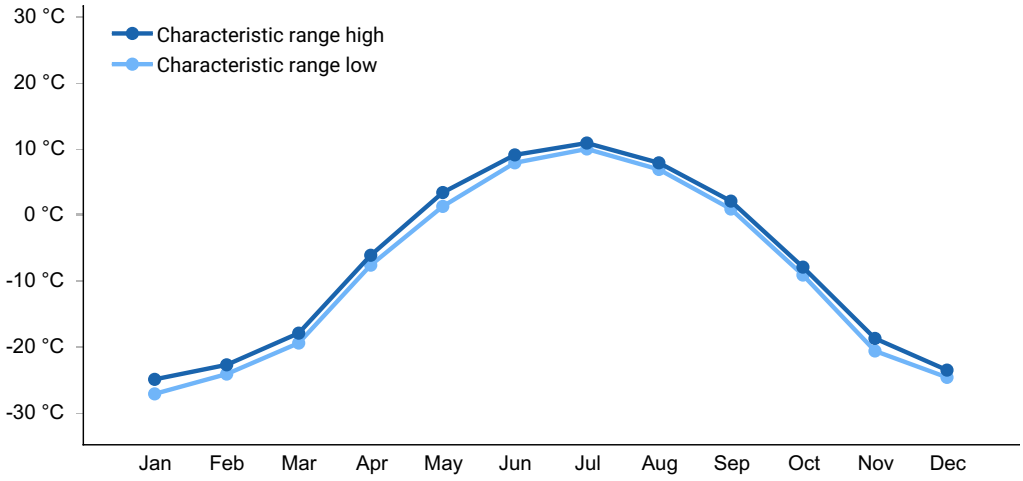


Figure 2. Monthly minimum temperature range

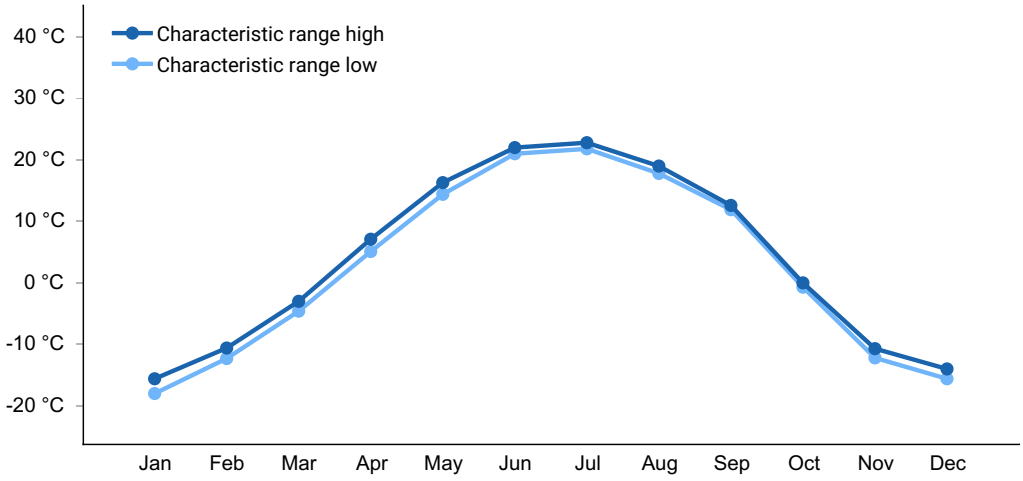


Figure 3. Monthly maximum temperature range

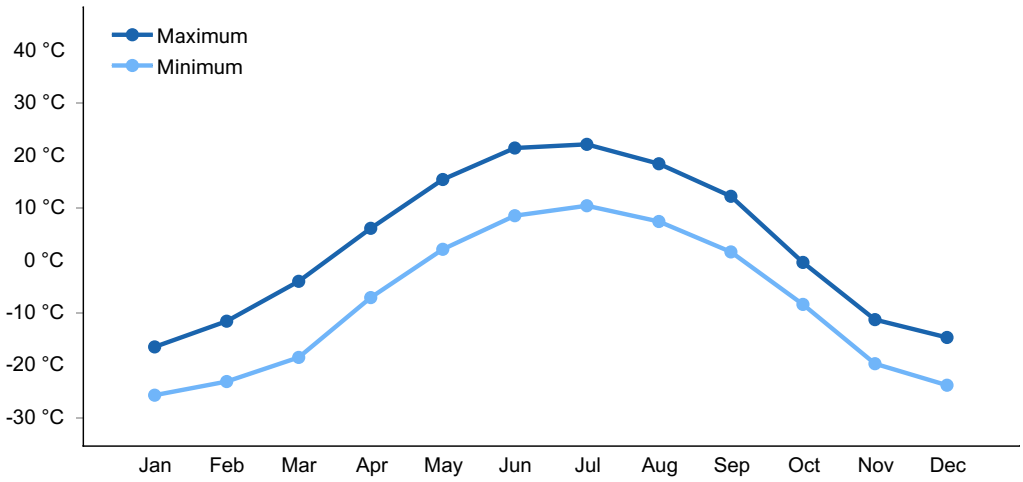


Figure 4. Monthly average minimum and maximum temperature

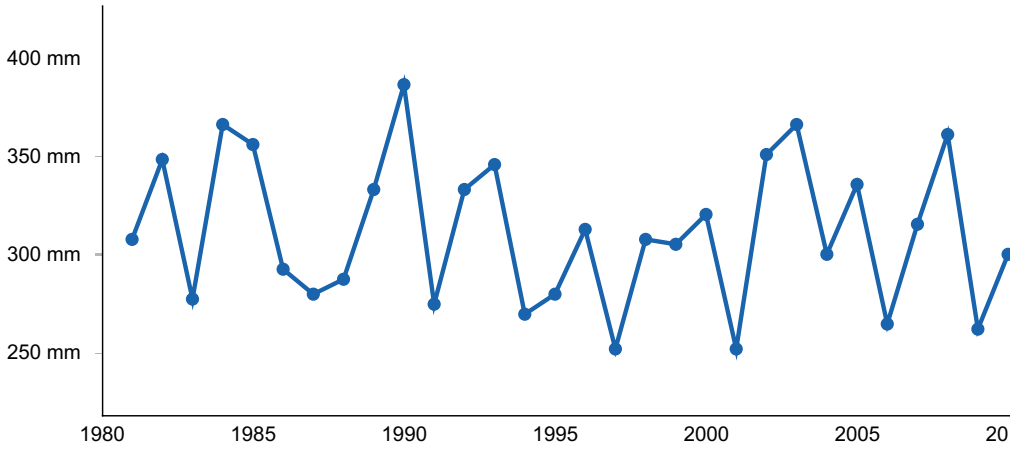


Figure 5. Annual precipitation pattern

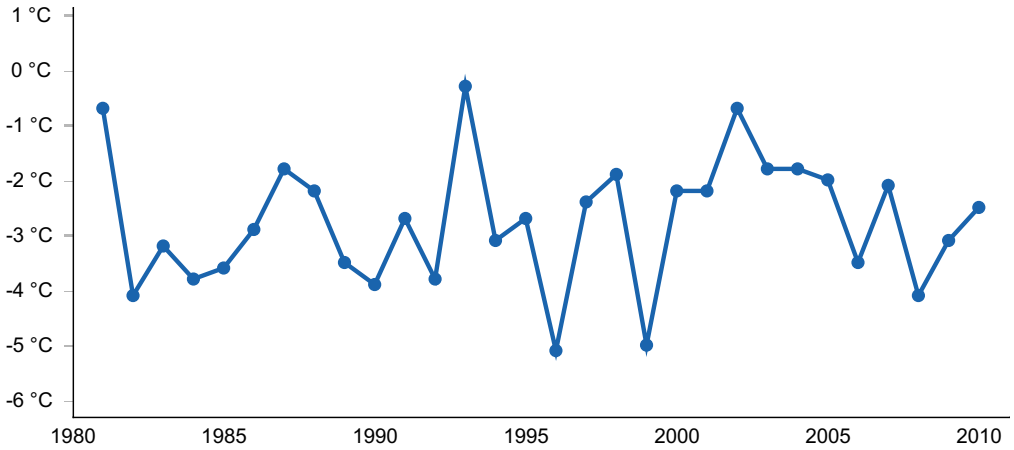


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GALENA [USC00503212], Nulato, AK
- (2) TANANA CALHOUN MEM AP [USW00026529], Tanana, AK
- (3) MCGRATH AP [USW00026510], Mc Grath, AK
- (4) MINCHUMINA [USW00026512], Lake Minchumina, AK
- (5) KOBE HILL [USC00504971], Healy, AK
- (6) NENANA MUNI AP [USW00026435], Clear, AK
- (7) FAIRBANKS INTL AP [USW00026411], Fairbanks, AK
- (8) NORTH POLE [USC00506581], North Pole, AK
- (9) EIELSON FLD [USC00502707], Eielson AFB, AK
- (10) SALCHA [USC00508140], Salcha, AK
- (11) BIG DELTA AP [USW00026415], Delta Junction, AK

Influencing water features

Depressional wetlands occur in topographic depressions. Dominant water sources are precipitation, ground water discharge, and both interflow and overland flow from adjacent uplands.

Wetland description

This ecological site is classified as a depressional wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008).

Soil features

- Soils formed in organic matter over alluvium.
- Rock fragments do not occur on the soil surface or in the soil subsurface.
- Mineral soils are capped with 12 to 28 or more inches of peat. The surface mineral horizon is a mucky silt loam.
- While soils are considered very deep, permafrost is a restriction that occurs as shallow to moderate depth (18 to 39 inches).
- The pH of the soil profile ranges from moderately acidic to slightly acidic.
- Soils are considered very poorly to poorly drained.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Alluvium
Surface texture	(1) Peat (2) Mucky silt loam
Family particle size	(1) Coarse-loamy (2) Fine-loamy
Drainage class	Very poorly drained to poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	46–99 cm
Soil depth	152–183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	11.68–24.38 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	5–8%
Electrical conductivity (25.4-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0

Soil reaction (1:1 water) (25.4-101.6cm)	5.1–6.5
Subsurface fragment volume <=3" (0-152.4cm)	0%
Subsurface fragment volume >3" (0-152.4cm)	0%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	Not specified
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	5–50%
Electrical conductivity (25.4-101.6cm)	Not specified
Sodium adsorption ratio (25.4-101.6cm)	0–1
Soil reaction (1:1 water) (25.4-101.6cm)	4.5–7.8
Subsurface fragment volume <=3" (0-152.4cm)	0–3%
Subsurface fragment volume >3" (0-152.4cm)	Not specified

Ecological dynamics

Fire

In the Interior Alaska Lowlands MLRA area, fire is a common and natural event that has a significant control on the vegetation dynamics across the landscape. A typical fire event in the lands associated with this ecological site will reset plant succession and alter dynamic soil properties (e.g., depth of permafrost or thickness of organic matter). For this

ecological site to progress from the earliest stages of post-fire succession to the oldest stages of succession, data suggest that 10 to 20 years or more must elapse without another fire event (Johnstone et al. 2010a).

Within this area, wildfire is considered a natural and common event that in many places goes unmanaged. Fire suppression is limited and occurs adjacent to the municipalities spread throughout the area or on allotments with known structures, all of which have a relatively limited acre footprint. Most fires are caused by lightning strikes. From 2000 to 2020, 513 known fire events occurred in this area and the burn perimeter of the fires totaled approximately 12.4 million acres (AICC 2022). Fire-related disturbances are highly patchy and can leave undisturbed areas within the burn perimeter. During this time frame, 73 percent of the fire events were smaller than 20,000 acres but 34 fire events were greater than 100,000 acres in size (AICC 2022). Over this period of 20 years, these burn perimeters cover approximately 50 percent of this area.

The fire regime within Interior Alaska follows two general scenarios—low-severity burns and high-severity burns. It should be noted, however, that the fire regime in Interior Alaska is generally thought to be much more complex (Johnstone et al. 2008). Burn severity refers to the proportion of the vegetative canopy and organic material consumed in a fire event (Chapin et al. 2006). Fires in cool and moist habitat tend to result in low-severity burns, while fires in warm and dry habitat tend to result in high-severity burns. Because the soils have a thick organic cap and are poorly to very poorly drained, the typical fire scenario for this ecological site is considered to result in a low severity burn.

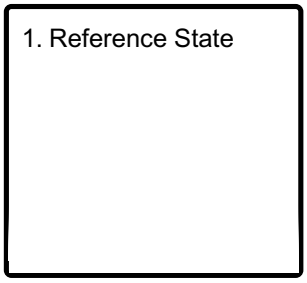
While low-severity fires have a range of impacts to vegetation and soils for this site, permafrost generally remains in the soil profile. While a low-severity fire can consume the bulk of above ground vegetation, minimal proportions of the organic mat are removed. Organic matter continues to insulate these cold soils. Field data support that each plant community has permafrost and that the associated low-severity fire event had a negligible impact on the depth of permafrost. If permafrost remains at similar depths after a fire event, then soil drainage is unlikely to improve post-fire.

When minimal proportions of the organic mat are consumed, many species regenerate asexually from belowground root systems or rhizomes. Species known to regenerate after low- severity fire events include various graminoids (e.g. Carex spp. and Eriophorum spp.), forbs (e.g. Equisetum sp.), and shrubs (e.g. *Ledum groenlandicum*, *Vaccinium uliginosum*, Salix sp.) (Johnstone et al. 2010; Bernhardt et al. 2011).

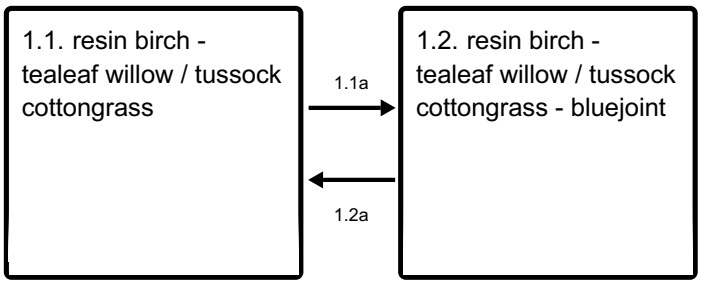
Because the dominant vegetation (sedges, ericaceous shrubs, and shrub birch) grows quickly and commonly regenerate after a fire event, minimal time is needed for postfire recovery back to the reference plant community (as compared to adjacent forested ecological sites). Based on the data reported above and the dominant vegetation associated with this ecological site, full recovery of vegetation is thought to take between 10 and 20 years. In comparison, it typically takes 70 to 150 years for a black spruce or white spruce stand in Interior Alaska to mature (Chapin et al. 2006).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1a - A low-severity fire sweeps through and incinerates much of the above ground vegetation

1.2a - Occurs 10 to 20 years after wildfire

State 1
Reference State

The reference plant community is characterized as mixed shrub-sedge tussock bog (Viereck et al. 1992). Two plant communities were identified within the reference state related to fire. The vegetation modeled for this site has limited data and is considered provisional.

Dominant plant species

- dwarf birch (*Betula nana*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass

Community 1.1
resin birch - tealeaf willow / tussock cottongrass

Figure 7. Typical plant community associated with community 1.1. Photo is from a similar ecological site in the Yukon Flats Lowlands MLRA.

Plant community 1.1 is characterized as mixed shrub-sedge tussock bog (Viereck et al. 1992). Black spruce seedlings and mature trees occasionally occur but have limited cover. Common plants include resin birch, tealeaf willow, and tussock cottongrass.

Dominant plant species

- dwarf birch (*Betula nana*), shrub
- resin birch (*Betula glandulosa*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- water sedge (*Carex aquatilis*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- sphagnum (*Sphagnum*), other herbaceous
- cloudberry (*Rubus chamaemorus*), other herbaceous

Community 1.2
resin birch - tealeaf willow / tussock cottongrass - bluejoint

Figure 8. A typical plant community associated with community 1.2. Photo is from the Totchaket Area, soil survey.

Community 1.2 is in the early stage of fire-induced secondary succession for this ecological site. This community is characterized as closed low scrub (Viereck et al. 1992). While similar to community 1.1, tree cover has been removed and many additional species either increased cover or colonized after wildfire. Two species that increase cover after fire are resin birch and bluejoint.

Dominant plant species

- resin birch (*Betula glandulosa*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.2

resin birch - tealeaf willow / tussock cottongrass

resin birch - tealeaf willow / tussock cottongrass - bluejoint

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated cold and wet soils, this site commonly experiences low-severity fires. Minimal proportions of the organic mat are typically removed. The pre-fire vegetation

generally reestablishes quickly from below ground root systems and rhizomes.

Pathway 1.2a
Community 1.2 to 1.1

resin birch - tealeaf willow / tussock cottongrass - bluejoint

→

resin birch - tealeaf willow / tussock cottongrass

Community pathway 1.2b is thought to occur 10 to 20 years after wildfire (Landfire 2009). Plants that colonized after the disturbance like bluejoint and fireweed are largely replaced by pre-fire dominant plants.

Additional community tables

Animal community

not available

Hydrological functions

not available

Recreational uses

not available

Wood products

not available

Other products

not available

Other information

not available

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 species are largely based on the soil survey of Denali National Park Area, Alaska (Clark and Duffy 2006).

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Other references

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Contributors

Blaine Spellman

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	03/13/2026
Approved by	Blaine Spellman

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:**