Ecological site F231XY187AK
Boreal Forest Silty Slopes Moist

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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): 231X–Interior Alaska Highlands

The Interior Alaska Uplands (MLRA 231X) is in the Interior Region of Alaska and includes the extensive hills, mountains, and valleys between the Tanana River to the south and the Brooks Range to the north. These hills and mountains surround the Yukon Flats Lowlands (MLRA 232X). MLRA 231X makes up about 69,175 square miles. The hills and mountains of the area tend to be moderately steep to steep resulting in high-relief slopes. The mountains are generally rounded at lower elevations and sharp-ridged at higher elevations. Elevation ranges from about 400 feet in the west, along the boundary with the Interior Alaska Lowlands (MLRA 229X), to 6,583 feet at the summit of Mt. Harper, in the southeast. Major tributaries include large sections of the Yukon, Koyukuk, Kanuti, Charley, Coleen, and Chatanika Rivers. This area is traversed by several major roads, including the Taylor Highway in the east and the Steese, Elliott, and Dalton Highways north of Fairbanks. The area is mostly undeveloped wild land that is sparsely populated. The largest community along the road system is Fairbanks with smaller communities like Alatna, Allakaket, Chicken, Eagle, Eagle Village, Hughes, and Rampart occurring along the previously mentioned rivers and highways.

The vast majority of this MLRA was unglaciated during the Pleistocene epoch with the exceptions being the highest mountains and where glaciers extended into the area from the Brooks Range. For the most part, glacial moraines and drift are limited to the upper elevations of the highest mountains. Most of the landscape is mantled with bedrock colluvium originating from the underlying bedrock. Valley bottoms are filled with Holocene fluvial deposits and colluvium from the adjacent mountain slopes. Silty loess, which originated from unvegetated flood plains in and adjacent to this area, covers much of the surface. On hill and mountain slopes proximal to major river valleys (e.g., Tanana and Yukon Rivers), the loess is many feet thick. As elevation and distance from major river valleys increases, loess thickness decreases significantly. Bedrock is commonly exposed on the highest ridges.

This area is in the zone of discontinuous permafrost. Permafrost commonly is close to the surface in areas of the finer textured sediments throughout the MLRA. Isolated masses of ground ice occur in thick deposits of loess on terraces and the lower side slopes of hills. Solifluction lobes, frost boils, and circles and stripes are periglacial features common on mountain slopes in this area. Pingos, thermokarst pits and mounds, ice-wedge polygons, and earth hummocks are periglacial features common on terraces, lower slopes of hills and mountains, and in upland valleys in the area.

The dominant soil orders in this area are Gelisols, Inceptisols, Spodosols, and Entisols. The soils in the area have a subgelic or cryic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. Gelisols are common on north facing slopes, south facing footslopes, valley bottoms, and stream terraces. Gelisols are typically shallow or moderately deep to permafrost (10 to 40 inches) and are poorly or very poorly drained. Wildfires can disturb the insulating organic material at the surface, lowering the permafrost layer, eliminating perched water tables from Gelisols, and thus changing the soil classification. Inceptisols and Spodosols commonly form on south facing hill and mountain slopes. Entisols are common on flood plains and high elevation mountain slopes. Miscellaneous (non-soil) areas make up about 2 percent of this MLRA. The most common miscellaneous areas are rock outcrop and rubble land. In many valleys placer mine tailings are common.

Short, warm summers and long, cold winters characterize the subarctic continental climate of the area. The mean annual temperature of the area ranges from 22 to 27 degrees F. The mean annual temperature of the southern half of the area is approximately 3 degrees warmer compared to the northern half (PRISM 2018). The warmest months span June through August with mean monthly temperatures ranging from 50 to 56 degrees F. The coldest months span November through February with mean monthly temperatures ranging from -5 to 3 degrees F. When compared to the high-elevation alpine and subalpine life zones, the lower elevation boreal life zone tends to be 2-3 degrees F colder during the coldest months and 1-2 degrees F warmer during the warmest months (PRISM 2018). The freeze-free period at the lower elevations averages about 60 to 100 days, and the temperature usually remains above freezing from June through mid-September.

Precipitation is limited across this area, with the average annual precipitation ranging from 12 to 19 inches. The southern half of the areas receives approximately 2.5 inches more annual precipitation then the northern half (PRISM 2018). The lower elevation boreal life zone receives approximately 2.5 inches less annual precipitation than the high-elevation alpine and subalpine life zones (PRISM 2018). Approximately 3/5th of the annual precipitation occurs during the months of June through September with thunderstorms being common. The average annual snowfall ranges from about 45 to 100 inches. The ground is consistently covered with snow from November through March.

Most of this area is forested below an elevation of about 2500 feet. Dominant tree species on slopes are white spruce and black spruce. Black spruce stands are most common on north-facing slopes, stream terraces, and other sites with poor drainage and permafrost. White spruce stands are most common on warm slopes with dry soils. At lower elevations, lightning-caused wildfires are common, often burning many thousands of acres during a single fire. Following wildfires, forbs, grasses, willow, ericaceous shrubs, paper birch, and quacking aspen communities are common until they are eventually replaced by stands of spruce. Tall willow and alder scrub is extensive on low flood plains. White spruce and balsam poplar are common on high flood plains.

With increasing elevation, the forests and woodlands give way to subalpine communities dominated by krummholz spruce, shrub birch, willow, and ericaceous shrubs. At even higher elevations, alpine communities prevail which are characterized by diverse forbs, dwarf ericaceous shrubs, and eightpetal mountain-avens. Many of these high elevation communities have a considerable amount of lichen cover and bare ground.

LRU notes

This area supports three life zones defined by the physiological limits of plant communities along an elevational gradient: boreal, subalpine, and alpine. The boreal life zone is the elevational band where forest communities dominate. Not all areas in the boreal life zone are forest communities, however, particularly in places with too wet or dry soil to support tree growth (e.g., bogs or river bluffs). Above the boreal band of elevation, subalpine and alpine vegetation dominate. 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 ≥ 1 m 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. In this area, the boreal life zone occurs below 2500 feet elevation on average. 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 (>10% 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. Warm boreal slope soils have a cryic soil temperature regime and lack permafrost. In this area, white spruce forests are an indicator of warm boreal slopes. Cold boreal slope soils typically have a gelic soil temperature regime and commonly have permafrost. In this area, black spruce forests and woodlands are an indicator of cold boreal slopes. The boreal life zone can occur at higher elevations on warm slopes, and lower elevations on cold slopes.

Classification relationships

Landfire BPS – 7416030 – Western North American Boreal White Spruce-Hardwood Forest (Landfire 2009)

Ecological site concept

This boreal site occurs on warm slopes with a very thick layer of windblown silt and silty colluvium that are prone to thermokarst. This site occurs on the toeslopes and footslopes of hills that are south to west facing. Gravelly horizons, bedrock, and permafrost do not occur in the soil profile (0 to 72 inches). Thermokarst is common which results from the thawing of ice rich permafrost and subsequent settling of ground. Because of the unique associated soil and site properties, thermokarst depressions result in an alternate state. Reference state soils do not pond or flood. These soils have a seasonally high-water table in April through May and are considered moderately well drained. Due to the very thick layer of moist and unfrozen silts, soils support productive stands of white and black spruce. Soils with a thinner layer of windblown silt tend to support much less productive stands of spruce.

The thermokarst state has unique soil and site properties resulting in different kinds and amounts of vegetation. Ice wedges formed on the associated footslopes and toeslopes in the distant past and have subsequently been buried by deep layers of windblown loess and silty colluvium (CRREL 2023). For this site, ice rich permafrost is deep below the soil profile often occurring 20 feet or more below the ground surface. Land clearing and fire are both disturbances that can thaw this ice rich permafrost leading to thermokarst. For this site, the degree of ground subsidence is highly variable. In areas with significant subsidence, soils can commonly have a water table at or above the soil surface for the entire growing season (NRCS staff). In this instance, the associated plant community would have an abundance of obligate wetland species including various sedges and wetland grasses.

Multiple plant communities occur within the reference state and the vegetation in each community differs in large part due to fire (Landfire 2009). When the reference state vegetation burns, the post-fire plant community is dominantly grasses, forbs, and weedy mosses. With time and lack of another fire event, the post-fire vegetation goes through multiple stages of succession. For this site, the reference plant community is the most stable with the longest time since the vegetation was burned. This community is characterized as open needleleaf forest (Viereck et al. 1992) with black spruce and white spruce as the dominant tree. For this ecological site to progress from the earliest stages of post-fire succession to the oldest stages of succession, data suggest that 150 years or more must elapse without another fire event (Foot 1982; Chapin et al. 2006; Landfire 2009).

The reference plant community understory commonly has russet buffaloberry, kinnikinnick, lingonberry, crowberry, red fruit bearberry, prickly rose, squashberry, bog Labrador tea, tall bluebells, false toadflax, horsetail, and feather mosses (Landfire 2009). Tree cover primarily occurs in the tall tree strata (greater than 40 feet). Live deciduous trees, primarily resin birch, occasionally occur in the tree canopy but with limited cover. All plant communities associated with the site have limited plot data, so the state-and-transition model is provisional.

Associated sites

F231XY111AK	**Boreal Forest Loamy Frozen Slopes** Occurs on the same slopes as site 187 but in wetter positions with permafrost in the soil profile. Soils support stands of black spruce.
F231XY118AK	**Boreal Woodland Organic Frozen Slopes** Occurs downslope on wetter soils with permafrost in the soil profile. Soils support stands of stunted black spruce.
F231XY182AK	**Boreal Forest Gravelly Slopes** Occurs upslope on drier soils that are not prone to thermokarst. Soils support stands of white spruce.
F231XY186AK	**Boreal Forest Silty Slopes** Occurs upslope on drier soils that are not prone to thermokarst. Soils support stands of white spruce.
F231XY188AK	**Boreal Forest Silty Slopes Bedrock** Occurs upslope on drier soils that are not prone to thermokarst. Soils support stands of white spruce.

Similar sites

F231XY188AK	**Boreal Forest Silty Slopes Bedrock** Both sites occur on the same boreal hills but site 188 is not associated with thermokarst. Soils support productive stands of white spruce.
F231XY186AK	**Boreal Forest Silty Slopes** Both sites occur on the same boreal hills but site 186 is not associated with thermokarst. Soils support productive stands of white spruce.
F231XY190AK	**Boreal Forest Silty Slopes Cold** Both sites occur on the same boreal hills but site 190 is not associated with thermokarst. Soils support productive stands of black spruce.

Table 1. Dominant plant species

Tree	(1) *Picea glauca* (2) *Picea mariana*
Shrub	(1) *Alnus viridis ssp. fruticosa* (2) *Rosa acicularis*
Herbaceous	(1) *Equisetum arvense* (2) *Hylocomium splendens*

Physiographic features

This boreal site occurs on warm footslopes and toeslopes of hills. This site occurs up to 2000 feet elevation. Slopes commonly range from 3 percent on toeslopes to 12 percent or more on footslopes, which are typically east to west facing. Reference state soils do not pond or flood. In April and May, these soils have a high-water table at very shallow to shallow depth perched on seasonal frost. After May, the soils drain with no water table in the soil profile. This site generates limited amounts of runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Landforms	(1) Hill
Runoff class	Very low to low
Flooding frequency	None
Ponding frequency	None
Elevation	122–610 m
Slope	3–12%
Water table depth	5–30 cm
Aspect	W, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Negligible to low
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–20%
Water table depth	0–30 cm

Climatic features

Short, warm summers and long, cold winters characterize the subarctic continental climate associated with this boreal site. The mean annual temperature of the site ranges from 22 to 27 degrees F. The warmest months span June through August with mean normal maximum monthly temperatures ranging from 60 to 66 degrees F. The coldest months span November through February with mean normal minimum temperatures ranging from -3 to -12 degrees F. The freeze-free period for the site ranges from 80 to 120 days, and the temperature usually remains above freezing from late May through mid-September.

The area receives minimal annual precipitation with the summer months being the wettest. Average annual precipitation across the area typically ranges between 12 to 18 inches. Approximately 3/5th of the annual precipitation occurs during the months of June through September with thunderstorms common. The average annual snowfall ranges from about 45 to 100 inches. The ground is consistently covered with snow from November through March.

Table 4. Representative climatic features

Frost-free period (characteristic range)	16-78 days
Freeze-free period (characteristic range)	76-114 days
Precipitation total (characteristic range)	305-457 mm
Frost-free period (actual range)	4-87 days
Freeze-free period (actual range)	48-120 days
Precipitation total (actual range)	229-508 mm
Frost-free period (average)	53 days
Freeze-free period (average)	90 days
Precipitation total (average)	381 mm

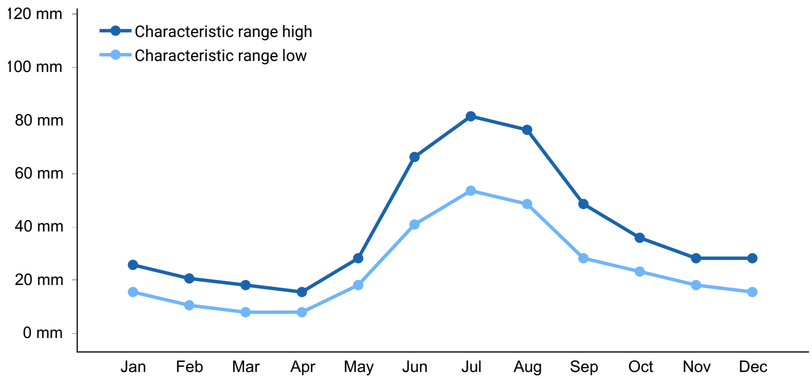


Figure 1. Monthly precipitation range

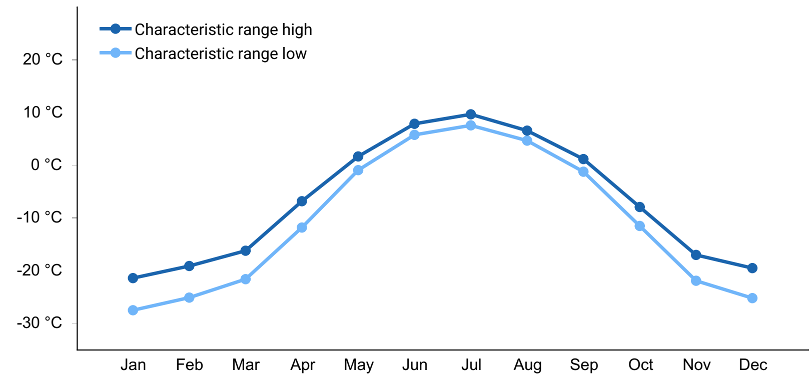


Figure 2. Monthly minimum temperature range

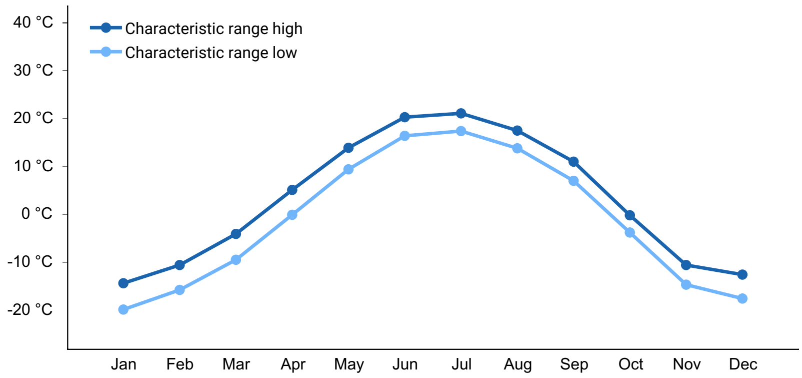


Figure 3. Monthly maximum temperature range

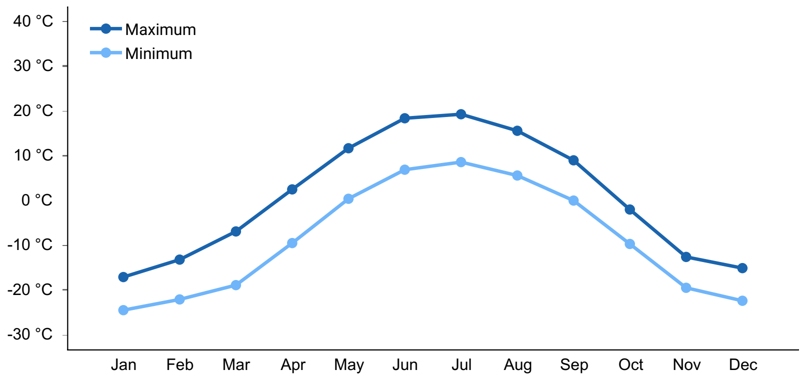


Figure 4. Monthly average minimum and maximum temperature

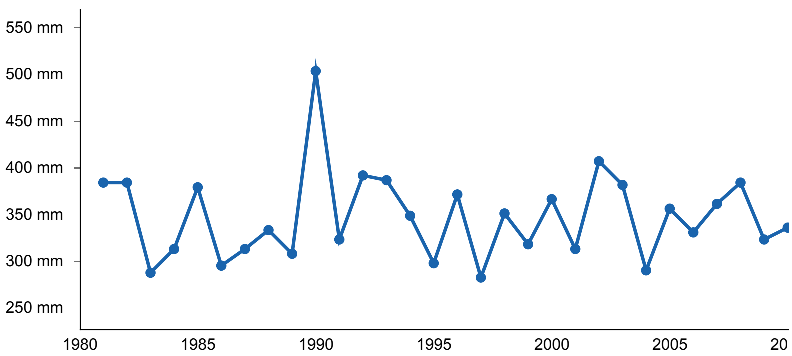


Figure 5. Annual precipitation pattern

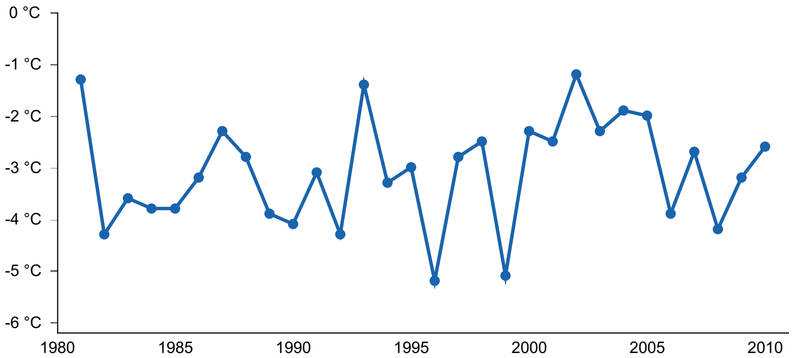


Figure 6. Annual average temperature pattern

Climate stations used

- (1) EAGLE AP [USW00026422], Tok, AK
- (2) CHICKEN [USC00501684], Tok, AK
- (3) MILE 42 STEESE [USC00505880], Fairbanks, AK

- (4) BETTLES AP [USW00026533], Bettles Field, AK
- (5) CIRCLE HOT SPRINGS [USC00501987], Central, AK
- (6) FT KNOX MINE [USC00503160], Fairbanks, AK
- (7) GILMORE CREEK [USC00503275], Fairbanks, AK
- (8) FOX 2SE [USC00503181], Fairbanks, AK
- (9) ESTER DOME [USC00502868], Fairbanks, AK
- (10) ESTER 5NE [USC00502871], Fairbanks, AK
- (11) COLLEGE 5 NW [USC00502112], Fairbanks, AK
- (12) COLLEGE OBSY [USC00502107], Fairbanks, AK
- (13) KEYSTONE RIDGE [USC00504621], Fairbanks, AK

Influencing water features

Soil features

Soils formed in a thick layer of windblown silts and silty colluvium and do not have permafrost in the soil profile (0 to 72 inches). Surface rock fragments are not present. These are mineral soils commonly capped with about 5 inches of organic material. The mineral soil below the organic material is a silt loam formed from either wind-blown loess or silty colluvium, which has no rock fragments. Soils are very deep without restrictions. The pH of the soil profile typically ranges from moderately acidic to slightly acidic. From April through May, reference state soils have a high-water table that eventually drains. As a result, these soils are considered moderately well drained.

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium
Surface texture	(1) Silt loam
Family particle size	(1) Coarse-silty
Drainage class	Moderately well drained
Permeability class	Moderately rapid
Depth to restrictive layer	152 cm
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	20.83–23.11 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	5–10%
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)	5.6–6.5
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)	Not specified
Electrical conductivity (25.4-101.6cm)	Not specified
Sodium adsorption ratio (25.4-101.6cm)	Not specified
Soil reaction (1:1 water) (25.4-101.6cm)	5.6
Subsurface fragment volume <=3" (0-152.4cm)	Not specified
Subsurface fragment volume >3" (0-152.4cm)	Not specified

Ecological dynamics

Fire

In the Interior Alaska Uplands 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., thickness of the organic material). For this ecological site to progress from the earliest stages of post-fire succession dominated by grasses and forbs to the oldest stages of succession dominated by mixed spruce forests, data suggest that 100 to 150 years or more must elapse without another fire event (Foot 1982; Chapin et al. 2006; Landfire 2009).

Within this area, fire is considered a natural and common event that typically is unmanaged. Fire suppression is limited, and generally occurs adjacent to Fairbanks and the various villages 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, 596 known fire events occurred in the Interior Alaska Uplands area and the burn perimeter of the fires totaled about 13.8 million acres (AICC 2022). Fire-related disturbances are highly patchy and can leave undisturbed areas within the burn perimeter. During this time frame, 80% of the fire events were smaller than 20,000 acres but 18 fire events were greater than 200,000 acres in size (AICC 2022). These burn perimeters cover approximately 30% of the Interior Alaska Uplands area over a period of 20 years.

The fire regime within Interior Alaska follows two basic 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 thin organic cap and are moderately well drained, the typical fire scenario for this ecological site is considered to result in a high-severity burn.

Large portions of the organic mat are consumed during a high-severity fire event, commonly exposing pockets of mineral soil. The loss of this organic mat, which insulates the mineral soil, and the decrease in site albedo tends to cause overall soil temperatures to increase (Hinzman et al. 2006). These alterations to soil temperature may result in increased depths of seasonal frost in the soil profile and thermal erosion of deep, ice-rich permafrost. High-severity fire events also destroy a majority of the vascular and nonvascular biomass above ground.

Field data from similar sites suggest that each of the forested community phases will burn and that fire events will cause a transition to the pioneering stage of fire succession. This stage (community phase 1.5) is a mix of species that either regenerate in place (e.g., subterranean root crowns for willow and rhizomes for graminoids) and/or from wind-dispersed seed or spores that colonize exposed mineral soil (e.g., quaking aspen [*Populus tremuloides*] and Ceratodon moss [*Ceratodon purpureus*]). The pioneering stage of fire succession is primarily composed of tree seedlings, forbs, grasses, and weedy bryophytes. This stage of succession is thought to persist for up to 10 years post-fire. Willow (Salix spp.) and quick growing deciduous tree seedlings continue to colonize and grow in stature on recently burned sites until they become dominant in the overstory, which marks the transition to the early stage of fire succession (community phase 1.4). This early stage of fire succession is thought to persist 10 to 30 years post-fire. In the absence of fire, tree species continue to become more dominant in the stand and eventually develop into forests.

The later stages of succession have an overstory that is dominantly deciduous trees (community phase 1.3), a mix of broadleaf and needleleaf trees (community phase 1.2), or needleleaf trees (community phase 1.1). The recruitment of trees species during the pioneering and early stages of post-fire succession largely controls the composition of the stand of trees in the later stages of post-fire succession (Johnstone et al. 2010a). During these later stages of succession, the slower growing spruce seedlings mature and eventually replace the shade-intolerant broadleaf tree species. The typical fire return interval for white spruce stands in Interior Alaska is 150 years (Landfire 2009; Abrahamson 2014) and about once a century for stands of black spruce (Johnstone et al. 2010a).

Lands associated with this site may be burning more frequently than in the past, which may result in alternative states of succession. Due to global climate change, stands of spruce in certain portions of the Alaskan boreal forest are burning more frequently than these historic averages (Kelly et al. 2013). Increases to burn frequency favors forested stands dominated by quick growing deciduous trees (community 1.3). A major reason being that increased fire frequency decreases the presence and abundance of mature, cone-bearing spruce trees. Less mature trees result in less spruce seedlings post-fire and an overall decreased abundance of spruce in the developing forest canopy. Increased burn frequency in the boreal forest may result in alternative states of post-fire succession with stands of deciduous trees persisting for longer than normal durations of time (Johnstone et al. 2010b).

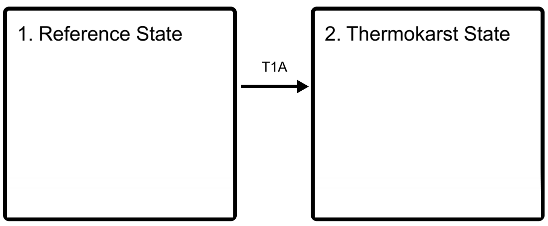
Thermokarst

This site is prone to thermokarst. The footslopes and toeslopes of hills adjacent to the Tanana and Yukon Rivers have very thick accumulations of silty loess and colluvium (CRREL 2023). Deep below the soil profile on these hillslope positions, ice-rich permafrost is common (CRREL 2023). Land clearing and fire can thaw permafrost and the thermal erosion of ground ice results in the settling of soil, which is thermokarst. Subsidence can be significant with collapsed pits going down and spanning across several feet.

The response of vegetation to thermokarst is variable. Thermokarst can cause significant ground subsidence, but the soil does not become appreciably wetter. This scenario is more common on steeper slopes (NRCS staff) where adjacent vegetation is like the vegetation within the thermokarst feature. Thermokarst can also result in the formation of perennially ponded depressions, which are more common on gentle slopes (NRCS staff). This scenario leads to unique plant communities that have obligate wetland species.

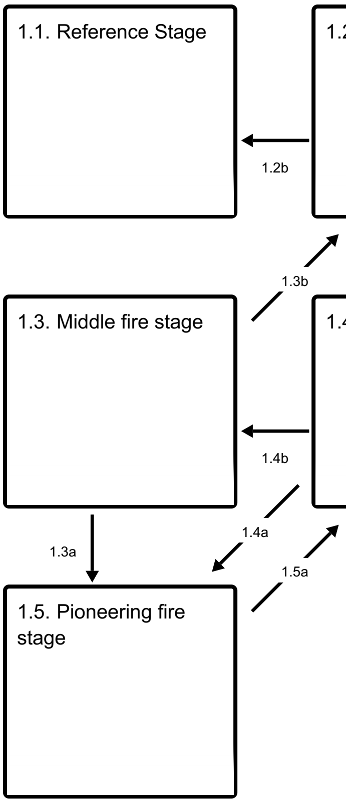
State and transition model

Ecosystem states

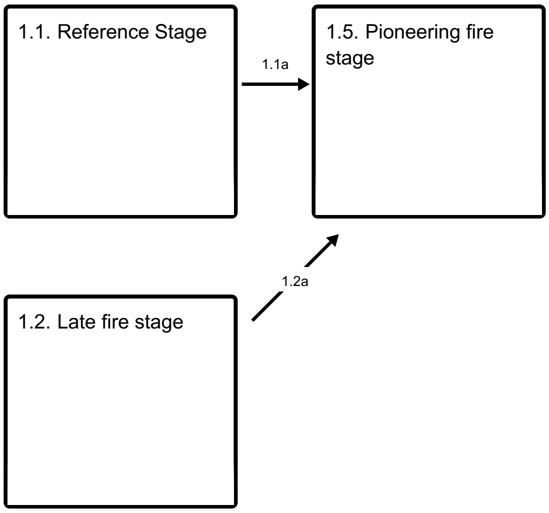


T1A - Disturbance leads to the thermal erosion of ground ice and the subsidence of soil resulting in formation of thermokarst depressions.

State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



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

1.2b - Time without fire.

1.2a - A high-severity fire sweeps through and incinerates much of the above ground vegetation.

1.3b - Time without fire.

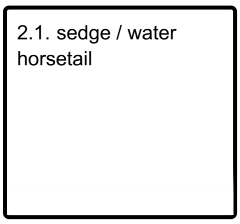
1.3a - A high-severity fire sweeps through and incinerates much of the above ground vegetation.

1.4b - Time without fire.

1.4a - A high-severity fire sweeps through and incinerates much of the above ground vegetation.

1.5a - Time without fire.

State 2 submodel, plant communities



State 1
Reference State

The reference plant community is open needleleaf forest (Viereck et al. 1992) with the dominant tree being white and black spruce. There are five plant communities in the reference state related to fire. All plant communities associated with the site have limited data, so the state-and-transition model is provisional.

Dominant plant species

- white spruce (*Picea glauca*), tree
- black spruce (*Picea mariana*), tree
- resin birch (*Betula neoalaskana*), tree
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- prickly rose (*Rosa acicularis*), shrub

- field horsetail (*Equisetum arvense*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous

Community 1.1
Reference Stage

This phase is characterized as open needleleaf forest (Viereck et al. 1992) with white spruce and black spruce as the dominant tree. Common and abundant understory species for this community include Siberian alder, russet buffaloberry, kinnikinnick, lingonberry, crowberry, red fruit bearberry, prickly rose, squashberry, bog Labrador tea, twinflower, tall bluebells, false toadflax, horsetail, wintergreen, and feather mosses (Landfire 2009).

Dominant plant species

- white spruce (*Picea glauca*), tree
- black spruce (*Picea mariana*), tree
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- prickly rose (*Rosa acicularis*), shrub
- russet buffaloberry (*Shepherdia canadensis*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- red fruit bearberry (*Arctostaphylos rubra*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- twinflower (*Linnaea borealis*), shrub
- field horsetail (*Equisetum arvense*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- wintergreen (*Pyrola*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous

Community 1.2
Late fire stage

Community 1.2 is in the late stage of fire-induced secondary succession for this ecological site. It is characterized as open mixed forest (Viereck et al. 1992) with mature resin birch and a mixture of immature and mature white spruce and black spruce as the dominant trees. Common and abundant understory species for this community include Siberian alder, russet buffaloberry, kinnikinnick, lingonberry, crowberry, red fruit bearberry, prickly rose, squashberry, bog Labrador tea, twinflower, tall bluebells, false toadflax, horsetail, wintergreen, and feather mosses (Landfire 2009).

Dominant plant species

- resin birch (*Betula neoalaskana*), tree
- white spruce (*Picea glauca*), tree
- black spruce (*Picea mariana*), tree
- prickly rose (*Rosa acicularis*), shrub
- squashberry (*Viburnum edule*), shrub
- russet buffaloberry (*Shepherdia canadensis*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- red fruit bearberry (*Arctostaphylos rubra*), shrub
- twinflower (*Linnaea borealis*), shrub
- false toadflax (*Geocaulon lividum*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous
- wintergreen (*Pyrola*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous

Community 1.3
Middle fire stage

Community 1.3 is in the middle stage of fire-induced secondary succession for this ecological site. It is characterized as closed deciduous forest (Viereck et al. 1992) with mature stands of resin birch. Immature white spruce and black spruce are a common subdominant tree in the canopy. Common and abundant understory species for this community include Siberian alder, prickly rose, russet buffaloberry, kinnikinnick, lingonberry, red fruit bearberry, squashberry, field horsetail, fireweed, wintergreen, and false toadflax (Landfire 2009).

Dominant plant species

- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- prickly rose (*Rosa acicularis*), shrub
- russet buffaloberry (*Shepherdia canadensis*), shrub
- squashberry (*Viburnum edule*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- red fruit bearberry (*Arctostaphylos rubra*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- fireweed (*Chamerion angustifolium*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- wintergreen (*Pyrola*), other herbaceous

Community 1.4
Early fire stage

Community 1.4 is in the early stage of fire-induced secondary succession for this ecological site. It is characterized as open tall scrubland (Viereck et al. 1992). The overstory canopy is primarily composed of willow, Siberian alder, and broadleaf tree species, commonly resin birch. White spruce and black spruce seedlings are common in the understory but are not a dominant overstory species. Tree cover primarily is in the regenerative tree stratum (less than 15 feet in height). Commonly observed understory species include bluejoint and fireweed.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- resin birch (*Betula neoalaskana*), tree
- willow (*Salix*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- horsetail (*Equisetum*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous

Community 1.5
Pioneering fire stage

Community 1.5 is in the pioneering stage of fire-induced secondary succession for this ecological site. It is characterized as a mesic forb herbaceous community (Viereck et al. 1992). Tree seedlings, primarily resin birch, quaking aspen, and white spruce, are common throughout the community. Although small areas of exposed bare soil are common, the soil surface is primarily covered with a mixture of weedy bryophyte species, woody debris, and herbaceous litter. Commonly observed species include an assortment of willow, bluejoint, horsetail, and fireweed (Landfire 2009).

Dominant plant species

- willow (*Salix*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- field horsetail (*Equisetum arvense*), other herbaceous

- woodland horsetail (*Equisetum sylvaticum*), other herbaceous
- (*Marchantia polymorpha*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- ceratodon moss (*Ceratodon purpureus*), other herbaceous
- pohlia moss (*Pohlia*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.5

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.2b
Community 1.2 to 1.1

Time without fire results in the continued growth and increased abundance of white spruce, which overtop and remove the shade intolerant deciduous tree species from the forest canopy.

Pathway 1.2a
Community 1.2 to 1.5

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.3b
Community 1.3 to 1.2

Time without fire results in the continued growth and increased abundance of white spruce, which overtop and remove the shade intolerant deciduous tree species from the forest canopy.

Pathway 1.3a
Community 1.3 to 1.5

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.4b
Community 1.4 to 1.3

Time without fire results in the continued development of a forest canopy dominated by resin birch or quaking aspen.

Pathway 1.4a
Community 1.4 to 1.5

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.5a
Community 1.5 to 1.4

Time without fire results in the herbaceous community being overtopped by willow and deciduous tree seedlings.

State 2
Thermokarst State

Figure 7. Thermokarst in a farm field in the greater Fairbanks area.

Thermokarst occurs due to the thermal erosion of ice-rich permafrost in soil after disturbances such as fire events or land clearing. While thermokarst can be readily observed, details related to thermokarst succession are poorly understood. After an unknown timeframe, thermokarst depressions could theoretically revert back to plant communities associated with the reference state (Myers-Smith et al. 2008). However, the timeframe for recovery is likely outside the scope of typical land management priorities. At this time, restoration back to reference conditions is not considered within the state-and-transition model. Future data collection efforts and research would likely enhance information about existing plant community phases within this state and allow for better understanding of the potential transitions from one community phase or state to another.

Dominant plant species

- sedge (*Carex*), grass
- cottongrass (*Eriophorum*), grass
- American sloughgrass (*Beckmannia syzigachne*), grass
- mannagrass (*Glyceria*), grass
- water horsetail (*Equisetum fluviatile*), other herbaceous

Community 2.1
sedge / water horsetail

After collapse, thermokarst can result in depressional features that pond water. Common species in thermokarst depressions include water sedge, Northwest territory sedge, and water horsetail (NRCS staff).

Dominant plant species

- water sedge (*Carex aquatilis*), grass
- Northwest Territory sedge (*Carex utriculata*), grass
- rush (*Juncus*), grass
- American mannagrass (*Glyceria grandis*), grass
- American sloughgrass (*Beckmannia syzigachne*), grass
- water horsetail (*Equisetum fluviatile*), other herbaceous

Transition T1A
State 1 to 2

Land clearing or fire can thaw permafrost and the thermal erosion of ground ice results in the settling of soil, which is thermokarst. Subsidence can be significant with collapsed pits going down and spanning across several feet.

Additional community tables

Animal community

n/a

Hydrological functions

n/a

Recreational uses

n/a

Wood products

n/a

Other products

n/a

Other information

n/a

Inventory data references

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

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Approval

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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	11/23/2024
Approved by	Marji Patz
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:**