Ecological site F230XY611AK
Boreal Forest Loamy Frozen Slopes

Last updated: 6/11/2025
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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): 230X–Yukon-Kuskokwim Highlands

MLRA notes The Yukon-Kuskokwim Highlands (MLRA 230X) include the most western parts of Interior Alaska (Land Resource Region X2) and have a continental climate. MLRA 230X is approximately 42,300 square miles spread across mountain, hills, and valleys. Flood plain systems are common. The watershed drains into the Bering Sea to the west and Bristol Bay to the southwest. Major rivers include the Yukon, Innoko, Kuskokwim, Mulchatna, and Nushagak Rivers. This sparsely populated area is mostly undeveloped wildland. Residents use this remote area primarily for subsistence hunting, fishing, and gathering. Villages are primarily located along rivers along the MLRA 230X boundary and include Greyling, Nulato, and Koyukuk. Federally managed lands in the MLRA include parts of Innoko, Nowitna, and Koyukuk National Wildlife Refuges. Geology and Soils The Yukon-Kuskokwim Highlands MLRA was mostly unglaciated during the Pleistocene. Glaciers were limited to the Lime Hills in the southeast. Glacial moraines and drift are evident in areas of past glacial activity. Unglaciated upland areas are covered with colluvium and slope alluvium originating from bedrock. Loess deposits cover gentle sloping hills and footslopes of mountains near major rivers. Bedrock material is primarily sedimentary rocks with intrusive volcanic rock (USDA, 2022). This MLRA is in the zone of discontinuous permafrost. Permafrost is most common in finely textured soils on terraces, gently sloping hills, and cold mountain footslopes. It is typically absent from flood plains and mountain backslopes. Across the MLRA, permafrost presence decreases as proximity to the Yukon-Kuskokwim delta increases. The dominant soil orders are Gelisols, Entisols, Inceptisols, and Spodosols. Gelisols support shallow to deep permafrost and often have a perched water table for at least part of the growing season. Inceptisols, Spodosols, and Entisols lack permafrost. Two important factors that prevent permafrost aggradation are groundwater connectivity and thick bands of sandy and/or gravelly soil horizons. Inceptisols have minimal development and are common on alpine scrublands and high flood plains. Entisols are common on mountain backslopes and scoured flood plains. Spodosols support a spodic soil horizon and are common in the acidic soils underlying spruce forests and ericaceous shrublands. Non-soil areas such as rock outcrops, rubble lands and beaches make up approximately ten percent of the MLRA surface. Climate The Yukon-Kuskokwim Highlands MLRA has short, warm summers and cold, long winters. Mean annual precipitation is 10 to 15 inches at low elevations and increases to 20 to 40 inches at higher elevations (USDA, 2022). Annual snowfall is between 80 and 100 inches. Mean annual temperatures ranges from 25 to 32 degrees F (SNAP, 2014a; SNAP, 2014b). Vegetation Vegetation is mainly influenced by site and soil characteristics such as temperature-degree days, exposure, soil depth, and soil hydrology. Dwarf scrublands are prevalent on shallow soils on convex slopes and in the alpine. Mesic, lowland slopes are a mix of forests and shrublands of alder, willow, and ericaceous shrubs. Cold slopes generally support black spruce, while warm slopes support white spruce. Valley bottoms and steep slopes support a deciduous forest. Tussock tundra is associated with wet soils underlain by shallow permafrost and is ubiquitous across the lower footslopes of mountains and the coastal plain (USDA, 2022). Fire Fire is a major disturbance across the Yukon-Kuskokwim Highlands. Low severity fires destroy the canopy but leave the organic mat and rootstock mostly undisturbed. The vegetative community progresses directly back to a forest. Severe forest fires are stand replacement events. Post-first communities typically pass through an herbaceous meadow community before ericaceous shrubs, birch, and willows colonize. Drier soils may support a deciduous aspen or birch forest, while moist soils support cottonwoods and spruce. 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.

LRU notes

MLRA 230X contains three life zones defined by the physiological limits of plant communities along an elevational gradient. The boreal life zone is the elevational band where forest communities dominate. Non-forested areas in the boreal life zone are often hydrologically driven, and are either too wet (i.e., bogs) or too dry (i.e., river bluffs) to support forest communities. Subalpine and alpine vegetation dominates at higher elevations. The subalpine zone is a transitional band between the boreal and the alpine life zones, and is characterized by sparse, stunted trees. Shrub height can be over four feet. Trees are absent from the alpine, and all shrubs are dwarf or prostrate. In general, the boreal life zone occurs below 1,200 feet; the subalpine life zone occurs between 1,200 and 1,600 feet; and the alpine life zone occurs above 1,600 feet. Within each life zone, there are plant assemblages associated with cold and warm slopes. Slope

temperature is a factor of slope steepness, aspect, and shading from surrounding ridges and mountains. Warm slopes occur on southeast to west aspects that are moderate to very steep and are not shaded by the surrounding landscape. Cold slopes 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 slopes have a cryic soil temperature regime and lack permafrost. White spruce forests are an indicator of warm boreal slopes. Cold boreal slope soils 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.

Classification relationships

Alaska Vegetation Classification: Open needleleaf forest (I.A.2 - level III) / Open black spruce forest (I.A.2.f- level IV) (Viereck et al., 1992) Circumboreal Vegetation Map: Alaska-Yukon Wet Black Spruce Woodlands and Scrub (Jorgensen and Meidinger, 2015) BioPhysical Settings: 7316220 – Western North American Boreal Black Spruce Wet-Mesic Slope Woodland (Landfire, 2009)

Ecological site concept

Ecological Site characteristics: • Occurs in the boreal life zone on cold slopes of hills, mountains, plains, and terraces • While soils are very deep, root-restricting permafrost occurs shallow to moderately deep depths • Soils commonly formed in loess and colluvium and are capped with 9- to 13-inch-thick organic horizons • Soils do not pond or flood. These poorly drained soils have a shallow water table throughout the growing season • The reference plant community is an open black spruce forest with low shrubs, graminoids, and mosses dominating the understory • Fire is the major disturbance in this ecological site and is responsible for three plant communities.

Associated sites

R230XY620AK	**Boreal Peat Frozen Flats Complex** R230XY620AK describes the tussock tundra. They are located on the nearly level hill and mountain toeslopes down slope from F230XY611AK.
F230XY614AK	**Boreal Black Spruce Unfrozen Well Drained Slopes** Ecological site F230XY614AK occurs on the same hills and mountains but does not support permafrost in the soil.
F230XY615AK	**Boreal Deciduous Forest Loamy Steep Slopes** Ecological site F230XY615AK occurs on adjacent slopes that are much steeper and are associated with paper birch forests.
F230XY612AK	**Boreal Forest Loamy Slopes** Ecological site F230XY612AK describes white spruce forest on warm slopes. These ecological sites abut each other on the same slopes, but F230XY611AK is mostly restricted to north-facing slopes.

Similar sites

F230XY614AK	**Boreal Black Spruce Unfrozen Well Drained Slopes** F230XY614AK and F230XY611AK both support black spruce forests. F230XY611AK is distinguished by poorly drained soils with permafrost which influences the vegetative community and fire dynamics.

Table 1. Dominant plant species

Tree	(1) *Picea mariana*

Shrub	(1) *Betula nana* (2) *Ledum palustre ssp. decumbens*
Herbaceous	(1) *Carex bigelowii*

Physiographic features

• This boreal ecological site occurs on cold slopes of hills, mountains, plains, and terraces
• Elevation typically ranges between 100 and 1,200 feet
• Slope gradients are nearly level to steep (0 to 25 percent)
• This ecological site occurs on cold slopes. It is normally restricted to north-facing slopes, or slopes shaded by adjacent hills and mountains
• Flooding and ponding do not occur. A shallow water table (0 to 10 inches deep) is from May through September and often is present year-round.

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Linear
Hillslope profile	(1) Backslope (2) Footslope
Geomorphic position, hills	(1) Side Slope
Geomorphic position, mountains	(1) Mountainbase (2) Mountainflank
Geomorphic position, terraces	(1) Tread
Landforms	(1) Hills > Plain (2) Mountains > Mountain (3) Hills > Hill (4) Valley > Terrace
Runoff class	Negligible to high
Flooding frequency	None
Ponding frequency	None

Elevation	30 – 370 m
Slope	0 – 30 %
Water table depth	0 – 30 cm
Aspect	NW, N, NE, E

Climatic features

The Yukon-Kuskokwim Highlands MLRA has short, warm summers and long, cold winters. Mean annual temperature ranges from 25 to 32 degrees Fahrenheit, with temperatures typically below freezing from October through April. June through August are the warmest months of the year and constitute the heart of the growing season. Approximately 60 percent of total annual precipitation occurs from June through September (PRISM, 2018; SNAP, 2014a). Across the MLRA, snowfall ranges from 80 to 100 inches (USDA, 2022).

Table 3 Representative climatic features

Frost-free period (characteristic range)	80-100 days
Freeze-free period (characteristic range)	70-90 days
Precipitation total (characteristic range)	330-510 mm
Frost-free period (actual range)	60-110 days
Freeze-free period (actual range)	50-100 days
Precipitation total (actual range)	250-1,020 mm
Frost-free period (average)	80 days
Freeze-free period (average)	70 days
Precipitation total (average)	380 mm

Influencing water features

Precipitation and ground water are the main sources of water (Smith et al. 1995).
Depth to the water table may decrease following summer storm events or spring snowmelt and increase during extended dry periods

Wetland description

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

Soil features

• Common Gelisol great groups are Historthels and Histoturbels (Soil Survey Staff, 2013)
• Soils formed in loess over colluvium. Organic material is often intermixed with the mineral material due to cryoturbation.
• Rock fragments do not occur on the soil surface.
• Soils have a thick, 9- to 13-inch organic cap
• Soils are very deep but contain a shallow to moderately deep restrictive layer in the form of permafrost
• Subsurface rock fragments are generally absent except where cryoturbation has occurred
• Soil pH is extremely to moderately acidic near the surface and strongly acidic to neutral in permafrost
• Soils are poorly drained

Table 4. Representative soil features

Parent material	(1) Organic material (2) Loess (3) Eolian deposits (4) Colluvium
Surface texture	(1) Peat (2) Silt loam
Drainage class	Poorly drained
Permeability class	Moderate
Depth to restrictive layer	30 – 70 cm
Soil depth	150 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	21.59 – 28.96 cm
Soil reaction (1:1 water) (0-25.4cm)	3.9 – 5.7
Subsurface fragment volume <=3" (0-152.4cm)	Not specified

Subsurface fragment volume >3" (0-152.4cm)	Not specified

Table 5. 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
Soil reaction (1:1 water) (0-25.4cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	0 – 20 %
Subsurface fragment volume >3" (0-152.4cm)	0 – 10 %

Ecological dynamics

Fire

Fire has a major influence on vegetation across the Yukon-Kuskokwim Highlands MLRA. Wildland fire is a common and natural event that is unmanaged except near towns and villages. Fires are patchy and different locations within a single burn experience different levels of fire intensity, or no fire at all. In general, cooler and wetter areas experience low-severity fires, while warmer and drier areas experience high-severity fires. Because the soils have a thick organic cap and are poorly drained, the typical fire scenario for this ecological site is considered to result in a low severity burn. Other factors such as fire load and recent weather also affect fire characteristics. A typical fire event considerably alters vegetation, above ground biomass, and the organic soil cap.

Fire is the major natural disturbance for this ecological site. The fire return interval ranges between 50 and 150 years, with an average of less than 100 years (Viereck et al., 1992; Fryer, 2014). Fire is facilitated by a high fuel load, flammable chemical contents within the plant, and the multilayer community structure of black spruce (Landfire, 2009; Fryer, 2014). Ericaceous shrubs in the lower canopy act as

ladder fuels. Black spruce forests are susceptible to all fire severity levels. This tree species is fire adapted, and seed release is facilitated by fire. Post-fire seeding rates are exceptionally high, and reestablishment occurs within five years (Fryer, 2014).

Low-severity fires have modest impacts on soil organic matter thickness, depth to permafrost, and soil drainage. While a low-severity fire can consume the bulk of above ground vegetation, minimal proportions of the organic mat are typically removed. Organic matter continues to insulate these cold soils. If permafrost remains at similar depths after a fire event, then soil drainage is unlikely to improve post-fire.

The normal fire cycle in black spruce is a stand-replacement event. There is no single pathway regarding boreal forest fire dynamics; post-fire communities depend on various factors including pre-fire community composition, fire severity, weather, and the presence/absence of permafrost (Fryer, 2014). In general, a typical post-fire successional pathway begins with an herbaceous meadow before progressing through a low shrubland and then onto a black spruce woodland or forest.

The information in this Ecological Dynamics section, including the state-and-transition model (STM), was developed based on current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

State and transition model

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Inventory data references

Vegetative communities and transitions are described using existing models and expert knowledge. There are no vegetation inventory data points in NASIS associated with this ecological site. External model data sources: The Alaska-Yukon Region of the Circumboreal Vegetation Map (CBVM) (Jorgensen and Meidinger, 2015) LANDFIRE Biophysical Settings Models (Landfire, 2009) Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 p. (Viereck et al., 1992)

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Approval

Blaine Spellman, 6/11/2025

Acknowledgments

This ecological site description (ESD) fulfills the requirements of the Provisional Ecological Site (PES) national initiative. This ESD is published to fit current site-soil correlations as they are currently mapped and understood. Further data collection may provide the information to update this ESD from the provisional level to the approved level.

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	11/02/2026
Approved by	
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:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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:**
