USDA Natural Resources Conservation Service

Ecological site R230XY634AK
Alpine Sedge Gravelly Frozen Slopes

Last updated: 6/11/2025
Accessed: 12/19/2025

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

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:
Mesic graminoid herbaceous (II.A.2 - level III) / Sedge – willow tundra (III.A.2.h - level IV) (Viereck et al., 1992)

Circumboreal Vegetation Map:
Central-Northern Alaska-Yukon Alpine Dwarf Scrub and Meadows
(Jorgensen and Meidinger, 2015)

BioPhysical Settings:
7316330 – Western North American Boreal Alpine Mesic Herbaceous Meadow
(Landfire, 2009)

Ecological site concept

Ecological Site characteristics:
• Occurs in the alpine on concave slopes of hill and mountain.
• While soils are very deep, permafrost occurs at shallow permafrost.
• Soils formed in loess and till and are often capped with 11-inches of organic material.

• Soils do not pond or flood. These poorly drained soils have a water table near the soil surface throughout the growing season.
• The reference plant community is an open sedge-willow tundra community with low and dwarf shrubs and dense sedges throughout.

Associated sites

F230XY612AK	**Boreal Forest Loamy Slopes** F230XY612AK describes boreal white spruce forests on well drained soils. They are downslope of the alpine and support trees, which are absent from the alpine.
R230XY633AK	**Subalpine Scrub Loamy Slopes** R230XY633AK describes low ericaceous shrublands on well drained soils in the subalpine. It is downslope of the alpine, and supports a taller, more productive shrubland than the alpine.
R230XY630AK	**Alpine Dwarf Scrub Gravelly Slopes** R230XY634AK describes the dwarf scrubland on drier soils in the alpine and has less hydrophytic plants with more shrub and less graminoid cover.

Similar sites

R230XY620AK	**Boreal Peat Frozen Flats Complex** R230XY620AK and R230XY634AK share similar graminoid-dominant species on wet soils. R230XY634AK is restricted to the alpine and does not support the tussock tundra described by R230XY620AK.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Empetrum nigrum* (2) *Betula nana*
Herbaceous	(1) *Carex* (2) *Eriophorum*

Physiographic features

• Occurs on concave slopes of mountains and hills
• This alpine ecological site occurs at elevations above 1,600 feet
• Slopes are gentle (2 to 8 percent) and occur on all aspects
• Ponding and flooding do not occur. A very shallow water table is present throughout the growing season.

Table 2. Representative physiographic features

Slope shape across	(1) Concave (2) Linear
Slope shape up-down	(1) Concave (2) Linear
Hillslope profile	(1) Backslope
Geomorphic position, hills	(1) Side Slope
Geomorphic position, mountains	(1) Mountainflank
Landforms	(1) Mountains > Mountain (2) Plains > Hill
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	1,600–2,600 ft
Slope	2–8%
Water table depth	0–10 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Negligible to medium
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–20%
Water table depth	0–20 in

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 4. Representative climatic features

Frost-free period (characteristic range)	60-76 days

Freeze-free period (characteristic range)	52-68 days
Precipitation total (characteristic range)	13-20 in
Frost-free period (actual range)	48-88 days
Freeze-free period (actual range)	40-80 days
Precipitation total (actual range)	10-40 in
Frost-free period (average)	64 days
Freeze-free period (average)	56 days
Precipitation total (average)	15 in

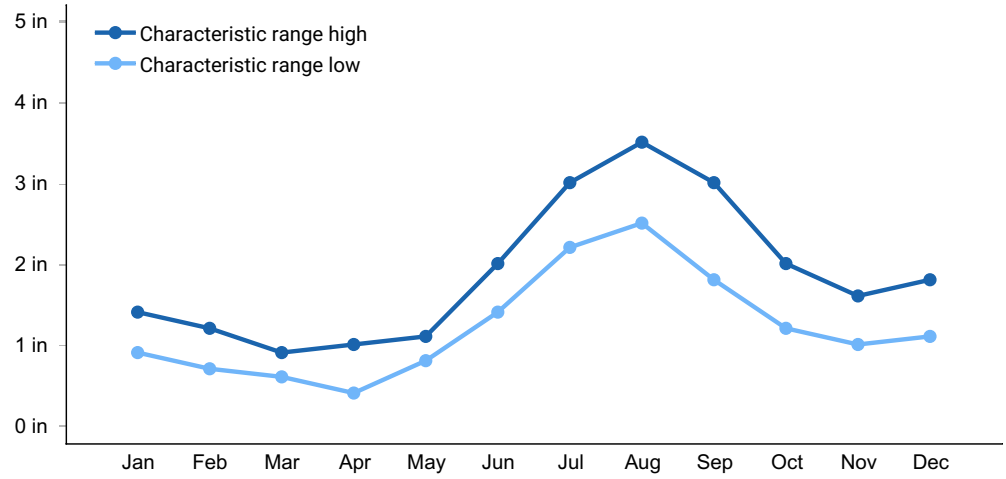

Figure 1. Monthly precipitation range

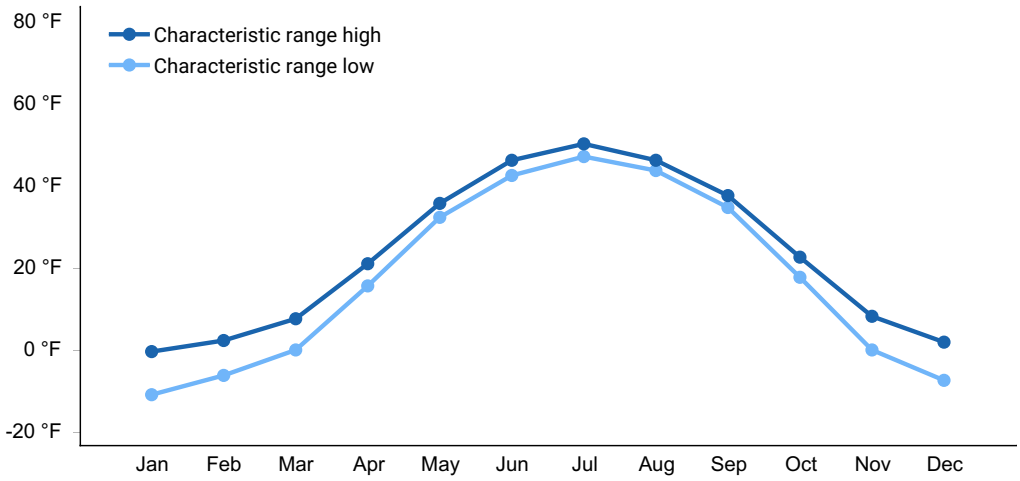

Figure 2. Monthly minimum temperature range

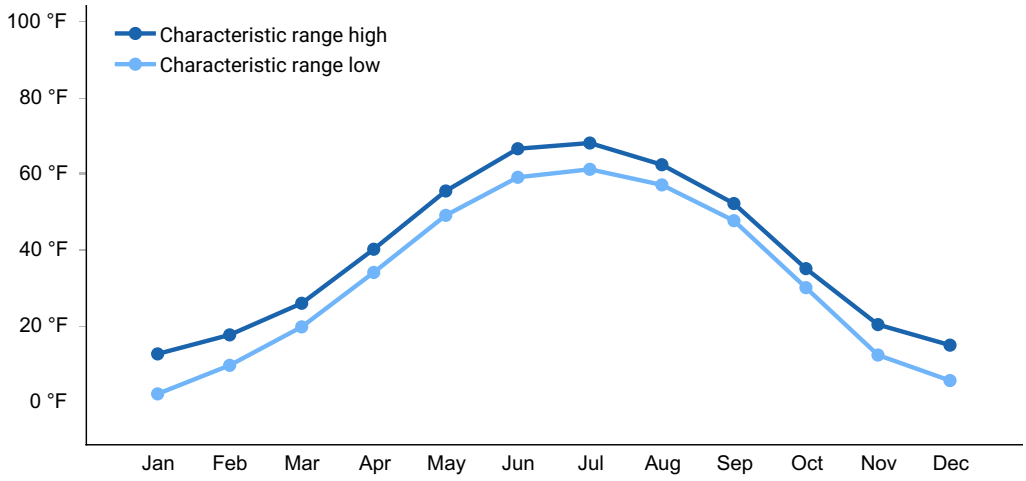

Figure 3. Monthly maximum temperature range

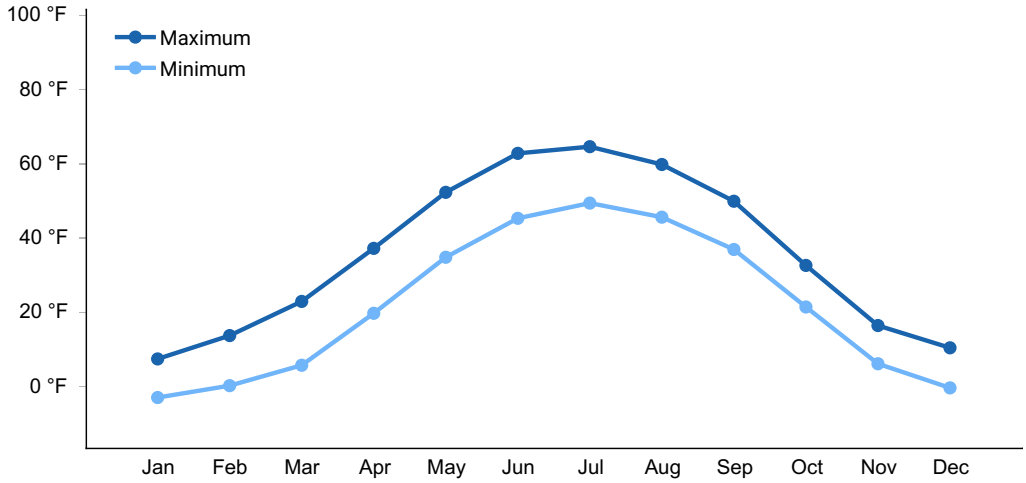

Figure 4. Monthly average minimum and maximum temperature

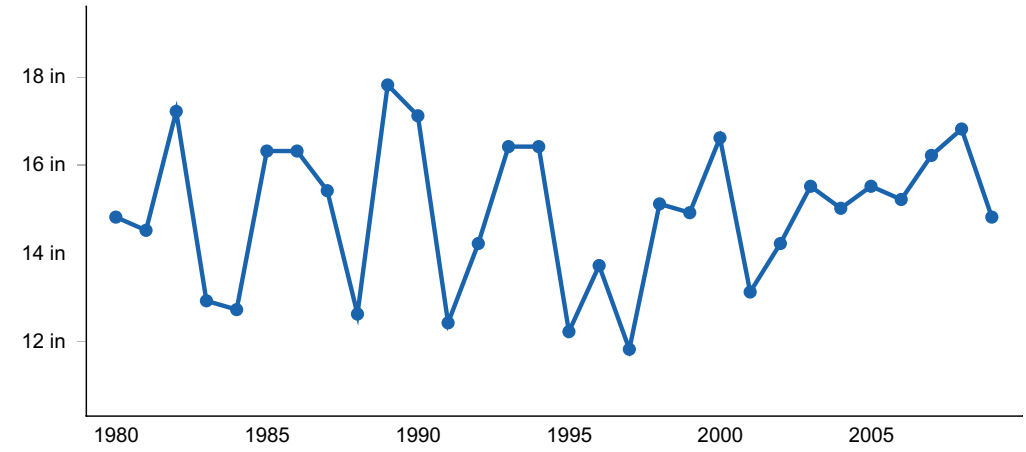

Figure 5. Annual precipitation pattern

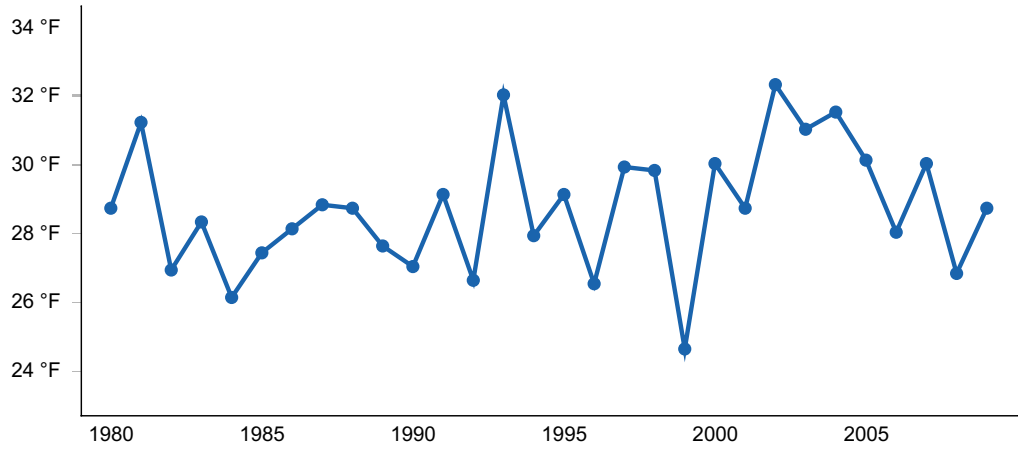

Figure 6. Annual average temperature pattern

Influencing water features

Dominant water sources are precipitation, ground water discharge, and both interflow and overland flow from adjacent uplands.

Wetland description

This ecological site is a depressional wetland under the Hydrogeomorphic (HGM) classification system (Brinson, 1993; USDA-NRCS, 2008). Slope contours generally allow for surface ponding. In areas where surface ponding does not occur, this ecological site is better described as a slope wetland. Depth to the water table may decrease during peak snow melt and following summer storm events and increase during extended dry periods.

Soil features

• Common soils include the Gelisol great group Historthels (Soil Survey Staff, 2013)
• Soils formed in loess over till
• Rock fragments cover zero to two percent of the soil surface
• Soils have a moderately thick, 11-inch organic cap
• Soils are very deep but have permafrost at shallow depth (13 to 19 inches)
• Subsurface rock fragments vary from absent to 35 percent by volume
• Soil pH is extremely to very strongly acidic near the surface, but drops to moderately acidic to neutral in the permafrost
• Soils are poorly drained

Table 5. Representative soil features

Parent material	(1) Loess (2) Till
Surface texture	(1) Peat (2) Sandy loam

Drainage class	Poorly drained
Permeability class	Moderate
Depth to restrictive layer	13–19 in
Soil depth	60 in
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	5–10.3 in
Soil reaction (1:1 water) (0-10in)	3.6–4.9
Subsurface fragment volume <=3" (0-60in)	0–35%
Subsurface fragment volume >3" (0-60in)	0%

Table 6. Representative soil features (actual values)

Drainage class	Poorly drained to somewhat poorly drained
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 (0-40in)	Not specified
Soil reaction (1:1 water) (0-10in)	Not specified
Subsurface fragment volume <=3" (0-60in)	Not specified
Subsurface fragment volume >3" (0-60in)	Not specified

Ecological dynamics

This ecological site occurs on wet, concave slopes in the alpine. The reference plant community is shaped by alpine climatic factors such as cold temperatures, wind exposure, and a short growing season. Additionally, hydrology further shapes the vegetative community in the reference state. Vegetation is primarily restricted to facultative-to-facultative wet wetland species.

Site and soil conditions result in one community (Viereck et al., 1992; Landfire 2009). Cool temperatures and a shortened growing season support slow growing shrubs. Shrubs are prostrate due to wind exposure. Soils are cold and wet. Permafrost perches water and supports a shallow water table from May through September. These conditions are ideal for hydrophytic graminoids such as sedges (Carex spp.) and cottongrasses (Eriophorum spp.).

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

Ecosystem states

1. Reference State

State 1 submodel, plant communities

1.1. Empetrum nigrum - Betula nana / Carex spp. - Eriophorum spp.

State 1
Reference State

The reference state describes one distinct vegetative community on poorly drained alpine slopes. Site hydrology and a shortened, cold growing season are the major influences on community composition and dynamics on this ecological site. Soils are organic with a high available water capacity. Moderately deep permafrost contributes to a shallow, year-round water table (0 to 10 inches). The reference state is developed and characterized using available vegetation models, including Landfire BpS and the Alaska vegetation classification system (Landfire, 2009; Viereck et al., 1992).

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- dwarf birch (*Betula nana*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- cottongrass (*Eriophorum*), grass
- cloudberry (*Rubus chamaemorus*), other herbaceous

Community 1.1
Empetrum nigrum - Betula nana / Carex spp. - Eriophorum spp.

The reference plant community is a closed low or dwarf scrubland (Viereck et al. 1992). The dominant vegetative strata are low shrubs, dwarf shrubs, medium graminoids, and mosses. This community is highly variable. Community composition is shaped by specific site factors such as growing season length and local site hydrology. Ericaceous shrubs and dwarf birch are common. Low and dwarf willows may also be present. Graminoids are generally facultative to facultative wet wetland species. The soil surface is primarily covered with mosses, lichens, and herbaceous litter. The binomial and vernacular name of common plants are listed in the dominant plant species table.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- dwarf birch (*Betula nana*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- alpine bearberry (*Arctostaphylos alpina*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- arctic bluegrass (*Poa arctica*), grass
- cloudberry (*Rubus chamaemorus*), other herbaceous
- Labrador lousewort (*Pedicularis labradorica*), other herbaceous
- arctic sweet coltsfoot (*Petasites frigidus*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

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

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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Other references

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Western Regional Climate Center (WRCC). 2025. “McGrath WB Airport, Alaska ‘Freeze Free’ Season Probabilities.” https://wrcc.dri.edu/cgi-bin/cliTFrezD.pl?akmcgr. Accessed Mar 6, 2025.

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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	12/19/2025
Approved by	Blaine Spellman
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:**

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

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

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

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

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

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

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

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

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
