USDA Natural Resources Conservation Service

Ecological site R233XY134AK
Alpine Dwarf Scrub Gravelly Frozen Slopes

Last updated: 6/10/2025
Accessed: 04/13/2026

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): 233X–Upper Kobuk and Koyukuk Hills and Valleys

The Upper Kobuk and Koyukuk Hills and Valleys MLRA (herein called area) occurs in Interior Alaska. This area makes up 8,405 square miles. The largest tributaries are the Kobuk and the Koyukuk Rivers. Major tributaries of the Kobuk are the Reed, Beaver, Mauneluk, and Pau Rivers. Major tributaries of the Koyukuk River are the Alatna, John, and Kanuti Rivers. This area is primarily undeveloped wildland and sparsely populated. The communities within or near this area are Bettles, Kobuk, and Shungnak.

The terrain of this area consists of broad, nearly level river valleys and basins and rolling uplands separated by isolated hills and low rounded mountains. In the river valleys, nearly level flood plains and stream terraces gradually transition to gently sloping to moderately steep slopes leading to the hills and mountains. Basins are on the Pau River Flats between the eastern Zane and Lockwood Hills, on the Kanuti Flats between the Kanuti and Koyukuk Rivers, and along the middle reaches of the Hogatza River. Basins and stream terraces are dotted with hundreds of lakes and interconnecting wetlands. Elevation ranges from about 150 feet in the western part of the area, at the confluence of the Kobuk and Mauneluk Rivers, to 4,765 feet at the summit of Fritts Mountain, in the Angaycuham Mountains.

Geology and Soils

The northern part of the area was covered repeatedly by Pleistocene glaciers originating in the Brooks Range to the north. Slightly modified to highly modified moraines and drift cover many of the rolling uplands. Glacial ice flowed over most of the hills and low mountains, removing existing deposits and leaving a thin layer of glacial deposits. Today, the lower mountain slopes, hills, and valley bottoms are covered with a variety of material, including glacial drift, colluvium, slope alluvium, fluvial deposits, and silty loess. In the southern part of the area, basins and valleys are filled with Quaternary glaciofluvial and fluvial deposits. Hills and upland slopes are covered with bedrock colluvium and slope alluvium, which are mantled with loess in places. The bedrock geology underlying much of the area consists dominantly of Permian through Lower Cretaceous stratified sedimentary and volcanic rocks.

This area is in the zone of discontinuous permafrost. Permafrost is close to the surface in lands with finer textured sediments throughout the area. Isolated masses of ground ice occur on terraces and the lower side slopes of hills. Permafrost does not occur on flood plains, on steep south-facing slopes, or other lands with very gravelly soils. Periglacial features, such as thermokarst pits, peat plateaus, and earth hummocks, are on the lower hill and mountain slopes and in upland valleys.

The dominant soil orders in this area are Gelisols, Inceptisols, and Entisols. The Gelisols are shallow or moderately deep to permafrost, occur on finer textured sediments, and are poorly drained or very poorly drained. Common Gelisol suborders are Histels, Orthels, and Turbels. The Histels have thick accumulations of surface organic material and occur in depressions, lake margins, and peat plateau. The Orthels and Turbels have comparably thinner surface organic material and occur on stream terraces and hill and upland slopes. The Inceptisols and Entisols are typically associated with gravelly soils that do not have permafrost within their profile, are deep, and are somewhat poorly drained to well drained. The common Inceptisol suborders are Cryepts and Gelepts both of which occur on upland and mountain slopes. Cryepts occur under forested soils at lower elevations and Gelepts on alpine tundra at higher elevations. Common Entisol suborders are Cryofluvents and Cryorthents both of which occur on alluvium on flood plains. Miscellaneous (non-soil) areas make up about 8 percent of this MLRA. The most common are rock outcrop, rubble land, and water.

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, cold winters characterize the continental subarctic climate of the area. The average annual precipitation ranges from 15 to 19 inches on valley bottoms and basins and from 19 to 26 inches at the higher elevations in the hills and mountains (PRISM 2018). Most of the precipitation falls as rain between May and September. The average annual snowfall ranges from 65 to 80 inches. The average annual temperature is 22 to 24 degrees Fahrenheit (PRISM 2018). The temperature normally remains above freezing from mid-June through August in river valleys and basins with a freeze-free period ranging from 109 to 125 days. The free-free period is significantly shorter on higher elevation mountain slopes.

Vegetation

Most of this area is forested below an elevation of 1600 feet. Dominant tree species on slopes are white spruce and black spruce. Black spruce stands dominate on north-facing slopes, stream terraces, and other sites with poor drainage and permafrost. White spruce stands dominate on steep, south-facing slopes with dry soils. At lower elevations, lightning-caused wildfires are common, often burning many thousands of acres during a single fire event. 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

In this area, we refer to three life zones that are 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 a narrow transitional band between the boreal and the alpine life zones, and is characterized by sparse, stunted trees that can be considered tree line. In the subalpine, certain types of birch and willow shrub species grow at greater than or equal to one meter in height (commonly *Betula glandulosa* and Salix pulchra). In the alpine, trees no longer occur, and all shrubs are dwarf or lay prostrate on the ground. In this area, the boreal life zone occurs below 1600 feet elevation on average. The transition between boreal and subalpine vegetation can occur within a range of approximately 350 feet of elevation, and is highly dependent on slope, aspect, and shading from adjacent mountains.

Within each life zone, there are plant assemblages that are associated with cold slopes and warm 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 occur on southeast to west facing slopes that are moderate to very steep (greater than 10 percent slope) 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 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 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 – 16101 – Western North American Boreal Mesic Scrub Birch-Willow Shrubland - Boreal

Ecological site concept

- Occurs in the alpine on slopes of rounded mountains.
- Non-sorted circles are common periglacial features with unique site and soil properties that result in a mosaic of vegetation.
- Soils formed in loess and gravelly colluvium and/or gravelly residuum.
- Soils range from deep to very deep based on depth to bedrock.
- Non-sorted circles have moderately well drained soils with permafrost at deep depths. Adjacent areas have very poorly to poorly drained soils that pond and have permafrost at shallow to moderate depths.
- The reference plant community is ericaceous dwarf scrub (Viereck et al. 1992) with scrub birch, marsh Labrador tea, Bigelow's sedge and Sphagnum moss the dominant vegetation. Multiple plant communities occur within the reference state related to wildfire. Non-sorted circles have lichen dominant plant communities.

Associated sites

R233XY101AK	**Alpine Dwarf Scrub Gravelly Slopes** Occurs on the same alpine slopes but on dry and gravelly soils without permafrost.
R233XY115AK	**Alpine Sedge Silty Frozen Slopes** Occurs on the same alpine slopes but with siltier soils.
R233XY152AK	**High-elevation Scrub Gravelly Flood Plains** Occurs downslope in high elevation drainageways.
R233XY148AK	**Subalpine Scrub Gravelly Moist Slopes** Occurs downslope in the subalpine.

Similar sites

R231XY134AK	**Alpine Dwarf Scrub Gravelly Frozen Slopes** Occurs in an adjacent area (MLRA 231X) on similar soils and is provisionally thought to have similar vegetation and disturbance dynamics.
R233XY101AK	**Alpine Dwarf Scrub Gravelly Slopes** Both ecological sites support dwarf shrub communities. Site 101 has dry and unfrozen soils with different kinds and amounts of vegetation.
R233XY115AK	**Alpine Sedge Silty Frozen Slopes** Ecological site 115 has much siltier soils, is not associated with nonsorted circles, and has less dwarf shrub cover and more sedge and lichen cover.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Betula glandulosa* (2) *Ledum palustre ssp. decumbens*
Herbaceous	(1) *Carex bigelowii* (2) *Sphagnum*

Physiographic features

- Occurs on the tops, flanks, and the base of rounded mountains.
- Associated with the alpine life zone. Elevation is most commonly between 1600 and 2700 feet but can range to lower elevations on windswept positions like nose slopes.
- Slopes are gentle to moderately steep and occur on all slope aspects.
- Flooding does not occur.
- Associated with moderate amounts of runoff to adjacent, downslope ecological sites.
- Non-sorted circles and turf hummocks are common periglacial microfeatures on all associated landforms. Turf hummocks consist of vegetation and organic matter with or without a core of mineral soil or stones that are 8 to 20 inches in height and 8 to 35 inches in diameter. The diameter of non-sorted circles ranges from 1.5 to 10 feet and can be mounded well above the surrounding vegetation. Non-sorted circles have unique site and soil properties that result in a mosaic of vegetation.

Reference State Soils
- Ponding occurs frequently to occasionally for long to brief durations. Ponding depth ranges up to 12 inches above the soil surface. Ponding frequency, durations, and depth all decrease as slope percentage increases.
- A seasonal water table occurs between 0 and 10 inches.

Non-sorted Circle State Soils
- Ponding does not occur.
- A seasonal water table occurs between 20 and 40 inches.

Table 2. Representative physiographic features

Geomorphic position, mountains	(1) Mountaintop (2) Mountainflank (3) Mountainbase
Landforms	(1) Mountains > Mountain (2) Mountains > Mountain > Nonsorted circle (3) Mountains > Mountain > Turf hummock
Runoff class	Medium
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Frequent to occasional
Elevation	488–823 m
Slope	5–25%
Ponding depth	0–30 cm
Water table depth	0–51 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	None to frequent
Elevation	152–823 m
Slope	0–25%
Ponding depth	30 cm
Water table depth	0–102 cm

Climatic features

This Alpine Dwarf Scrub Gravelly Frozen Slopes ecological site is associated with a harsh climate especially when compared to ecological sites at lower elevations in the boreal life zone. In MLRA 233X, snow first blankets and persists the longest in the alpine and subalpine life zones. During the growing season (May through September), it is consistently 2 to 3 degrees Fahrenheit colder in the alpine and subalpine (PRISM 2018). These small differences in temperature are exacerbated due to constant and strong winds. Winds are much more intense in these high elevation areas because of limited trees providing windbreaks. When compared to the boreal life zone, this site has a much shorter growing season, and the growing season is significantly colder for associated vegetation.

Short, warm summers and long, cold winters characterize the subarctic continental climate associated with this boreal forest gravelly slopes ecological site. The mean annual temperature for MLRA 233X ranges from 22 to 24 degrees Fahrenheit (PRISM 2008). The warmest months span May through August with mean normal maximum monthly temperatures ranging from 51 to 64 degrees Fahrenheit. The coldest months span December through March with mean normal minimum temperatures ranging from -2 to 3 degrees Fahrenheit. The freeze-free period for this alpine ecological site ranges from 65 to 88 days, and the temperature generally remains above freezing from late May through early-September.

The area receives minimal annual precipitation with July through September being the wettest. Average annual precipitation across MLRA 233X ranges between 17 to 21 inches (PRISM 2008). Approximately half of the annual precipitation occurs during the months of July through September with seasonal thunderstorms. The average annual snowfall ranges from 65 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)	48-69 days
Freeze-free period (characteristic range)	69-85 days
Precipitation total (characteristic range)	432-533 mm
Frost-free period (actual range)	17-73 days
Freeze-free period (actual range)	65-88 days
Precipitation total (actual range)	356-610 mm
Frost-free period (average)	60 days
Freeze-free period (average)	76 days
Precipitation total (average)	457 mm

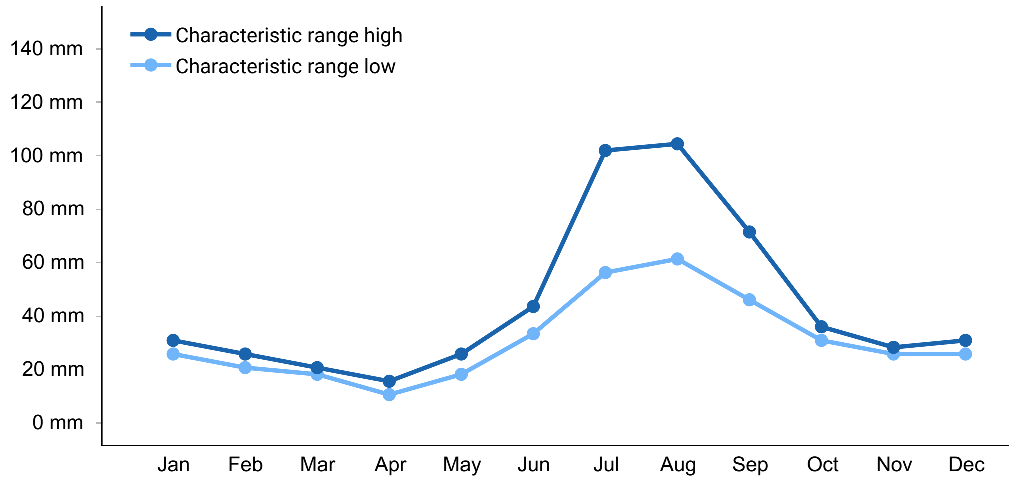


Figure 1. Monthly precipitation range

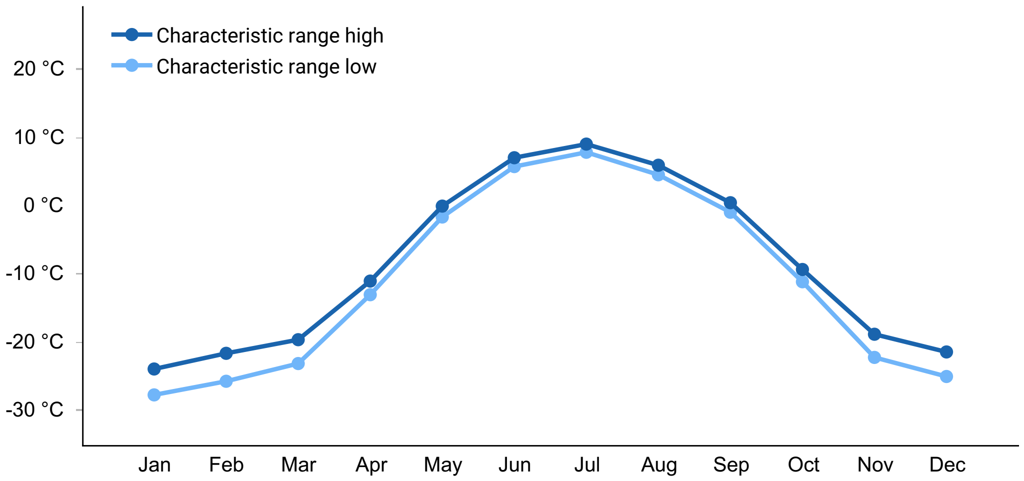


Figure 2. Monthly minimum temperature range

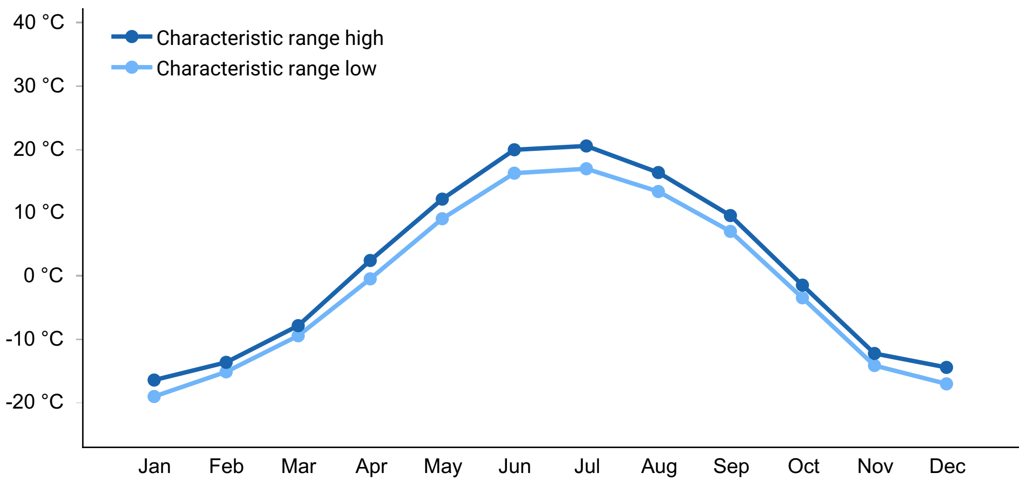


Figure 3. Monthly maximum temperature range

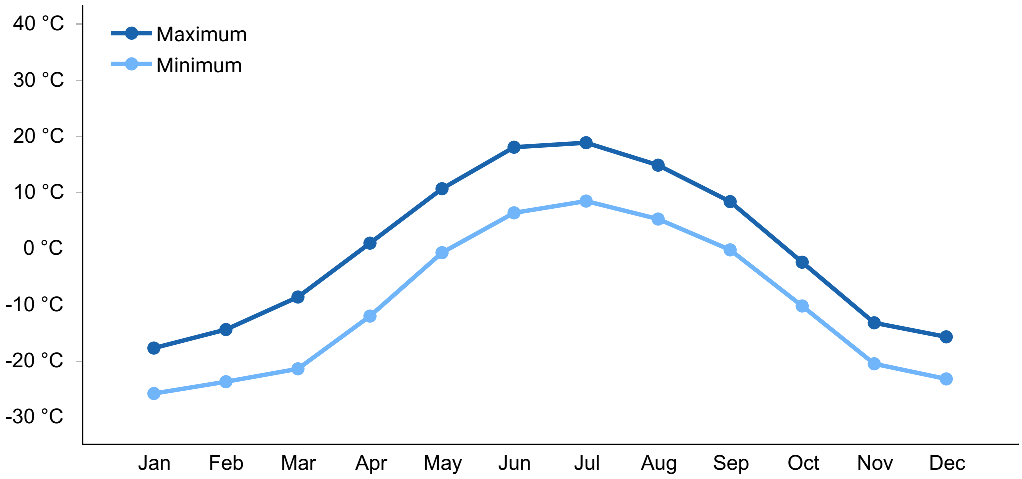


Figure 4. Monthly average minimum and maximum temperature

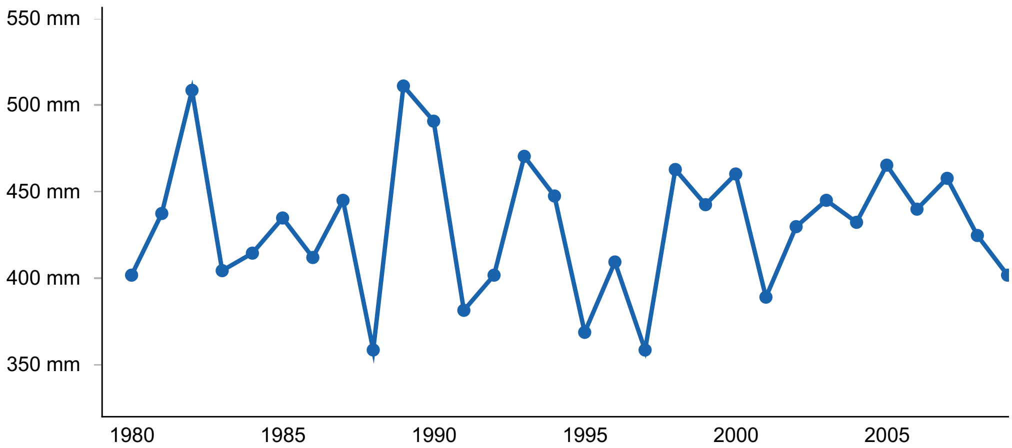


Figure 5. Annual precipitation pattern

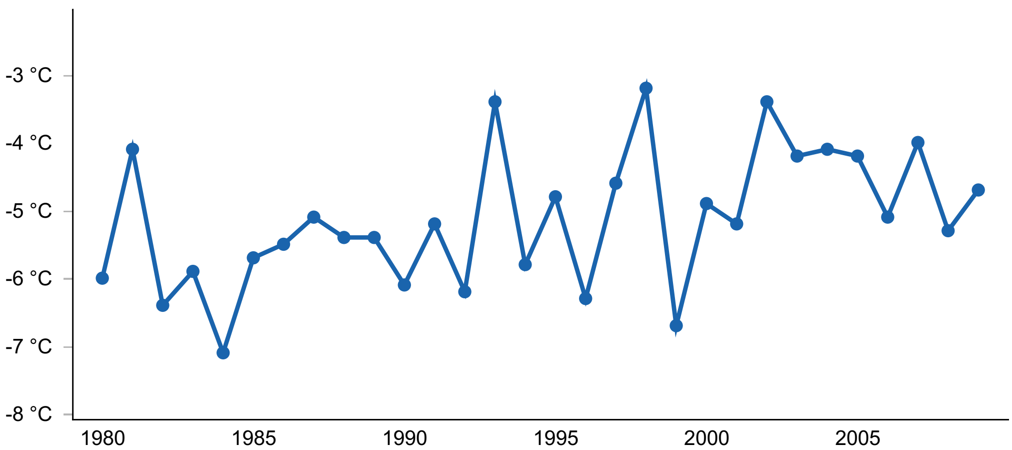


Figure 6. Annual average temperature pattern

Climate stations used

- (1) BETTLES AP [USW00026533], Bettles Field, AK

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

Soil features

- Soils formed in cryoturbated loess and gravelly colluvium and/or gravelly residuum.
- Rock fragments on the soil surface typically range between 0 and 15 percent cover.
- The surface mineral horizons are silt loams with silty material being derived from loess or silty colluvium. This silt loam surface layer is up to four inches thick.
- These gravelly soils have subsurface rock fragments ranging between 20 and 45 percent of the soil profile by volume.
- Soils are deep to very deep with soil depth controlled by bedrock contact.
- The pH of the soil profile ranges from very strongly acidic to slightly acidic.

Reference State Soils
- Capped with up to eight inches of organic material.
- Permafrost restrictions occur at shallow to moderate depths (14 to 21 inches).
- Soils are considered very poorly to poorly drained.
- Soils are classified as Gelisols in the great group Histoturbels.

Non-sorted Circles State Soils
- Capped with up to one inch of organic material.
- Permafrost restrictions occur at deep depths (51 to 60 inches).
- Soils are considered moderately well drained.
- Soils are classified as Gelisols in the great group Haploturbels.

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium–schist (3) Colluvium–igneous rock (4) Colluvium–schist (5) Residuum–igneous rock (6) Residuum–sedimentary rock
Surface texture	(1) Peat (2) Silt loam
Family particle size	(1) Loamy-skeletal

Drainage class	Very poorly drained to poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	36–53 cm
Soil depth	130–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–1%
Available water capacity (0-101.6cm)	4.32–12.19 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	5–10%
Electrical conductivity (25.4-101.6cm)	0 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)	20–35%
Subsurface fragment volume >3" (0-152.4cm)	0–10%

Table 6. Representative soil features (actual values)

Drainage class	Very poorly drained to moderately well drained
Permeability class	Not specified
Depth to restrictive layer	36–130 cm
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	Not specified
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	5–15%

Electrical conductivity (25.4-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0–3
Soil reaction (1:1 water) (25.4-101.6cm)	4.6–6.5
Subsurface fragment volume <=3" (0-152.4cm)	20–50%
Subsurface fragment volume >3" (0-152.4cm)	0–35%

Ecological dynamics

Climate

This Alpine Dwarf Scrub Gravelly Frozen Slopes ecological site is exposed to a variety of harsh environmental conditions. In the Upper Kobuk and Koyukuk Hills and Valleys MLRA (herein called area), snowfall first appears and persists the longest in the alpine. As a result, snowpack tends to be deeper and persist for longer durations of time compared to lower-elevation sites and alpine vegetation has a comparatively shorter growing season. When this ecological site is snow-free, cold soil temperatures and high winds also inhibit plant growth and vigor. This harsh climate maintains the dwarfed vegetation within this site and prevents the establishment and/or growth of dominant boreal species like white spruce and black spruce.

Non-sorted Circles

Non-sorted circles are a type of patterned ground. On gentle slopes, these patterned features are roughly circular and as steepness increases these features become slightly elongated. In this area, the diameter of non-sorted circles commonly ranges from 1.5 to 10 feet and are mounded above the surrounding vegetation. These circles are considered non-sorted due to an absence of coarse rock fragments on their borders (Schoeneberger and Wysocki 2017). The formation of these non-sorted circles leads to a distinct mosaic of vegetation.

Non-sorted circles have distinct plant communities that are associated with different positions on the non-sorted circle. The first plant community occurs between the non-sorted circles (community 2.1) and generally resembles the reference plant community. Plant community 2.1 is classified as open low scrub (Viereck et al. 1992) with scrub birch and Bigelow's sedge the dominant vegetation. The second plant community occurs on the non-sorted circle (community 2.2), which supports a dwarf scrub and lichen dominant plant community.

Fire

Within this area, wildfire is considered a natural and common event that typically goes unmanaged. Fire suppression is limited and occurs adjacent to the small 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, 124 known fire events occurred in this area and the burn perimeter of the fires totaled approximately one million acres (AICC 2022). Fire-related disturbances are highly patchy and can leave undisturbed areas within the burn perimeter. During this time frame, 90 percent of the fire events were smaller than 20,000 acres but three fire events were greater than 100,000 acres in size (AICC 2022). Over this period of 20 years, these burn perimeters cover approximately 20 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 can be considered 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 reference state soils have a thick organic cap and are very poorly to poorly drained, the typical fire scenario for this ecological site is considered to result in a low severity burn.

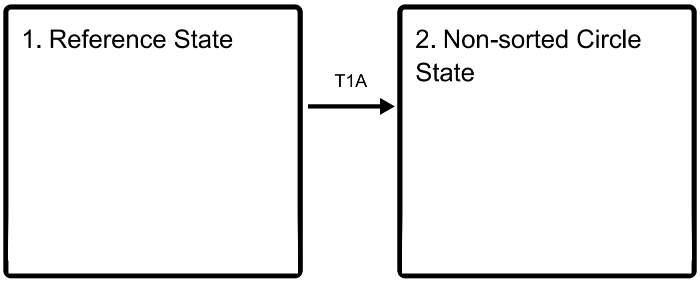
While low-severity fires have a range of impacts to vegetation and soils for this ecological site, permafrost generally remains in the soil profile. While a low-severity fire can consume the bulk of above ground vegetation, minimal proportions of the organic mat are removed. Organic matter continues to insulate these cold soils. Field data from a similar ecological site in the Interior Alaska Uplands MLRA support that each plant community has permafrost and that the associated low-severity fire event has 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. For this ecological site, additional plots and environmental co-variate data will help clarify the variability in fire severity (e.g., timing of fire, soil organic matter moisture content, and pre-fire vegetation) and its effects to soil organic thickness, depth to permafrost, and drainage.

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 data from similar ecological sites and the dominant vegetation associated with this ecological site, full recovery of vegetation is thought to take between 20 to 40 years. In comparison, it typically takes 100 to 150 years for a white spruce stand in Interior Alaska to mature (Chapin et al. 2006).

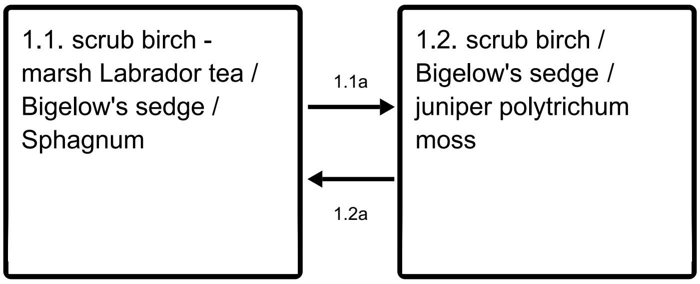
State and transition model

Ecosystem states



T1A - Formation of non-sorted circles

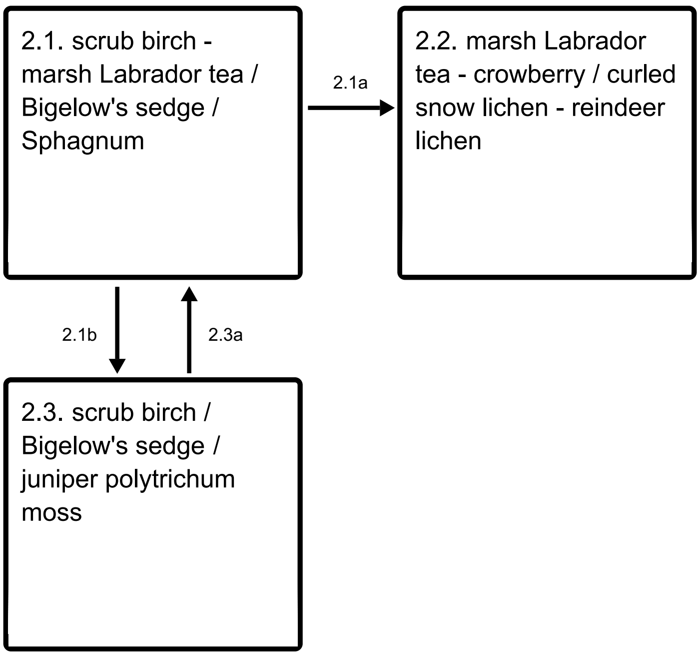
State 1 submodel, plant communities



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

1.2a - Time without fire

State 2 submodel, plant communities



2.1a - Formation of non-sorted circles.

2.1b - Fire.

2.3a - Time without fire.

State 1
Reference State

The reference plant community is ericaceous dwarf scrub (Viereck et al. 1992). There are two plant communities in the reference state related to fire. Solifluction is a process associated with this state but does not happen to a degree resulting in a mosaic of vegetation. Solifluction is the slow, viscous downslope flow of water-saturated soil (Shoeneberger and Wysocki 2017). This process is most active for this site during spring thaw where the upper band of soil material slips on a seasonally frozen layer. Solifluction is a common process associated with several ecological sites in this area and this site can at times have small solifluction lobes. Since these small solifluction lobes are uncommon and do not result in a vegetation mosaic, no alternative solifluction state was developed for this site (see R231XY113AK for a site that does have this solifluction alternate state). The vegetation modeled for this site has limited data and is considered provisional.

Dominant plant species

- resin birch (*Betula glandulosa*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- sphagnum (*Sphagnum*), other herbaceous

Community 1.1
scrub birch - marsh Labrador tea / Bigelow's sedge / Sphagnum

The reference plant community is characterized as ericaceous dwarf scrub (Viereck et al. 1992) with scrub birch (*Betula glandulosa*), marsh Labrador tea, Bigelow's sedge and Sphagnum moss the dominant vegetation. Stunted white spruce occasionally occur but have limited cover. Other common species include dwarf birch, tealeaf willow, bog blueberry, crowberry, lingonberry, tussock cottongrass, curled snow lichen (*Flavocetraria cucullata*), Schreber's big red stem moss, and splendid feathermoss. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- resin birch (*Betula glandulosa*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- dwarf birch (*Betula nana*), shrub

- Bigelow's sedge (*Carex bigelowii*), grass
- tussock cottongrass (*Eriophorum vaginatum*), grass
- sphagnum (*Sphagnum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous

Community 1.2
scrub birch / Bigelow's sedge / juniper polytrichum moss

Community 1.2 is in the early stage of fire-induced secondary succession for this ecological site. Community 1.2 is characterized as open low scrub (Viereck et al. 1992) with scrub birch and Bigelow's sedge the dominant vegetation. Other common species include tealeaf willow, dwarf birch, lingonberry, marsh Labrador tea, crowberry, wideleaf polargrass, curled snow lichen, and juniper polytrichum moss. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), and medium graminoids (between 4 and 24 inches). The soil surface is primarily covered with herbaceous litter.

Dominant plant species

- dwarf birch (*Betula nana*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- resin birch (*Betula glandulosa*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- wideleaf polargrass (*Arctagrostis latifolia*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- tussock cottongrass (*Eriophorum vaginatum*), grass
- (*Flavocetraria cucullata*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.2

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

Time without fire. Ericaceous shrub, shrub birch, and Sphagnum moss cover all increase.

State 2
Non-sorted Circle State

Non-sorted circles are a type of patterned ground. On gentle slopes, these patterned features are roughly circular and as steepness increases these features become slightly elongated. In this area, the diameter of non-sorted circles commonly ranged from 1.5 to 10 feet and are mounded above the surrounding vegetation. These circles are considered non-sorted due to an absence of coarse rock fragments on their borders (Schoeneberger and Wysocki 2017). For this site, these non-sorted patterned ground features form through the process of cryoturbation. Cryoturbation is a collective term used to describe all soil movements due to frost action, characterized by folded, broken and dislocated beds and lenses of unconsolidated deposits (Schoeneberger and Wysocki 2017). In this instance, these patterned ground features result through differential heave of frost susceptible material resulting in mounds (Schoeneberger and Wysocki 2017). During active periods of cryoturbation, freshly churned up mineral soil and rock fragments were commonly observed on mounded surfaces. The formation of these non-sorted circles leads to a distinct mosaic of vegetation. This vegetation mosaic has two distinct plant communities that are associated with different positions on or adjacent to the non-sorted circle. The first plant community occurs in adjacent areas that have not yet formed these non-sorted circles or is the community that occurs between the non-sorted circles (community 2.1). This community generally resembles the reference state vegetation. The second plant community occurs on the non-sorted circle (community 2.2), which supports a lichen dominant plant community. When compared to community 2.1 soils, the non-sorted circle soils are much drier and have much less organic matter.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous

Community 2.1
scrub birch - marsh Labrador tea / Bigelow's sedge / Sphagnum

Community 2.1 is characterized as mixed shrub-sedge tussock tundra (Viereck et al. 1992) with scrub birch , marsh Labrador tea, Bigelow's sedge and Sphagnum moss the dominant vegetation. Stunted white spruce occasionally occur but have limited cover. Other common species include dwarf birch, tealeaf willow, bog blueberry, crowberry, lingonberry, tussock cottongrass, curled snow lichen, Schreber's big red stem moss, and splendid feathermoss. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- resin birch (*Betula glandulosa*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- dwarf birch (*Betula nana*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- tussock cottongrass (*Eriophorum vaginatum*), grass
- sphagnum (*Sphagnum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous

Community 2.2
marsh Labrador tea - crowberry / curled snow lichen - reindeer lichen

Community 2.2 is characterized as ericaceous dwarf scrub (Viereck et al. 1992) with the dominant vegetation being curled snow lichen and various reindeer lichen. Stunted white spruce occasionally occur but have limited cover. Other common species include crowberry, marsh Labrador tea, scrub birch, bog blueberry, lingonberry, and Bigelow's sedge. The vegetative strata that characterize this community are dwarf shrubs (less than 8 inches) and foliose and fruticose lichen. The soil surface is primarily covered with lichen but can at times have significant amounts of surface rock fragments and bare soil (up to 20 percent of the plot).

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- resin birch (*Betula glandulosa*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- (*Flavocetraria cucullata*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- reindeer lichen (*Cladina mitis*), other herbaceous
- reindeer lichen (*Cladina stygia*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous

Community 2.3
scrub birch / Bigelow's sedge / juniper polytrichum moss

Community 2.3 is in the early stage of fire-induced secondary succession for this ecological site. Community 2.3 is characterized as open low scrub (Viereck et al. 1992) with scrub birch and Bigelow's sedge the dominant vegetation. Other common species include tealeaf willow, dwarf birch, lingonberry, marsh Labrador tea, crowberry, wideleaf polargrass, curled snow lichen, and juniper polytrichum moss. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), and medium graminoids (between 4 and 24 inches). The soil surface is primarily covered with herbaceous litter.

Dominant plant species

- resin birch (*Betula glandulosa*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- dwarf birch (*Betula nana*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- wideleaf polargrass (*Arctagrostis latifolia*), grass
- snow lichen (*Stereocaulon*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous

Pathway 2.1a
Community 2.1 to 2.2

Cryoturbation leads to formation of non-sorted circles. The circles are raised mounds that have comparatively drier soils than the surrounding vegetation.

Pathway 2.1b
Community 2.1 to 2.3

Fire.

Pathway 2.3a
Community 2.3 to 2.1

Time without fire.

Transition T1A
State 1 to 2

Cryoturbation results in the formation of non-sorted circles. These patterned ground features are pronounced enough to have a distinct a mosaic of vegetation.

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.

References

Bernhardt, E.L., T.N. Hollingsworth, and . 2011. Fire severity mediates climate-driven shifts in understorey community composition of black spruce stands of interior Alaska. Journal of Vegetation Science 22:32–44.

Chapin, F.S., L.A. Viereck, P.C. Adams, K.V. Cleve, C.L. Fastie, R.A. Ott, D. Mann, and J.F. Johnstone. 2006. Successional processes in the Alaskan boreal forest. Page 100 in Alaska’s changing boreal forest. Oxford University Press.

Hinzman, L.D., L.A. Viereck, P.C. Adams, V.E. Romanovsky, and K. Yoshikawa. 2006. Climate and permafrost dynamics of the Alaskan boreal forest. Alaska's changing boreal forest 39–61.

Johnstone, J.F., T.N. Hollingsworth, F.S. CHAPIN III, and M.C. Mack. 2010. Changes in fire regime break the legacy lock on successional trajectories in Alaskan boreal forest. Global change biology 16:1281–1295.

Johnstone, J.F., F.S. Chapin, T.N. Hollingsworth, M.C. Mack, V. Romanovsky, and M. Turetsky. 2010. Fire, climate change, and forest resilience in interior Alaska. Canadian Journal of Forest Research 40:1302–1312.

Johnstone, J.F. 2008. A key for predicting postfire successional trajectories in black spruce stands of interior Alaska. US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Jorgensen, T. and D. Meidinger. 2015. The Alaska Yukon Region of the Circumboreal Vegetation map (CBVM). CAFF Strategies Series Report. Conservation of Arctic Flora and Fauna, Akureyri, Iceland..

Landfire. 2009. Biophysical Setting. LANDFIRE National Vegetation Dynamics Models. USDA Forest Service and US Department of Interior, Washington, DC..

Schoeneberger, P.J. and D.A. Wysocki. 2012. Geomorphic Description System. Natural Resources Conservation Service, 4.2 edition. National Soil Survey Center, Lincoln, NE.

Smith, R.D., A.P. Ammann, C.C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices.

United States Department of Agriculture Staff. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service.

United States Department of Agriculture, . 2022. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.

Other references

PRISM Climate Group. 2018. Alaska – average monthly and annual precipitation and minimum, maximum, and mean temperature for the period 1981-2010. Oregon State University, Corvallis, Oregon. https://prism.oregonstate.edu/projects/alaska.php. (Accessed 4 September 2019).

Scenarios network for Alaska and arctic planning (SNAP). Historical Monthly Temperature – 1km, 1901-2009. http://ckan.snap.uaf.edu/dataset/. (Accessed 5 May 2021).

SNAP. Historical monthly and derived precipitation products downscaled from CRU TS data via the delta methods – 2km, 1901-2009. http://ckan.snap.uaf.edu/dataset/. (Accessed 5 May 2021).

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	04/13/2026
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:**
