Ecological site F231XY182AK
Boreal Forest Gravelly Slopes

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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 dry and gravelly soils that do not have permafrost. The most common hillslope positions are summits, shoulders, backslopes, and footslopes of hills and low-elevation mountains that are south to west facing. These well drained soils do not pond or flood and do not have a water table in the soil profile. Soils formed in a thin layer of windblown silts over gravelly residuum and/or colluvium. While these soils support stands of white spruce, soils with greater amounts of windblown silt are much more productive. On rare occasion, soils with residuum contact bedrock at shallow to moderate depths.

Multiple plant communities occur within the reference state and the vegetation in each community differs in large part due to fire. When the reference state vegetation burns, the post-fire plant community is dominantly grasses, forbs, and weedy mosses. Field data indicate most of the soil organic matter is consumed during these fire events which could increase site erosion. 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 typically characterized as open needleleaf forest (Viereck et al. 1992) with 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 Siberian alder, prickly rose, beauverd spirea, lingonberry, twinflower, bluejoint, false toadflax, tall bluebells, bunchberry dogwood, various reindeer lichen, splendid feathermoss, and Schreber's big red stem moss. White spruce 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. The understory vegetative strata that characterize this community are dwarf shrubs (less than 8 inches) and mosses.

Associated sites

F231XY111AK	**Boreal Forest Loamy Frozen Slopes** Occurs on the same hills and low-elevation mountains but on cold and frozen slopes with stands of black spruce.
F231XY118AK	**Boreal Woodland Organic Frozen Slopes** Occurs downslope on cold and frozen footslopes and toeslopes with stands of black spruce.
F231XY160AK	**Boreal Forest Loamy Frozen Slopes** Occurs on the same hills and low-elevation mountains but on cold and frozen slopes with stands of black spruce.
R231XY164AK	**Subalpine Scrub Gravelly Slopes Dry** Occurs upslope of site 182 in the subalpine life zone with shrubby communities.
F231XY180AK	**Boreal Woodland Gravelly Slopes Dry** Occurs on the same hill and mountain slopes but has a thinner cap of windblown silts. Soils support stands of white spruce.
F231XY110AK	**Boreal Forest Gravelly Slopes Steep** Occurs on the same hill slopes but on steeper slopes. Soils support stands of white spruce.
F231XY186AK	**Boreal Forest Silty Slopes** Occurs on the same hill and mountain slopes but has a thicker cap of windblown silts. Soils support stands of white spruce.
F231XY187AK	**Boreal Forest Silty Slopes Moist** Occurs downslope on warm footslopes and toeslopes prone to thermokarst. Soils support stands of white spruce.
F231XY188AK	**Boreal Forest Silty Slopes Bedrock** Occurs on the same hill and mountain slopes but has a thicker cap of windblown silts. Soils support stands of white spruce.

F231XY190AK	**Boreal Forest Silty Slopes Cold** Occurs on the same hills and low-elevation mountains but on colder slopes with moist soils that support stands of black spruce.

Similar sites

F231XY110AK	**Boreal Forest Gravelly Slopes Steep** Both sites occur on the same warm boreal slopes. The steeper slopes associated with site 110 have comparatively warmer soils that result in more productive white spruce stands.
F231XY180AK	**Boreal Woodland Gravelly Slopes Dry** Both sites occur on the same warm boreal slopes. Due to the thinner layer of windblown silt, site 180 has less productive white spruce stands.
F231XY186AK	**Boreal Forest Silty Slopes** Both sites occur on the same warm boreal slopes. Due to the thicker layer of windblown silt, site 186 has more productive white spruce stands.
F231XY188AK	**Boreal Forest Silty Slopes Bedrock** Both sites occur on the same warm boreal slopes. Due to the thicker layer of windblown silt, site 188 has more productive white spruce stands.

Table 1. Dominant plant species

Tree	(1) *Picea glauca*
Shrub	(1) *Rosa acicularis* (2) *Vaccinium vitis-idaea*
Herbaceous	(1) *Hylocomium splendens* (2) *Pleurozium schreberi*

Physiographic features

This boreal site occurs on warm slopes of hills and mountains. While backslopes are the most common hillslope position, this site at times occurs on summits, shoulders, and footslopes. This site is associated with the boreal life zone which typically occurs below 2500 feet in this area. At times, elevation can range up to 3000 feet or more on warmer mountain slopes. Slopes commonly range from 12 percent on summits to 40 percent or more on backslopes, which are warm slopes that are southeast to west facing. This site does not flood or pond. A water table is often not present but at times can occur at very deep depths. This site generates limited to medium amounts of runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope (4) Footslope
Landforms	(1) Hill (2) Mountain
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	99–762 m
Slope	12–40%
Water table depth	152 cm
Aspect	W, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	99–1,006 m
Slope	2–50%
Water table depth	102 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

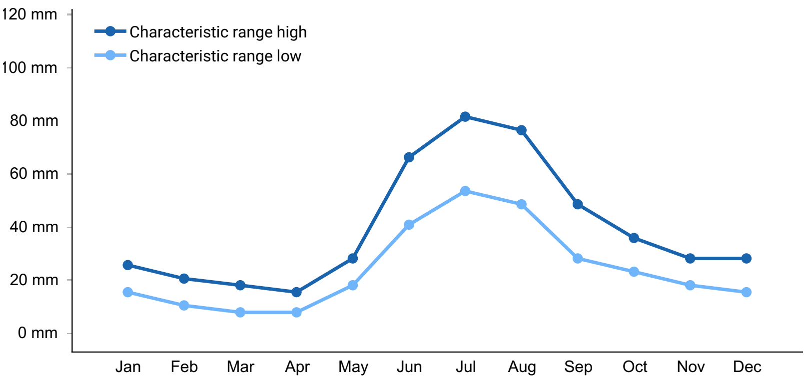


Figure 1. Monthly precipitation range

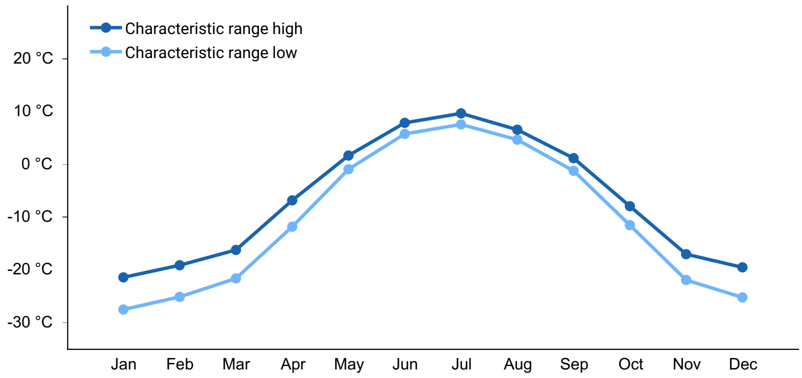


Figure 2. Monthly minimum temperature range

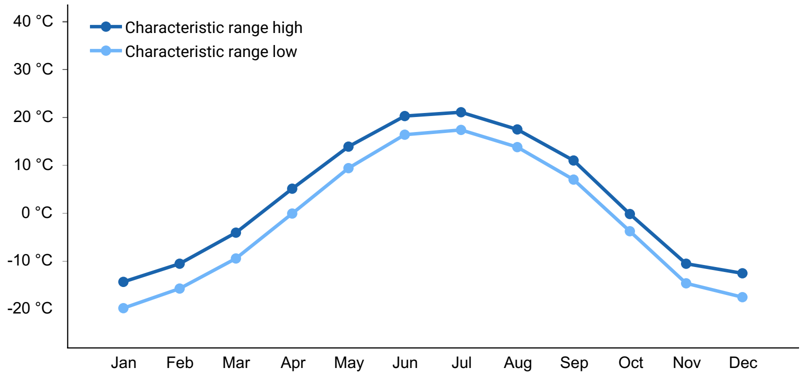


Figure 3. Monthly maximum temperature range

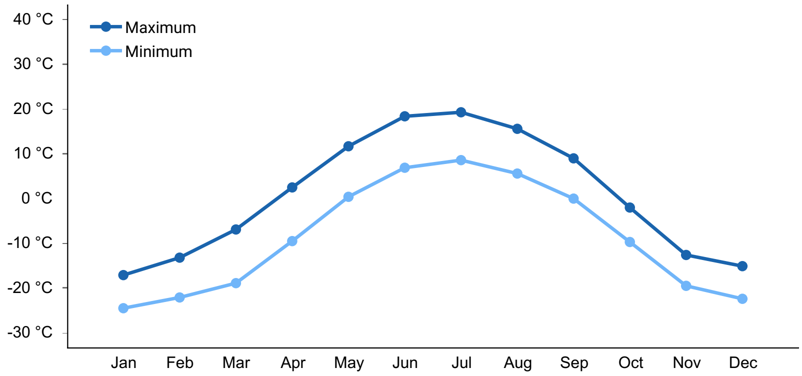


Figure 4. Monthly average minimum and maximum temperature

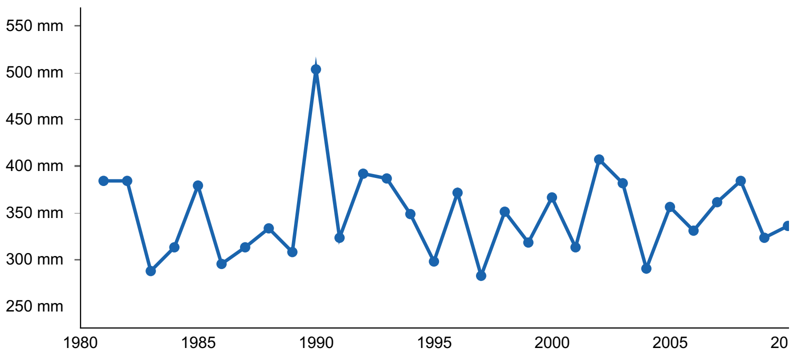


Figure 5. Annual precipitation pattern

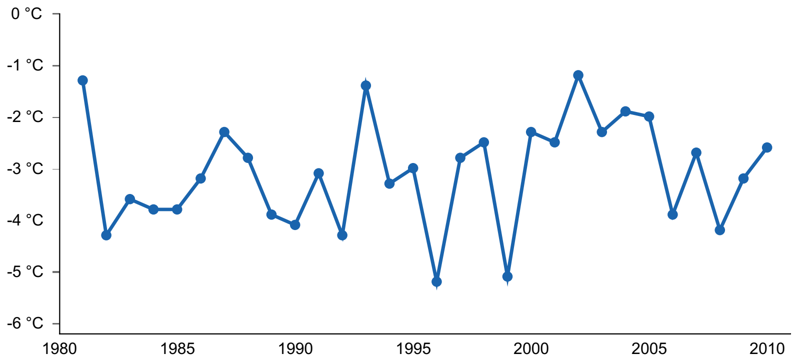


Figure 6. Annual average temperature pattern

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

Due to its landscape position, this site is neither associated with or influenced by streams or wetlands. Precipitation and throughflow are the main source of water for this ecological site. Surface runoff and throughflow contribute some water to downslope ecological sites.

Wetland description

n/a

Soil features

Soils formed in windblown silts over gravelly parent material and do not have permafrost. Rock fragments on the soil surface are variable commonly ranging from zero to 25 percent cover. These are mineral soils capped with up to 3 inches of organic material. The mineral soil below the organic material is a silt loam formed from wind-blown loess, which lacks rock fragments and has high water holding capacity. This silty layer is thin and ranges in thickness from 2 to 10 inches. Below the silty parent material is gravelly colluvium or residuum with rock fragments ranging between 25 and 75 percent of the soil profile by volume. Soils are typically very deep. On occasion, soils with residuum contact bedrock at shallow to moderate depths (13 to 24 inches). The pH of the soil profile ranges from very strongly acidic to moderately acidic. The soils are dry for the growing season and are considered well drained.

Figure 7. A typical soil profile associated with this site.

Table 5. Representative soil features

Parent material	(1) Loess (2) Eolian deposits (3) Colluvium (4) Residuum
Surface texture	(1) Silt loam (2) Gravelly silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	Not specified
Soil depth	152 cm
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	6.86–13.46 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	0–8%
Electrical conductivity (25.4-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0
Soil reaction (1:1 water) (25.4-101.6cm)	4.5–6.5
Subsurface fragment volume <=3" (0-152.4cm)	20–45%
Subsurface fragment volume >3" (0-152.4cm)	5–25%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified

Depth to restrictive layer	33 cm
Soil depth	33 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	3.56–13.97 cm
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	0–15%
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)	3.5–7.7
Subsurface fragment volume <=3" (0-152.4cm)	11–51%
Subsurface fragment volume >3" (0-152.4cm)	2–32%

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 white spruce forests, data suggest that 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). Over this period of 20 years, these burn perimeters cover approximately 30% of the Interior Alaska Uplands area.

The fire regime within Interior Alaska follows two general scenarios—low-severity burns and high-severity burns. It should be noted, however, that the fire regime in Interior Alaska is generally thought to be much more complex (Johnstone et al. 2008). Burn severity refers to the proportion of the vegetative canopy and organic material consumed in a fire event (Chapin et al. 2006). Fires in cool and moist habitat tend to result in low-severity burns, while fires in warm and dry habitat tend to result in high-severity burns. Because the soils have a thin organic cap and are 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. High-severity fire events also destroy a majority of the vascular and nonvascular biomass above ground.

Field data suggest that each of the forested communities burn and that fire events will cause a transition to the pioneering stage of fire succession. This stage (community 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 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 1.3), a mix of broadleaf and needleleaf trees (community 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 white 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).

Lands associated with this site may be burning more frequently than in the past, which may result in alternative pathways of succession. The historic fire return interval for white spruce stands in Interior Alaska occurs approximately once every 150 years (Landfire 2009; Abrahamson 2014). 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 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 pathways of post-fire succession with stands of deciduous trees persisting for longer than normal durations of time (Johnstone et al. 2010b).

Field Observations

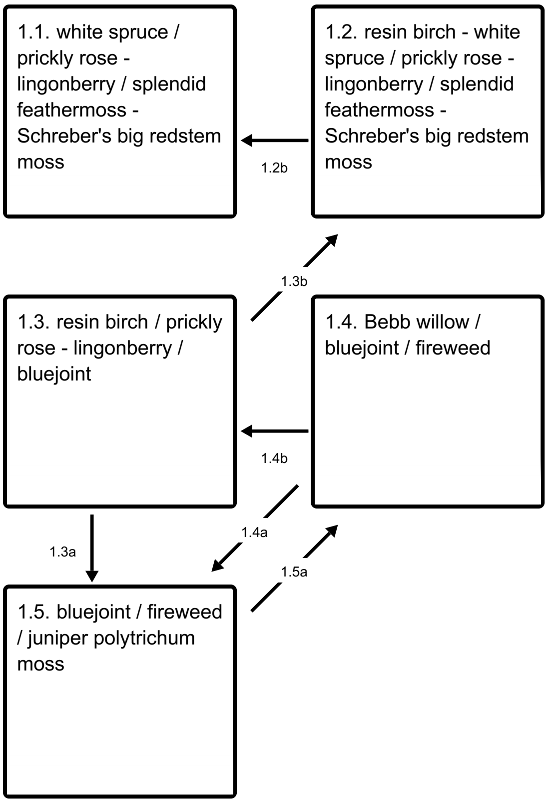
Field data indicate the high severity fires associated with this site impacts soil organic matter thickness. From 2011 to 2016, four field observations were collected in areas that burned 7 to 12 years before sampling occurred (AICC 2022) and resemble the earliest stages of fire-related succession for this ecological site (communities 1.4 and 1.5). When comparing soils between the more recently burned plots and plots not recently burned, there were noticeable differences in soil mean organic matter thickness (1 inch [burned] vs. 5 inches [not burned]). All the organic mat was consumed in one of the four sample plots. From these data and for this site, it appears that high-severity fire events cause impactful alterations to the soil organic matter thickness that could increase soil erosion. For this 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 mat thickness and other important dynamic soil properties.

State and transition model

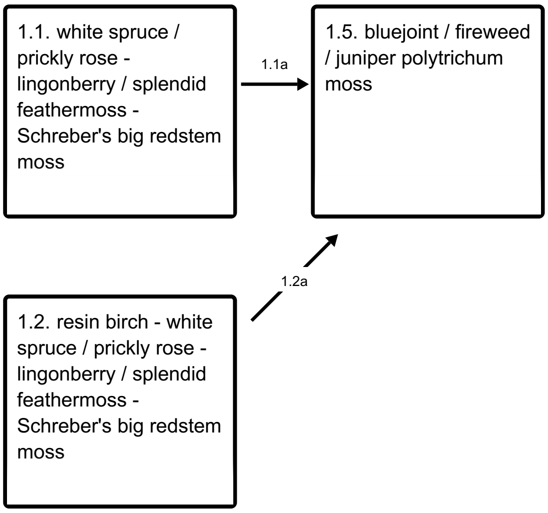
Ecosystem states

1. Reference State

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 1
Reference State

Figure 8. A white spruce forest associated with this site.

The reference plant community is open needleleaf forest (Viereck et al. 1992) with the dominant tree being white spruce. There are five plant communities within the reference state related to fire.

Dominant plant species

- white spruce (*Picea glauca*), tree

- prickly rose (*Rosa acicularis*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous

Community 1.1
white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

Figure 9. A typical plant community associated with community 1.1.

The reference plant community is characterized as open needleleaf forest (Viereck et al. 1992) with white spruce as the dominant tree. White spruce 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. The soil surface is primarily covered with herbaceous litter and moss. Common understory species include Siberian alder, prickly rose, beauverd spirea, lingonberry, twinflower, bluejoint, false toadflax, tall bluebells, bunchberry dogwood, various reindeer lichen, splendid feathermoss, and Schreber's big red stem moss. The understory vegetative strata that characterize this community are dwarf shrubs (less than 8 inches) and mosses.

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Basal area values reported for white spruce below are actually for all tree species in the plot.

Dominant plant species

- white spruce (*Picea glauca*), tree
- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- lingonberry (*Vaccinium vitis-idaea*), shrub
- prickly rose (*Rosa acicularis*), shrub
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- twinflower (*Linnaea borealis*), shrub
- beauverd spirea (*Spiraea stevenii*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous

Community 1.2
resin birch - white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

Figure 10. A typical plant community associated with community 1.2.

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 as the dominant trees. Tree cover is split between the tall tree (greater than 40 feet) and medium tree strata (between 15 and 40 feet). The soil surface is primarily covered with herbaceous litter and moss. Common understory species include Siberian alder, prickly rose, lingonberry, bog Labrador tea, twinflower, false toadflax, tall bluebells, splendid feathermoss, and Schreber's big redstem moss. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), and mosses.

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Basal area values reported for white spruce below are actually for all tree species in the plot.

Dominant plant species

- white spruce (*Picea glauca*), tree
- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- twinflower (*Linnaea borealis*), shrub
- prickly rose (*Rosa acicularis*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- beauverd spirea (*Spiraea stevenii*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- tall bluebells (*Mertensia paniculata*), other herbaceous
- horsetail (*Equisetum*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- stiff clubmoss (*Lycopodium annotinum*), other herbaceous

Community 1.3
resin birch / prickly rose - lingonberry / bluejoint

Figure 11. A typical plant community associated with community 1.3.

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 resin birch the dominant tree. Seedlings and saplings of white spruce are common but have comparatively limited cover. Tree cover is split between the tall tree (greater than 40 feet) and medium tree strata (between 15 and 40 feet). The soil surface is primarily covered with herbaceous litter. Common understory species include Siberian alder, prickly rose, lingonberry, bog Labrador tea, twinflower, bluejoint, and splendid feathermoss. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches) and medium graminoids (between 4 and 24 inches).

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Basal area values reported for white spruce below are actually for all tree species in the plot.

Dominant plant species

- resin birch (*Betula neoalaskana*), tree
- white spruce (*Picea glauca*), tree
- quaking aspen (*Populus tremuloides*), tree
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- twinflower (*Linnaea borealis*), shrub
- prickly rose (*Rosa acicularis*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Community 1.4
Bebb willow / bluejoint / fireweed

Figure 12. A typical plant community associated with community 1.4.

Community 1.4 is in the early stage of fire-induced secondary succession for this ecological site. It is best characterized as open tall scrub (Viereck et al. 1992) with saplings of resin birch and Bebb willow the dominant overstory vegetation. Other common species include bluejoint, fireweed, juniper polytrichum moss, and ceratodon moss. The soil surface is primarily covered with woody litter, herbaceous litter, and mosses. The vegetative strata that characterize this community are medium shrubs (between 3 and 10 feet), tall graminoids (greater than 2 feet), and mosses.

Dominant plant species

- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- Bebb willow (*Salix bebbiana*), shrub
- Siberian alder (*Alnus viridis ssp. fruticosa*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass
- wideleaf polargrass (*Arctagrostis latifolia*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- ceratodon moss (*Ceratodon purpureus*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous

Community 1.5
bluejoint / fireweed / juniper polytrichum moss

Figure 13. A typical plant community associated with community 1.5.

Community 1.5 is in the pioneering stage of fire-induced secondary succession for this ecological site. It is characterized as a mesic forb or mesic graminoid herbaceous community (Viereck et al. 1992). Tree seedlings, primarily resin birch and white spruce, are common throughout the community but have limited cover. Commonly observed species include Bebb willow, bluejoint, fireweed, Alaska wild rhubarb, juniper polytrichum moss, and ceratodon moss. Although areas of exposed bare soil are common (up to 40% of the plot), the soil surface is primarily covered with a mixture of weedy bryophyte species, woody debris, and herbaceous litter.

Dominant plant species

- Bebb willow (*Salix bebbiana*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- Altai fescue (*Festuca altaica*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- ceratodon moss (*Ceratodon purpureus*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- Alaska wild rhubarb (*Polygonum alpinum*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.5

white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

bluejoint / fireweed / juniper polytrichum moss

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

resin birch - white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

Time without fire. White spruce replace resin birch in the tree canopy and the community turns into a needleleaf forest community.

Pathway 1.2a
Community 1.2 to 1.5

resin birch - white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

bluejoint / fireweed / juniper polytrichum moss

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

resin birch / prickly rose - lingonberry / bluejoint

resin birch - white spruce / prickly rose - lingonberry / splendid feathermoss - Schreber's big redstem moss

Time without fire. White spruce cover increases and the community turns into a mixed forest community.

Pathway 1.3a
Community 1.3 to 1.5

resin birch / prickly rose - lingonberry / bluejoint

bluejoint / fireweed / juniper polytrichum moss

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

Bebb willow / bluejoint / fireweed

resin birch / prickly rose - lingonberry / bluejoint

Time without fire. Resin birch mature are turn into a deciduous forest community.

Pathway 1.4a
Community 1.4 to 1.5

Bebb willow / bluejoint / fireweed

bluejoint / fireweed / juniper polytrichum moss

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

bluejoint / fireweed / juniper polytrichum moss

Bebb willow / bluejoint / fireweed

Time without fire. Deciduous tree and willow cover increases.

Additional community tables

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white spruce	PIGL	*Picea glauca*	Native	12.2–22.9	45–90	13.7–33.5	–
resin birch	BENE4	*Betula neoalaskana*	Native	–	0–20	–	–
quaking aspen	POTR5	*Populus tremuloides*	Native	–	0–3	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bluejoint	CACA4	*Calamagrostis canadensis*	Native	0.6–1.2	0–30
Forb/Herb					
false toadflax	GELI2	*Geocaulon lividum*	Native	0.1–0.6	0–20
tall bluebells	MEPA	*Mertensia paniculata*	Native	0.1–0.6	0–15
bunchberry dogwood	COCA13	*Cornus canadensis*	Native	0–0.1	0–15
stiff clubmoss	LYAN2	*Lycopodium annotinum*	Native	0–0.1	0–10
arctic lupine	LUAR2	*Lupinus arcticus*	Native	0.1–0.6	0–3
fireweed	CHAN9	*Chamerion angustifolium*	Native	0.6–1.2	0–2
northern bedstraw	GABO2	*Galium boreale*	Native	0.1–0.6	0–2
sidebells wintergreen	ORSE	*Orthilia secunda*	Native	0–0.1	0–2
Shrub/Subshrub					
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0–0.1	0–45
black crowberry	EMNI	*Empetrum nigrum*	Native	0–0.1	0–40
prickly rose	ROAC	*Rosa acicularis*	Native	0.9–1.2	0–28
Siberian alder	ALVIF	*Alnus viridis ssp. fruticosa*	Native	1.5–3	0–25
beauverd spirea	SPST3	*Spiraea stevenii*	Native	0.2–0.9	0–15
russet buffaloberry	SHCA	*Shepherdia canadensis*	Native	0.2–0.9	0–10
squashberry	VIED	*Viburnum edule*	Native	0.9–1.5	0–5
twinflower	LIBO3	*Linnaea borealis*	Native	0–0.1	0–5
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–85
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–55
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0–0.1	0–10
felt lichen	PEAP60	*Peltigera aphthosa*	Native	0–0.1	0–5
cup lichen	CLADO3	*Cladonia*	Native	0–0.1	0–5
felt lichen	PELTI2	*Peltigera*	Native	0–0.1	0–5

Table 9. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white spruce	PIGL	*Picea glauca*	Native	5.8–19.5	18–52	3.8–38.9	–
resin birch	BENE4	*Betula neoalaskana*	Native	9.8–17.4	6–50	10.2–47	–
quaking aspen	POTR5	*Populus tremuloides*	Native	–	0–40	–	–

Table 10. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
resin birch	BENE4	*Betula neoalaskana*	Native	6.1–13.1	65–75	5.6–11.7	–
white spruce	PIGL	*Picea glauca*	Native	9.8–18.3	4–15	6.9–23.6	–
black spruce	PIMA	*Picea mariana*	Native	–	0–2	–	–

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

Tier 2 sampling plots used to develop the reference state. Plot numbers as recorded in NASIS with associated community phase.

Community 1.1

08CS00605, 09NP00301, 09NP00305, 09NP03205, 10TC03206, 13NR00302, 2016AK290603, 2016AK290639, 2016AK290387

Community 1.2

08CS00101, 08CS00202, 08CS00606, 08CS00901, 10NP04103, 11MC01803, 2015AK290561, 2015AK290806, 2016AK290422

Community 1.3

08CS00602, 10NP03105, 14JP03204

Community 1.4

2015AK290544, 2016AK290377

Community 1.5

11MC00103, 13BA00502

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Approval

Kirt Walstad, 2/13/2024

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	07/17/2024
Approved by	Kirt Walstad
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):

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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:**
