USDA Natural Resources
Conservation Service

Ecological site R223XY710AK
Alpine dwarf scrub gravelly slopes

Last updated: 6/12/2025
Accessed: 12/05/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 223X–Cook Inlet Mountains

Physiography
The Cook Inlet Mountains (Major Land Resource Area (MLRA) 223) are part of the Pacific Mountain physiographic system and occur in Southcentral Alaska. Comprising 19,550 square miles, this alpine MLRA includes mountains of the Chugach, Kenai, Talkeetna, Aleutian, and Alaska Ranges that drain into the Cook Inlet via the Cook Inlet Lowlands (MLRA 224). These rugged mountains are primarily undeveloped and sparsely populated. This MLRA concept is defined by the true alpine zone, while the Cook Inlet Lowlands (MLRA 224) are characterized by lower elevation hills and plains of the subalpine and boreal life zones. Large glaciers and icefields make up 15 percent of the Cook Inlet Mountains, and some glaciers extend down into the Cook Inlet Lowlands to elevations of 1,000 feet. The alpine zone in this MLRA ranges in elevation from roughly 2,500 feet near the boundary MLRA 224 to 20,320 feet at the summit of Denali, the tallest mountain in North America. All rivers in this MLRA drain into Cook Inlet including the Matanuska, Susitna and Little Susitna, Knik, Kenai, and Chakachatna Rivers.

Geology
The entire Cook Inlet Mountains area, except for the highest peaks and upper ridges, was glaciated during the Pleistocene. Throughout the Holocene, most of the Pleistocene glacial deposits have eroded or were buried in colluvium and slope alluvium, of which now comprise 65 percent of the current landscape. Mid-to-lower mountain slopes and valleys consist of modified moraine and outwash deposits overlain by varying thickness of eolian loess and volcanic ash. Lower valley bottoms are covered in contemporary fluvial deposits. Underlying bedrock consists of Late Paleozoic and Early Mesozoic sedimentary and Tertiary intrusive rock.

Soils
The dominant soil orders in MLRA 223 are Entisols, Inceptisols, and Spodosols. Soils have a cryic temperature regime or a subgelic soil temperature class, udic or aquic moisture regime, and amorphic or mixed minerology. Miscellaneous areas such as rock outcrop, rubble land, and glaciers, and others make up 70 percent of this MLRA.

Climate
The climate of this area is characterized by short summers, cloudy conditions, and moderate to cold temperatures. The average annual precipitation ranges from 15 to 30 inches at lower elevations to more than 100 inches in the high mountains, with most rain occurring in the late summer and fall. This area sees high levels of snowfall, ranging from 80 to 400 inches or more. Average annual temperatures in this alpine MLRA are near freezing, with freeze-free periods averaging 60 to 80 days, while at higher elevations, freezing temperatures can occur throughout any time of year.

Vegetation
The Cook Inlet Mountains are defined by an alpine life zone and therefore plant communities in this area are void of tree and tall shrub species that are common in subalpine and boreal zones. Alpine vegetation primarily consists of dwarf scrub, lichen and herbaceous communities. Low willow-graminoid communities are common in drainages, depression, and stream terraces. On shallow soils on mountain slopes and rocky ridges lichen and ericaceous scrub mosaics are accompanied by scattered forbs are alpine grasses. At elevations above 7,500 feet, little to no plant growth takes place.

Classification relationships

Alaska Vegetation Classification
Dwarf scrub Dryas-lichen tundra (II.D.1.c – level IV)
(Viereck et al., 1992)

Circumboreal Vegetation Map – Alaska-Yukon Region:
Southern Alaska - Yukon Alpine Dwarf Scrub and Meadows
(Jorgensen and Meidinger, 2015)

LANDFIRE Biophysical Settings:
7516351 – Western North American Boreal Alpine Ericaceous Dwarf-Shrubland – Complex
(LANDFIRE biophysical settings, 2009)

Ecological site concept

• Alpine dwarf scrub community on mountain slopes without permafrost
• Well-drained soils formed in volcanic ash and silty loess over gravelly colluvium and glacial till

• Elevation generally ranges between 1,370 and 3,720 feet
• Vegetation community influenced by harsh conditions, short growing season, and persistent snowpack
• A single community identified in reference state. Reference community is characterized as a dwarf scrub Dryas-lichen tundra community

Associated sites

R223XY702AK	**Alpine dwarf scrub earth hummocks** Ecological site R223XY702AK occurs on mountain slopes adjacent to this ecological site but occurs on hummocks and supports a different plant community.

Similar sites

R223XY702AK	**Alpine dwarf scrub earth hummocks** Ecological site R223XY702AK occurs on mountain slopes adjacent to this ecological site but occurs on hummocks and supports a different plant community.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Dryas octopetala ssp. octopetala* (2) *Vaccinium uliginosum*
Herbaceous	(1) *Cladina mitis* (2) *Cladina stellaris*

Physiographic features

This ecological site occurs at high elevation on mountain slopes in the alpine zone. This site is associated with mountain backslopes, summits, and shoulders. Elevations range from 1,370 to 3,720 feet or higher. Slopes generally range from 15 to 60 percent, and this ecological site occurs on all aspects. Flooding and ponding do not occur, and a water table is absent throughout the growing season.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	418–1,134 m

Slope	15–60%
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 frequency	Not specified
Elevation	418–2,167 m
Slope	0–85%

Climatic features

The climate associated with this high-elevation, alpine ecological site is characterized by a short growing season, cloudy conditions, and cold temperatures. Mean annual precipitation ranges from 15 to 32 inches at lower elevations to 100 inches or more at higher elevations. Snowfall ranges from 80 to 400 inches or more, increasing with elevation. Frost free period averages between 23 and 85 days at lower elevations, but at higher elevations, temperatures below freezing can occur any month of the year. Precipitation is greatest between August and October and least in March and April.

Table 4. Representative climatic features

Frost-free period (characteristic range)	23-85 days
Freeze-free period (characteristic range)	69-119 days
Precipitation total (characteristic range)	381-813 mm
Frost-free period (actual range)	15-108 days
Freeze-free period (actual range)	65-138 days
Precipitation total (actual range)	356-1,245 mm
Frost-free period (average)	56 days
Freeze-free period (average)	96 days
Precipitation total (average)	635 mm

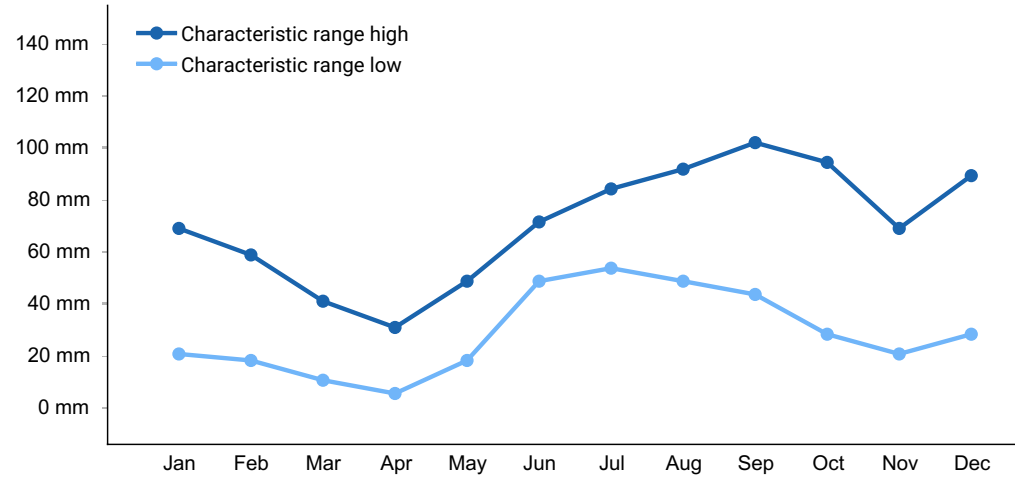

Figure 1. Monthly precipitation range

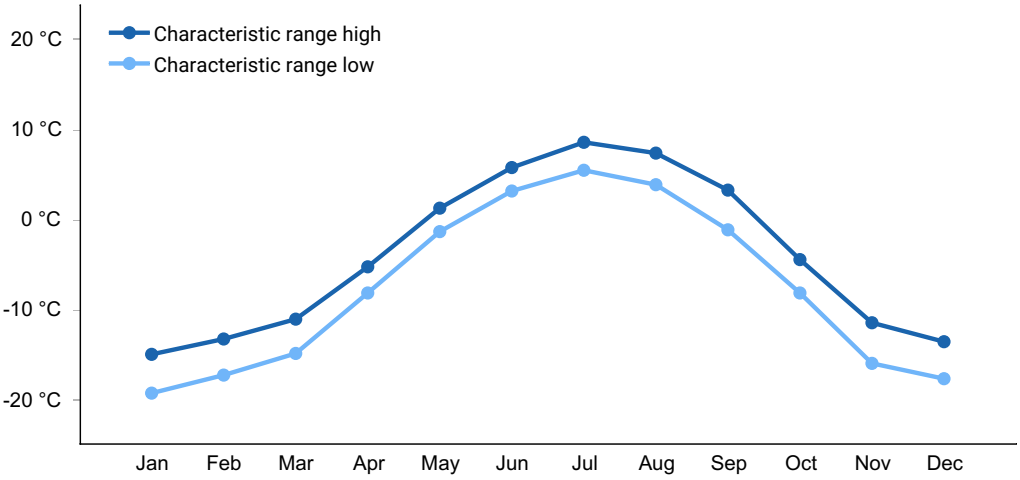

Figure 2. Monthly minimum temperature range

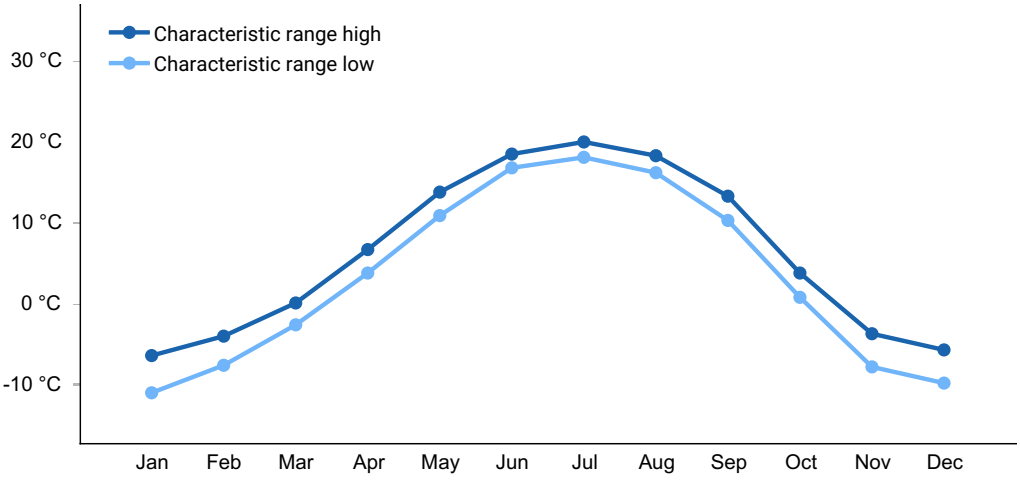

Figure 3. Monthly maximum temperature range

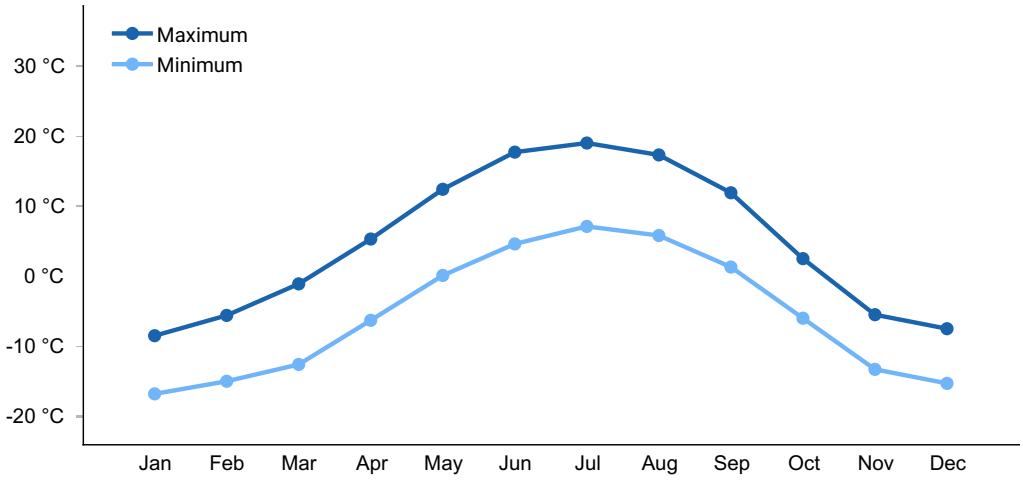

Figure 4. Monthly average minimum and maximum temperature

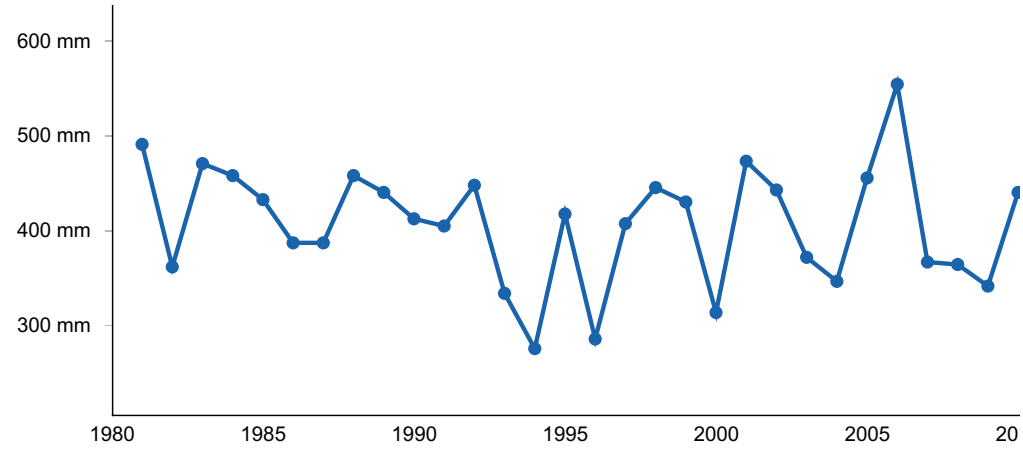

Figure 5. Annual precipitation pattern

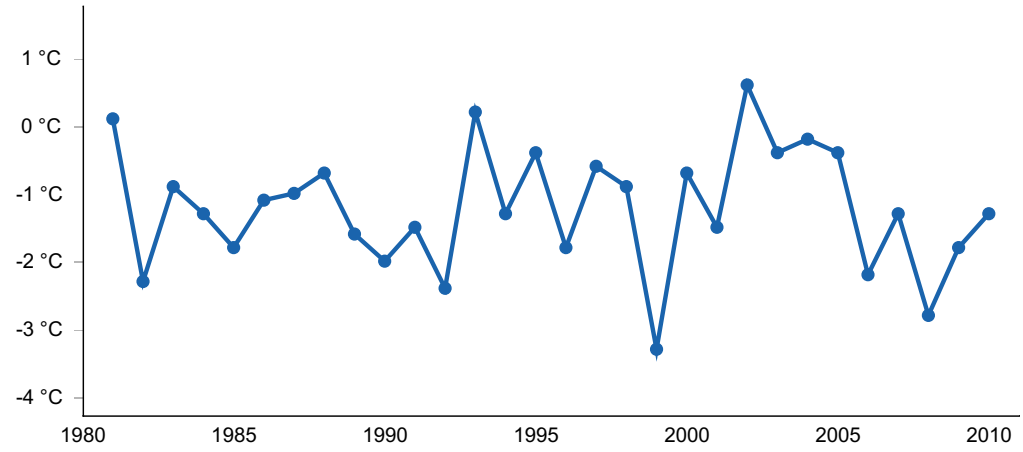

Figure 6. Annual average temperature pattern

Climate stations used

- (1) PUNTILLA [USC00507783], Matanuska-Sustina Bor, AK
- (2) TAHNETA PASS [USC00508945], Palmer, AK
- (3) SHEEP MTN LODGE [USC00508409], Palmer, AK
- (4) BIG RIVER LAKES [USC00500788], W Kenai Peninsula Boroug, AK

Influencing water features

Due to topographic position, this ecological site is not associated with streams or wetlands. Precipitation and throughflow are the main sources of water for this site.

Soil features

Soils formed in volcanic ash or windblown silt over gravelly parent material and do not have permafrost. Surface fragments are not common, and surface textures are silt loams. With few exceptions, organic caps are generally lacking in these soils. The mineral soil material is considered loamy-skeletal and formed in volcanic ash or loess overlying gravelly colluvium or glacial till. In instances when a restrictive layer occurs, it takes the form of a strongly contrasting textural stratification or paralithic contact with underlying bedrock material. These soils range in depth from shallow to very deep, depending on topographic position, and pH ranges from strongly acidic to slightly acidic. Drainage class is rated as well drained.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Loess (3) Colluvium (4) Till
Surface texture	(1) Silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	5–152 cm
Soil depth	107–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-25.4cm)	2.03–9.91 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Clay content (0-50.8cm)	3–10%
Electrical conductivity (0-101.6cm)	0 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-25.4cm)	3.2–6.7
Subsurface fragment volume <=3" (0-152.4cm)	0–25%
Subsurface fragment volume >3" (0-152.4cm)	0–15%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-25.4cm)	1.52–9.91 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Clay content (0-50.8cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-25.4cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	0–36%
Subsurface fragment volume >3" (0-152.4cm)	0–33%

Ecological dynamics

Located in the alpine life zone, this ecological site is exposed to a variety of harsh environmental conditions. In this 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 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.

Although fire plays an important role in shaping vegetation communities throughout Alaska, fire frequency in alpine communities is largely unstudied, when compared to interior forest stands. This is likely due to the diminished influence of fire above tree line. Most wildfires in Alaska are caused by lightning strikes which tend to occur near tree line, decreasing in frequency into the subalpine and alpine zones (Dewilde et al. 2006). Despite the propensity of fires to move from boreal stands upslope into higher life zones, it is likely a general lack of fuel in alpine scrub communities that accounts for diminished fire frequency (Kasischke et al. 2002, Dewilde et al. 2006). Due to low fire frequency, the disturbance regime in this alpine community is likely driven by avalanche, rockslides, and other mass movement events associated with eroding and unstable mountain slopes.

Field data suggests there is a single dominant plant community on this ecological site, without known transitional pathways to other plant communities or alternative states. Community 1.1 is characterized by a dwarf scrub Dryas-lichen tundra community (Viereck et al., 1992). Notable species include bog blueberry (*Vaccinium uliginosum*), eightpetal mountain avens (*Dryas octopetala*), willow (Salix spp.) species, and other ericaceous shrubs. Lichen species are also common in this alpine scrub community and could amount to 25 percent cover.

On mountain slopes more proximal to Cook Inlet, a plant community closer resembling a maritime alpine herbaceous dwarf shrubland (LANDFIRE, 2009) may occur. In this instance, changes in species assemblage and community composition are likely to result from a cool maritime summer climate that could lead to greater snowpack and more persistent snow beds throughout the growing season. In this scenario, it is likely that species such as partridgefoot (*Luetkea pectinata*), western moss heather (*Cassiope mertensiana*), Alaska bellheather (*Harrimanella stelleriana*), and Aleutian mountainheather (*Phyllodoce aleutica*) play a more important and potentially dominant role in this community.

State and transition model

Ecosystem states

1. Reference state

State 1 submodel, plant communities

1.1. Eightpetal mountain-avens - bog blueberry / reindeer lichen

State 1
Reference state

The reference state supports one community phase. The reference plant community is characterized by a dwarf scrub Dryas-lichen tundra community (Viereck et al., 1992) comprised of eightpetal mountain avens (*Dryas octopetala*), ericaceous shrubs, assorted herbaceous alpine species, and various foliose and fruticose lichens.

Dominant plant species

- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- netleaf willow (*Salix reticulata*), shrub
- smallawned sedge (*Carex microchaeta*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- woolly geranium (*Geranium erianthum*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous

Community 1.1
Eightpetal mountain-avens - bog blueberry / reindeer lichen

The reference community (1.1) is characterized as a dwarf scrub Dryas-lichen tundra community (Viereck et al., 1992). Common species include eightpetal mountain-avens (*Dryas octopetala*), bog blueberry (*Vaccinium uliginosum*), crowberry (*Empetrum nigrum*), netleaf willow (*Salix reticulata*), woolly geranium (*Geranium erianthum*), reindeer lichen (Cladina spp.), and star reindeer lichen (*Cladina stellaris*). In areas of closer proximity to Cook Inlet, maritime climate influences community composition and selects for higher cover in partridgefoot (*Luetkea pectinata*), western moss heather (*Cassiope mertensiana*), Alaska bellheather (*Harrimanella stelleriana*), and Aleutian mountainheath (*Phyllodoce aleutica*). This plant community is diverse and also includes various dwarf shrubs, forbs, mosses, and lichen species not listed above.

Dominant plant species

- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- black crowberry (*Empetrum nigrum*), shrub

- netleaf willow (*Salix reticulata*), shrub
- partridgefoot (*Luetkea pectinata*), shrub
- smallawned sedge (*Carex microchaeta*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- woolly geranium (*Geranium erianthum*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous

Additional community tables

Inventory data references

The vegetation modeled for this ecological site has limited data and is considered provisional. The associated model was largely developed from NRCS (Natural Resources Conservation Service) staff with working knowledge of the area and literature review.

Plant community composition is largely based on ecological sites from AK651: Soil Survey of Denali National Park Area, Alaska.

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be

known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	12/05/2025
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:

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17. **Perennial plant reproductive capability:**
