USDA Natural Resources
Conservation Service

Ecological site R223XY706AK
Alpine scrub wet depressions and drainageways

Last updated: 6/12/2025
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General information

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

MLRA notes

Major Land Resource Area (MLRA): 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
Willow-graminoid shrub bog (II.C.1.b – level IV)
(Viereck et al., 1992)

Landfire Biophysical Settings:
Western North American Boreal Mesic Scrub Birch-Willow Shrubland – Alaska Sub-boreal
(LANDFIRE biophysical settings, 2009)

Ecological site concept

• High elevation scrub community on drainageways and depressions
• Somewhat poorly to very poorly drained soils formed in silty volcanic ash and windblown silts over gravelly glacial material or alluvium
• Elevation generally ranges between 1,500 and 3,600 feet
• The vegetative community is influenced by a persistent shallow water table and other hydrologic effects associated with drainageways (run-off)
• A single plant community identified in reference state. Community 1.1 is characterized as a willow-graminoid shrub bog community

Associated sites

R223XY710AK	**Alpine dwarf scrub gravelly slopes** Ecological site R223XY710AK occurs on gravelly mountain slopes, supporting an alpine dwarf scrub community, and is proximal to R223XY706AK, which occurs in drainageways on these same mountain slopes.

Similar sites

R223XY710AK	**Alpine dwarf scrub gravelly slopes** Ecological site R223XY710AK occurs on mountain slopes and supports an alpine dwarf scrub community.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Salix barclayi* (2) *Salix pulchra*
Herbaceous	(1) *Sanguisorba canadensis* (2) *Calamagrostis canadensis*

Physiographic features

Ecological site R223XY706AK occurs in depressions and drainageways on mountain slopes in the alpine zone. Elevations range from 1,540 to 3,610 feet above sea level or higher. Slopes generally range from 1 to 16 percent, and this ecological site occurs on all aspects. Although flooding and ponding do not occur, a shallow water table persists within 0 to 18 inches of the soil surface throughout the growing season.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Drainageway (2) Mountains > Depression
Runoff class	Low
Flooding frequency	None
Ponding duration	Not specified
Ponding frequency	None
Elevation	469–1,100 m
Slope	1–16%
Water table depth	0–46 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	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	469–1,649 m
Slope	0–30%
Water table depth	Not specified

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

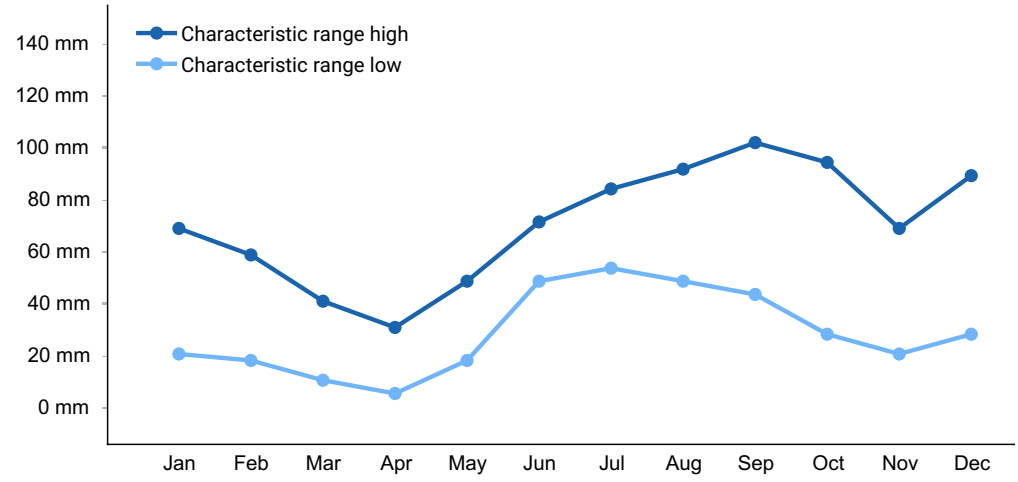

Figure 1. Monthly precipitation range

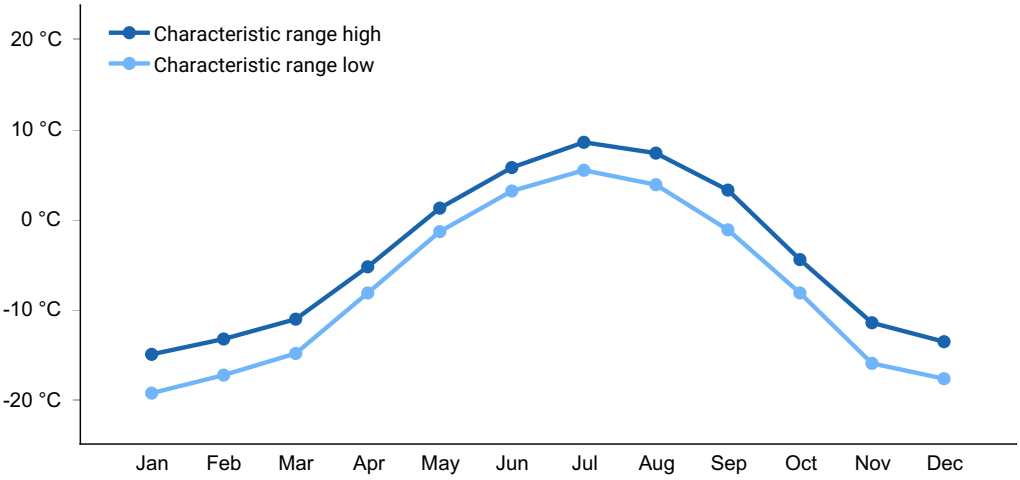

Figure 2. Monthly minimum temperature range

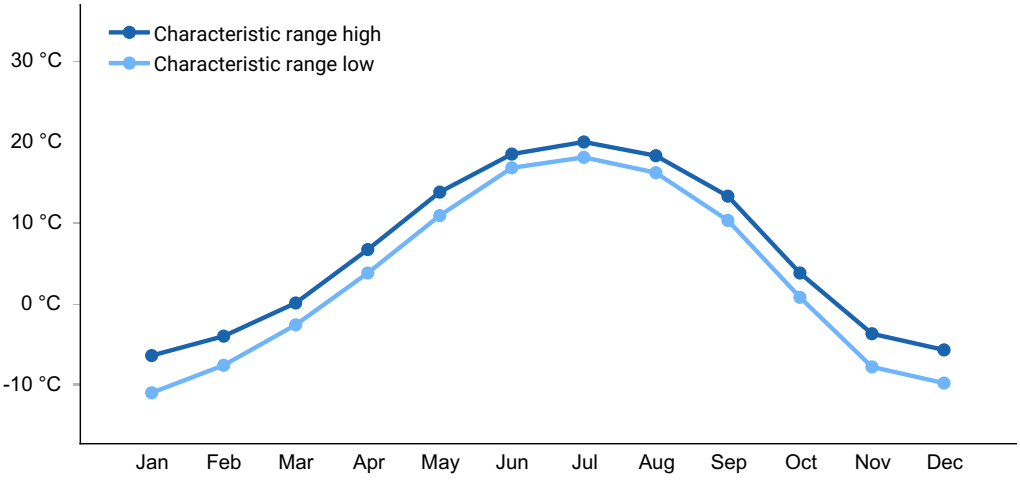

Figure 3. Monthly maximum temperature range

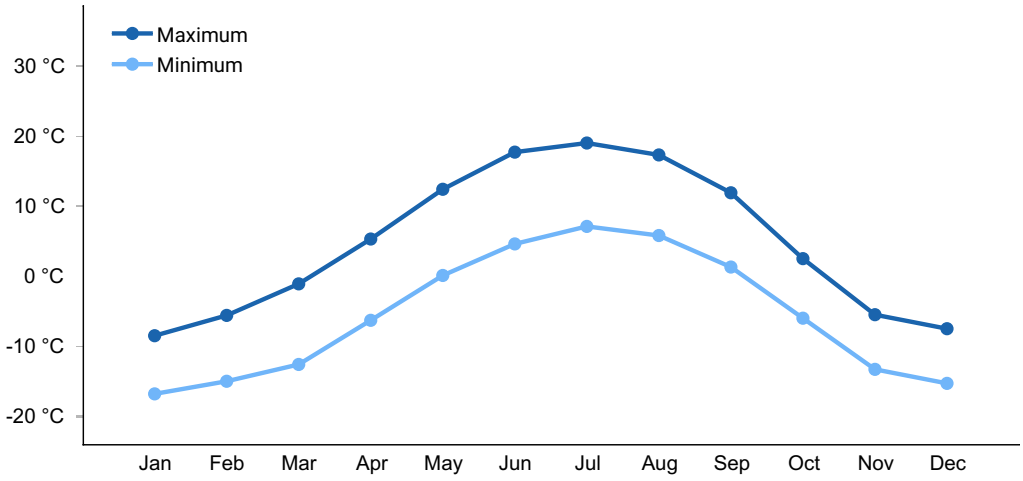

Figure 4. Monthly average minimum and maximum temperature

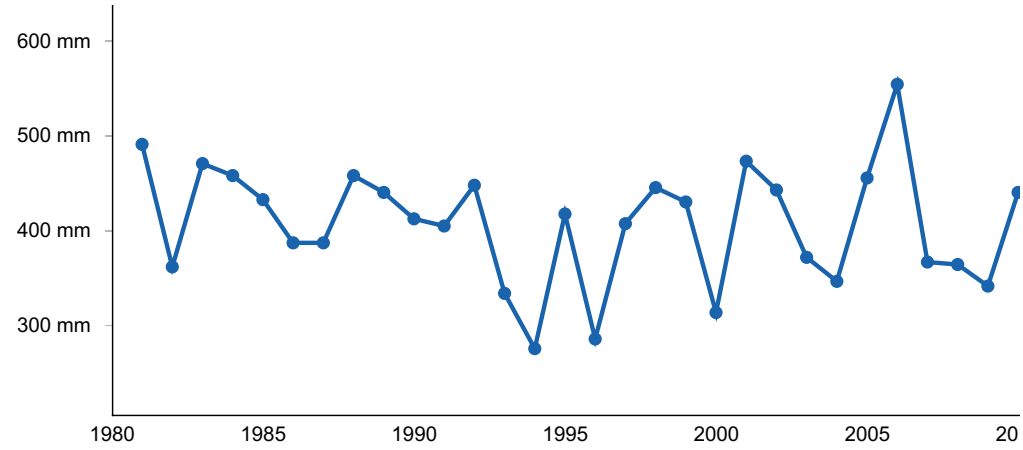

Figure 5. Annual precipitation pattern

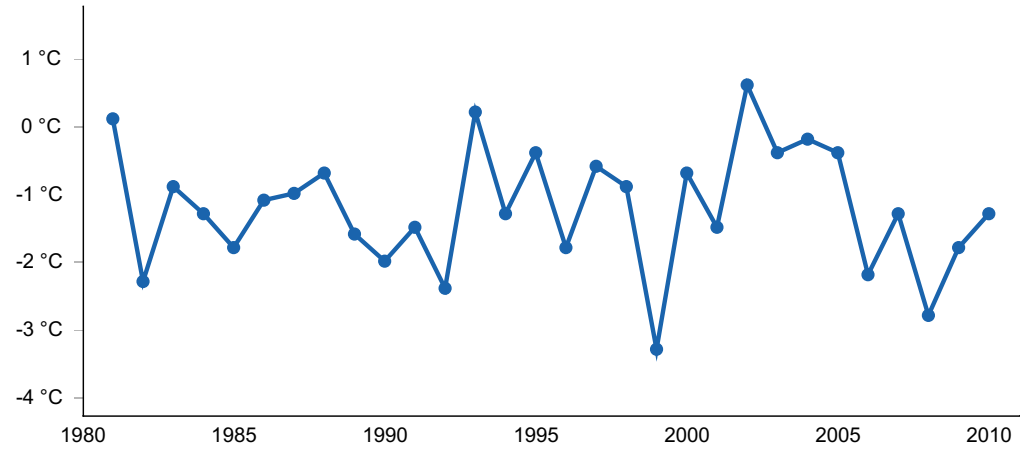

Figure 6. Annual average temperature pattern

Climate stations used

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

Influencing water features

Ecological site R223XY706AK is associated with depressions and drainageways that are somewhat poorly- to very poorly drained. A shallow, seasonal water table persists throughout the growing season ranging from 0 to 18 inches below the soil surface, influencing plant community dynamics on this ecological site. No ponding or flooding occurs on this site.

Soil features

The soils of ecological site R223XY706AK formed in silty volcanic ash or windblown silt over gravelly parent material. Surface fragments are uncommon, and these mineral soils have a very thin organic cap, if present. The mineral soil is a silt loam formed in volcanic ash or loess overlying gravelly glacial material. These soils are considered very deep, yet a restrictive layer in the form of a strongly contrasting textural stratification is present 5 to 17 inches below the soil surface. Soil pH ranges from strongly acidic to slightly acidic and drainage class is rated from somewhat poorly- to very poorly drained.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Loess (3) Till
Surface texture	(1) Silt loam (2) Mucky silt loam (3) Mucky
Family particle size	(1) Medial (2) Loamy-skeletal
Drainage class	Somewhat poorly drained to very poorly drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	13–43 cm
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-25.4cm)	3.05–9.91 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Clay content (0-50.8cm)	5–10%

Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	3.5–6.7
Subsurface fragment volume <=3" (0-152.4cm)	0–23%
Subsurface fragment volume >3" (0-152.4cm)	0–5%

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)	2.54–10.41 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) (0-101.6cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	0–32%
Subsurface fragment volume >3" (0-152.4cm)	0–10%

Ecological dynamics

Located in the alpine life zone, this ecological site is exposed to a variety of harsh environmental conditions. In the Cook Inlet Mountains, 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 ecological site R223XY706AK is snow-free, cold soil temperatures and high winds also inhibit plant growth and vigor. This harsh climate maintains the dwarfed vegetation within this ecological 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 suggest this ecological site supports a single dominant plant community, without known transitional pathways to other plant communities or alternative states. Community 1.1 is characterized by a willow-graminoid shrub bog community (Viereck et al. 1992). Notable species include *Salix barclayi*, *Salix pulchra*, *Sanguisorba canadensis*, and *Calamagrostis canadensis*. Various moss species including Sphagnum are common on this site and make up as much as 90 percent of the soil surface cover.

This plant community extends from the alpine zone into the subalpine zone, which is classified as Major Land Resource Area (MLRA) 224: The Cook Inlet Lowlands. However, hydrologic influence leads to congruency between alpine and subalpine plant communities at the elevations on which this ecological site is found. This congruency leads to plant community composition that includes shrub species that would otherwise only be found in subalpine community but are found at higher elevations in stunted growth forms.

State and transition model

Ecosystem states

1. Reference state

State 1 submodel, plant communities

1.1. Barclay's willow - tealeaf willow / bluejoint / Canadian burnet

State 1
Reference state

The reference state of this ecological site includes a single plant community characterized as a willow-graminoid shrub-bog. This community extends into the subalpine zone where shrubs exhibit medium to tall growth forms. In this alpine community, these same shrubs are diminished to the low shrub class.

Dominant plant species

- Barclay's willow (*Salix barclayi*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- Richardson's willow (*Salix richardsonii*), shrub
- feltleaf willow (*Salix alaxensis*), shrub
- resin birch (*Betula glandulosa*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- Canadian burnet (*Sanguisorba canadensis*), other herbaceous
- subarctic ladyfern (*Athyrium filix-femina ssp. cyclosorum*), other herbaceous
- field horsetail (*Equisetum arvense*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous

Community 1.1
Barclay's willow - tealeaf willow / bluejoint / Canadian burnet

The reference community is characterized by a willow-graminoid shrub bog community (Viereck et al. 1992). Shrubs in this community include several willow species (Salix spp.) and resin birch (Betula glandulosum). Bluejoint (*Calamagrostis canadensis*) and Bigelow's sedge (*Carex bigelowii*) are the dominant graminoids in this community and various forbs are present. Notable willow species include Barclay's willow (*Salix barclayi*), tealeaf willow (*S. pulchra*), feltleaf willow (*S. alaxensis*), and Richardson's willow (*S. richardsonii*). Although designated as an alpine community, a similar community extends into the subalpine zone where shrubs exhibit full growth forms.

Dominant plant species

- Barclay's willow (*Salix barclayi*), shrub
- tealeaf willow (*Salix pulchra*), shrub

- Richardson's willow (*Salix richardsonii*), shrub
- feltleaf willow (*Salix alaxensis*), shrub
- resin birch (*Betula glandulosa*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- Canadian burnet (*Sanguisorba canadensis*), other herbaceous
- subarctic ladyfern (*Athyrium filix-femina ssp. cyclosorum*), other herbaceous
- field horsetail (*Equisetum arvense*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), 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	12/07/2025
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):**

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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):**

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:**