USDA Natural Resources Conservation Service

Ecological site F088XY003MN
Open Peatland

Last updated: 8/12/2024
Accessed: 05/11/2025

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): 088X–Northern Minnesota Glacial Lake Basins

MLRA 88 consists of the lake beds of glacial Lakes Agassiz, Upham, and Aitkin. These vast glacial lake beds were formed by meltwaters associated with the last glaciation of the Wisconsin age. The large, flat, wet landscapes are filled with lacustrine lake sediments, wave-washed glacial till, and vast expanses of organic soils. This area is entirely in Minnesota and makes up about 11,590 square miles (30,019 square kilometers).

The western boundary of MLRA 88 with MLRA 56B is gradual. MLRA 56B is a portion of the Red River Valley that was formed by glacial Lake Agassiz and is dominantly prairie. The southern boundary of MLRA 88 with MLRA 57 consists of distinct moraines that formed from the glacial drift sediments of Late Wisconsin age. The eastern and southeastern boundaries are with portions of MLRAs 90A and 93A. These MLRAs are in a distinct glaciated region of sediments of the Rainy and Superior Lobes, and much of MLRA 93A is bedrock controlled (USDA-Ag Handbook 296, 2022).

Classification relationships

MN DNR Native Plant Community (MN DNR, 2003); the reference community of this Provisional Ecological Site is most similar to:
OPn81 Northern Shrub Shore Fen
OPn91 Prairie Rich Fen
OPn92 Northern Rich Feb (Basin)

Ecological site concept

Open Peatland sites typically occur on level to gently sloping surfaces on all landforms through the area. Soils have greater than 16” of organic material and soil pH values are greater than 4.5.

Associated sites

F088XY002MN	**Marsh** Marsh occurs on level or slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways, and adjacent to open water. They are very poorly drained soils and are frequently inundated with water for long durations. Soil surface textures are typically muck or mucky-modified surface layers over variable parent materials.
F088XY004MN	**Acid Peatland** Acid Peatland occurs in shallow wetland basins, closed depressions, and along drainage ways. Soils and water content have lower pH than the open peatland sites, lending to different vegetation. Soils are occasionally ponded with standing water in spring but tend to recede by late summer. Soil surface layers are typically muck 8 to 16” thick over variable parent materials.

F088XY005MN	**Forestland Peatland** Forestland Peatland occurs on level to gently sloping surfaces. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. This site has a water table typically below the peat surface that drops during the summer to allow for the establishment of significant tree cover.

Similar sites

F088XY004MN	**Acid Peatland** Acid Peatland occurs in shallow wetland basins, closed depressions, and along drainage ways. Soils and water content have lower pH than the open peatland sites, lending to different vegetation. Soils are occasionally ponded with standing water in spring but tend to recede by late summer. Soil surface layers are typically muck 8 to 16” thick over variable parent materials.
F088XY005MN	**Forestland Peatland** Forestland Peatland occurs on level to gently sloping surfaces. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. This site has a water table typically below the peat surface that drops during the summer to allow for the establishment of significant tree cover.

Table 1. Dominant plant species

Tree	(1) *Larix laricina* (2) *Picea mariana*
Shrub	(1) *Salix pedicellaris* (2) *Chamaedaphne calyculata*
Herbaceous	(1) *Carex lasiocarpa* (2) *Comarum palustre*

Physiographic features

Open Peatland sites typically occur on level to gently sloping surfaces on all landforms through the area. Soils have greater than 16” of organic material and soil pH values are greater than 4.5.

Table 2. Representative physiographic features

Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Depression (2) Swamp (3) Bog (4) Lake plain
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	Frequent
Elevation	980–1,610 ft
Slope	0–1%
Ponding depth	4–12 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 25 to 28 inches (635 to 711 millimeters). Most of the rainfall comes from convective thunderstorms during the growing season. Snowfall generally occurs from October through April. The average annual temperature is 43 to 46 degrees F (6 to 8 degrees C). The mean frost free period ranges from 86 to

110 days, with the mean freeze-free period ranging from 118 to 136 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	86-110 days
Freeze-free period (characteristic range)	118-136 days
Precipitation total (characteristic range)	25-28 in
Frost-free period (actual range)	79-112 days
Freeze-free period (actual range)	114-142 days
Precipitation total (actual range)	24-29 in
Frost-free period (average)	97 days
Freeze-free period (average)	129 days
Precipitation total (average)	26 in

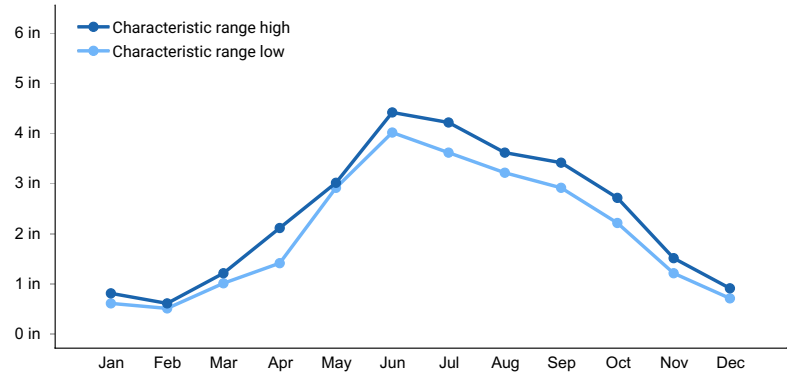


Figure 1. Monthly precipitation range

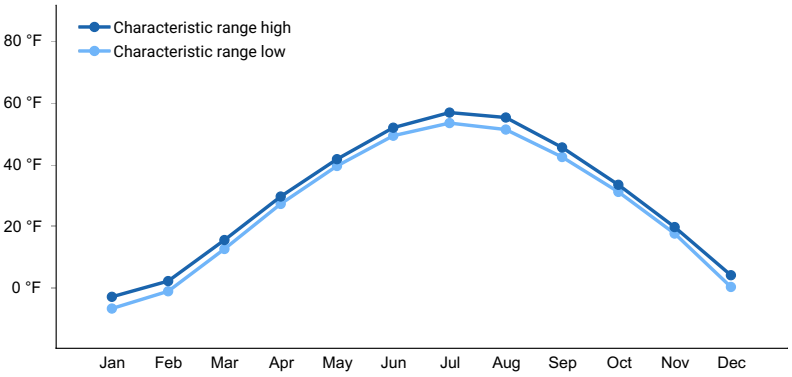


Figure 2. Monthly minimum temperature range

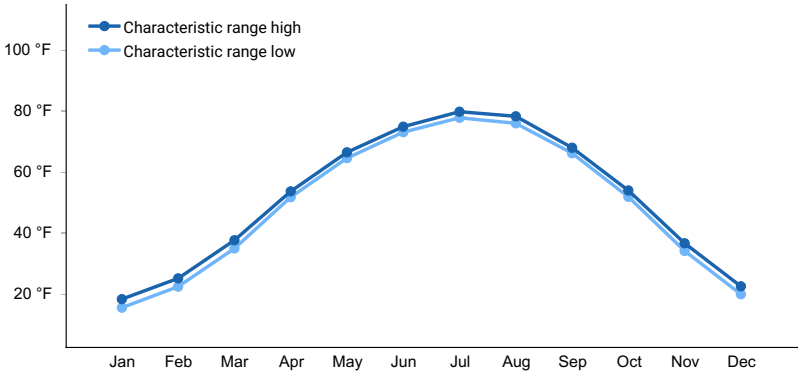


Figure 3. Monthly maximum temperature range

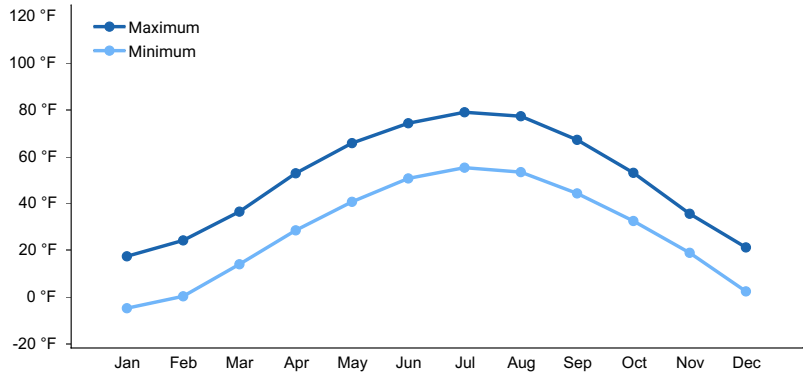


Figure 4. Monthly average minimum and maximum temperature

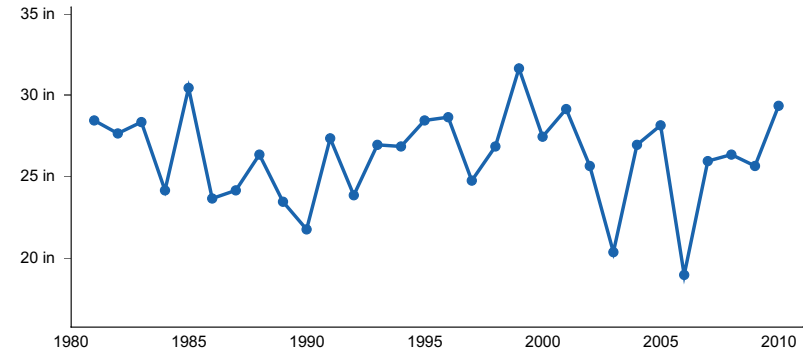


Figure 5. Annual precipitation pattern

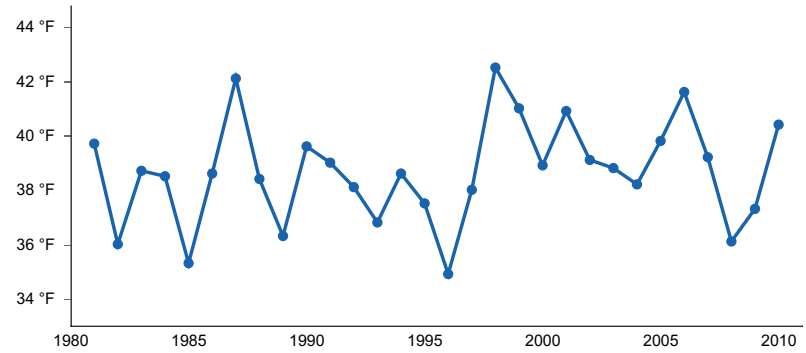


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WARROAD [USC00218679], Warroad, MN
- (2) CAMP NORRIS DNR [USC00211250], Beltrami Isl State for, MN
- (3) WASKISH 4NE [USC00218700], Big Falls, MN
- (4) BIG FALLS [USC00210746], Big Falls, MN
- (5) RED LAKE INDIAN AGCY [USC00216795], Ponemah, MN
- (6) LITTLEFORK 10 SW [USC00214809], Big Falls, MN
- (7) INTL FALLS INTL AP [USW00014918], International Falls, MN
- (8) LEECH LAKE [USC00214652], Bena, MN
- (9) POKEGAMA DAM [USC00216612], Cohasset, MN
- (10) GRAND RPDS FOREST LAB [USC00213303], Grand Rapids, MN
- (11) FLOODWOOD 3 NE [USC00212842], Floodwood, MN
- (12) EVELETH WWTP [USC00212645], Eveleth, MN

Influencing water features

These sites are typically groundwater recharged and are highly influenced by the abundant concentration of minerals such as calcium found in the ground water that has percolated through the highly calcareous parent

material that typically occurs throughout the region. These sites have minimal slopes with minimal runoff potential.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), these sites could be classified as:
1) Palustrine, scrub-shrub, broad-leaved deciduous, saturated, or
2) Palustrine, moss-lichen, saturated, or
3) Palustrine, scrub-shrub, broad-leaved evergreen, saturated, or
4) Palustrine emergent, persistent, saturated

NRCS Hydrologic group: A/D, B/D, C/D.
Many of these sites have hydric soils.

Soil features

Open Peatland soils developed as organic materials over Till and Glaciolacustrine deposits. Open peatlands have minimal runoff potential and deep soils. Surface soils are often made up of herbaceous organic material or other highly decomposed organic material. These sites are very poorly drained, and have a relatively high available water capacity (13.4 to 17.7).

All soils in the Open Peatland ecological site are Histosols. Soils for this site can be further described as Terric Haplohemists, Terric Haplosaprists, and Typic Haplohemists. The soil series included in the Open Peatland ecological site include Dora, Cathro, Rifle, Berner, Merwin, Markey, and Beseman.

Table 4. Representative soil features

Parent material	(1) Organic material (2) Till (3) Glaciolacustrine deposits
Surface texture	(1) Muck (2) Mucky peat (3) Peat
Drainage class	Very poorly drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	0 in
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	13.3–17.7 in
Soil reaction (1:1 water) (10-40in)	5.1–7.3
Subsurface fragment volume <=3" (0-40in)	0–4%
Subsurface fragment volume >3" (0-40in)	0–1%

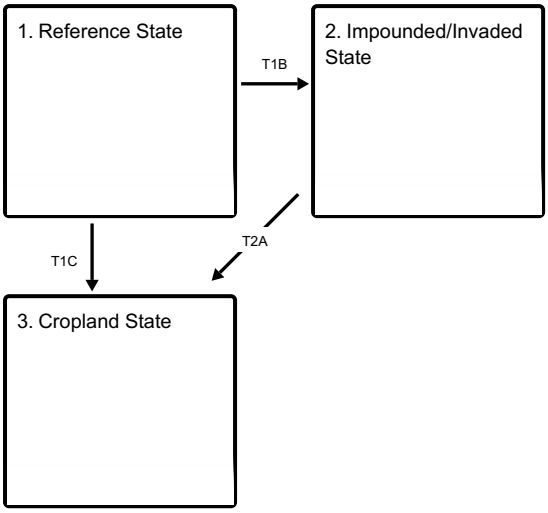
Ecological dynamics

Open Peatland sites typically occur on level to gently sloping surfaces on all landforms through the area. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. The organic material ranges in decomposition from muck, mucky peat to peat textures underlain by variable parent material. These sites are typically groundwater recharged and are highly influenced by the abundant concentration of minerals such as

calcium found in the ground water that has percolated through the highly calcareous parent material that typically occurs throughout the region. Plant communities typical with Open Peatland tend to be dominated by sedges, ericaceous shrubs, bog willow, or bog birch.

State and transition model

Ecosystem states

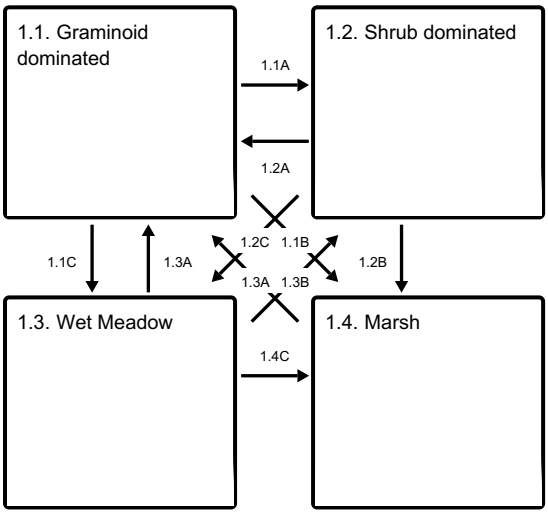


T1B - Impoundment of water on-site, maintenance of water on-site, and/or establishment of invasive species

T1C - Tile drainage, tilling, seeding, herbicide

T2A - Tile drainage, tilling, seeding, herbicide.

State 1 submodel, plant communities



1.1A - Lack of fire and/or periodic drought

1.1C - Seasonal water oscillations becomes high compared to the more stable groundwater

1.1B - Beaver dam off-site restricts water flow or contributes to ponding on-site

1.2A - Fire, higher than average precipitation. and/or decreased frequency of inundation by surface runoff.

1.2C - Seasonal water oscillations becomes high compared to the more stable groundwater.

1.2B - Beaver dam off-site restricts water flow or contributes to ponding on-site

1.3A - Accumulating of peat and water levels stabilize (but still remain fairly high) with stable groundwater influence.

1.3B - Lack of fire and/or periodic drought.

1.4C - Increased beaver dam off-site restricts water flow and contributes to ponding on-site or fire.

1.3A - Removal of beaver or beaver dam.

State 2 submodel, plant communities

2.1. Invaded Native

State 3 submodel, plant communities

3.1. Annual Crops

State 1
Reference State

This community is dominated by fine-leaved sedges, graminoids, and shrubs. Soils are mucky peat or peat.

Dominant plant species

- tamarack (*Larix laricina*), tree
- black spruce (*Picea mariana*), tree
- bog birch (*Betula pumila*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- woollyfruit sedge (*Carex lasiocarpa*), grass
- bluejoint (*Calamagrostis canadensis*), grass

Community 1.1
Graminoid dominated

The peatland system of Minnesota forms a mosaic of plant community variations across the landscape. Community 1.1. describes those area that are dominated by a diversity of wet-tolerant graminoid species. Multiple species of native sedges are present on site. The shrub layer is variable but usually sparse to scattered.

Dominant plant species

- sedge (*Carex*), grass
- woollyfruit sedge (*Carex lasiocarpa*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- hairy sedge (*Carex lacustris*), grass
- Northwest Territory sedge (*Carex utriculata*), grass
- upright sedge (*Carex stricta*), grass
- slimstem reedgrass (*Calamagrostis stricta*), grass
- Buxbaum's sedge (*Carex buxbaumii*), grass
- purple marshlocks (*Comarum palustre*), other herbaceous

Community 1.2
Shrub dominated

Water depth, microtopography, peat depth, and other soil characteristics will influence the plant community composition.

Dominant plant species

- bog birch (*Betula pumila*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub

- gray alder (*Alnus incana*), shrub
- sweetgale (*Myrica gale*), shrub

Community 1.3
Wet Meadow

Dominated by dense cover of broad-leaved graminoids or tall shrubs.

Dominant plant species

- bog birch (*Betula pumila*), shrub
- bog willow (*Salix pedicellaris*), shrub
- woollyfruit sedge (*Carex lasiocarpa*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- creeping sedge (*Carex chordorrhiza*), grass
- Northwest Territory sedge (*Carex utriculata*), grass
- eastern marsh fern (*Thelypteris palustris*), other herbaceous
- Fraser's marsh St. Johnswort (*Triadenum fraseri*), other herbaceous

Community 1.4
Marsh

Zones within this site may have areas that can be described as a sedge-cattail marsh. Areas of open water may be present. Areas of deeper water will contain floating and submerged forbs such as duckweed (Lemna spp.), smartweed (Polygonum spp.), and American white water lily (*Nymphaea odorata*).

Dominant plant species

- sedge (*Carex*), grass
- duckweed (*Lemna*), other herbaceous
- waterlily (*Nymphaea*), other herbaceous
- knotweed (*Polygonum*), other herbaceous
- cattail (*Typha*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Lack of fire and/or periodic drought. Also, if frequency of inundation by surface runoff or rising lake levels increases (Minnesota Department of Natural Resources (2003)). Perhaps the stability of water level favors graminoids but the stochastic nature of fluctuating water favors shrubs.

Pathway 1.1C
Community 1.1 to 1.3

Plant community 1.1 to 1.4 conversion occurs when substrate changes from one that is sphagnum peat dominated to one that is more sedimentary peat, sapric peat, muck or mineral soil dominated. This can occur when seasonal water oscillations becomes high compared to the more stable groundwater influenced plant communities. Beaver dam off-site restricts water flow or contributes to ponding on-site.

Pathway 1.1B
Community 1.1 to 1.4

Beaver dam off-site restricts water flow or contributes to ponding on-site

Pathway 1.2A
Community 1.2 to 1.1

Fire, higher than average precipitation. and/or decreased frequency of inundation by surface runoff.

Pathway 1.2C
Community 1.2 to 1.3

Plant community 1.1 to conversion 1.4 occurs when substrate changes from one that is sphagnum peat dominated to one that is more sedimentary peat, sapric peat, muck or mineral soil dominated. This can occur when seasonal water oscillations becomes high compared to the more stable groundwater influenced plant communities. Beaver damming can cause this to happen.

Pathway 1.2B
Community 1.2 to 1.4

Beaver dam off-site restricts water flow or contributes to ponding on-site

Pathway 1.3A
Community 1.3 to 1.1

The wet meadow, if it changes to be actively accumulating peat and water levels stabilize (but still remain fairly high) with stable groundwater influence, can transition to plant community 1.1.

Pathway 1.3B
Community 1.3 to 1.2

Lack of fire and/or periodic drought

Pathway 1.4C
Community 1.3 to 1.4

Increased beaver dam off-site restricts water flow and contributes to ponding on-site or fire.

Pathway 1.3A
Community 1.4 to 1.1

Removal of beaver or beaver dam

State 2
Impounded/Invaded State

The plant community is still an open peatland dominated by shrubs and graminoids; however, invasive species are now present on site and will increase with the absence of management inputs.

Dominant plant species

- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass
- reed canarygrass (*Phalaris arundinacea*), grass
- American white waterlily (*Nymphaea odorata*), other herbaceous
- watershield (*Brasenia schreberi*), other herbaceous
- pondweed (*Potamogeton*), other herbaceous

Community 2.1
Invaded Native

Native species with invaders starting to emerge.

Dominant plant species

- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), grass

- reed canarygrass (*Phalaris arundinacea*), grass
- American white waterlily (*Nymphaea odorata*), other herbaceous
- watershield (*Brasenia schreberi*), other herbaceous
- pondweed (*Potamogeton*), other herbaceous

State 3
Cropland State

Annual Crops

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 3.1
Annual Crops

Disturbances related to agricultural activities have altered the site to a state suitable for annual crop production.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Transition T1B
State 1 to 2

Impoundment of water on-site, maintenance of water on-site, and/or establishment of invasive species.

Transition T1C
State 1 to 3

Tile drainage, tilling, seeding, herbicide.

Transition T2A
State 2 to 3

Tile drainage, tilling, seeding, herbicide.

Additional community tables

Inventory data references

Information presented was derived from Minnesota Department of Natural Resources Field Guide to the Native Plant Communities of Minnesota, USDA-NRCS soil survey information, and USDA Plants Database.

Other references

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Contributors

Kade Anderson, Ecological Site Specialist for North Central Region
Patty Burns, Soil Scientist, USDA-NRCS-Bemidji, MN.
Stacey Clark, Regional Ecologist, USDA-NRCS-St.Paul, MN.
Landon Wolter, Rangeland Management Specialist for North Central Region
Ezra Hoffman, Ecological Site Specialist for North Central Region

Approval

Suzanne Mayne-Kinney, 8/12/2024

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	08/12/2024
Approved by	Suzanne Mayne-Kinney
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):**

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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:**
