USDA Natural Resources Conservation Service

Ecological site F093BY001MI
Acidic Poor Fens

Last updated: 9/27/2023
Accessed: 07/17/2024

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): 093B–Superior Stony and Rocky Loamy Plains and Hills

The Wisconsin portion of this MLRA is a mixture of high-relief moraines and flat till plains with interspersed glacial meltwater deposits. It is bordered on the north by glaciolacustrine deposits of Glacial Lake Duluth and on the south by extensive pitted and unpitted outwash plains. The approximate land area is just under 600,000 acres (935 sq miles).

The Penokee-Gogebic Iron Range runs through the middle of the Wisconsin portion of this MLRA and into Michigian. The range is a hilly, bedrock-controlled moraine. The bedrock outcropping is composed of igneous and metamorphic materials and was created by inland folding and faulting of the ancient Superior continent when it collided with the Marshfield continent about 1.8 billion years ago (Dott & Attig, 2004). Volcanic and intrusive bedrock occurs in some places. This bedrock is overlain by a thin layer of glacial till deposited by the Chippewa Lobe.
To the north of the range is a former spillway for Glacial Lake Ontonagon. The flowing meltwater cut deep channels into the morainal systems. Glaciofluvial landforms here include old beaches and dunes. South of the range, along the southern edge of this MLRA, are rolling collapsed end moraines, pushed to their extent by the Chippewa and Ontonagon Lobes. The landscape is dotted with abundant kettle lakes and swamps, especially in the eastern portion. Ice-walled lake plains and eskers are also found along these collapsed moraines.

The climate is influenced by Lake Superior in areas near the lake, resulting in cooler summers, warmer winters, and greater precipitation – especially snowfall – compared to more inland locations. Historically, mixtures of eastern hemlock (Tsuga canadensis), sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis), eastern white pine (Pinus strobus), and red pine (Pinus resinosa) covered the area. In wetter pockets (such as the swamps that dot the moraines to the south) white cedar (Thuja occidentalis), black spruce (*Picea mariana*), and tamarack (*Larix laricina*) were common (Finley, R., 1976).

Classification relationships

Relationship to Established Frameworks and Classification Systems:
Wetland Forest Habitat Types (Kotar, 2017): These sites are represented by *Picea mariana – Larix laricina* / *Ledum groenlandicum* (PmLLe) habitat type, with one outlier site as *Abies balsamea*-Fraxinus nigra-Thuja occidentalis/Ilex verticilata (AbFnThIx).
Biophysical Setting (Landfire, 2014): This ES is mapped Boreal Acidic Peatland System.
WDNR Natural Communities (WDNR (2015): This ES is most similar to the Black Spruce Swamp.

Hierarchical Framework Relationships:
Major Land Resource Area (MLRA): Superior Stoney and Rocky Loamy Plains and Hills, Eastern Part (93B)
USFS Subregions: Winegar Moraines (212Jc)
Small sections occur in the Gogebic-Penokee Iron Range (212Jb) subregion
Wisconsin DNR Ecological Landscapes: North Central Forest

Ecological site concept

The Acidic poor fens ecological site occurs primarily in the southern half of MLRA 93B in bogs and depressions almost exclusively in outwash plains. These sites are characterized by very deep, very poorly drained soils that formed in deep organic deposits of herbaceous origin. Some sites are underlain by sandy outwash. Sites are subject to rare ponding in the spring. Water is primarily received from precipitation and runoff from adjacent uplands, though limited groundwater discharge and stream inflow may contribute as well. Sites remain saturated throughout the growing season and meet hydric soil requirements. Soils range from ultra acid to strongly acid. These sites are wetlands.

Acidic poor fens are extremely acidic, much more so than their Organic Lowlands counterpart. The acidity is a result of limited interaction with groundwater that may be enriched with dissolved carbonates. In addition, the groundwater discharging into Acidic poor fens is likely passing through surrounding parent materials that are acidic (i.e. outwash sands as opposed to loamy morainal deposits). The extreme low pH limits vegetative growth.

Associated sites

F093BY004MI	**Wet Lowlands** Wet Lowlands occur on depressions and drainageways and form in loamy till or loamy alluvium underlain by dense sandy till or sandy and gravelly outwash. These sites are poorly drained and are higher up on the drainage sequence than Acidic poor fens. They typically border Acidic poor fens
F093BY005MI	**Moist Lowlands** Moist Lowlands occur on footslope positions across the landscape. They are not subject to flooding nor ponding. Soils form in till, lacustrine deposits, or outwash deposits and may be loamy to sandy. These sites are somewhat poorly drained and occur higher on the drainage sequence than Acidic poor fens.
F093BY011MI	**Dry Uplands** Dry Uplands are found in the sandiest, most permeable soils on the driest landscape positions. They are very deep and excessively drained and occupy the highest position on the drainage sequence, whereas Acidic poor fens occupy the lowest.

Similar sites

F093BY002MI	**Mucky Swamps** Like Acidic poor fens, Organic Lowlands consist of deep herbaceous organic material, are very poorly drained, and remain saturated throughout year. They also occupy landscape depressions and the lowest positions on their drainage sequences. Organic Lowlands are more alkaline than Acidic poor fens and, as a result, the vegetative communities on these two sites are quite different.

Table 1. Dominant plant species

Tree	(1) *Picea mariana* (2) *Larix laricina*
Shrub	Not specified
Herbaceous	(1) *Ledum groenlandicum*

Physiographic features

This site occurs in bogs and depressions on lake plains, outwash plains, floodplains, and moraines. Slope ranges from 0 to 1 percent.

These sites are subject to rare ponding in the spring. The ponding duration is brief (2 to 7 days) to long (7 to 30 days). These sites typically do not flood. The soils have an apparent seasonally high water table at a depth of 0 inches. Runoff is negligible.

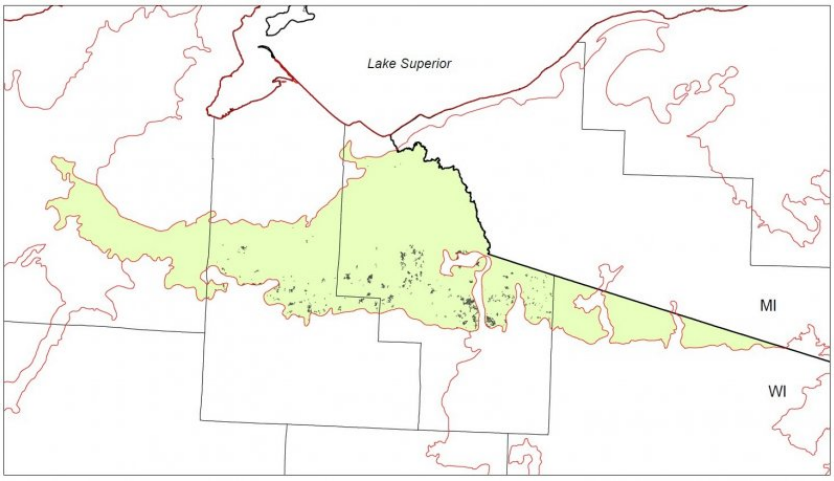


Figure 1. distribution of Acidic Poor fens in the Superior Stoney and Rocky Loamy Plains and Hills- Eastern Part.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Flood plain (3) Moraine
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to rare
Elevation	200–250 m
Slope	0–1%
Ponding depth	0–76 cm
Water table depth	0–30 cm
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Superior Stoney and Rocky Loamy Plains and Hills, Eastern Part MLRA is characterized by long, cold winters and short, warm summers where precipitation exceeds evapotranspiration. Neither average annual precipitation nor average annual minimum and maximum temperatures vary greatly within this MLRA, though the climate of the northern tip is somewhat affected by Lake Superior and receives higher annual precipitation in the form of lake effect snow.

Table 3. Representative climatic features

Frost-free period (characteristic range)	86-119 days
Freeze-free period (characteristic range)	116-149 days
Precipitation total (characteristic range)	737-813 mm
Frost-free period (actual range)	78-121 days
Freeze-free period (actual range)	113-157 days
Precipitation total (actual range)	711-838 mm
Frost-free period (average)	102 days
Freeze-free period (average)	133 days
Precipitation total (average)	762 mm

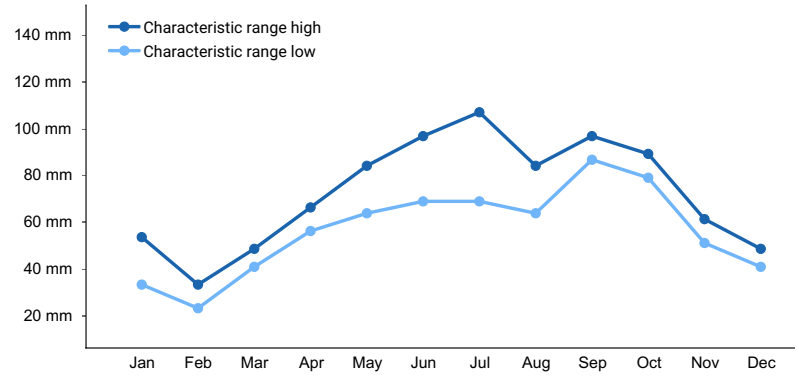


Figure 2. Monthly precipitation range

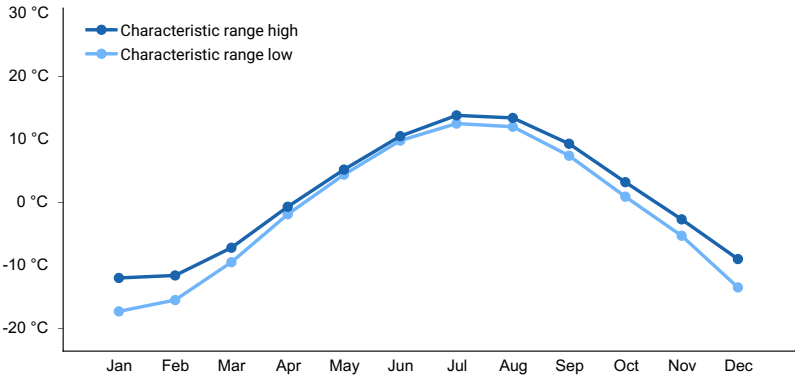


Figure 3. Monthly minimum temperature range

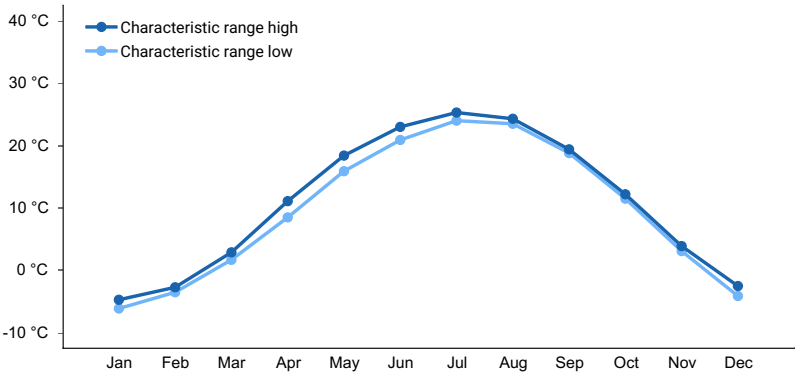


Figure 4. Monthly maximum temperature range

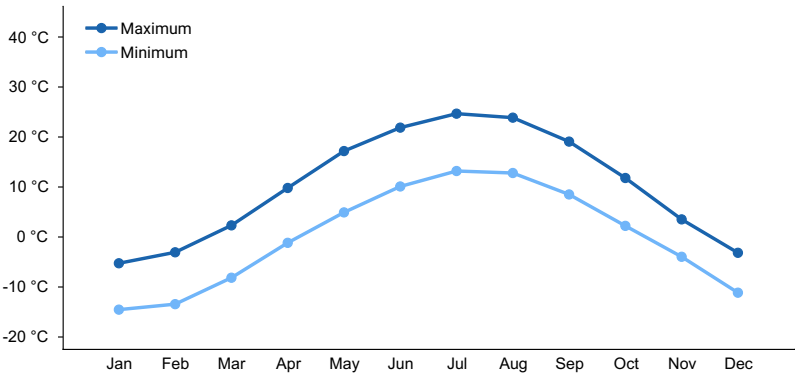


Figure 5. Monthly average minimum and maximum temperature

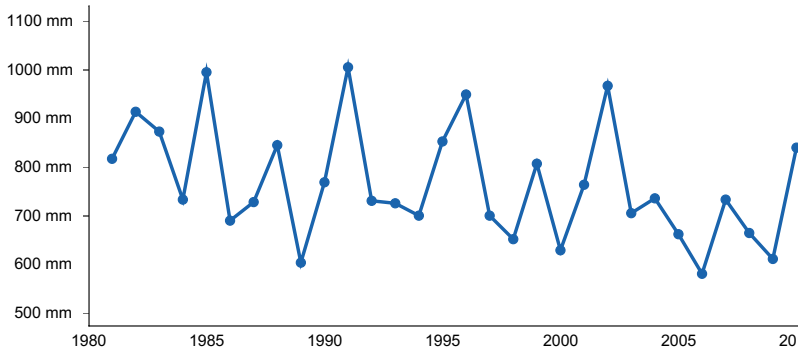


Figure 6. Annual precipitation pattern

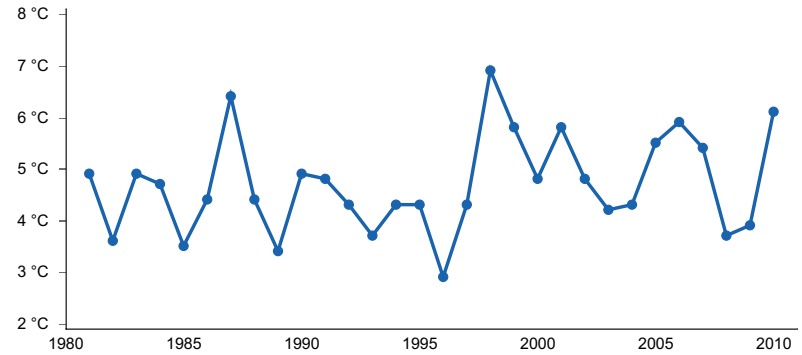


Figure 7. Annual average temperature pattern

Climate stations used

- (1) MELLEN 4 NE [USC00475286], Mellen, WI
- (2) REST LAKE [USC00477092], Manitowish Waters, WI
- (3) HANCOCK HOUGHTON CO AP [USW00014858], Calumet, MI
- (4) MARQUETTE [USW00014838], Marquette, MI

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, and groundwater. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water is lost from the site primarily through evapotranspiration and groundwater recharge. These sites are wetlands.

The hydrology of Acidic Organic sites significantly impacts their ecological development. Some sites are acid bogs that have little to no interaction with groundwater, which makes them extremely acidic. On other sites, groundwater is discharged and brings in water that is exposed to surrounding acidic parent materials, such as sand deposits. This interaction keeps the soils acidic, but less acidic than if it had no groundwater discharge on the site. Permeability of the soil is slow. The hydrologic group of this site is A/D.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, forested, needle-leaved evergreen, saturated, or
2) Palustrine, scrub-shrub, broad-leaved evergreen, saturated, or
3) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, acid, forested/organic, or
2) Depressional, acid, scrub-shrub/organic

Hydrogeomorphic Wetland Classification: Depressional acidic forested/organic; Depressional acidic scrub-shrub/organic

Soil features

The soils of this site are represented by the Loxley, Dawson, and Greenwood series, classified as Typic Haplosaprists, Terric Haplosaprists, and Typic Haplohemists, respectively.

These soils are formed in moderate to deep, moderately to highly decomposed herbaceous organic material. Some sites have underlying sandy deposits or—rarely—loamy deposits. The thickness of the organic material ranges from 16 to over 80 inches. These sites are very poorly drained and remain saturated throughout the year. These soils meet hydric soil requirements.

Soil pH is extremely acidic to very strongly acidic, ranging from 3.5 to 5.0. Both coarse fragments and carbonates are absent within 80 inches.

Table 4. Representative soil features

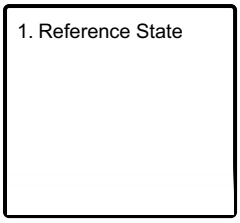
Parent material	(1) Herbaceous organic material
Surface texture	(1) Mucky (2) Muck (3) Peat
Drainage class	Very poorly drained
Permeability class	Moderately slow to moderately rapid
Soil depth	508 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	39.57–76.2 cm
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	3.3–5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

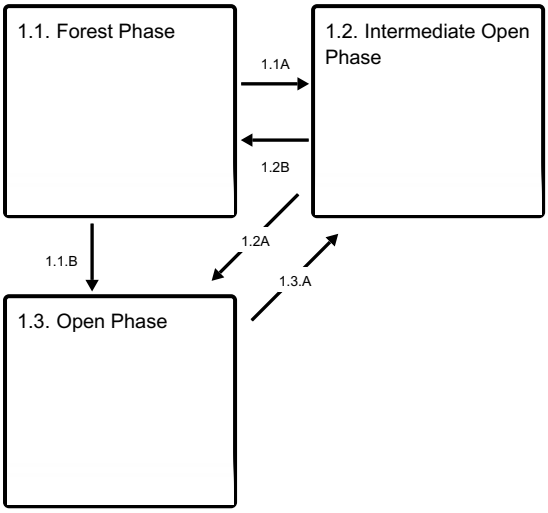
Vegetative communities on this ecological site develop over very long and slow processes. These sites are part of the acid peatlands of northern Wisconsin. Communities range from open bogs to black spruce swamps. These sites developed in wet depressions that allowed organic matter to build over time. These communities are distinct from other wetland communities by the dominance and total carpeting of Sphagnum moss and its effects on the hydrology, pH, and nutrient availability of the site. As Sphagnum moss dominates these sites, it develops thick layers that raise the surface and effectively isolates vegetation from groundwater interaction. Precipitation and runoff become the primary sources of water, which causes sites to become very acidic and poor in nutrients. These sites remain saturated throughout the year based on the moss' ability to retain water. Vegetation on these sites is limited by species that can tolerate saturation, high acidity, and low nutrient availability. Changes to the hydrology can cause severe changes. Drainage near the site that lowers the water table can allow for invasion of woody shrubs.

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Site disturbance; increase in ponding; wind/ice damage

1.1.B - Increase in ponding frequency/duration

1.2B - Decrease in ponding frequency/duration

1.2A - Increase ponding frequency/duration

1.3.A - Decrease in ponding frequency/duration

State 1
Reference State

The reference state includes three community phases that are part of the mosaic of norther acid peatlands. We chose three distinct community phases to represent the Reference state: 1, a forested phase, 2, shrub phase, and 3, open bog phase. Other communities may exist within this ecological site if they lack similar hydrology. In addition, many sites may exhibit characteristics of multiple community phases. These community phases are not necessarily linear success but may develop in that fashion.

Dominant plant species

- black spruce (*Picea mariana*), tree
- tamarack (*Larix laricina*), tree
- leatherleaf (*Chamaedaphne calyculata*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- sedge (*Carex*), grass
- blueberry (*Vaccinium*), other herbaceous

Community 1.1
Forest Phase

This community phase consists forest communities tolerant of seasonal, brief ponding. Vegetation must also be tolerant of acidic soils. The presence of moisture and low pH cause these communities to be slow-growing and canopy trees may be stunted. Such forests are characterized by strong presence, or dominance of black spruce (*Picea mariana*), with tamarack (*Larix laricina*) as a common associate. Other tree species may be present on sites including red maple (*Acer rubrum*), white pine (Pinus storbus), and balsam fir (*Abies balsamea*), but these species will not persist because of the lack of nutrients and high acidity. The shrub layer may be well developed in some

communities and often include Labrador tea (*Ledum groenlandicum*) and leatherleaf (*Chamaedaphne calyculata*). Characteristic understory plants include a total covering of Sphagnum moss, blueberries (Vaccinium, spp.), and sedges (Carex, spp.).

Dominant plant species

- black spruce (*Picea mariana*), tree
- tamarack (*Larix laricina*), tree
- leatherleaf (*Chamaedaphne calyculata*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- sedge (*Carex*), grass
- blueberry (*Vaccinium*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

Community 1.2
Intermediate Open Phase

This community phase is dominated by Labrador tea and leatherleaf, two species tolerant of extended ponding. The understory is dominated by Sphagnum and sedges. Sphagnum moss is developing thick layers and isolating site from groundwater.

Dominant plant species

- leatherleaf (*Chamaedaphne calyculata*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous

Community 1.3
Open Phase

This community is dominated by Sphagnum moss and sedges with a few very tolerant associates. These sites often have standing water throughout the growing season.

Dominant plant species

- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Mortality of canopy species from blow-downs, ice storms, or an increase in ponding frequency and duration. Lack of tree species may be increase ponding duration with the loss of transpiration. Increased connection to nutrient-rich groundwater.

Pathway 1.1.B
Community 1.1 to 1.3

Increase in ponding frequency and duration. Ponding is deep enough to cause mortality of trees and shrubs.

Pathway 1.2B
Community 1.2 to 1.1

Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thicker layers, causing surface to be isolated from groundwater. Establishment of black spruce and tamarack.

Pathway 1.2A

Community 1.2 to 1.3

Increase in ponding frequency and duration. Mortality of some woody species intolerant to increased ponding. Increased connection to nutrient-rich groundwater.

Pathway 1.3.A
Community 1.3 to 1.2

Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thick layers, beginning to isolate surface from groundwater. Labrador tea and leatherleaf establishment.

Additional community tables

Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in ecological site description.

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Approval

Suzanne Mayne-Kinney, 9/27/2023

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	09/27/2023
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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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):**

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:**