Ecological site F094BY001MI
Poor Fen

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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): 094B–Michigan Eastern Upper Peninsula Sandy Glacial Deposits

The Michigan Eastern Upper Peninsula MLRA (94B) corresponds closely with the Northwestern Sands Ecological Landscape. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources ecological landscape publication (2015).

The Michigan Eastern Upper Peninsula MLRA is in northeast Wisconsin on the border of the Upper Peninsula of Michigan, with a very small portion on the Lake Michigan coast disjoined from the rest of the MLRA. The Wisconsin portion of the MLRA is a bit shy of 1.1 million acres (1,668 square miles). This region, which was covered entirely by the Green Bay Lobe in Wisconsin's most recent glaciation, has a unique glacial landscape defined by intermingled loamy moraines and sandy heads-of-outwash. Extensive pitted outwash plains dominate the region, with significant glaciolacustrine sediments in the southeast portion of this region.

A prominent landform in this MLRA is the hummocky ridges of intermingled loamy moraines and sandy heads-of-outwash that protrude from extensive pitted outwash plains. These north-south trending, loamy morainal ridges were deposited as the Green Bay Lobe was stagnant—the rate of melting was relatively equal to the rate of advancement. This stagnation allowed the deposition of a ridge of sandy loam materials. Supraglacial till was deposited unevenly, and buried ice blocks melted and collapsed the surface to form hummocky topography on the moraines. The heads-of-outwash formed while the ice was melting and thinning rapidly. Large amounts of sand and gravel outwash materials, and some till and loamy debris-flow sediment, were deposited on top of the thin edge of ice. They, too, have hummocky topography resulting from the collapse of buried ice. The topographically similar appearances of the moraines and heads-of-outwash make them difficult to distinguish superficially, but they are formed in different-textured materials and the vegetation divergence is often evident. These moraines and heads-of-outwash mark the western extent of the Green Bay Lobe and are sometimes referred to as the Athelstane Moraines.

As the Green Bay Lobe receded, meltwaters carried sand and gravel outwash sediments to lower-lying areas. The outwash buried broken ice that melted, collapsed the surface, and created extensive pitted outwash plains that occur between the high elevation moraines and heads-of-outwash. More than 50% of this land region is covered in outwash sediments, and most of the outwash is pitted or collapsed.

The southeast portions of this MLRA are dominated by glacial lake sediments. Glacial Lake Oshkosh covered a portion of this MLRA when it was at its largest extent (1.4 million acres). The lake deposited silts and clays along the southeast portion of the inland section of this MLRA. Beach terraces, ridges, and dunes were also formed by the lake. In the Lake Michigan coastal section of this MLRA, Glacial Lake Nipissing deposited a level lake plain full of sandy lacustrine material that overlies dolomite and limestone bedrock. Glacial Lake Nipissing was a postglacial lake that occurred in the Lake Michigan Basin as the Lake Michigan Lobe was receding. Wetlands are abundant in this area of the MLRA. In the north section, Glacial Lake Dunbar formed when ice dams impounded glacial meltwater between the Athelstane Moraine and the Inner Athelstane Moraine. This glacial lake deposited small areas of level sandy lacustrine materials.

The northeast section of this MLRA is a till plain that formed in later advances of the Green Bay Lobe. Some pitted outwash is present, but the till plain is much more exposed here than elsewhere in the MLRA. The till deposited throughout 94B is primarily sandy, dolomitic till. The dolomite was scraped off the Niagara Escarpment as the Green Bay Lobe moved across it. In some areas, the carbonates are deeply leached.

Historically, this MLRA was dominated by a mixture of northern hardwood forests, Jack pine-scrub oak barrens, and forested coniferous wetlands at 30%, 29%, and 20%, respectively. White pine (*Pinus strobus*) and red pine (Pinus resinosa) were dominant tree species and covered an estimated 15% of the area. Northern hardwood forests were dominated by eastern white pine, eastern hemlock (Tsuga canadensis), and American beech (Fagus grandifolia). The Jack pine-scrub oak barrens were dominant in the sandy portions of this MLRA. Forested coniferous wetlands were occupied by norther white-cedar (Thuja occidentalis), black spruce (*Picea mariana*), and tamarack (*Larix laricina*).

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of N. Wisconsin (Kotar, 2017): Picea-Larix/Ledum (PmLLe)

Biophysical Settings (Landfire, 2014): Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen

WDNR Natural Communities (WDNR, 2015): Black Spruce Swamp

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Michigan Eastern Upper Peninsula MLRA (94B)

USFS Subregions: Athelstane Sandy Outwash and Moraines (212Tc), Green Bay Sandy Lake Plain (212Te)

Wisconsin DNR Ecological Landscapes: Northeast Sands, Northern Lake Michigan Coastal

Ecological site concept

The Poor Fen ecological site accounts for approximately 5,200 acres in MLRA 94B, or about 0.5% of total land area. It is the second-least extensive site in MLRA 94B. It is scattered throughout the MLRA in landscape depressions in pitted outwash plains. Poor Fen sites are characterized by very deep, very poorly drained soils formed in thick organic deposits sometimes underlain by sandy outwash. Sites are subject to frequent ponding in the spring and fall. Soils remain saturated during the growing season and meet hydric soils requirements. Water is primarily received form precipitation and runoff from adjacent uplands with little groundwater discharge and stream inflow. Soils range from very strongly acid to extremely acid. These sites are wetlands.

Poor Fen sites have low pH (dysic) caused by limited interaction with groundwater that may be enriched with carbonates. In addition, the groundwater discharging into Poor Fen sites is likely passing through surrounding parent materials that are acidic (i.e. outwash sands). The low pH limits vegetative growth.

Associated sites

F094BY004MI	**Wet Sandy Lowland** Wet Sandy Lowland wetland sites occupy landscape depressions in sandy landscapes, often sandy pitted outwash plains. They are poorly drained. They are found in association with the Poor Fen Ecological Site in slightly higher positions along the drainage sequence.
F094BY006MI	**Moist Sandy Lowland** Moist Sandy Lowland sites are found in lower landscape positions on outwash plains. They are somewhat poorly drained. They are found in association with the Poor Fen Ecological Site in higher positions along the drainage sequence.

F094BY008MI	**Sandy Upland** Sandy Upland sites are found in upland landscape positions on outwash plains, stream terraces, sandy lake plains, and moraines. They are moderately well to somewhat excessively drained. They are found in association with the Poor Fens Ecological Site in higher positions along the drainage sequence and are often found directly adjacent.
F094BY011MI	**Dry Upland** Dry Upland sites are found in upland landscape positions on outwash plains and stream terraces. They are excessively drained. They are found in association with the Poor Fen ecosite in higher positions along the drainage sequence and are often found directly adjacent.

Similar sites

F094BY002MI	**Mucky Swamp** Like the Poor Fen site, these organic lowland Mucky Swamp sites occupy landscape depressions and drainageways. Formed in deep, herbaceous organic deposits and are very poorly drained. Organic Lowland sites have a higher pH (euic rather than dysic) and improved growing conditions over Poor Fen sites.

Table 1. Dominant plant species

Tree	(1) *Picea mariana* (2) *Larix laricina*
Shrub	(1) *Chamaedaphne calyculata* (2) *Ledum groenlandicum*
Herbaceous	(1) *Sphagnum* (2) *Carex*

Physiographic features

Poor Fen sites are found on outwash plains in landscape depressions that receive little to no water from stream or groundwater flow. Slopes range from 0 to 1 percent.

Poor Fen sites are subject to occasional ponding. Ponding duration may be long (7 to 30 days) to very long (greater than 30 days). These soils have an apparent seasonally-high water table (endosaturation) at the surface. Runoff potential is negligible.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Depression (2) Drainageway (3) Bog
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	None to occasional
Elevation	170–263 m
Slope	0–1%
Ponding depth	0–30 cm
Water table depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Michigan Eastern Upper Peninsula MLRA is typical of northern Wisconsin: cooler summers, colder winters, and shorter growing seasons.

Table 3. Representative climatic features

Frost-free period (characteristic range)	100-108 days
Freeze-free period (characteristic range)	125-139 days
Precipitation total (characteristic range)	762-787 mm
Frost-free period (actual range)	99-110 days
Freeze-free period (actual range)	122-143 days
Precipitation total (actual range)	762-787 mm
Frost-free period (average)	115 days
Freeze-free period (average)	137 days
Precipitation total (average)	787 mm

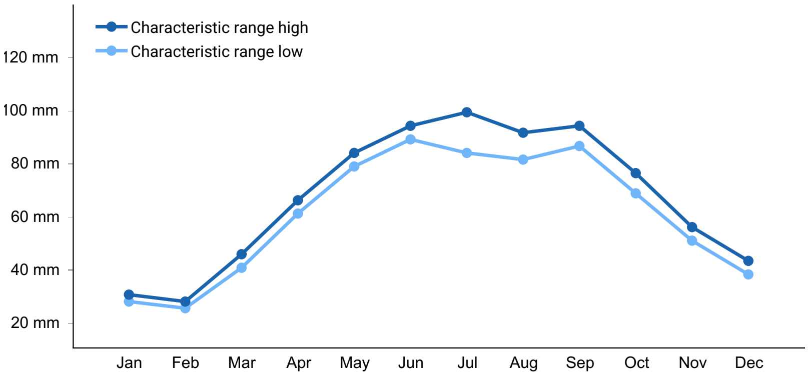


Figure 1. Monthly precipitation range

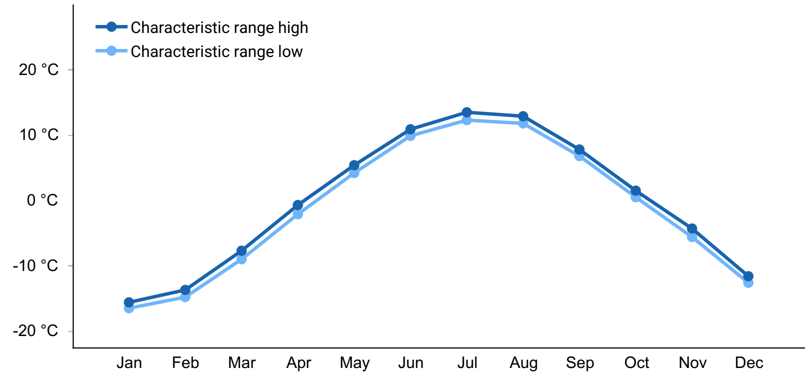


Figure 2. Monthly minimum temperature range

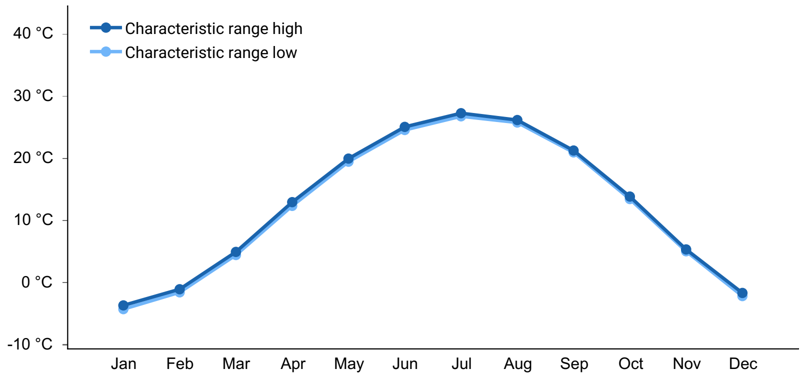


Figure 3. Monthly maximum temperature range

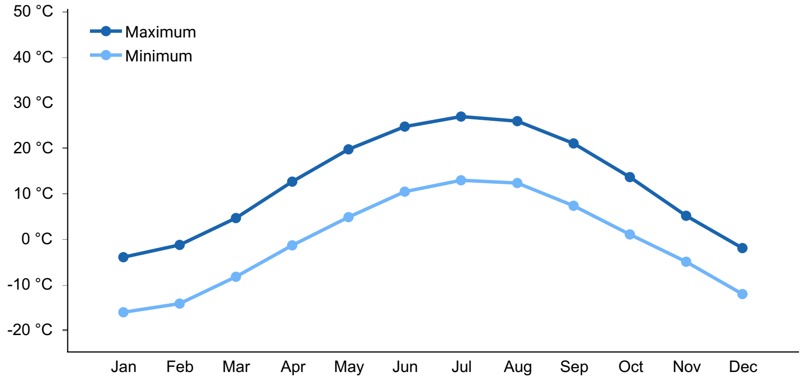


Figure 4. Monthly average minimum and maximum temperature

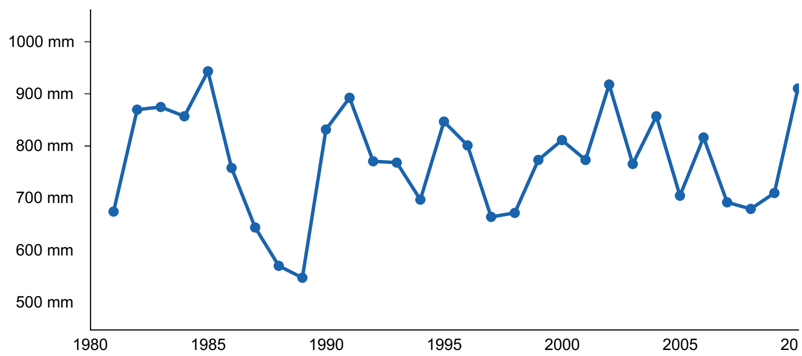


Figure 5. Annual precipitation pattern

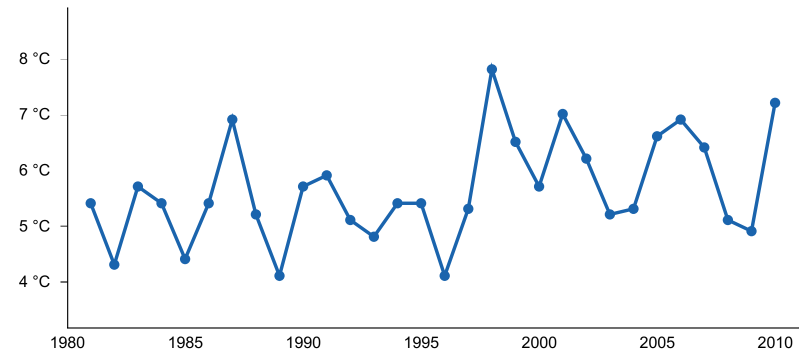


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (2) SURING [USC00478376], Suring, WI
- (3) IRON MT KINGSFORD WWTP [USC00204090], Kingsford, 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 leaves the site primarily through evapotranspiration, groundwater recharge, and less often, stream outflow.

The hydrology of Poor Fen sites significantly impacts their ecological development. Groundwater movement into these sites 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, as it is in the case of acid bogs.

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 deciduous, saturated, or
3) Palustrine, scrub-shrub, broad-leaved evergreen, saturated, or
4) Palustrine emergent, persistent, saturated

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

Permeability of the soil is slow.
Hydrologic Group: A/D
Hydrogeomorphic Wetland Classification: Depressional acidic forested/organic; Depressional acidic scrub-shrub/organic
Cowardin Wetland Classification: PFO4B, PSS4B, PSS3B, PEM1B

Soil features

The soils of Poor Fen sites are represented by the Loxley and Dawson soil series, both classified as Typic Haplosaprists.

These soils are form in very deep, highly decomposed organic material primarily of herbaceous origin. Some soils have contact with sandy, mineral subsoil within two meters of the surface. Soils are very strongly acid to extremely acid (dysic). They are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface horizon of these soils is often dominated by sphagnum moss with some fibric materials directly underlying. The subsurface horizons are composed of highly decomposed organic muck, or sapric materials. Sites are absent of carbonates within 80 inches (200 cm).

Figure 7. Dawson soil series photograph courtesy of UWSP taken on 6/26/2020 in Oconto County, WI.

Table 4. Representative soil features

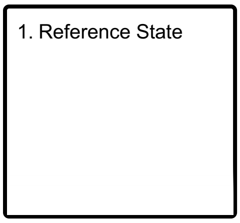
Parent material	(1) Organic material
Surface texture	(1) Mucky peat
Drainage class	Very poorly drained
Permeability class	Slow
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	61.47–63.75 cm
Soil reaction (1:1 water) (0-101.6cm)	3.5–5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

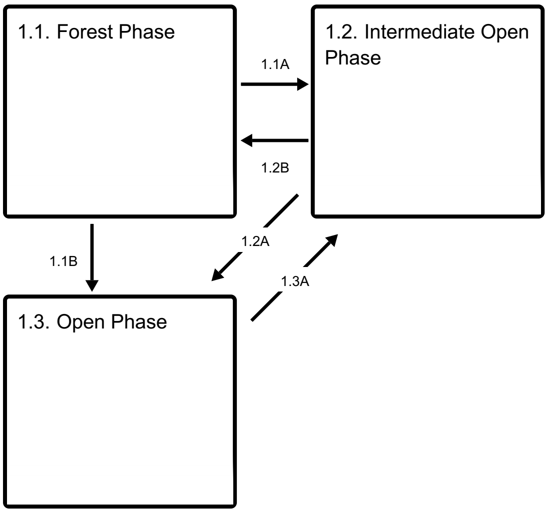
Vegetative communities on Poor Fen ecological sites develop over very long and slow processes. These sites are part of the acid peatlands of northern Wisconsin. Communities range from open bogs to black spruce swamps. These sites developed in wet depressions that allowed organic matter to build over 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 cause sites to become very acidic and poor in nutrients. Poor Fen 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. Alteration to the hydrology can cause severe changes. Drainage on or 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 - Mortality of canopy species from blow-downs, ice storms, or an increase in ponding frequency and duration from lack of transpiration.

1.1B - Ponding frequency and duration increases dramatically.

1.2B - Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thicker layers, causing surface to be isolated from groundwater.

1.2A - Ponding frequency and duration increases.

1.3A - Decrease in ponding frequency and duration. Sphagnum moss continues to grow and build up thick layers, beginning to isolate surface from groundwater.

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: a forested phase, shrub phase, and 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.

Community 1.1
Forest Phase

Figure 8. Photo courtesy of UWSP taken on 8/25/2020 in Oconto County, WI.

The forest phase consists of plant species 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*) and white pine (*Pinus strobus*), 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*), and other ericaceous species. Characteristic understory plants include a total covering of Sphagnum moss, with blueberries and cranberries (Vaccinium, spp.), sedges (Carex, spp.), and cottongrass (Eriophorum, spp.)

Resilience management. The forest phase is driven by seasonal, brief ponding.

Dominant plant species

- black spruce (*Picea mariana*), tree
- tamarack (*Larix laricina*), tree
- eastern white pine (*Pinus strobus*), tree
- bog Labrador tea (*Ledum groenlandicum*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- blueberry (*Vaccinium*), shrub
- sedge (*Carex*), grass
- cottongrass (*Eriophorum*), grass
- cranberry (*Vaccinium macrocarpon*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

Community 1.2
Intermediate Open Phase

Figure 9. Photo courtesy of UWSP taken on 6/30/2020 in Marinette County, WI.

The intermediate open phase also known as the shrub 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.

Resilience management. The intermediate open phase is driven by extended ponding.

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

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

Resilience management. The open phase is often driven by extended ponding.

Dominant plant species

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

Pathway 1.1A
Community 1.1 to 1.2

Forest Phase

Intermediate Open Phase

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 1.1B
Community 1.1 to 1.3

Dramatic increase in ponding frequency and duration relative to intermediate open phase. Mortality of most woody species intolerant to standing ponding. Increased connection to nutrient-rich groundwater.

Pathway 1.2B
Community 1.2 to 1.1


Intermediate Open Phase


Forest Phase

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 1.3A
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

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.
Habitat Types of N. Wisconsin (Kotar, 2017): Picea-Larix/Ledum (PmLLe)
Biophysical Settings (Landfire, 2014): Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen
WDNR Natural Communities (WDNR, 2015): Black Spruce Swamp

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Approval

Suzanne Mayne-Kinney, 11/16/2023

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NRCS contracted UWSP to write ecological sites in MLRA 94B, completed in 2021.

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	05/19/2024
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):

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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):**

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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:**