Ecological site F091XY001WI
Poor Fen

Last updated: 9/27/2023
Accessed: 04/23/2024

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): 091X–Wisconsin and Minnesota Sandy Outwash

The Wisconsin and Minnesota Sandy Outwash MLRA is the most extensive glacial outwash system in the northern half of Wisconsin. The total land area of the Wisconsin portion is just under 1.4 million acres (2,170 sq miles). The northern half is a former spillway for Glacial Lake Duluth. The flowing meltwater from the draining lake has left behind thick deposits of drift and carved a terraced river valley now occupied by the St. Croix and Bois Brule Rivers.

The northeastern section – the Bayfield hills – is a collapsed outwash plain where drift deposits are thick. Lacustrine materials from Glacial Lake Duluth line the northeastern tip. Moving southwest, the landscape transitions into a large pitted outwash plain. This is an area of extensive kettle holes, and, where the underlying till is less permeable, kettle lakes with some interspersed morainic hills and ridges. The glacial drift deposits are thinner in the southwestern section, although there is still no documented surface bedrock within this MLRA.

The St. Croix and Bois Brule rivers share a channel that lines much of the northwestern border of this MLRA. In some places along the channel, the underlying reddish-brown sandy loam till of the Copper Falls Formation is exposed along cut banks, though most of it is covered by a mantle of outwash. Glacial lakes deposited pockets of fine-textured lacustrine materials, most of which were washed away or buried by glacial outwash and meltwater flowing through the channel. East of the channel, some of the silty and clayey lakebed deposits are found near the surface, where they impede drainage and contribute to the formation of extensive wetlands.

Historically, the area supported jack pine (Pinus banksiana), scrub, and oak forests and barrens. The northern portion also supported stands of red pine (Pinus resinosa) and eastern white pine (*Pinus strobus*) as well. Marsh and sedge meadow, wet prairies, and lowland shrubs dominated the extensive wetland complexes in the southern tip of this MLRA (Finley, R., 1976).

Classification relationships

Relationship to Established Framework and Classification Systems:
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Boreal Acidic Peatland Forest, Boreal Acidic Peatland Shrubland, Laurentian-Acadian Herbaceous Wetlands, Boreal White Spruce-Fir Forest, Boreal White Spruce-Fir Forest, and Laurentian-Acadian Northern Hardwoods Forest

Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to two habitat types: *Picea mariana*-Larix/Ledum (PmLLe); *Picea mariana*-Larix/Nemopanthus (PmLNe)

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Black Spruce Swamp, Northern Wet Forest, and Northern Tamarack Swamp communities

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Wisconsin and Minnesota Sandy Outwash (91X)

USFS Subregions: Bayfield Sand Plains (212Ka)
Small sections occur in the Mille Lacs Uplands (212Kb) subregion

Wisconsin DNR Ecological Landscapes: Northwest Sands

Ecological site concept

The Poor Fen ecological site is scattered throughout MLRA 91X in depressions on lake plains and outwash plains. These sites are characterized by very deep, very poorly drained soils that formed in thick, highly decomposed organic deposits of herbaceous origin. Sites are subject to occasional ponding in the spring and fall and remain saturated throughout the growing season. These soils meet hydric requirements. Precipitation and runoff from adjacent uplands are the primary sources of water, though these sites may also receive limited groundwater discharge and stream inflow. Soils are extremely acidic.

Plant communities consist of typical Bog and Fen species. Sphagnum moss has almost continuous cover and other bog species, particularly those of Heath (Ericacea) family have high frequency of occurrence. Most common are leatherleaf (*Chamaedaphne calyculata*), Labrador tea (*Ledum groenlandicum*) and bog lauerel (Kalmia polifolia). The site can be treeless, sparsely wooded, or a forest. The only well-adapted and enduring tree species are tamarack (*Larix laricina*) and black spruce (*Picea mariana*). Other species that often occur, but show poor vigor due to nutrient deficiency and typically do not reach maturity, are paper birch (Betula papyriphera), white pine (*P. strobus*) and jack pine (P. banksiana).

Poor Fen sites are extremely acidic, much more so than their Mucky Swamp ecological site counterpart. The acidity is a result of limited interaction with groundwater that may be enriched with dissolved 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 extreme low pH limited vegetative growth.

Associated sites

F091XY005WI	**Wet Sandy and Loamy Lowland** These sites occur on depressions and drainageways on outwash plains and lake plains. They primarily form in sandy outwash are subject to some ponding and flooding. Soils are very deep and poorly or very poorly drained. They are saturated for much of the year. They may be adjacent to Poor Fen. They occur higher on the drainage sequence and are slightly drier.
F091XY007WI	**Moist Sandy and Loamy Lowland** These soils formed in sandy outwash, sandy lacustrine deposits, sandy eolian deposits, or loess that is sometimes underlain by sandy or loamy till. Soils are very deep and somewhat poorly drained. They occur higher on the drainage sequence and are drier than Poor Fen.
F091XY011WI	**Sandy Upland** These soils formed primarily in sandy outwash or sandy eolian deposits, but some sites formed in sandy lacustrine or loamy alluvium underlain by sandy outwash. Soils are very deep and are moderately well to somewhat excessively drained. They are neutral to extremely acid and lack a spodic horizon. They occur higher on the drainage sequence and are much drier than Poor Fen.
F091XY012WI	**Loamy Upland** These soils formed in loamy lacustrine, loamy alluvium, loamy till, sandy outwash, sandy eolian, or loess deposits. Some sites have underlying lacustrine deposits, till, or basalt bedrock. They are moderately well or well drained. They occur higher on the drainage sequence and are much drier than Poor Fen.
F091XY015WI	**Dry Upland** These sites formed in sandy outwash or eolian deposits. Soils are very deep, excessively drained, and lack a spodic horizon. They occur higher on the drainage sequence and are much drier than Poor Fen.

Similar sites

F091XY002WI	**Mucky Swamp** Like Acidic Poor Fen, Organic Lowlands consist of deep herbaceous organic materials. These sites are also wetlands. They occur on drainageways, depressions, and floodplains and are very poorly drained. Some sites have mineral soil contact. They receive more groundwater than Acidic Organic Lowlands and are therefore more alkaline and have better growing conditions that Poor Fen.
F091XY003WI	**Floodplain** These sites occur in depressions and flats on floodplains. They form in sandy to silty alluvium and are somewhat poorly to very poorly drained. They are subject to flooding. They are more alkaline and have better growing conditions that Poor Fen. Not all these sites are wetlands.

Table 1. Dominant plant species

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

Physiographic features

The Poor Fen ecological site occurs in depressions on moraines, lake plains, and outwash plains. Some sites may be in depressions on floodplains. Landform shape is concave and sites are often located on the footslope or toeslope position. Slopes are 0 to 2 percent.

These sites are subject to occasional to frequent ponding during the spring and fall months. The ponding duration ranges from brief (2 to 7 days) to long (7 to 30 days) with depths up to 6 inches above the surface. Typically, these sites do not flood. The soil has an apparent seasonally high water table (endosaturation) at the surface. The water table may drop to 60 inches during drought conditions. Runoff is negligible to medium.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Depression
Runoff class	Negligible to medium
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to occasional
Elevation	985–1,180 ft
Slope	0–2%
Ponding depth	0–15 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Wisconsin and Minnesota Sandy Outwash MLRA is typical of northern Wisconsin – colder winters and warmer summers. In general, the northern latitudes have cooler summers, colder winters, lower precipitation, and shorter growing seasons than the south; however, neither average annual precipitation nor average annual minimum and maximum temperatures vary greatly within this MLRA. The climate of the northernmost tip is somewhat affected by Lake Superior and receives higher annual precipitation in the form of lake effect snow.

Site sometimes occurs on landscape depressions and its local topography is expected to influence its growing season length. The freeze-free and frost-free periods may be shorter than what is represented here.

Table 3. Representative climatic features

Frost-free period (characteristic range)	74-98 days
Freeze-free period (characteristic range)	109-127 days
Precipitation total (characteristic range)	30-32 in
Frost-free period (actual range)	73-108 days
Freeze-free period (actual range)	105-134 days
Precipitation total (actual range)	29-32 in
Frost-free period (average)	89 days
Freeze-free period (average)	120 days
Precipitation total (average)	31 in

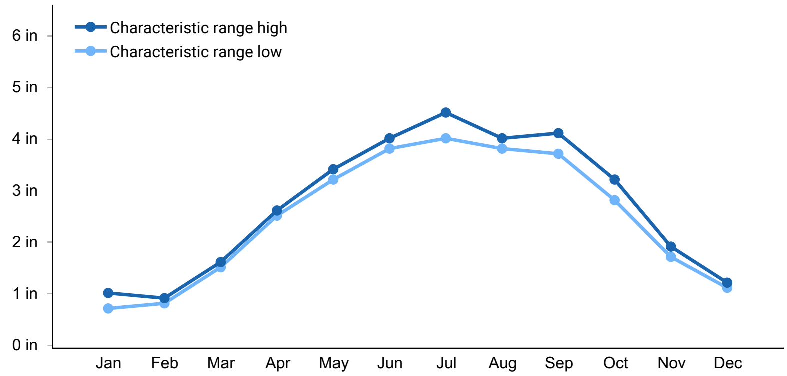


Figure 1. Monthly precipitation range

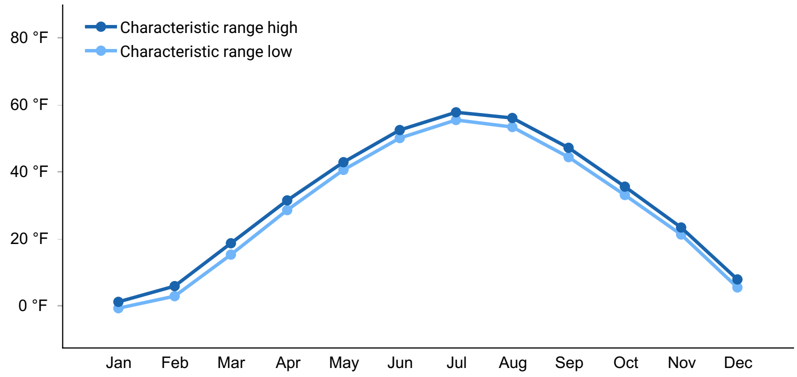


Figure 2. Monthly minimum temperature range

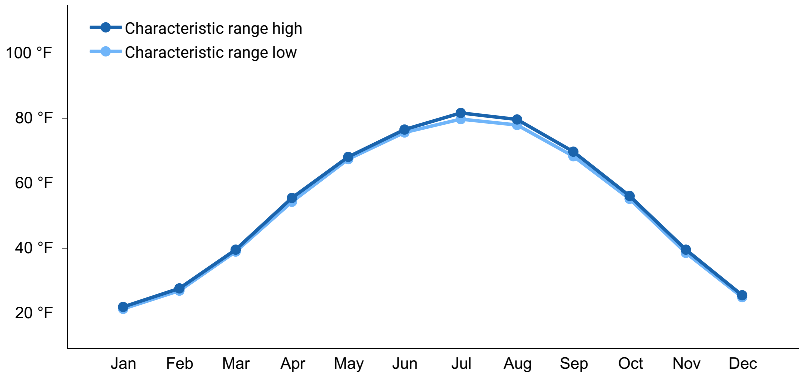


Figure 3. Monthly maximum temperature range

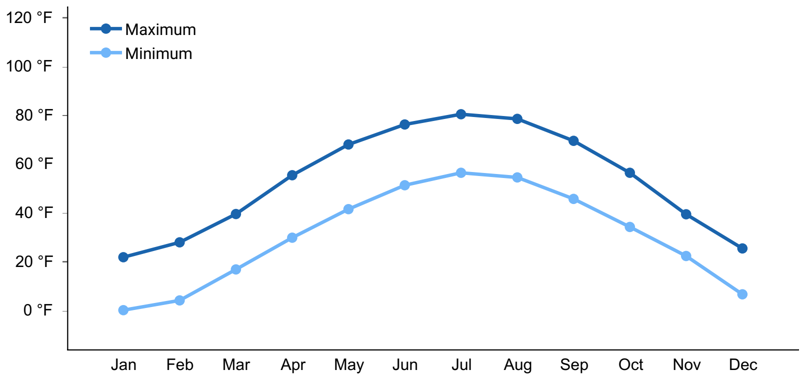


Figure 4. Monthly average minimum and maximum temperature

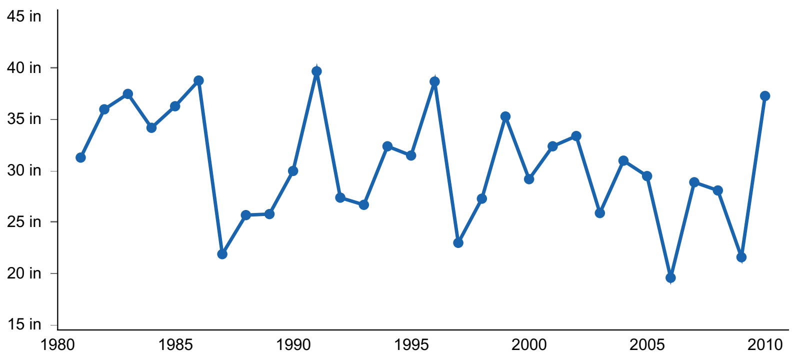


Figure 5. Annual precipitation pattern

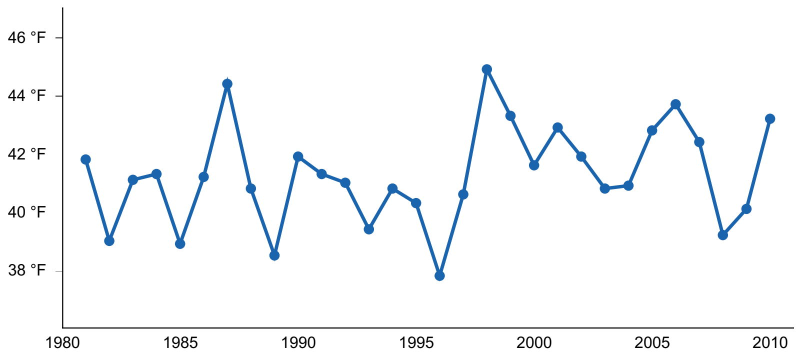


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DANBURY [USC00471978], Danbury, WI
- (2) MINONG 5 WSW [USC00475525], Minong, WI
- (3) GORDON [USC00473186], Gordon, WI

- (4) SOLON SPRINGS [USC00477892], Solon Springs, WI
- (5) HAYWARD RS [USC00473511], Hayward, WI
- (6) HAYWARD MUNI AP [USW00094973], Hayward, WI

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 Poor Fen site primarily through evapotranspiration and groundwater recharge.

The hydrology of Poor Fen 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.

Wetland description

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

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

Permeability of the soil is moderate. The hydrologic group of this site is A/D.

Soil features

The soils of Poor Fen ecological 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.

Figure 7. Loxley Soil Series sample taken on 07/24/2019 in Burnett County,

WI. Courtesy of UWSP

Table 4. Representative soil features

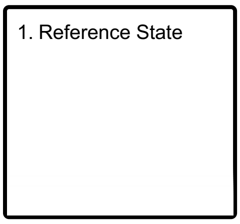
Parent material	(1) Organic material
Surface texture	(1) Mucky peat
Drainage class	Very poorly drained
Permeability class	Slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	24.2–25.1 in
Soil reaction (1:1 water) (0-40in)	3.5–5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

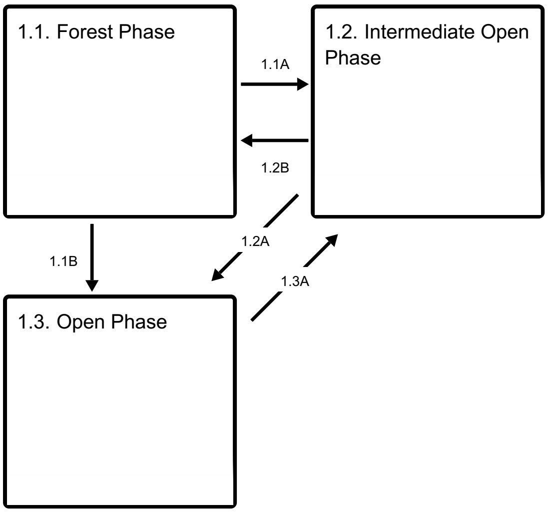
Vegetative communities on Poor Fen ecological sites develop over very long and slow processes. These sites are part of the acid peatlands of northern Wisconsin. Communities range from open bogs to black spruce swamps. These sites developed in wet depressions that allowed organic matter to build over 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 07/24/2019 in Burnett 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 intermediate open 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

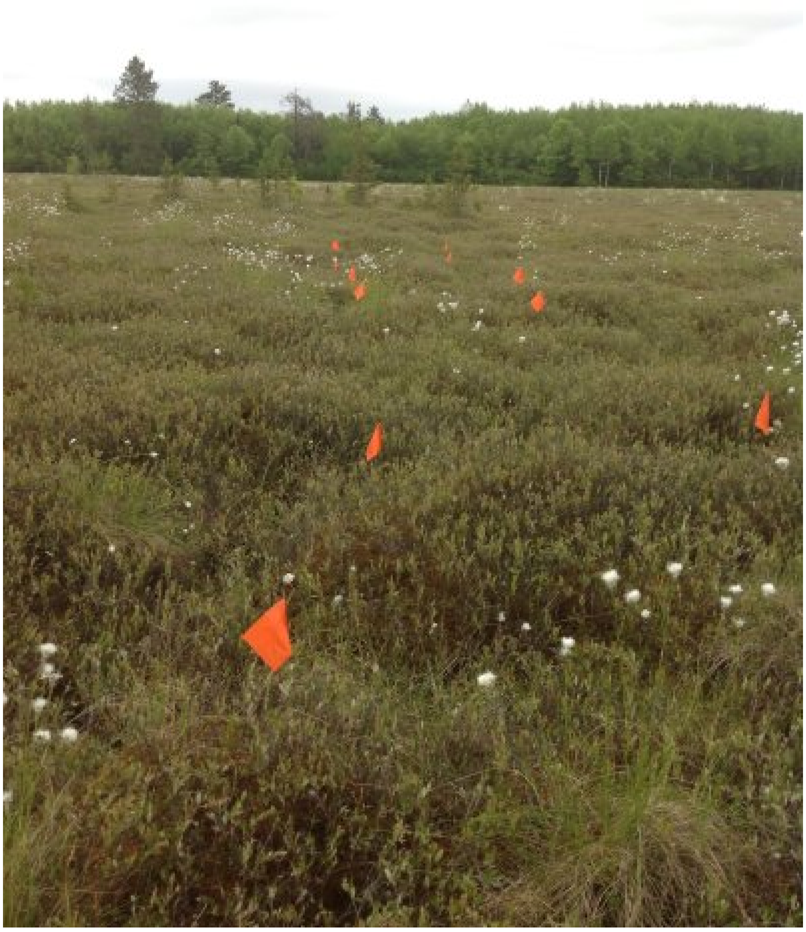


Figure 9. Photo courtesy of UWSP taken on 08/17/2019 in Douglas County, WI.

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

Figure 10. Photo courtesy of UWSP taken on 07/23/2019 in Kewaunee County, WI.

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

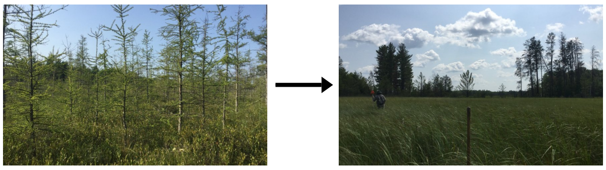
- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous

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.

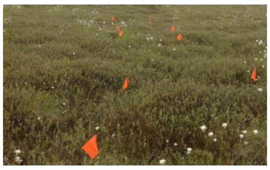
Pathway 1.1B
Community 1.1 to 1.3



Forest Phase **Open Phase**

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.

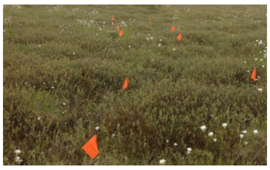
Pathway 1.2B
Community 1.2 to 1.1


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

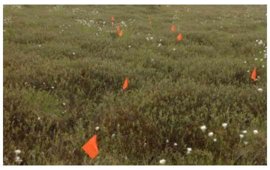

Intermediate Open Phase


Open Phase

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


Open Phase


Intermediate Open Phase

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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Contributors

Jacob Prater, Associate Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist, independent contractor
Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point

Approval

Suzanne Mayne-Kinney, 9/27/2023

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NRCS contracted UWSP to write ecological sites in MLRA 91. 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	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:**

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

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

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

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**