Ecological site F092XY003WI
Peaty Shore Fens

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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): 092X–Superior Lake Plain

The Wisconsin portion of the Superior Lake Plain (MLRA 92) corresponds very closely to the Superior Coastal Plain Ecological Landscape published by Wisconsin Department of Natural Resources (WDNR 2015). The following brief overview of this MLRA is borrowed from that publication.

The Superior Coastal Plain is bordered on the north by Lake Superior and on the south by the Northwest Sands, Northwest Lowlands, and North Central Forest Ecological Landscapes. The total land area is approximately 1.2 million acres, which mostly consists of privately-owned forestland. The climate is strongly influenced by Lake Superior, resulting in cooler summers, warmer winters, and greater precipitation compared to more inland locations. The most extensive landform in this ecological landscape is a nearly level plain of lacustrine clays that slopes gently northward toward Lake Superior. The coastal plain is cut by deeply incised stream drainages and interrupted by the comparatively rugged Bayfield Peninsula.

During the Late Wisconsin glacial period, this area was covered with the advancing and retreating lobes of Superior and Chippewa. The landscape was rippled with moraines, but they were subdued by deposition of lacustrine materials. As the glaciers receded, glacial lakes riddled the landscape—most notably, Glacial Lake Duluth. The glacier receded eastward, exposing the western Lake Superior Basin. The ice covered the eastern basin, blocking the outlet of the lake, and continued to recede and contribute meltwaters that filled the glacial lake. The deep, red clays were deposited during this period of glacial lakes. The meltwaters from the glacier also contained sands which were deposited along the edge of the glacial lakes as beach deposits. Deep, narrow valleys have since been

carved by rivers and streams flowing north into Lake Superior.

Historically, the Superior Coastal Plain was almost entirely forested. Various mixtures of eastern white pine (Pinus strobus), white spruce (Picea glauca), balsam fir (Abies balsamea), white birch (Betula papyrifera), balsam poplar (Populus balsamifera), quaking aspen (Populus tremuloides), and northern white-cedar (Thuja occidentalis) occurred on the fine-textured glacio-lacustrine deposits bordering much of the Lake Superior coast. Sandy soils, sometimes interlayered with clays, occur in some places. Such areas supported forests dominated by eastern white pine and red pine (Pinus resinosa). Eastern white pine was strongly dominant in some areas, according to mid-19th century notes left by surveyors of the federal General Land Office (Finley, R. 1976). Dry-mesic to wet-mesic northern hardwoods or hemlock-hardwood forests were prevalent on the glacial tills of the Bayfield Peninsula. Large peatlands occurred along the Lake Superior shoreline, associated with drowned river mouths.

Classification relationships

Habitat Types of N. Wisconsin (Kotar, 2002): These sites are open wetlands, so they do not truly key out to any Kotar Habitat Types. The closest type that may represent them is Picea mariana – Larix laricina / Ledum groenlandicum.[PmLLe]

Biophysical Setting (landfire, 2014): This ES is mapped as Eastern Boreal Floodplain and Boreal Acidic Peatland System; though, it is likely most represented by the latter.

WDNR Natural Communities (WDNR (2015): This ES is most similar to the Great Lakes Shore Fen.

USFS Subregions: Superior-Ashland Clay Plain Subsection (212Ya); May contain small areas of Ewen Dissected Lake Plain Subsection (212Jo), Winegar Moraines Subsection (212Jc), Gogebic-Penokee Iron Range Subsection (212Jb), and NorthShore Highlands Subsection (212Lb)*

Major Land Resource Area (MLRA): Superior Lake Plain (92)

Ecological site concept

Peaty Shore Fens has a very small extent in MLRA 92. Sites are located on the shore of Lake Superior, most concentrated on the Bayfield peninsula and the Apostle Islands. This ES occurs on very deep, partially decomposed organic herbaceous material. These sites are fens on shore complexes of Lake Superior and a major influencing water feature is groundwater discharge, causing this ES to be slightly acidic. The soils of the adjacent upland sites are often coarse-textured, which can lead to acidic groundwater. These sites are subject to the water level of Lake Superior and are saturated throughout the year, with seasonal ponding up to 15 cm above the soil surface. These sites are classified as hydric soils. Mucky Swamps tend to have a wider range of pH, occurs on the landscape away

from active shore complexes, and are comprised of highly decomposed herbaceous and woody organic materials. In addition, Peaty Shore Fens often have deeper organic layers, without lithic contact. Typical vegetation includes cattails, sphagnum, rushes, horsetail, sedges, leatherleaf, and bog rosemary.

Associated sites

F092XY006WI	**Wet Sandy Lowlands** Wet Sandy Depressions are poorly or very poorly drained sandy soils that have formed in outwash and lake plains. The sites are seasonally ponded depressions that remain saturated for sustained periods, allowing for hydric conditions to occur. Primarily associated with Kinross soil series. HGM criteria: recharge; Depressional. These sites are often directly adjacent to Peaty Shore Fens and are the next step up in the drainage sequence.
F092XY010WI	**Moist Sandy Lowlands** Moist Sandy Flats have a sandy mantle overlying finer glaciofluvial materials. The finer materials can cause episaturation in spring and fall, allowing the site to remain moist for some of the growing season, but does not remain saturated, nor does it have hydric conditions. These sites are higher up in the drainage sequence of Peaty Shore Fens.
F092XY013WI	**Sandy Uplands** These sites are formed primarily in sandy outwash or beach deposits, and some are underlain by finer glaciofluvial material. Sites are moderately well to well drained, but sites with underlying finer materials may have extended saturation in spring and fall. Sites range from strongly acid to neutral and may contain carbonates. These sites are often the top of the drainage sequence of Peaty Shore Fens.

Similar sites

F092XY002WI	**Mucky Swamps** These sites consist of saprist soils that have formed in deep organic materials in depressions. The soils are highly decomposed herbaceous and woody materials and range from 40 to greater than 200cm in depth. Sites are underlain by sandy or loamy glacial deposits. The sites are poorly to very poorly drained and remain saturated throughout the year. These are slightly acidic to slightly alkaline wetland soils. These sites are similar to Peaty Shore Fens in that they are both permanently saturated wetlands. They differ greatly in that these sites are often more alkaline, do not have direct influence from Lake Superior, and often have contact with mineral soil within 200cm.

F092XY001WI	**Sandy Shore Complex** These sites are active shore complexes on Lake Superior that are heavily influenced by water levels and wave action from the lake. They range from somewhat poorly (lower, wet flats) to excessively drained (higher, beach dune). Lower sites are more influenced by water levels and wave action than beach dunes. Various sites will also range in vegetation based on drainage and influence of the lake. These sites differ from Peaty Shore Fens because they are mineral soils formed in beach deposits.

Table 1. Dominant plant species

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

Physiographic features

This site occurs in fens located on shore complexes along Lake Superior. Landform shape is concave to linear. Elevation of the landforms range from 185 to 210 meters above sea level. Slopes are 0 to 1 percent.

Table 2. Representative physiographic features

Landforms	(1) Fen
Runoff class	Negligible
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	185–210 m
Slope	0–1%
Ponding depth	0–38 cm
Aspect	Aspect is not a significant factor

Climatic features

The Peaty Shore Fens PESD has a geographic spread across the MLRA but is contained to the shores of Lake Superior on the mainland and the Apostle Islands. The annual average precipitation is 29-32 inches, with an annual average snowfall range of 56-103 inches (PRISM, 1981-2010). The annual average minimum temperatures range from 31-55oF, and the annual average maximum ranges from 56-51oF (PRISM, 1981-2010). The length of the freeze-free period ranges from 173 to 197 days, with an average of 187 days (Table 2). The length of the frost-free period ranges from 143 to 169 days, with an average

of 159 days (Table 2). The data gathered from PRISM and the NOAA weather stations may not fully represent the very local weather to this PESD, as it may have a shorter freeze-free period, and different annual average maximum and minimum temperatures than what is presented. In addition, this PESD exists only on the shores of Lake Superior and may be subject to mores specific climatic features like wind and waves.

Table 3. Representative climatic features

Frost-free period (characteristic range)	109-114 days
Freeze-free period (characteristic range)	134-138 days
Precipitation total (characteristic range)	787-838 mm
Frost-free period (actual range)	108-114 days
Freeze-free period (actual range)	133-138 days
Precipitation total (actual range)	787-838 mm
Frost-free period (average)	111 days
Freeze-free period (average)	136 days
Precipitation total (average)	813 mm

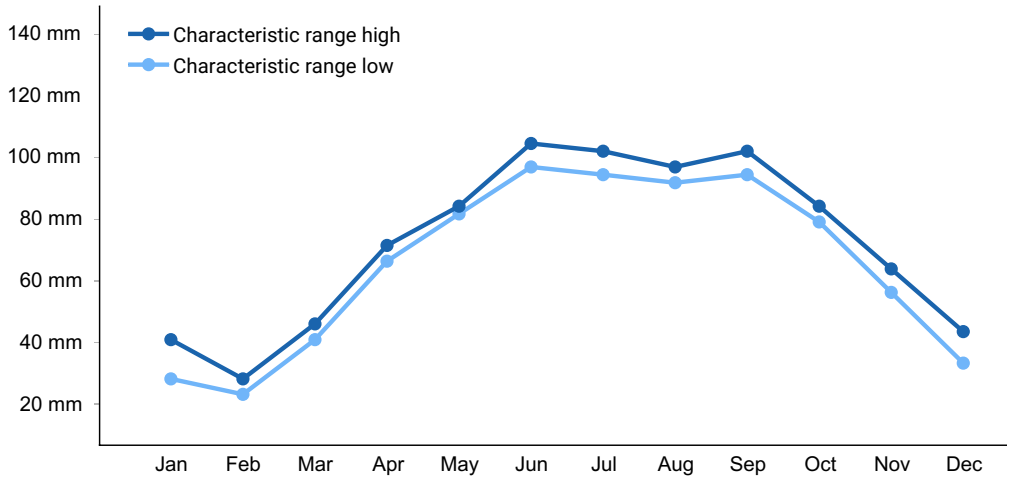


Figure 1. Monthly precipitation range

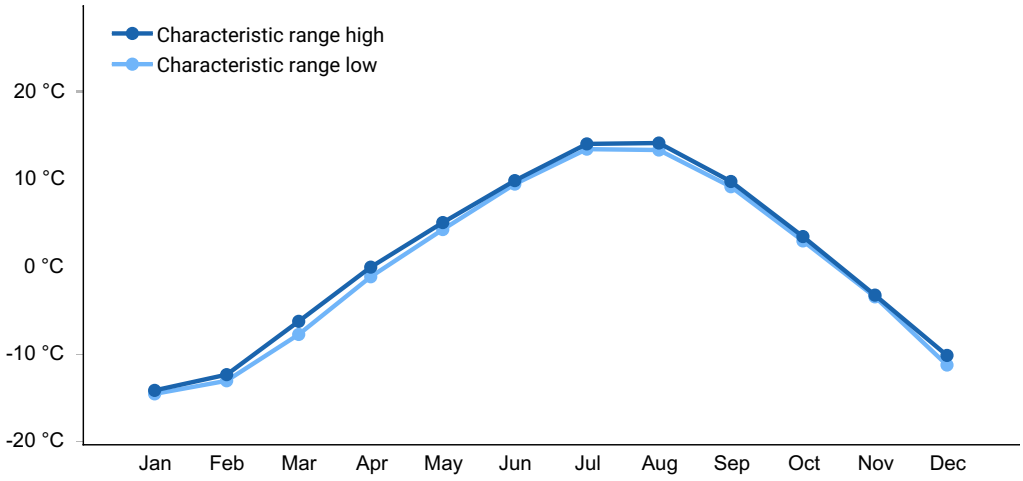


Figure 2. Monthly minimum temperature range

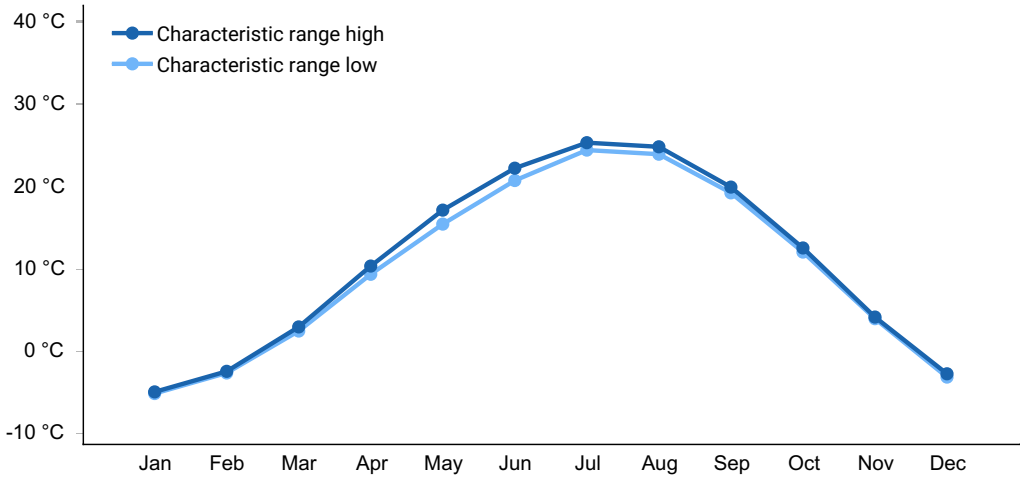


Figure 3. Monthly maximum temperature range

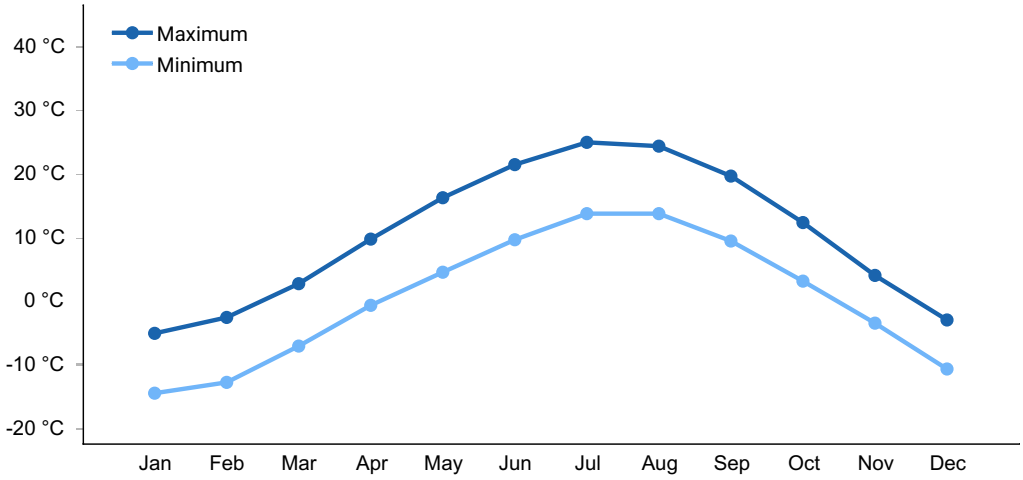


Figure 4. Monthly average minimum and maximum temperature

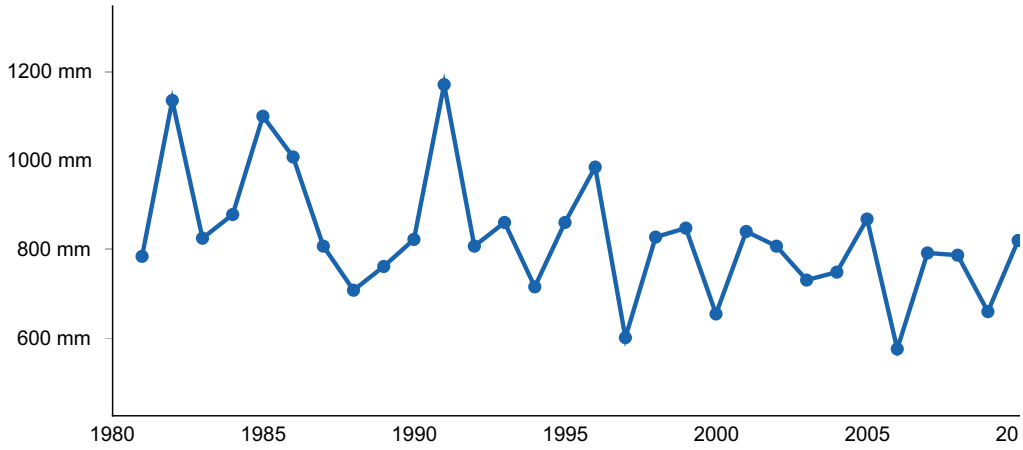


Figure 5. Annual precipitation pattern

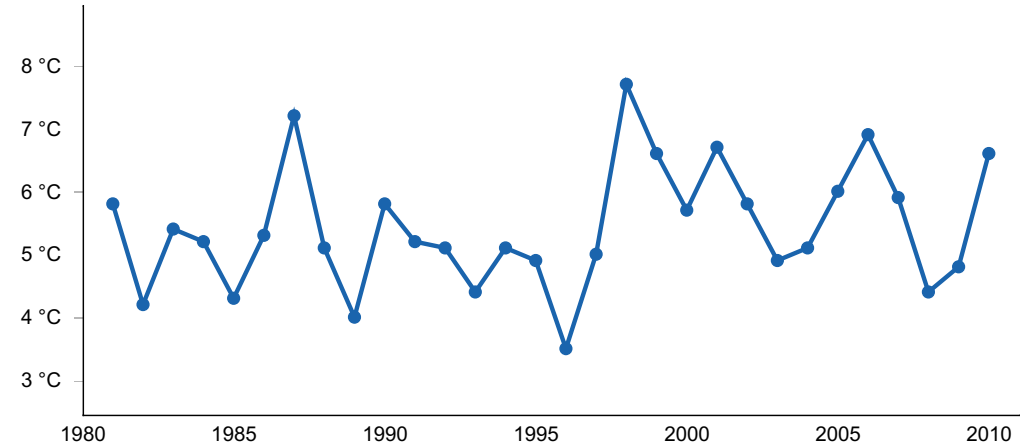


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SUPERIOR [USC00478349], Superior, WI
- (2) MADELINE ISLAND [USC00474953], La Pointe, WI
- (3) BAYFIELD 6 N [USC00470603], Bayfield, WI

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, stream inflow, and ground water. Water levels are greatly influenced by water levels of Lake Superior. Water is lost from the site primarily through stream outflow, subsurface outflow, evapotranspiration, and ground water recharge. These sites are wetlands.

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

These sites are subject to occasional to frequent ponding for brief to long periods during the spring and fall with water depths up to 15 cm above the surface. Typically these sites do not flood. The soil has an apparent seasonally high water table (endosaturation) that is

at a depth of 0 cm throughout the year. Water within the soil is generally lost through subsurface outflow, along with plant uptake and evapotranspiration. There is a very high potential for significant ground water recharge.

Wetland description

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

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Lacustrine Fringe, emergent/organic, or
2) Lacustrine Fringe, scrub-shrub/organic

Hydrologic Group: A/D
Hydrogeomorphic Wetland Classification: Lacustrine fringe, emergent/organic; Lacustrine fringe, scrub-shrub/organic
Cowardin Wetland Classification: PEM1B, PSS1B, PSS3B

Soil features

The soils of this site are represented by the Rifle soil series. Rifle is classified as a Haplohemist.

This ecological site is characterized by very deep, very poorly drained soils formed in partially decomposed organic deposits. The mucky peat is primarily of herbaceous origin, but does include some woody origin. These soils formed under saturated conditions throughout most of the year and meet the criteria for hydric soils.

Gravel, cobbles, and stones are typically absent. Soil reaction (pH) in the upper 100 cm is slightly acid. Carbonates are absent within 200 cm.

Table 4. Representative soil features

Parent material	(1) Organic material
Surface texture	(1) Peat
Drainage class	Very poorly drained
Permeability class	Slow
Soil depth	203 cm

Available water capacity (0-152.4cm)	51 cm
Soil reaction (1:1 water) (0-101.6cm)	6.5

Ecological dynamics

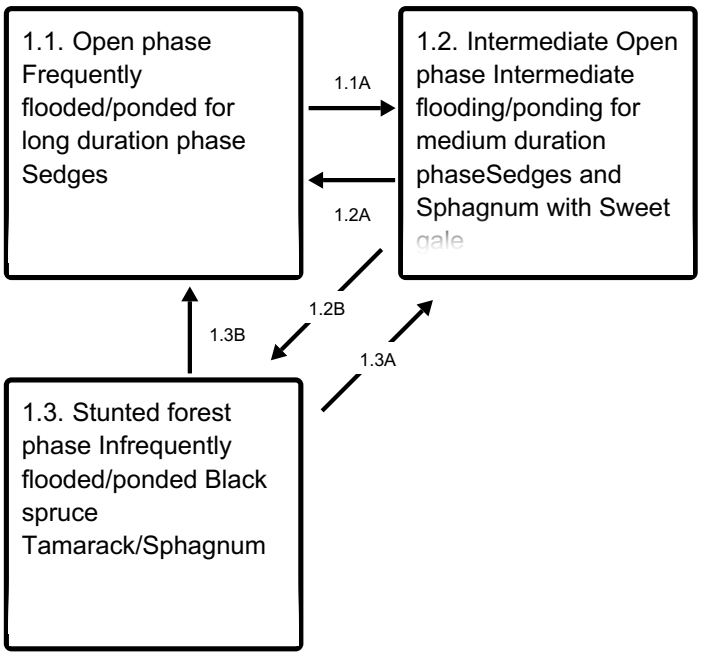
This ES is unique in that the pHs of the soils are relatively high and thus these are not necessarily dysic environments. That said it is common to find sphagnum and carnivorous plants on Rifle soils which comprise this ES. As this ES is adjacent to Lake Superior it is highly influenced by fluctuating lake levels. These flooding/ponding events, their frequency, and duration are the main drivers of the vegetative changes. The states of these ecosystems span a spectrum of high frequency flooding with long duration to low frequency with short duration. Along this spectrum a site with high frequency of flooding and longer duration will be dominated by sedges and have few if any trees and shrubs (phase 1.1). As the frequency of flooding and its duration decrease the site will be a mixture of sphagnum and sedges with buckbean and sweet gale (phase 1.2). As the frequency and duration of flooding becomes minimal Black spruce and Tamarack will take hold and grow as a stunted forest (phase 1.3). At some sites behind the sandy beach ridges of Lake Superior you can find a continuum of these phases together extending from 1.1 nearest the surface water input from the lake to 1.3 at the point farthest from an inlet.

State and transition model

Ecosystem states

1. Reference State

State 1 submodel, plant communities



1.1A - Flooding frequency and duration decreases

1.2A - Flooding frequency and duration increases

1.2B - Very infrequent flooding

1.3B - Flooding frequency and duration increases dramatically

1.3A - Flooding frequency and duration increases moderately

State 1
Reference State

The reference state for Peaty Shore Fens represents multiple stable phases influenced by hydroperiod disturbances. The fluctuation of lake levels drives changes over long periods of time between these alternate stable phases. These phases represent a continuum of change from a stable stunted forest of tamarack with complete soil surface cover of sphagnum in the driest conditions to an open phase consisting primarily of sedges in the wettest condition with an intermediate phase in between where a few tamaracks may persist, but not reproduce, and a few woody species of stunted shrubs may be present.

Community 1.1
Open phase Frequently flooded/ponded for long duration phase Sedges

This open phase community consists primarily of sedges and grasses and is a response to high lake levels. Shrubs are very uncommon in this phase, but may be present in a stunted form. Trees are most likely absent or dead when present. Reproduction of trees and shrubs is severely limited due to long wet periods.

Community 1.2
Intermediate Open phase Intermediate flooding/ponding for medium duration phaseSedges and Sphagnum with Sweet gale

This community phase represents a less frequent flooding and shorter duration inundation period than phase 1.1. As such plants that cannot tolerate long periods of wetness begin to appear. Sphagnum is often present on these sites, but does not represent a full

coverage. The sedges and grasses that were present in phase 1.1 are still present, but there are additional plants present such as sweet gale and the occasional tamarack seedling or stunted tree.

Community 1.3
Stunted forest phase Infrequently flooded/ponded Black spruce Tamarack/Sphagnum

As lake levels begin to effect a site less (shorter flooding periods and lower water levels) a sphagnum carpet will cover the site and a stunted tamarack forest with be present. There is significant reproduction of tamaracks, but the mature trees are quite stunted.

Pathway 1.1A
Community 1.1 to 1.2

Open phase Frequently flooded/ponded for long duration phase Sedges

Intermediate Open phase Intermediate flooding/ponding for medium duration phaseSedges and Sphagnum with Sweet gale

Flooding frequency and duration decreases somewhat due to lowering lake levels allowing sphagnum and other plants to grow among the sedges and grasses.

Pathway 1.2A
Community 1.2 to 1.1

Intermediate Open phase Intermediate flooding/ponding for medium duration phaseSedges and Sphagnum with Sweet gale

Open phase Frequently flooded/ponded for long duration phase Sedges

Flooding frequency and duration increases due to lake levels rising and the site becomes inundated for longer periods of time causing sedges and grasses tolerant to high water for long periods to dominate the site.

Pathway 1.2B
Community 1.2 to 1.3

Intermediate Open phase Intermediate flooding/ponding for medium duration phaseSedges and Sphagnum with Sweet gale

Stunted forest phase Infrequently flooded/ponded Black spruce Tamarack/Sphagnum

Flooding frequency and duration becomes infrequent and shorter allowing the site to remain drier at the soil surface for more of the year. This allows tamarack to reproduce and thrive in a stunted condition.

Pathway 1.3B

Community 1.3 to 1.1

Stunted forest phase Infrequently flooded/ponded Black spruce Tamarack/Sphagnum

Open phase Frequently flooded/ponded for long duration phase Sedges

Flooding frequency and duration increases due to lake levels rising and the site becomes inundated for longer periods of time shifting the vegetation away from woody plants to sedges and grasses.

Pathway 1.3A
Community 1.3 to 1.2

Stunted forest phase Infrequently flooded/ponded Black spruce Tamarack/Sphagnum

Intermediate Open phase Intermediate flooding/ponding for medium duration phaseSedges and Sphagnum with Sweet gale

Flooding frequency and duration increases moderately and trees such as tamarack are no longer able to reproduce and thrive.

Additional community tables

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Contributors

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

Approval

Chris Tecklenburg, 4/09/2020

Acknowledgments

Contact for Lead Authors: Jacob Prater (jprater@uwsp.edu) Associate Professor at University of Wisconsin Stevens Point, John Kotar (jkotar@wsic.edu) Ecological Specialist, independent contract, and Bryant Scharenbroch Assistant Professor at University of Wisconsin Stevens Point

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	05/20/2025
Approved by	Chris Tecklenburg
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):**

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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:**
