Ecological site F095XB001WI
Mucky Swamp

Last updated: 11/16/2023
Accessed: 05/10/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 095X–Eastern Wisconsin, Northern Illinois, and Upper Michigan Drift Plain

This MLRA is characterized by nearly level to rolling till plains, outwash plains, drumlin fields, and glacial lake plains. It is used to produce cash crops, feed grain, and livestock. It includes the shorelines of Lake Winnebago and Lake Michigan. This area is in Wisconsin (85 percent), Illinois (10 percent), and Michigan (5 percent). It makes up about 17,255 square miles (44,690 square kilometers). This area is in the Central Lowland province of the Interior Plains. Most of the area is in the Eastern Lake section. A narrow strip along the southwestern edge of the area is in the Wisconsin Driftless section. The southwestern quarter is in the Till Plains section. The nearly level to rolling till plains, glacial lake plains, and outwash plains are mixed with drumlin fields, ground moraines, end moraines, flood plains, lake terraces, beaches, dunes, swamps, and marshes. Most of the southern part of this area has belts of morainic hills and ridges and nearly level outwash terraces. Drumlins are prominent features in the central part of the area. Glaciokarst topography occurs in the east-central parts of the area influenced by underlying Niagara Dolomite. Lakes and streams are numerous, and streams generally form a dendritic drainage pattern. Elevation ranges from 530 to 1,580 feet (160 to 480 meters). Local relief is mainly 25 feet (8 meters), but the moraines, drumlins, and bedrock escarpments rise 80 to 330 feet (25 to 100 meters) above the adjacent valleys.

The annual precipitation ranges from 28 to 37 inches (700 to 950 millimeters) with a mean of 33 inches (840 millimeters). The annual temperature ranges from 41 to 48 degrees F (5.1 to 9.2 degrees C) with a mean of 46 degrees F (7.7 degrees C). The freeze-free period ranges from 115 to 185 days with a mean of 155 days. It decreases in length from south to north and from the shore of Lake Michigan inland. Lake Michigan helps to moderate the climate of the area.

This MLRA is mostly covered with glacial drift of Wisconsin age. Some of the higher areas are moraines that appear as arc-shaped ridges representing the retreat of the ice from south to north. Most of the bedrock in the area consists of Silurian, Ordovician, and Cambrian sandstone, limestone, and dolomite. Some igneous and metamorphic rocks underlie the northwestern edge of the area. Devonian limestone and shale occur at the far eastern edge in the Milwaukee area.

The dominant soil orders in this MLRA are Alfisols, Entisols, Histosols, Mollisols, and Spodosols. The soils in the area dominantly have a mesic or frigid temperature regime, an aquic or udic moisture regime, and mixed mineralogy. They are very deep, excessively drained to very poorly drained, and sandy to clayey. Areas of Spodosols and soils with a frigid soil temperature regime occur in the northern part of the MLRA.
The northern part of this MLRA supports natural stands of mixed northern hardwoods and pine. Sugar maple, oak, white ash, elm, yellow birch, white pine, red pine, and American beech are the principal species. Low-lying areas support both mixed hardwoods and conifers. Elm, soft maple, black ash, and northern white cedar are the major species. Brush and sedge meadows also occur in the low-lying areas.

The southern part of this MLRA supports hardwoods and prairie vegetation. Uplands support natural stands of oak, sugar maple, and hickory, and natural prairie vegetation is characterized by little bluestem and big bluestem. Many of the prairies have scattered oak and hickory trees. Low-lying areas support sedge and grass meadows and mixed

stands of hardwoods and conifers. Elm, ash, eastern cottonwood, soft maple, and white cedar are the major species in the low-lying areas. (USDA-NRCS, 2022)

LRU notes

The Southern Wisconsin and Northern Illinois Drift Plain LRU (Land Resource Unit) (95XB) corresponds closely to the Central Sand Hills and Southeast Glacial Plains Ecological Landscapes. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources Ecological Landscape publication (2015).

The Southern Wisconsin and Northern Illinois Drift Plain MLRA is found in southeast Wisconsin and extends into northern Illinois. The Wisconsin portion of this LRU is approximately 6.3 million acres (9,900 square miles). This LRU was entirely glaciated – mostly formed by the Green Bay and Lake Michigan Lobes of the Wisconsin Glaciation except the southern part, which was covered by an earlier glaciation. The landscape is dominated by till plains with drumlins, but also has large areas of outwash, pitted outwash, and glaciolacustrine deposits. The LRUcontains the Kettle Interlobate Moraine—the end moraine system formed where the Green Bay and Lake Michigan lobes met. The thickness of glacial deposits is typically less than 15 meters deep throughout the LRU, but the eastern portion can reach up to 60 meters thick. Nearly all the LRU is covered in a loess cap ranging from 1.2 meters (in the west) to 15 centimeters (in the east).

The northwest portion of LRU 95XB is part of the Central Sand Hills Ecological Landscape. The area from Portage County south through Marquette is dominated by till plains covered in outwash. The Green Bay Lobe deposited the till and created a morainal system along the west margin. The Johnstown moraine is the terminal moraine, but smaller, lateral moraines are also prominent on the landscape. As the glacier receded, meltwaters covered the intermorainal till plain with sand and gravel outwash sediments, sometimes covering blocks of ice. As the temperatures rose, the ice melted and collapsed the surface, creating an extensive area of pitted outwash. Till in this area is sandy and lacks dolomite found in other tills of this LRU. It may be hard to distinguish from the sandy outwash of the area. The rest of the northwest portion is dominated by till plains and glacial lake sediments. Glacial Lake Wisconsin covered a portion of this LRU, but the Lewiston Basin is the most significant glacial lake in this region. The Lewiston Basin formed when glacial meltwaters were impounded behind the Johnstown Moraine. Most of the lake drained after a catastrophic breach of an ice dam that supported it. The rest of this region is a till plain covered in a thin layer of loess. This till is a sandy loam with dolomite from the Niagara Escarpment. The till plain is covered with drumlins and bedrock-cored knolls and hills where the overlying till has been eroded. Wetlands are common in the low-lying outwash and the fine-textured lake sediments.

The central portion of this LRU is dominated by a rolling till plain covered in drumlins. Terminal and recessional moraines show the extent of the Green Bay Lobe. The topography of the moraines is hummocky because the supraglacial till was deposited unevenly along the ice margin and the surface collapsed after buried ice melted. Glacial lakes formed on the ice margin from ice dams, bedrock ridges, and moraines. Glacial Lakes Scuppernong and Yahara were two significant lakes that deposited clay and silty clay in deep basins. Meltwater streams deposited outwash sediments over some areas of the till plain, creating pockets of outwash and pitted outwash. The till deposited here is gravelly, clayey, and silty sand with dolomite pebbles.

The Kettle Interlobate Moraine is a unique and significant feature along the eastern border this LRU. The Kettle Moraine is a complex range of ridges and hills that formed by the end moraine systems where the Green Bay and Lake Michigan lobes met. The area ranges from 1 to 30 miles wide and landforms up to 300 feet in elevation. The area experienced massive volumes of meltwater from the two glacial lobes, which deposited primarily sand and gravel, but morainal till is also present. There are two distinct portions for the Kettle Moraine. The south potion formed as the lobes receded and deposited a series of level outwash fans between the lobes. Buried ice melted and parts of the fan collapsed to form kettles—round depressions on the surface that often fill with water to become lakes when the water table is near the surface. In the northern section, debris collected in the ice where the two lobes flowed together. As the glaciers receded, meltwaters deposited outwash materials on top of ice. As the ice melted, the surface collapsed and created a mixture of collapsed outwash and till materials. The till was in and beneath the buried ice.

West of the Kettle Moraine lies a landscape dominated by till plains with drumlins and areas of outwash formed by the Lake Michigan Lobe. Braided proglacial streams deposited outwash and pitted outwash plains. A small extent of lake plains is present. Wetlands are abundant because of impeded drainage from the underlying till and lake sediments.

The southern portion of this LRU is comprised of older glacial sediment deposited before the Wisconsin Glaciation. In the east lie broad, flat to rolling till plains. In the west, an eroded and dissected, hilly bedrock-controlled landscape is present; this area is similar in appearance to the Driftless region. Some low areas have outwash deposited by proglacial streams from Green Bay Lobe meltwater. In some areas in the west, dissolution of bedrock has created karst topography. There is a small extent of lake plain sediments.

Historically, the vegetation in this LRU was dominated in the northwest by oak forest and opening with interspersed marsh and sedge wetlands. The southern portion was dominated by oak and mesic forests with abundant wetlands. Black oak (Quercus velutina), white oak (Quercus alba), and bur oak (Quercus macrocarpa) were significant tree species in all of the LRU. There were also many areas of prairie, maple-basswood upland forest, and small areas of tamarack (Larix laricina), northern white-cedar (*Thuja occidentalis*), and black spruce (Picea mariana) in the lowlands. Conifers were not significant in this LRU. Wetlands covered up to 17% of land area.

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of N. & S. Wisconsin (Kotar, 2002, 1996): The sites of this ES keyed out to *Fraxinus nigra*-Acer rubrum-Impatiens-Ilex [FnArI-Ix].

Biophysical Settings (Landfire, 2014): This ES is largely mapped as Central Interior and Appalachian Herbaceous Wetlands, Central Interior and Appalachian Swamp Forest, Central Interior and Appalachian Swamp Shrubland, North-Central Interior Maple-Basswood Forest, Eastern Cool Temperate Developed Ruderal Grassland, and Eastern Cool Temperate Row Crop

WDNR Natural Communities (WDNR, 2015): This ES is most similar to Shrub Carr, Southern Sedge Meadow, and Southern Hardwood Swamp as described by the WDNR.

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): 095X–Eastern Wisconsin, Northern Illinois, and Upper Michigan Drift Plain

USFS Subregions: Central Wisconsin Moraines and Outwash (222Kb), South Central Wisconsin Prairie and Savannah (222Kd), Southern Green Bay Lobe (222Ke), Geneva-Darien Moraines and Till Plains (222Kf), Rock River Old Drift Country (222Kh)

DNR Ecological Landscapes: Southeast Glacial Plains, Central Sand Hills

Ecological site concept

These soils form in very deep, herbaceous organic materials in floodplains and depressions. Some soils are underlain by fine alluvium, lacustrine, or drift deposits. Lacustrine deposits may sometimes be stratified with coarser materials. These sites occur on ground moraines, lake plains, and outwash plains.

These soils are generally slightly acid to moderately alkaline. A few sites in Marquette county may be moderately acid. Presence of carbonates varies greatly in these soils. They may be absent or as high at 70 percent in marly soils. Fragments may be found in soils underlain by glacial drift. These soils are very poorly drained and meet hydric soil requirements. These sites are usually wetlands.

Similar sites

F095XB002WI	**Wet Floodplain** These sites occur on floodplains and depressions and form in very deep, loamy or silty materials, primarily alluvial in origin. Most sites are subject to flooding events of varying frequency, duration, and intensity. They are very poorly to moderately well drained. These sites are sometimes wetlands and may sometimes host ecological communities similar to those supported by Mucky Swamp.

F095XB003WI	**Wet and Moist Sandy Lowland** These sites occur on depressions in sandy outwash plains and stream terraces, primarily in the northwestern portion of the MLRA. They form in very deep, sandy outwash or lacustrine materials, sometimes underlain or overlain by finer-textured materials. Generally, they lack secondary carbonates and are very poorly to somewhat poorly drained. Like Mucky Swamp, they often occupy landscape depressions and host vegetation tolerant of prolonged periods of wetness.
F095XB004WI	**Wet Loamy or Clayey Lowland** These sites occur on depressions within loamy glacial landscapes including till plains and lake plains. They form in very deep, loamy alluvium, till, outwash, or lacustrine materials. They are sometimes underlain by clayey lacustrine deposits or sandy outwash. They are very poorly to poorly drained. Like Mucky Swamp, they occupy landscape depressions and host vegetation tolerant of prolonged periods of wetness.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Quercus*
Shrub	(1) *Alnus incana* (2) *Cornus racemosa*
Herbaceous	(1) *Carex* (2) *Onoclea sensibilis*

Physiographic features

This site occurs in floodplains and depressions on ground moraines, lake plains, and outwash plains. It's found in lower landscape positions between drumlins, especially in the central portion of this MLRA where extensive drumlin field dominate the landscape. Landform shape is concave, and sites are in the toeslope position. Slope ranges from 0 to 2 percent.

Typically, these sites are not flooded and frequently ponded, though some sites may flood, and others may rarely pond. Ponding duration ranges from two days to over a month. The soil has a seasonally high water table (endosaturation) within 6 inches (15 cm) of the surface. Some sites found on silty or clayey glacial lake beds have perched water tables (episaturation). Runoff is negligible.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Slope shape across	(1) Concave
Landforms	(1) Depression (2) Flood plain (3) Swale
Runoff class	Negligible
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	Rare to frequent
Elevation	705–951 ft
Slope	0–2%
Ponding depth	0–24 in
Water table depth	0–6 in
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of MLRA 95B is typical of southern Wisconsin – cold winters and warm summers. The MLRA spans over 2 degrees of latitude, or about 150 miles. The lowest latitudes have warmer summers, warmer winters, and high precipitation rates. The growing season decreases from south to north and from the shores of the thermal mass of Lake Michigan inland.

This site occurs on landscape depressions and may have a microclimate with shorter freeze-free and frost-free periods than what is represented by the weather station data.

Table 3. Representative climatic features

Frost-free period (characteristic range)	121-127 days
Freeze-free period (characteristic range)	148-160 days
Precipitation total (characteristic range)	33-35 in
Frost-free period (actual range)	120-129 days
Freeze-free period (actual range)	144-162 days
Precipitation total (actual range)	31-36 in
Frost-free period (average)	124 days
Freeze-free period (average)	154 days
Precipitation total (average)	34 in

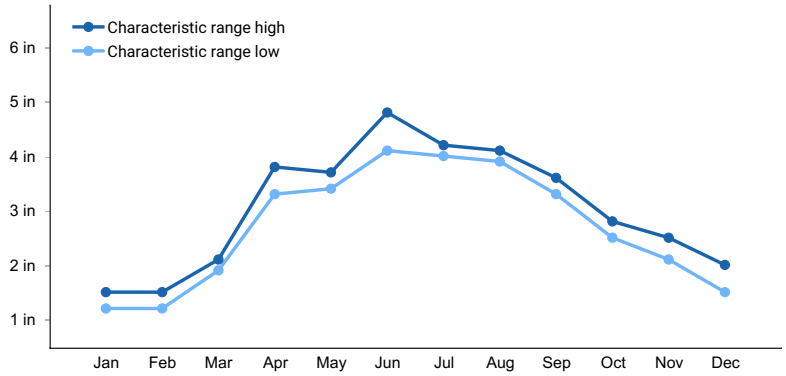


Figure 1. Monthly precipitation range

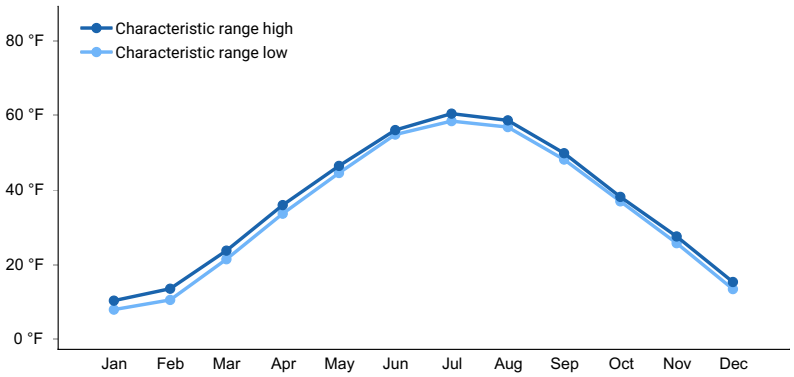


Figure 2. Monthly minimum temperature range

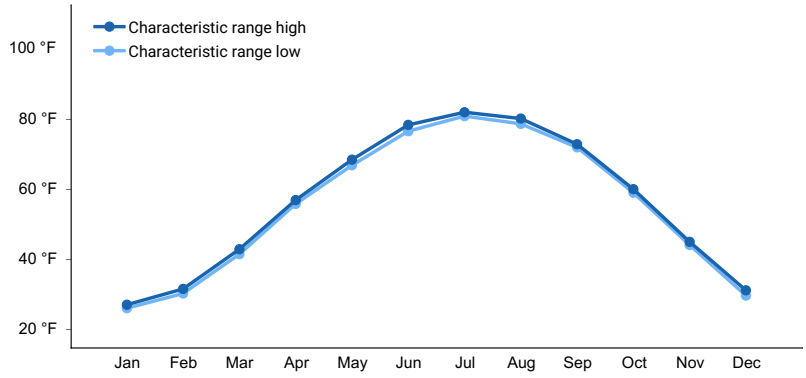


Figure 3. Monthly maximum temperature range

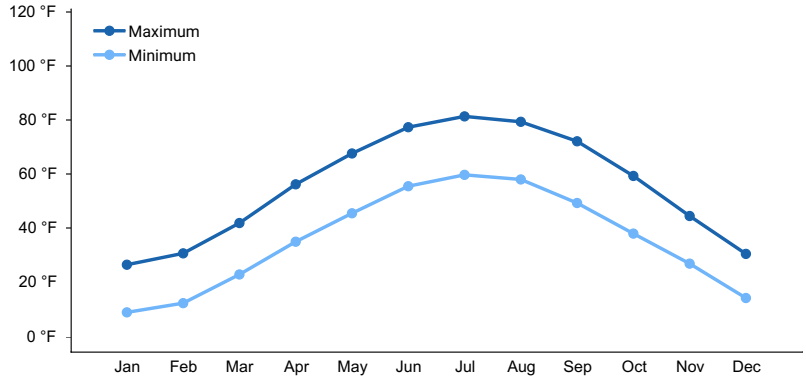


Figure 4. Monthly average minimum and maximum temperature

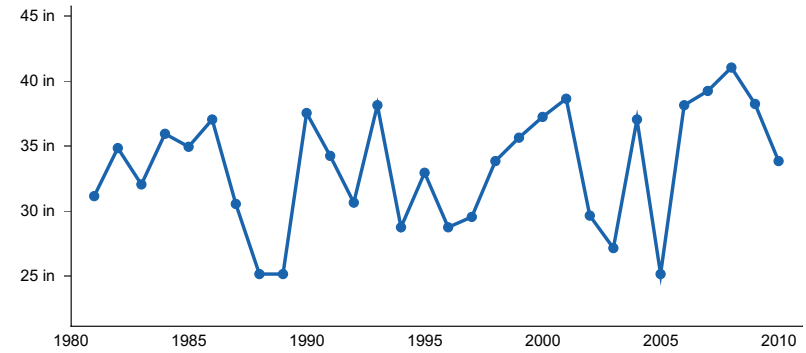


Figure 5. Annual precipitation pattern

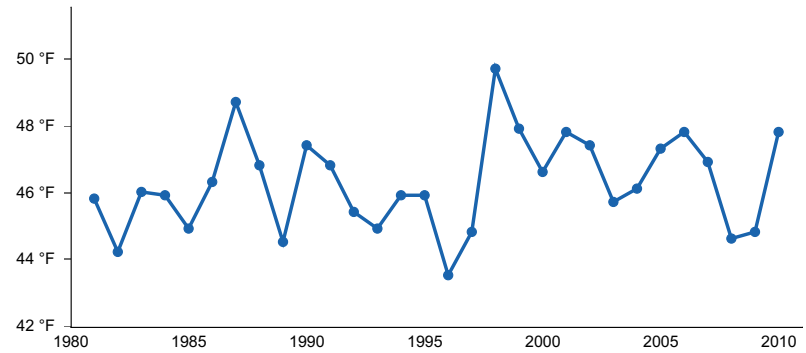


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HUSTISFORD WWTP [USC00473820], Hustisford, WI
- (2) MARKESAN [USC00475096], Markesan, WI
- (3) CHARMANY FARM [USC00471416], Madison, WI

- (4) BURLINGTON [USC00471205], Burlington, WI
- (5) HOLY HILL 2 E [USC00473702], Hubertus, WI
- (6) HORICON [USC00473756], Horicon, WI
- (7) RIPON 5 NE [USC00477209], Pickett, WI

Influencing water features

Water is received primarily through precipitation, runoff from adjacent uplands, groundwater discharge, and rarely from stream inflow. Water levels are greatly influenced by rates of precipitation and runoff from upland sites. Water leaves the site primarily through stream outflow, subsurface outflow, evapotranspiration, and groundwater recharge. These sites are wetlands. Many of these sites are emergent wetlands with sedges, grasses, and rushes with deciduous shrubs. Some sites have deciduous tree cover. Rarely do sites have conifer cover.

The hydrology of Organic sites significantly impacts their ecological development. Though these sites are primarily fed by precipitation and runoff from adjacent uplands, they often have strong interaction with groundwater. The groundwater discharged on these sites carry dissolved carbonates. In addition, many of these sites have carbonates in the underlying mineral material. These carbonates buffer acidic pH and raise the pH.

Few sites may be found in this MLRA to be raised bogs. In these rare conditions, there is little potential for groundwater interaction on these sites. Water is received from precipitation and runoff, causing acidic conditions. The plant communities are drastically different, with low pH species.

Wetland description

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

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, forested/organic, or
2) Depressional, scrub-shrub/organic
Permeability of the soil is impermeable to slow. The hydrologic group of this site is A/D.

Soil features

The soils of this site are represented by the Adrian, Boots, Carbondale, Edwards, Houghton, Ogden, Palms, and Seelyeville series, most of which are classified as Typic, Terric, or Limnic Haplosaprists. Boots is a Terric Haplohemists.

These soils form in very deep, herbaceous organic materials. Some soils are underlain by fine alluvium, lacustrine, or drift deposits. Lacustrine deposits may sometimes be stratified with coarser materials.

These soils are generally slightly acid to moderately alkaline. A few sites in Marquette county may be moderately acid. Presence of carbonates varies greatly in these soils. They may be absent or as high at 70 percent in marly soils. Fragments may be found in soils underlain by glacial drift. These soils are very poorly drained and meet hydric soil requirements. These sites are usually wetlands.

Figure 7. Houghton Soil Series sampled on 05/30/2020 in Jefferson County, Wisconsin. Image courtesy of UWSP.

Table 4. Representative soil features

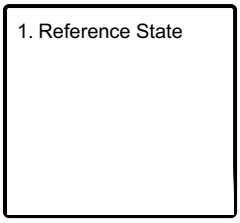
Parent material	(1) Herbaceous organic material (2) Alluvium (3) Lacustrine deposits (4) Drift
Surface texture	(1) Muck (2) Peat (3) Silt loam (4) Silty clay loam (5) Silty clay
Drainage class	Very poorly drained
Permeability class	Moderate
Soil depth	79 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-59.1in)	1.55–11.63 in
Calcium carbonate equivalent (0-39.4in)	0–70%
Soil reaction (1:1 water) (0-39.4in)	5.9–8.1
Subsurface fragment volume <=3" (0-39.4in)	0–12%
Subsurface fragment volume >3" (0-39.4in)	0–1%

Ecological dynamics

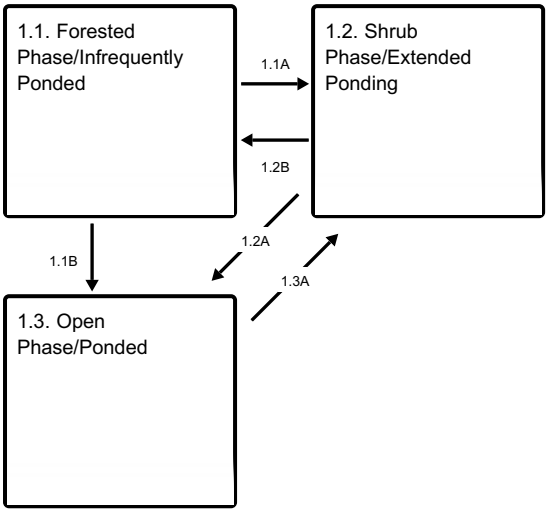
Because this Ecological Site is subject to seasonal, yearly and long-term variation in hydrological conditions, it is not possible to speak of any directional, community-driven plant succession, as is typical of more environmentally-stable upland plant communities. Instead, individual hydrologic events create conditions temporarily favorable to a given species, or groups of species, and unfavorable to other species or groups. Species differ greatly in their ability to tolerate frequency of flooding and duration of ponding. Frequency and duration of flooding/ponding is the main driver as to which of these community phases will be achieved and maintained.

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Ponding frequency and duration increase.

1.1B - Ponding frequency and duration increase dramatically.

1.2B - Very infrequent ponding.

1.2A - Ponding frequency and duration increase moderately.

1.3A - Ponding frequency and duration decrease.

State 1
Reference State

Because of the dynamic nature of hydrological events affecting this Ecological Site, many different plant communities can be found at any given time. Three distinct community phases represent the Reference state: 1) a forested phase with seasonal, brief ponding, community phase, 2) shrub phase with extended ponding community phase, and 3) open phase ponded community phase.

Community 1.1
Forested Phase/Infrequently Ponded

This community phase consists of forest communities tolerant of seasonal, brief ponding. Such forests are characterized by strong presence, or dominance of black ash (*Fraxinus nigra*), with various associates (oaks). White cedar (*Thuja occidentalis*) may be present when seed source is present and deer browse is limited. The shrub layer may be well developed in some communities and often includes tag alder (*Alnus incana*) and Gray dogwood (Cornus racemose). Characteristic understory plants include sedges, grasses, and sensitive fern (*Onoclea sensibilis*).

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- oak (*Quercus*), tree
- gray alder (*Alnus incana*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea sensibilis*), grass

Community 1.2
Shrub Phase/Extended Ponding

Figure 8. Image courtesy of UWSP taken on 05/30/2020 in Jefferson County, WI.

This community phase is dominated by tag alder, gray dogwood, and steeplebush, and other species tolerant of extended ponding. The understory is dominated by sedges and grasses.

Dominant plant species

- gray alder (*Alnus incana*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- steeplebush (*Spiraea tomentosa*), shrub
- sedge (*Carex*), grass

Community 1.3
Open Phase/Ponded

Figure 9. Image courtesy of UWSP taken on 08/08/2020 in Dane County, WI.

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

Dominant plant species

- willow (*Salix*), tree
- steeplebush (*Spiraea tomentosa*), shrub
- sedge (*Carex*), grass

Pathway 1.1A
Community 1.1 to 1.2

Increase in ponding frequency and duration. Mortality of canopy species. Lack of tree species may be cause of ponding duration with the loss of transpiration.

Pathway 1.1B
Community 1.1 to 1.3

Ponding frequency and duration increase dramatically.

Pathway 1.2B
Community 1.2 to 1.1

Decrease in ponding frequency and duration. Establishment of black ash and associates.

Pathway 1.2A
Community 1.2 to 1.3

Shrub Phase/Extended Ponding

Open Phase/Ponded

Ponding frequency and duration increase moderately.

Pathway 1.3A
Community 1.3 to 1.2

Open Phase/Ponded

Shrub Phase/Extended Ponding

Decrease in ponding frequency and duration. Establishment of tag alder and other species tolerant of some extended ponding events.

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 of 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.

Other references

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Approval

Suzanne Mayne-Kinney, 11/16/2023

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NRCS contracted UWSP to write ecological sites in MLRA 95X. 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	05/10/2025
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:**

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:**