Ecological site F094BY009MI
Loamy Upland

Last updated: 11/16/2023
Accessed: 04/26/2024

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): 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, 2002): Acer-Fagus/Viburnum (AFVb), Acer-Tsuga-Fagus/Dryopteris (ATFD), Pinus-Acer/Vaccinium (PArV)

Biophysical Settings (Landfire, 2014): Laurentian-Acadian Northern Hardwoods Forest, Laurentian-Acadian Pine-Hemlock Forest, Laurentian-Acadian Pine-Hemlock-Hardwood Forest, Laurentian-Acadian Sub-boreal Aspen-Birch Forest, Laurentian-Acadian Northern Oak Forest

WDNR Natural Communities (WDNR, 2015): Northern Mesic Forest

Hierarchical Framework Relationships:

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

USFS Subregions: Athelstane Sandy Outwash and Moraines (212Tc)

Wisconsin DNR Ecological Landscapes: Northeast Sands

Ecological site concept

The Loamy Upland ecological site accounts for approximately 110,000 acres in MLRA 94B, or about 10.6% of total land area. It is the third-most extensive site in MLRA 94B. Sites are found on loamy moraines, lake plains, and outwash plains throughout the MLRA. These sites are characterized by moderately well to somewhat excessively drained, loamy soils. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils are strongly acid to moderately alkaline.

Associated sites

F094BY002MI	**Mucky Swamp** Mucky Swamp are wetland sites occupying landscape depression and drainageways. They form in deep, herbaceous organic deposits and are very poorly drained. They occupy the lowest, wettest positions along the same drainage sequence as Loamy Upland.
F094BY005MI	**Wet Loamy Lowland** Wet Loamy Lowland are wetland sites that occupy landscape depressions on moraines, lake plains, or outwash plains. They are very poorly to poorly drained. They occupy the lower, wetter positions along the same drainage sequence as Loamy Upland.
F094BY007MI	**Moist Loamy Lowland** Moist Loamy Lowland are found in lower landscape positions on moraines, lake plains, or outwash plains. They are somewhat poorly drained. They occupy the lower, wetter positions along the same drainage sequence as Loamy Upland.

Similar sites

F094BY008MI	**Sandy Upland** Sandy Upland are found in upland landscape positions on outwash plains, stream terraces, sandy lake plains, and moraines. They are moderately well to somewhat excessively drained. These sites have coarser soil textures than Sandy Upland, and generally have a lower nutrient status.
F094BY010MI	**Clayey Upland** Clayey Upland are found in upland landscape positions on moraines, drumlins, and lake plains. They are moderately well to well drained. These sites have finer textures than Loamy Upland.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Fagus grandifolia*
Shrub	(1) *Corylus* (2) *Amelanchier*
Herbaceous	(1) *Eurybia macrophylla* (2) *Pteridium*

Physiographic features

This site is found on moraines, lake plains, drumlins, outwash plains, and stream terraces throughout the MLRA. It is common to the Aurora and Amberg moraines in northern Marinette county, Middle Inlet Moraines in central Marinette county, and the Mountain Moraines in Menominee county. Slopes range from 0 to 35 percent.

These sites are subject to neither flooding nor ponding. The overwhelming majority of sites lack evidence of a seasonally-high water table within80 inches (200 cm) of the soil surface. A few sites in southeastern Florence county have evidence of a seasonally-high water table within 18 inches (46 cm). The water table may drop in dry conditions. Runoff potential ranges from very low to very high. The runoff potential is higher where slopes are steeper and surfaces are more silty.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Linear
Slope shape up-down	(1) Convex
Landforms	(1) Moraine (2) Lake plain (3) Drumlin (4) Outwash plain (5) Stream terrace
Runoff class	Very low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	685–865 ft
Slope	0–35%
Water table depth	18–80 in
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)	104-110 days
Freeze-free period (characteristic range)	128-137 days
Precipitation total (characteristic range)	31-32 in
Frost-free period (actual range)	100-111 days
Freeze-free period (actual range)	123-142 days
Precipitation total (actual range)	30-32 in
Frost-free period (average)	100 days
Freeze-free period (average)	125 days
Precipitation total (average)	31 in

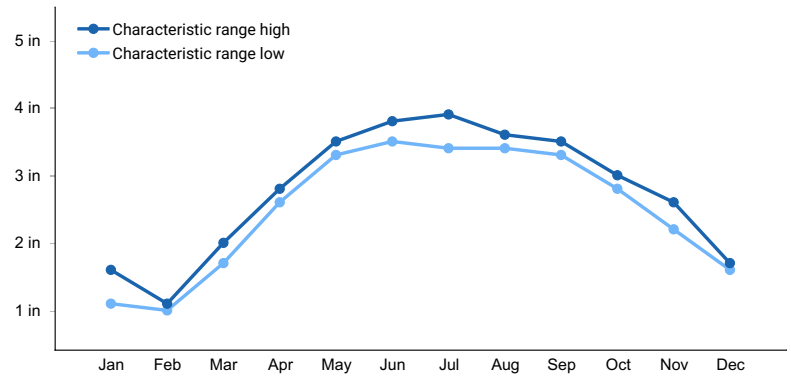


Figure 1. Monthly precipitation range

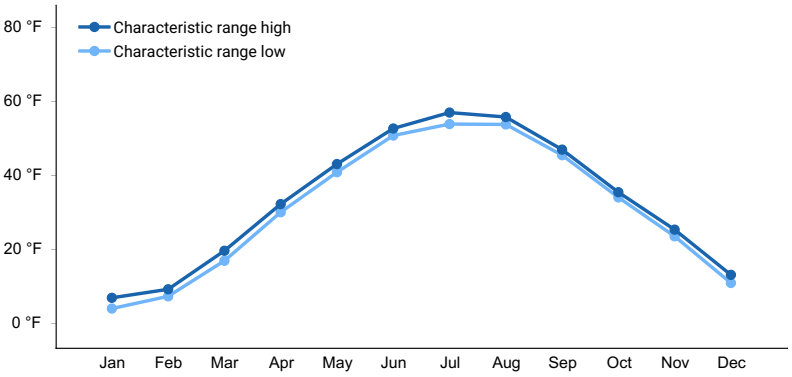


Figure 2. Monthly minimum temperature range

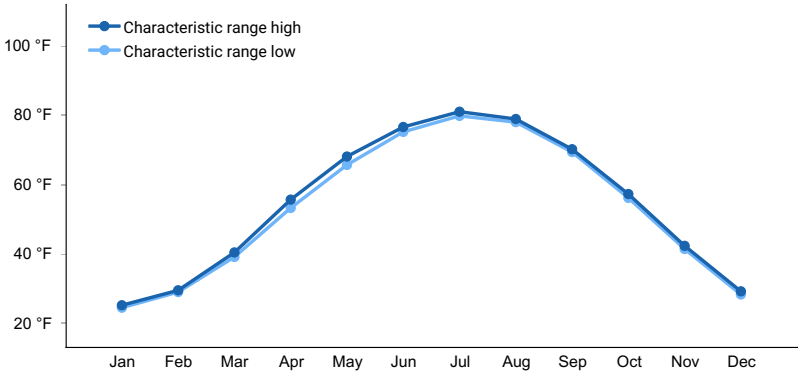


Figure 3. Monthly maximum temperature range

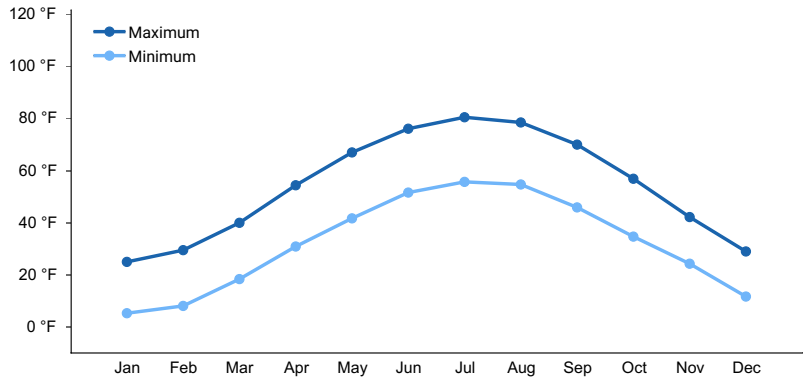


Figure 4. Monthly average minimum and maximum temperature

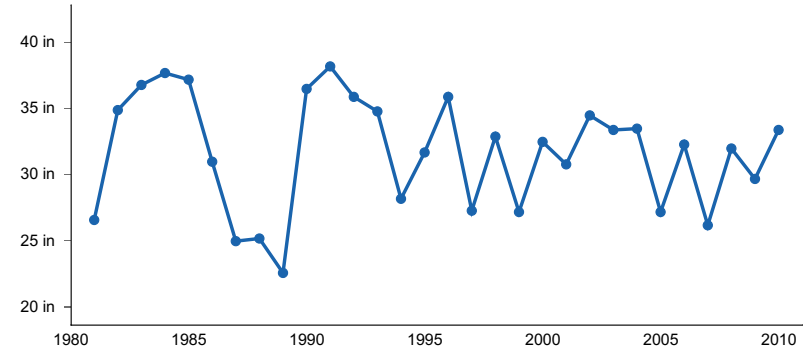


Figure 5. Annual precipitation pattern

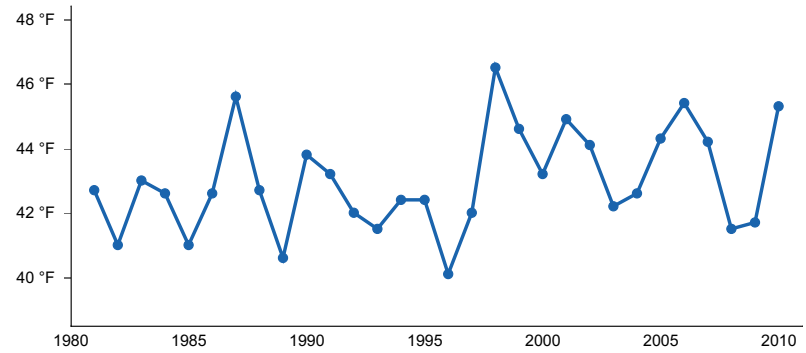


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CRIVITZ HIGH FALLS [USC00471897], Crivitz, WI
- (2) SURING [USC00478376], Suring, WI
- (3) BREED 6 SSE [USC00471044], Suring, WI
- (4) PESHTIGO [USC00476510], Peshtigo, WI
- (5) OCONTO 4 W [USC00476208], Oconto, WI

Influencing water features

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

Wetland description

Permeability of these sites is impermeable to moderately slow.
Hydrologic Group: B, C, D, B/D
Hydrogeomorphic Wetland Classification: None

Cowardin Wetland Classification: None

Soil features

The soils of this site are represented by the Annalake, Emmet, Fence, Frechette, Mequithy, Michigamme, Moshawquit, Nadeau, Padus, Perote, Peshekee, Rabe, Sarona, and Sunia soil series. Haplorthods make up 41% of the acreage of this site. Hapludalfs make up 34%. Glossudalfs make up 24%. Udipsamments make up the remaining 1% acreage.

These soils form in loamy deposits of till, alluvium, outwash, or human-transported materials. They may be underlain by sandy to silty lacustrine deposits or sandy outwash and overlain by sandy outwash. Some sites have contact with igneous bedrock as high as 17 inches (43 cm) of the surface. These sites are moderately well to somewhat excessively drained and do not meet hydric soil requirements.

The surfaces of these soils can be loamy sand to silt loam. Subsurface textures will generally be sandy loams to silt loams. Sand and loamy sand may also be found in outwash or lacustrine deposits. Thin bands of silt may be found in lacustrine deposits. Small fragments (gravel) may occupy up to 24 percent volume of the substratum. Large fragments (mainly cobbles) may occupy up to 15 percent volume. Soils are strongly acid to moderately alkaline. Many sites have accumulations of secondary carbonate. Carbonates may occupy up to 18 percent volume and start as high as 20 inches (51 cm) from the surface.

Figure 7. Padus Soil Series sample taken in Oconto County, WI on 08/25/2020. Courtesy of UWSP.

Table 4. Representative soil features

Parent material	(1) Till (2) Outwash (3) Alluvium (4) Lacustrine deposits (5) Human-transported material
Surface texture	(1) Loamy sand (2) Sandy loam (3) Silt loam
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Very slow to moderately slow
Soil depth	17–80 in
Surface fragment cover <=3"	0–8%
Surface fragment cover >3"	0–2%
Available water capacity (0-60in)	2.6–11.4 in

Calcium carbonate equivalent (0-40in)	0–18%
Soil reaction (1:1 water) (0-40in)	2–3.3
Subsurface fragment volume <=3" (Depth not specified)	0–24%
Subsurface fragment volume >3" (Depth not specified)	0–15%

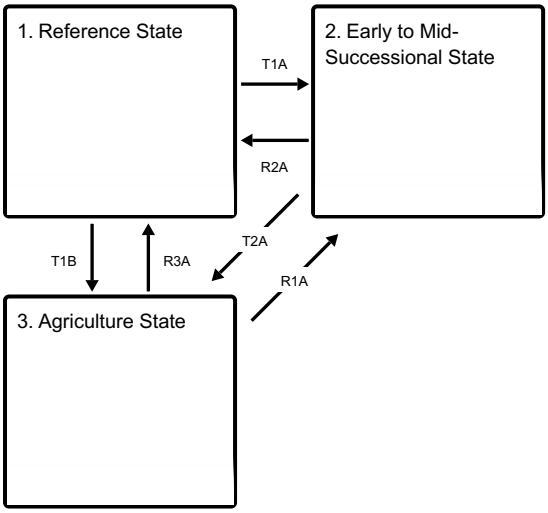
Ecological dynamics

Mesic hardwoods have dominated this ecological site historically with the landscape being adapted to fire disturbance allowing for a strong presence of oaks. In pre-European settlement time wildfire was the main controlling factor or disturbance affecting forest community dynamics. Following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. Many pine and oak species were dominant in the region because of their fire-resistant properties and successful regeneration post-fire. With clear cutting and continued fire suppression, many of these species adapted to fire and intolerant of shade are replaced by other species. Species such as white pine and red oak are still common on the landscape based on their tolerance to some shade; these species establish under a canopy, and in time, may become a component of the canopy. Mesic hardwoods are sensitive to fire, but in its absence, have the have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of sugar maple although red oak, and other mesic hardwoods may be present as well. Some sites have a strong presence of red oak, and white pine is successfully reinvading the landscape in some areas. These sites have the conditions to support shade tolerant mesic hardwoods, but historically had significant wind throw and fire disturbance that allowed for a strong presence of oak species and white pine. As long as fire is continually suppressed, maples and other mesic hardwoods will continue to dominate the canopy.

State and transition model

Ecosystem states



T1A - Clear cutting or stand-replacing fire.

T1B - Removal of forest vegetation and tilling.

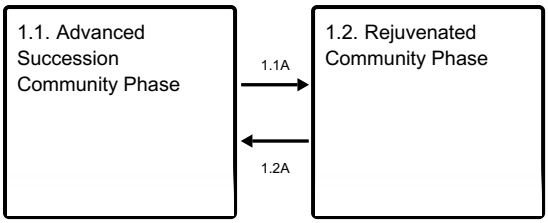
R2A - Disturbance-free period 70+ years.

T2A - Removal of forest vegetation and tilling.

R3A - Cessation of agricultural practices, natural or artificial afforestation.

R1A - Cessation of agricultural practices, natural or artificial afforestation.

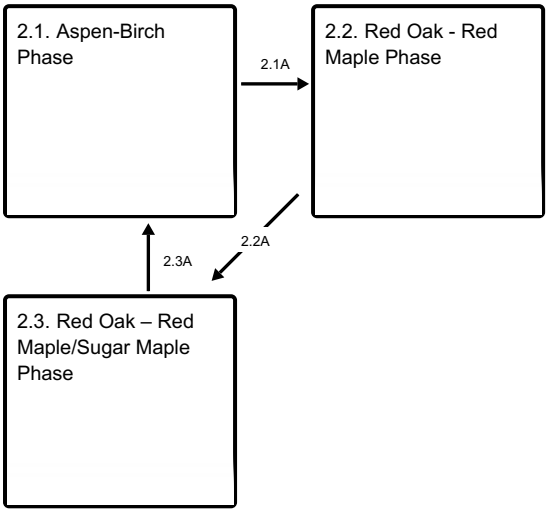
State 1 submodel, plant communities



1.1A - Light to moderate intensity fires, blow-downs, snow-ice breakage.

1.2A - Disturbance-free period 30+ years.

State 2 submodel, plant communities

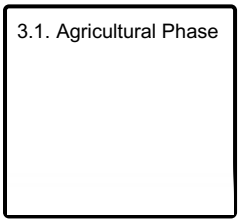


2.1A - Immigration and establishment of red oak and red maple.

2.2A - Immigration and establishment of red oak and red maple.

2.3A - Clear cutting or stand-replacing fire.

State 3 submodel, plant communities



State 1
Reference State

When allowed the time and lack of disturbance to achieve the reference state, this ecological site is best characterized as a mesic hardwood forest. The advanced succession or mature phase is likely to have a dense canopy with few shrubs and a relatively sparse understory as well. The canopy is usually dominated by Sugar maple with American beech and American basswood as common associates. In addition to the mature or advanced succession phase there is also a rejuvenated community phase in the reference state. The rejuvenated community phase includes the same overstory canopy, but often with some gaps, a more developed shrub layer and understory, as well as a few different tree associates including Ashes and Black cherry.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American beech (*Fagus grandifolia*), tree
- American basswood (*Tilia americana*), tree
- ash (*Fraxinus*), tree

- black cherry (*Prunus serotina*), tree

Community 1.1
Advanced Succession Community Phase

Figure 8. Photo courtesy of UWSP taken on 8/26/2020 in Oconto County, WI.

In the absence of any major disturbance, specifically fire, this community is dominated by sugar maple. Common associates include American beech and basswood. Other species may be present in the canopy as well, including: Red maple, White ash, and Yellow birch. Some sites may have historically included hemlock though it is no longer common. Some sites may be dominated by red oak but is unlikely without any disturbance. The shrub layer, which is typically not well developed in this phase, is often dominated by hazelnuts with ironwood (hophornbeam) being common. The ground layer is dominated by large leaf aster and Canada mayflower, with a mixture of ferns.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American beech (*Fagus grandifolia*), tree
- basswood (*Tilia*), tree
- hazelnut (*Corylus*), shrub
- serviceberry (*Amelanchier*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- brackenfern (*Pteridium*), other herbaceous

Community 1.2
Rejuvenated Community Phase

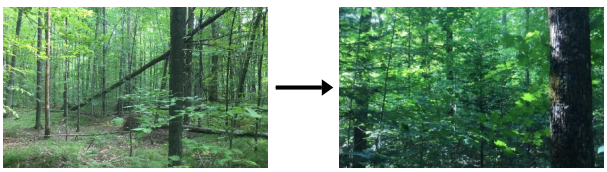
Figure 9. Photo courtesy of UWSP taken on 8/25/2020 in Oconto County, WI.

This community is dominated by a mixture of hardwoods including sugar maple, red oak and American beech. Associates may include basswood, white and/or green ash, and black cherry. The shrub (often more developed in this phase) and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American beech (*Fagus grandifolia*), tree
- hazelnut (*Corylus*), shrub
- serviceberry (*Amelanchier*), shrub
- bigleaf aster (*Eurybia macrophylla*), other herbaceous
- brackenfern (*Pteridium*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2



Advanced Succession Community Phase

Rejuvenated Community Phase

Light intensity fires, crown breakage from ice and snow and small scale blow-downs create canopy openings, allowing gap regeneration of less shade tolerant species such as white ash red oak. These species may join the canopy composition.

Pathway 1.2A

Community 1.2 to 1.1

Rejuvenated Community Phase

Advanced Succession Community Phase

A long period without major canopy disturbance allows gradual replacement of oldest canopy trees by younger cohorts. Lacking a major disturbance, the canopy will likely be replaced primarily with sugar maple. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

State 2
Early to Mid-Successional State

Following disturbances, such as clear cutting and fire a wide range of forest community phases may come into temporary existence, the three most common ones are described here. This ecological state is characterized as early to mid-successional and can be dominated by aspen or birch (possibly a mixture), Red oak and Red maple, or Sugar maple and Red maple. Each of these phases likelihood is strongly influenced by local seed source and the type of disturbance which led to this successional state.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- birch (*Betula*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree

Community 2.1
Aspen-Birch Phase

These two species have a very narrow window of environmental and ecological conditions for successful establishment. Main requirements are exposed mineral soil and elimination, most effectively by fire, of on-site seed sources of potential competing vegetation. In addition, adequate soil moisture must be available for initial seedling development. Once seedlings are firmly established, height growth of both species is relatively rapid and able to outgrow most competitive species. Paper birch seedlings and saplings tolerate partial shade and often become members of mixed species communities. This is not true for aspen which requires continuous full-sun exposure for survival. Aspen stands are initially very dense due to sprouting from extensive lateral roots, but rapid natural thinning ensues as stems compete for available light.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree

Community 2.2
Red Oak - Red Maple Phase

Figure 10. Photo courtesy of UWSP taken on 06/24/2020 in Florence County, WI.

This community phase occurs by invading and succeeding a pioneer aspen-birch community.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree

Community 2.3
Red Oak – Red Maple/Sugar Maple Phase

Stand structure consists of dominant red oak and red maple in combination with a modest, or strong presence of mature, or decaying, aspen and/or paper birch. The shrub layer typically reaches its best development in this community phase. Depending on seed source, sugar maple has become established and a young cohort exists in the subcanopy.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree

Pathway 2.1A
Community 2.1 to 2.2

Time and the immigration, establishment, and growth of red oak and red maple seedlings. These moderately shade tolerant species seed in beneath the aspen and birch and eventually outcompete these intolerant species.

Pathway 2.2A
Community 2.2 to 2.3

Time and natural succession. Red oak and red maple have succeeded the aspen-birch community. Depending on seed source, sugar maple begins growth and establishment in the understory.

Pathway 2.3A
Community 2.3 to 2.1

Clear cutting or major fire disturbance allows for the reinvasion of the shade intolerant aspen-birch community.

State 3
Agriculture State

Indefinite period of applying agricultural practices.

Community 3.1
Agricultural Phase

The agricultural phase constitutes tillage and the planting of row crops or hay or pasture.

Transition T1A
State 1 to 2

Clear cutting with initial control of competing vegetation, or stand-replacing fire, prepare the site for occupancy by shade intolerant species. This may occur through natural regeneration or by planting.

Transition T1B
State 1 to 3

Removal of forest cover, tilling and application of other agricultural techniques to grow agricultural crops.

Restoration pathway R2A
State 2 to 1

A period of some 70-100 years without major stand disturbance, especially fire, leads to decreased presence, through natural mortality, of early successional species and the dominance of shade tolerant sugar maple with less tolerant associates of red oak and white ash, returning the community to Reference State.

Transition T2A
State 2 to 3

Removal of forest cover, tilling and application of other agricultural techniques to grow agricultural crops.

Restoration pathway R3A
State 3 to 1

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation.

Restoration pathway R1A
State 3 to 2

Abandonment of agricultural practices and allowing natural vegetation to colonize the site or apply artificial afforestation.

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
Habitat Types of N. Wisconsin (Kotar, 2002): Acer-Fagus/Viburnum (AFVb), Acer-Tsuga-Fagus/Dryopteris (ATFD), Pinus-Acer/Vaccinium (PArV)
Biophysical Settings (Landfire, 2014): Laurentian-Acadian Northern Hardwoods Forest, Laurentian-Acadian Pine-Hemlock Forest, Laurentian-Acadian Pine-Hemlock-Hardwood Forest, Laurentian-Acadian Sub-boreal Aspen-Birch Forest, Laurentian-Acadian Northern Oak Forest
WDNR Natural Communities (WDNR, 2015): Northern Mesic Forest

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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	04/26/2024
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):**

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:

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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:**
