Ecological site F095XB007WI
Loamy Upland with Carbonates

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

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:

Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, North-Central Interior Dry Oak Forest and Woodland, North-Central Interior Dry-Mesic Oak Forest and Woodland, Eastern Cool Temperate Row Crop, Eastern Cool Temperate Close Grown Crop, Eastern Cool Temperate Pasture and Hayland, Eastern Cool Temperate Urban Shrubland, Developed-Low Intensity, and Developed-Medium Intensity

Habitat Types of N. & S. Wisconsin (Kotar, 2002, 1996): The sites of this ES keyed out to *Acer saccharum*-Tilia-Fraxinus/Viburnum(Cornus racemose) [ATiFrVb(Cr)] and *Acer saccharum*-Tilia-Fraxinus/Caulophyllum(Osmorhiza) [ATiFrCa(O)].

WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Southern Mesic Forest 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), Kickapoo-Wisconsin River Ravines (222Ld)

DNR Ecological Landscapes: Southeastern Glacial Plains

Ecological site concept

This site is composed of a variety of Mollisols and Alfisols that occur on till plains, lake plains, outwash plains, moraines, and stream terraces throughout the LRU. These soils formed in very deep, loamy materials deposited by glacial ice, glacial lakes, or flowing water. Many are underlain by sandy outwash or fine-textures lacustrine materials. Some have a silty loess mantle or a sandy outwash mantle. Fine lacustrine materials are sometimes stratified with sand. These soils are moderately acid to strongly alkaline. Some have loess surfaces that are strongly acidic. Secondary carbonates are present in the soils and are generally found within a meter of the surface. Soils are moderately well to somewhat excessively drained. They do not meet hydric soil requirements.

Ponding is rare on these sites. Water is received through precipitation and runoff from adjacent uplands. Water is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge. Presence of carbonates may increase pH of the water.

This is the most extensive site in LRU 95XB, occupying nearly 2 million acres (34% of the total area).

Typical vegetation includes *Acer saccharum*, *Fraxinus americana*, *Tilia americana*, *Carya ovata*, *Quercus rubra*,

Quercus alba, Prunus virginiana, Circaea lutetiana, and Parthenocissus quinquefolia.

Associated sites

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. They are found on the same landforms as Loamy Uplands with Carbonates but in lower, wetter landscape positions.
F095XB005WI	**Moist Loamy or Clayey Lowland** These sites consist of very deep, loamy or clayey materials deposited by flowing water, glacial ice, or ancient glacial lakes. Some sites are overlain or underlain by sandy outwash. They are somewhat poorly drained. They are often found adjacent to Loamy Uplands with Carbonates in slightly lower, wetter landscape positions.

Similar sites

F095XB008WI	**Clayey Upland with Carbonates** These sites consist of very deep, clayey till or lacustrine deposits, sometimes mantled with sandy outwash. Secondary carbonates usually occupy at least 10% volume in the upper 40 incbes (100 cm). They are moderately well to well drained. They occupy similar positions on the landscape as and have similar drainage capabilities as Loamy Uplands with Carbonates but have finer particle size classes.
F095XB010WI	**Loamy and Clayey Upland** These sites consist of very deep, sandy to clayey deposits of till, outwash, alluvium, colluvium, and lacustrine materials. They are moderately well to somewhat excessively drained. They occupy similar positions on the landscape, have similar drainage capabilities, and often share particle size classes with Loamy Uplands with Carbonates, but they have a smaller volume of secondary carbonates.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Fraxinus americana*
Shrub	Not specified
Herbaceous	(1) *Circaea ×intermedia* (2) *Parthenocissus quinquefolia*

Physiographic features

This extensive site occurs on till plains, lake plains, outwash plains, moraines, and stream terraces throughout the MLRA. Landform shape is usually linear or convex. It's generally found in the backslope, shoulder, or summit position. Slope ranges from 0 to 45 percent.

Ponding is rare on these sites and generally lasts between two and seven days. The depth to water table varies and may be as high at 61 cm. Runoff potential ranges from low to very high, with the highest potential found on sites with steep slopes and silt loam surfaces.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Backslope (3) Shoulder (4) Summit
Landforms	(1) Till plain (2) Lake plain (3) Outwash plain (4) Moraine (5) Stream terrace
Runoff class	Low to very high

Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to rare
Elevation	591–1,148 ft
Slope	0–45%
Ponding depth	0–6 in
Water table depth	24–80 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.

The average annual precipitation for this site is 35 inches. The average annual snowfall is 41 inches. The average annual maximum and minimum temperatures are 56oF and 36oF, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	134-136 days
Freeze-free period (characteristic range)	167-171 days
Precipitation total (characteristic range)	35-36 in
Frost-free period (actual range)	133-136 days
Freeze-free period (actual range)	167-172 days
Precipitation total (actual range)	32-37 in
Frost-free period (average)	135 days
Freeze-free period (average)	169 days
Precipitation total (average)	35 in

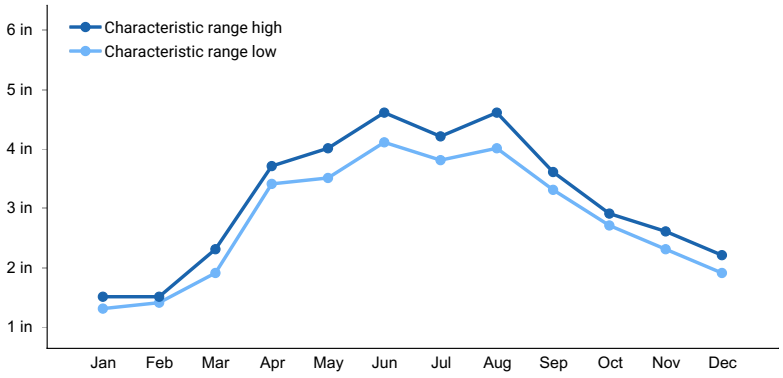


Figure 1. Monthly precipitation range

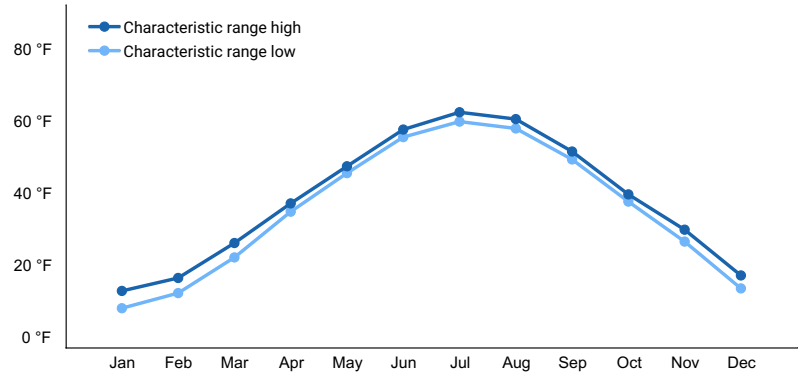


Figure 2. Monthly minimum temperature range

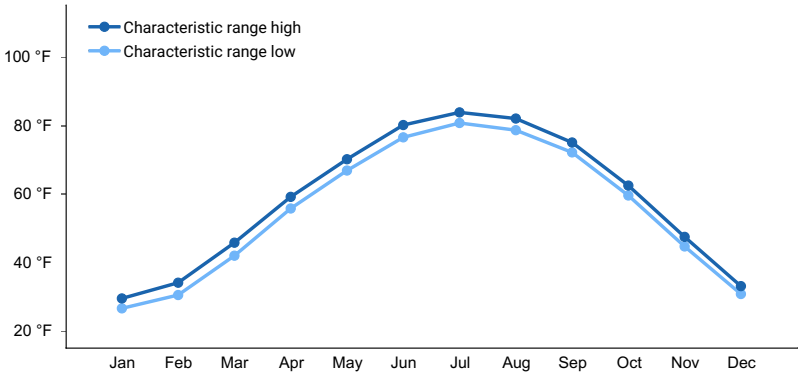


Figure 3. Monthly maximum temperature range

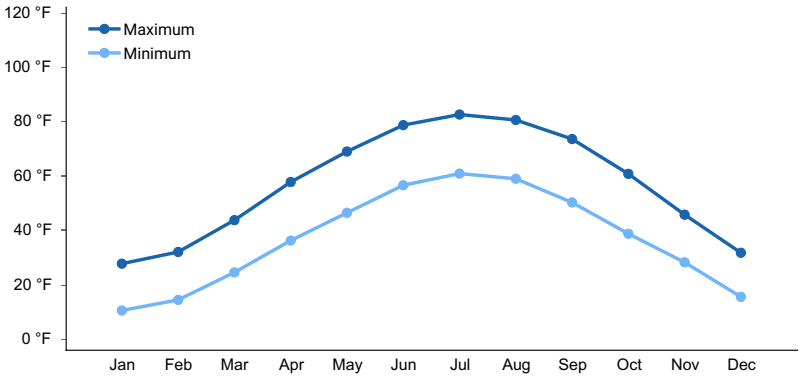


Figure 4. Monthly average minimum and maximum temperature

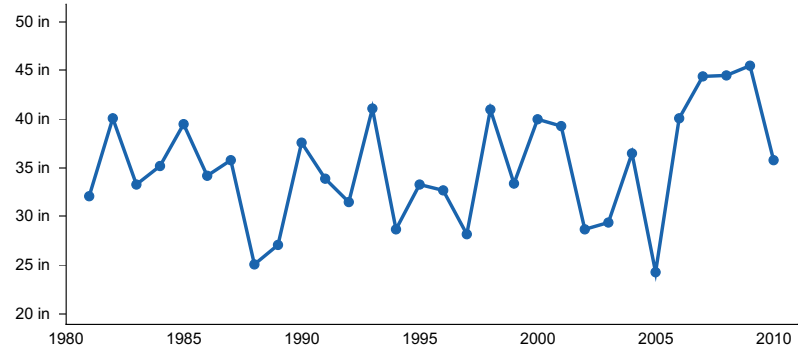


Figure 5. Annual precipitation pattern

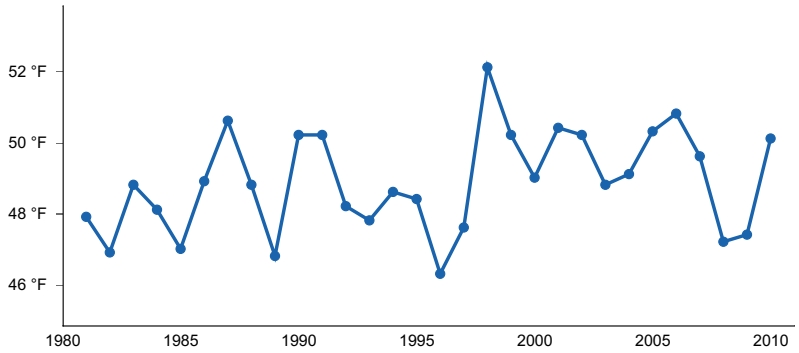


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CLINTON [USC00471667], Clinton, WI
- (2) AFTON [USC00470045], Janesville, WI
- (3) HOLY HILL 2 E [USC00473702], Hubertus, WI
- (4) HUSTISFORD WWTP [USC00473820], Hustisford, WI
- (5) RIPON 5 NE [USC00477209], Pickett, WI
- (6) ELGIN [USC00112736], Elgin, IL
- (7) ROCKFORD GTR ROCKFORD AP [USW00094822], Rockford, IL

Influencing water features

Water is received through precipitation and runoff from adjacent uplands. Water is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge. Presence of carbonates may increase pH of the water.
Permeability of the soil is impermeable to moderate. The hydrologic group of this site is A, B, or C.

Wetland description

Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

The soils of this series are represented by the Billett, Boyer, Casco, Dakota, Dodge, Dresden, Grays, Hochheim, Ionia, Lapeer, Leroy, Lomira, Lorenzo, Markesan, Mendota, Miami, Rotamer, Theresa, Tuscola, and Zurich series. These soils are classified as Argiudolls, Hapludolls, Hapludalfs, and Endoaquolls.

These soils form in very deep, loamy materials deposited by glacial ice, glacial lakes, or flowing water. Many are underlain by sandy outwash or fine-textures lacustrine materials. Some have a silty loess mantle or a sandy outwash mantle. Fine lacustrine materials are sometimes stratified with sand.

These soils are moderately acid to strongly alkaline. Some have loess surfaces that are strongly acidic. Secondary carbonates are present in the soils and are generally found within a meter of the surface. They usually occupy at least 10 percent volume. Small fragments are sometimes present in the substratum and may occupy up to 40 percent volume. Higher volumes of fragments are generally seen in the sandy outwash substratum found on some sites. Fragments may be stratified (in the case of outwash and lacustrine deposits) or unstratified (in the case of till). Some of these fragments may be pieces of limestone and dolomite plucked from the bedrock by glacial ice and mixed in with the mineral glacial deposits, and others may be rounded, mixed rocks deposited by flowing water. Soils are moderately well to somewhat excessively drained. They do not meet hydric soil requirements.

Figure 7. Casco Soil Series sampled on 5/30/2020 in Walworth County, Wisconsin. Image courtesy of UWSP.

Table 4. Representative soil features

Parent material	(1) Till (2) Outwash (3) Lacustrine deposits (4) Alluvium (5) Loess (6) Eolian deposits
Surface texture	(1) Loamy sand (2) Sandy loam (3) Loam (4) Silt loam (5) Silty clay loam (6) Clay loam
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderate
Soil depth	80–100 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-59.1in)	2.79–11.72 in
Calcium carbonate equivalent (0-39.4in)	1–75%
Soil reaction (1:1 water) (0-39.4in)	5.5–8.5
Subsurface fragment volume <=3" (0-39.4in)	0–40%
Subsurface fragment volume >3" (0-39.4in)	0–15%

Ecological dynamics

Historically, mature forests on this ecological site were dominated by shade tolerant sugar maple and White ash, often with an admixture of Basswood and a few Red oaks. This association was self-maintained with new cohorts of advance regeneration gaining canopy status through gaps formed by small-scale disturbances and natural mortality in the dominant canopy.

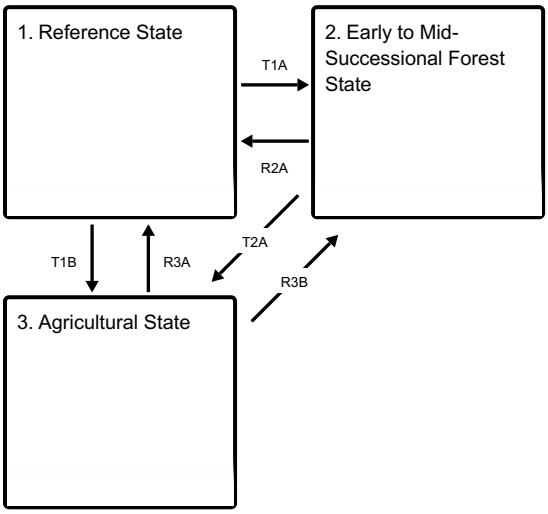
Small scale canopy disturbances are likely common in the ES as the is shallow bedrock leading to lower stability of

large trees due to shallow rooting. This will lead to trees tipping in wind storms and periodic openings in the canopy occurring more frequently than similar ESs without shallow bedrock. Additionally, due to soils being shallower, trees are likely to be smaller and shorter than on other similarly vegetated ESs.

Current stands on this Ecological Site represent the entire array of potential successional stages from pure aspen, or aspen-white birch, stands to sugar maple dominated mixed northern hardwoods stands. Succession to sugar maple dominance is evident everywhere that seed sources are present. In many cases the mesic hardwoods (Sugar maple and White ash) may be absent due to lack of seed source. In those cases a mixed oak stand may predominate and be stable ecologically.

State and transition model

Ecosystem states



T1A - Stand replacing disturbance that includes fire.

T1B - Removal of forest cover and tilling for agricultural crop production.

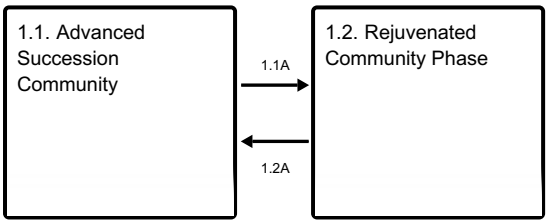
R2A - Deciduous forest community is slowly taken over by shade tolerant maples and other species.

T2A - Removal of forest cover and tilling for agricultural crop production.

R3A - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

R3B - Cessation of agricultural practices leads to natural reforestation, or site is replanted.

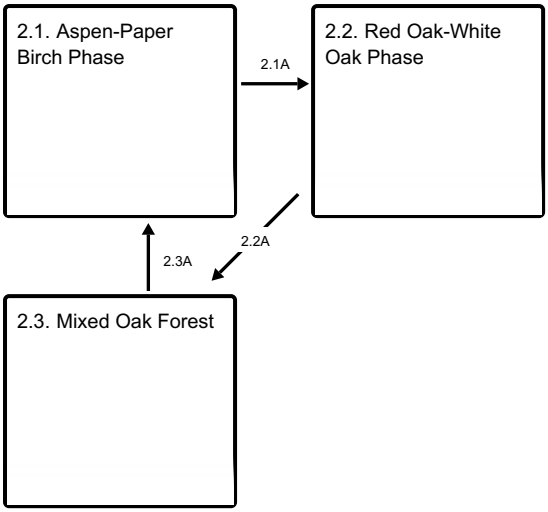
State 1 submodel, plant communities



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

1.2A - Disturbance-free period for 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 1
Reference State

The reference plant community is categorized as mesic forest community dominated by mixed deciduous species, primarily sugar maple (*Acer saccharum*) and White ash (*Fraxinus americana*), and Basswood (*Tilia americana*), with Red oak (*Quercus rubra*), White oak (*Quercus alba*) and Shagbark hickory (*Carya ovata*) occurring as well. Although forest communities can vary greatly in terms of species composition and stand structure, depending on type, degree, and frequency of disturbance, two common phases predominate:

Community 1.1
Advanced Succession Community

In the absence of any major disturbance, specifically fire, this community is dominated by Sugar maple. Common associates include Basswood, and Ashes. Other species may be present in the canopy as well, including: Red oak, White oak, and Shagbark hickory with Black cherry often having a small presence as well. The shrub layer is typically not well developed in this phase, but is likely to contain regenerating overstory species, chokecherry, Prickly ash, and Common buckthorn. The ground layer is often sparse but includes rich site species such as Blue cohosh, Virginia creeper, Mayapple, and Sweet cicely.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- white ash (*Fraxinus americana*), tree
- American basswood (*Tilia americana*), tree
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Community 1.2
Rejuvenated Community Phase

This community is dominated by a mixture of hardwoods including sugar maple, Red oak and White oak. 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 to include more shade intolerant species.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- chokecherry (*Prunus virginiana*), shrub
- American basswood (*Tilia americana*), shrub
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

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, and white oak. These species may join the canopy composition.

Pathway 1.2A
Community 1.2 to 1.1

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 Forest State

This state represents the post disturbance establishment of pioneer species and the further development of the site through a mid-successional state. An initial population of aspen or birch (or a mixture) will dominate and later give way to a mixture of deciduous trees leading into mid succession.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree
- red maple (*Acer rubrum*), tree

Community 2.1
Aspen-Paper 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-White Oak Phase

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

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree

Community 2.3
Mixed Oak Forest

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

Stand structure consists of dominant Red oak and White oak in combination with a modest, or strong presence of mature, or decaying, aspen and/or paper birch. A wide variety of tree species may be present with Red oak and White in the canopy (Black cherry, Hickory, Elms, Ashes). 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. If sugar maple seeds are not present the site may persist in this state/phase for a long time as an alternative stable state to the Reference State.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- shagbark hickory (*Carya ovata*), tree
- sugar maple (*Acer saccharum*), tree
- ash (*Fraxinus*), tree
- enchanter's nightshade (*Circaea ×intermedia*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Time and the immigration, establishment, and growth of red oak and white oak 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 White oak 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
Agricultural State

Indefinite period of applying agricultural practices. Crops likely include alfalfa, corn, soybeans, and hay or pasture.

Transition T1A
State 1 to 2

Transition T1A – Major stand-replacing disturbance. In pre-European settlement time, the event was most often a severe blow down, sometimes followed by fires. Such blow downs have been estimated to occur in this part of Wisconsin every 300 to 400 years (Schulte and Mladenoff, 2005). In post settlement virtually every acre has been logged either by clear cutting or successive cuts targeting species marketable at that time. Post logging slash fires also have been a significant factor in most areas. These disturbances created the environment suitable for natural regeneration of many shade-intolerant species and for commercial 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. The time required for forest community to reach the reference state conditions may exceed 100 years.

Restoration pathway R3B
State 3 to 2

Cessation of agricultural practices leads to natural reforestation, or site is replanted.

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.

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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	05/11/2025
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:**