Ecological site F095XA005WI
Moist Sandy Lowland

Last updated: 11/16/2023
Accessed: 08/19/2026

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 Northeastern Wisconsin Drift Plain LRU (Land Resource Unit - 95XA) corresponds closely to the Northern and Central Lake Michigan Coastal Ecological Landscapes. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources Ecological Landscape publication (2015). The Northeastern Wisconsin Drift Plain LRU is located along Wisconsin's northeastern and central coast of Lake Michigan and the Door Peninsula. This glacial landscape is comprised of approximately 3.6 million acres (5,715 square miles). It is dominated by till plains and glacial lake deposits. The Green Bay and Lake Michigan Lobes are responsible for the formation of the landscape. The Green Bay Lobe covered most of the LRU, excluding the eastern edge where the Lake Michigan Lobe advanced. The glaciers were separated by the Niagara Escarpment, a 650-mile-long dolomite ridge that begins in Wisconsin near the Illinois border, extends into Michigan's Upper Peninsula and down through Canada's Bruce Peninsula into Rochester, New York. Within LRU 95XA, the escarpment runs from Lake Winnebago northeast through the Door Peninsula. Much of the topography of this LRU is bedrock-controlled. Bedrock is generally deeper than 150cm except in the Door Peninsula, where bedrock is much shallower. Wetlands are common throughout this MLRA where drainage is impeded by fine-textured materials and shallow bedrock. The northern portion of this LRU is dominated by an undulating till plain, gently sloping to the east, formed entirely by the Green Bay Lobe.

This glacial lobe centered over the present-day city of Green Bay and flowed out in a fan shape, moving both south-southwest and south-southeast over the Door Peninsula. The lobe deposited loamy and coarse-loamy till mixed with dolomite fragments plucked from the bedrock. In some areas, the till has been reworked by Glacial Lake Oshkosh or overlain by its lacustrine deposits. Numerous drumlins formed, orientated to the south-southwest in the direction of glacial flow. Some eskers are present. Much of this area has dolomite and limestone within 50 ft of the surface. Proglacial streams formed small areas of pitted and unpitted outwash plains, terraces, and fans. The Door Peninsula was formed primarily by the early advances of the Green Bay Lobe. The till found here is comprised of relatively old, calcareous loamy materials mixed with dolomite and limestone fragments plucked by the glacial lobe from the shallow bedrock. The till is thinly draped over the Niagara Escarpment that lies 1 to 3 meters below the surface. A drumlin field is oriented south-southeast, the direction of the ice flow over the peninsula. The eastern shore of the peninsula is composed of lake sediments that were reworked and deposited by Lake Michigan Lobe. The northern tip of the peninsula has glaciolacustrine beach terrace and ridge deposits and eolian sand dunes, which are remnants of the intra- and postglacial lakes Nipissing and Algonquin. The central portion of this LRU is dominated by lacustrine deposits from Glacial Lake Oshkosh. In its largest stage, Glacial Lake Oshkosh covered 1.4 million acres. The lake formed from meltwater as the Green Bay Lobe receded between ice sheet advances. The glacial lobe stalled between present day Lake Winnebago and the city of Green Bay, blocking the drainage of meltwater north to the Lake Michigan Basin. Glacial Lake Oshkosh continued to rise until it found other drainage pathways, eventually draining into the Wisconsin River Valley. Glacial Lake Oshkosh reworked the till deposits of the Green Bay Lobe. Silty and clayey lacustrine deposits formed in the deepest area of the lakes, whereas sandy beach ridges, terraces, and dunes formed along the ancient shore. The area east of Glacial Lake Oshkosh and south along the shore of Lake Michigan are dominated by a thin till sheet over the Niagara Escarpment that was deposited by the Green Bay and Lake Michigan Lobes. The Green Bay Lobe deposited calcareous clay and silty till reworked from lake sediments. The Lake Michigan Lobe deposited silt loam, loam, and compacted sandy clay loam till. Remnants of the intra- and postglacial lakes Nipissing and Algonquin are also found along Lake Michigan shore. Proglacial streams formed small areas of pitted and unpitted outwash plains, terraces, and fans. Historically, the vegetation in this LRU was dominated by northern and central hardwood forests and wetlands. The northern hardwoods were comprised of eastern hemlock (Tsuga canadensis) and American beech (Fagus grandifolia). The central hardwoods were dominated by sugar maple (Acer saccharum), American basswood (Tilia Americana), and American beech (Fagus grandifolia). Forested wetlands were a major part of the landscape, covering more than 25% in some areas

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 Acer-Tilia-Fraxinus/Caullophyllum [ATiFrCa], Acer saccharum-Fraxinus/Desmodium {variants of which are Viburnrm=(Vb) -O=Osmorhiza} [AFrDe/AFrDe(Vb)/AFrDe-O], and Tsuga/Maianthemum-Coptis[TMC]. Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest, Laurentian-Acadian Pine-Hemlock Forest, Laurentian Oak Barrens, Laurentian-Acadian Northern Hardwoods Forest, and Eastern Cool Temperate Row Crop WDNR Natural Communities (WDNR, 2015): This ES is most similar to the Northern and Southern Mesic Forests described by the WDNR. Hierarchical Framework Relationships: Major Land Resource Area (MLRA): 095X–Eastern Wisconsin, Northern Illinois, and Upper Michigan Drift Plain USFS Subregions: West Green Bay Till Plain (212Tb), Outagamie Loamy Till and Silty Lake Plain (212Za), Green Bay Clayey and Silty Lake Plain (212Zb), Lake Winnebago Clay Plain (222Kc) DNR Ecological Landscapes: Northern Lake Michigan Coastal, Central Lake Michigan Coastal, Southeast Lake Michigan Coastal

Ecological site concept

The Moist Sandy Lowlands ecological site occurs throughout, but primarily in the western part of LRU 95XA. These sites are represented by various soil components that include Udipsamments, Udorthents, Eutrudepts, and Spodosols. All of these soils are dominated by sandy textures and are formed in very deep, sandy outwash or sandy lacustrine deposits. Some sites are underlain by loamy till or by loamy to clayey lacustrine deposits. A few sites may be found in sandy alluvium or sandy eolian deposits. These sites are somewhat poorly drained and do not meet hydric soil requirements. While characteristically sandy these soils represent a broad pH range from extremely acid to moderately alkaline. Water enters this ES primarily through precipitation, runoff from adjacent uplands, and groundwater discharge. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Typical vegetation includes Acer saccharum, Acer rubrum, Fraxinus americana, Onoclea sensibilis, and Lady fern.

Associated sites

F095XA009WI	**Sandy Uplands** These sites consist of very deep, sandy deposits, primarily of outwash or lacustrine origin. Some sites are overlain or underlain by finer-textured materials. They are moderately well to somewhat excessively drained. They occur much higher on the drainage sequence than Wet Sandy Lowlands.

F095XA003WI	**Wet Sandy Lowland** These sites consist of very deep, sandy materials, primarily glacial outwash. Some are underlain by finer-textured materials. They are very poorly to poorly drained. They form in similar parent materials and share particle size classes with Moist Sandy Lowlands, but Wet Sandy Lowlands occupy depressions and are found in lower landscape positions.

Similar sites

F095XA006WI	**Moist Loamy Lowland** These sites consist of moderately deep to very deep, loamy lacustrine, till, or outwash deposits. Some have a loess mantle. Some are underlain by sandy outwash. They are somewhat poorly drained. They occupy similar landscape positions as Moist Sandy Lowlands but have finer particle size classes.
F095XA007WI	**Moist Clayey Lowland** These sites consist of very deep, clayey deposits of various origin, primarily clayey glacial till but also clayey lacustrine materials. They are often mantled with loess. They are somewhat poorly drained. They occupy similar landscape positions as Moist Sandy Lowlands but have finer particle size classes. They are more common to the clayey till plains and lake plains in the southern half of the MLRA.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Acer rubrum*
Shrub	(1) *Fraxinus americana* (2) *Tilia americana*
Herbaceous	(1) *Onoclea sensibilis* (2) *Athyrium filix-femina*

Physiographic features

This site is most often found in lower landscape positions along the sandy outwash channels that dissect the moraines in northwest and east-central parts of this MLRA, or within the basin of Glacial Lake Oshkosh along its ancient shorelines. Some sites are found on current beaches. Landform shape is linear or concave, and sites are in the toeslope position. Slopes range from 0 to 4 percent.

Some sites may be subject to rare ponding. Most sites are not subject to flooding except for a few in the southern portion of this MLRA. Inundation usually lasts two to seven days. Soils have an apparent seasonally high water table (endosaturation) within 61 cm. Some sites west of Lake Winnebago have a layer of heavy lacustrine clay that perches the water table (episaturation). Runoff is negligible to high.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope
Slope shape across	(1) Linear
Slope shape up-down	(1) Concave

Landforms	(1) Depression (2) Drainageway (3) Outwash plain (4) Lake plain (5) Lake terrace (6) Swale (7) Flat (8) Beach
Runoff class	Negligible to high
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to rare
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to rare
Elevation	200 – 310 m
Slope	0 %
Ponding depth	0 – 20 cm
Water table depth	20 – 60 cm
Aspect	Aspect is not a significant factor

Climatic features

The continental climate of the Northeastern Wisconsin Drift Plain is typical of central Wisconsin – cold winters and warm summers. The climate is moderated by the thermal mass of Lake Michigan, especially in coastal areas. Fall and early winter temperatures are slightly warmer and spring and early summer temperatures are slightly cooler along the Lake Michigan coastline. Lake effect snow occurs along the coastline.

The average annual precipitation for this site is 31 inches. The average annual maximum and minimum temperatures are 54oF and 34oF, respectively. This site receives more annual snow than the MLRA average, 46 inches compared to 44 inches.

Table 3 Representative climatic features

Frost-free period (characteristic range)	110-130 days
Freeze-free period (characteristic range)	150-160 days
Precipitation total (characteristic range)	760-810 mm
Frost-free period (actual range)	110-130 days
Freeze-free period (actual range)	140-160 days
Precipitation total (actual range)	760-840 mm
Frost-free period (average)	120 days
Freeze-free period (average)	150 days
Precipitation total (average)	790 mm

- (1) GREEN BAY [USW00014898], Green Bay, WI
- (2) DENMARK WWTP [USC00472055], Denmark, WI
- (3) KEWAUNEE [USC00474195], Kewaunee, WI
- (4) NEW LONDON [USC00475932], Hortonville, 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 is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge.

Permeability of the soil is impermeable to rapid. The hydrologic group of this site is B, A/D, B/D, or C/D.

Wetland description

Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

The soils of this site are represented by the Allendale, Au Gres, Cosad, Fisk, Iosco, Morocco, Nebago, Tedrow, and Wainola series. Allendale is an Epiaquod; Au Gres, Iosco, and Wainola are Endoaquods; Fisk and Nebago are Eutrudepts; Cosad is a Udorthent; Morocco and Tedrow are Udipsamments. Spodosols make up 58% of the acreage of this site (of which, 89% are Endoaquods and 11% and Epiaquods). Udipsamments make up 23%. Eutrudepts make up 11%. Much of the remaining 8% is Udorthents. Less than half of one percent of the acreage of this site is beaches, which are not classified.

These soils formed in very deep, sandy outwash or sandy lacustrine deposits. Some sites are underlain by loamy till or by loamy to clayey lacustrine deposits. A few sites may be found in sandy alluvium or sandy eolian deposits. These sites are somewhat poorly drained and do not meet hydric soil requirements.

The surface textures of these soils are generally sands, loamy sands, or their fine analogues. The substratum may be sandy to clayey. Soils are extremely acid to moderately alkaline.

Surface fragments are generally absent in these soils. Subsurface fragments smaller than 3 inches in diameter often occupy between 3 and 12 percent volume. Larger fragments may occupy up to 3 percent volume. 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. Secondary carbonates are sometimes present, and CaCO3 equivalency is usually 5 to 10 percent.

Figure 7. Iosco Soil Series sampled on 06/06/2020 in Marinette County, Wisconsin.

Table 4. Representative soil features

Parent material	(1) Outwash (2) Glaciofluvial deposits (3) Eolian deposits (4) Lacustrine deposits (5) Alluvium (6) Till (7) Beach sand
Surface texture	(1) Loamy sand (2) Sand (3) Sandy loam
Drainage class	Somewhat poorly drained
Permeability class	Rapid
Soil depth	200 – 250 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-150.1cm)	3.68 – 9.07 cm
Calcium carbonate equivalent (0-100.1cm)	0 – 20 %

Soil reaction (1:1 water) (0-100.1cm)	4.2 – 8.2
Subsurface fragment volume <=3" (0-100.1cm)	0 – 10 %
Subsurface fragment volume >3" (0-100.1cm)	Not specified

Ecological dynamics

In pre-European settlement time wildfire was the main controlling factor of 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 to establish under a canopy, and in time, may become a component of the canopy. Red maple is sensitive to fire, but in its absence, it has the ability to dominate sites based on its shade tolerance and prolific seed production.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036, photographs, and Kotar Habitat Types.

Other references

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Contributors

Jacob Prater, Associate Professor at University of Wisconsin Stevens point
Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist Independent Contractor

Approval

Suzanne Mayne-Kinney, 11/16/2023

Acknowledgments

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	08/19/2026
Approved by	
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:**
