USDA Natural Resources
Conservation Service

Ecological site F090BY007WI
Wet Clayey Lowland

Last updated: 11/16/2023
Accessed: 05/21/2025

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): 090B–Central Wisconsin Thin Loess Dissected Till Plain

The Wisconsin and Minnesota Thin Loess MLRA, Northern and Southern Parts (90A and 90B) correspond closely to the North Central Forest and the Forest Transition Ecological Landscapes, respectively. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources ecological landscape publications (2015).

The Wisconsin and Minnesota Thin Loess MLRA, Northern and Southern Parts (90A and 90B) is an extensive glacial landscape that comprised of over 11.1 million acres (17,370 sq mi) throughout central and northern Wisconsin – about 27% of the total land area in the state. This glacial landscape is comprised of a heterogenous mix of loess-capped ground moraines, end moraines with eskers and ice-walled lake plains, and pitted, unpitted, and collapsed outwash plains sometimes interspersed with drumlins from the Illinoian and Pre-Illinoian glaciations. The entire area has been glaciated and nearly all of it is underlain by dense glacial till that impedes drainage. An extensive morainal system – the Perkinstown end moraine – spans most of the width of northern Wisconsin and divides the Northern and Southern Parts of this large landscape. This moraine, which has been sliced by outwash in many places, marks the southernmost extent of the Wisconsin glaciation (Wisconsin’s most recent glacial advance).

North of the Perkinstown morainal system is a loess plain, with a loess mantle 6 -24 inches thick. The northernmost edge of this landscape is an undulating till and outwash plain with materials deposited by the Chippewa Lobe. Drumlins are common in the northern and northeastern portions. The drumlins are oriented towards the southwest and formed during a glacial episode prior to the most recent glacial advance. Some are

covered with glacial till. Pitted, unpitted, and collapsed outwash plains fill the spaces between drumlins. Detached from the major land mass to the northeast is the hummocky Hayward collapsed end moraines, where swamps, ice-walled lake plains, and eskers are common.

Most of the MLRA to the south of the Perkinstown morainal system is an extensive ground moraine with some proglacial stream features including pitted outwash plains, terraces, and fans. A layer of loess 6-47 inches thick covers much of the area. Like the Northern Part, all areas of the Southern Part of this MLRA were glaciated, although the southcentral portion is a relatively older till plain with materials from the Illinoian and pre-Illinoian glaciations, not the most recent Wisconsin glaciation. The landforms in the southcentral portion are highly variable. Much of the area topography is controlled by underlying bedrock. Sandstone outcrops and pediments can be found here. Some of the most southern portions of the MLRA are mixed glacial deposits and residuum.

The land surface of the southeastern portion was formed by many small glacial advances and retreats. Morainal ridges protrude through an erosional, pitted outwash-mantled surface. These parallel ridges run in a northeast to southwest orientation and are dissected by many steams.

The continental climate of this MLRA is typical of northcentral Wisconsin, with cold winters and warm summers. The southern boundary of this MLRA straddles Wisconsin’s Tension Zone, a zone of transition between Wisconsin’s northern and southern ecological landscapes. Historically, the mesic forests were dominated by eastern hemlock (Tsuga canadensis), sugar maple (Acer saccharum), and yellow birch (Betula alleghaniensis).

Classification relationships

Major Land Resource Area (MLRA): Wisconsin and Minnesota Thin Loess and Till (Northern and Southern Parts - 90A an 90B)

USFS Subregions: Bayfield Sand Plains (212Ka), Rib Mountain Rolling Ridges (212Qd)

Small sections occur in St. Croix Moraine (212Qa) and Mille Lacs Uplands (212Kb)

Wisconsin DNR Ecological Landscapes: Northwest Sands, Forest Transition, Northwest Lowlands, North Central Forest

Ecological site concept

The Wet Clayey Lowland ecological site is uncommon in MLRA 90A and 90B, located in depressions and drainageways on lake plains and moraines. These sites are characterized by very deep, very poorly or poorly drained soils that formed primarily in clayey lacustrine, till, and residuum. Sites are subject to frequent ponding during the spring and fall. Soils remain saturated for long periods during the growing season and

meet hydric soil requirements. Precipitation, runoff from adjacent uplands, and groundwater discharge are the primary sources of water. Soils range from very strongly acid to moderately alkaline.

Wet Clayey Lowland is differentiated from other ecological sites by its deep clayey deposits and very poorly or poorly drained soils. Other very poorly or poorly drained sites have sandy or loamy deposits. Clays often have higher pH and available water capacity than sandy and loamy sites, which can promote vegetative growth. The poor drainage of this site differs it from other clayey sites.

Associated sites

F090BY012WI	**Moist Clayey Lowland** Moist Clayey Lowland sites consist of deep clayey lacustrine deposits. The finer textures perch the water table. These soils remain moist - but not saturated - throughout much of the growing season. They are drier and occur higher on the drainage sequence than Wet Clayey Lowland.
F090BY017WI	**Clayey Upland** Clayey Upland consist of loamy to clayey residuum or lacustrine deposits overlain by loess or sandy outwash. Bedrock contact may occur within two meters of the surface. These sites have a seasonally high water table within one meter of the surface, though they are not saturated for sustained periods. They are drier and occur higher on the drainage sequence than Wet Clayey Lowland.

Similar sites

F090BY006WI	**Wet Loamy Lowland** Wet Loamy Lowland consist primarily of deep loamy deposits derived from a mixture of outwash, alluvium, loess, and lacustrine sources. Some sites may have bedrock contact within two meters of the surface. These sites are seasonally ponded depressions that remain saturated for sustained periods, allowing hydric conditions to occur. They occur in similar landscape positions and have similar drainage as Wet Clayey Lowland, though with coarser particle sizes. The vegetative communities they support are similar to those found on Wet Clayey Lowland.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Quercus bicolor*
Shrub	(1) *Fraxinus pennsylvanica*
Herbaceous	(1) *Oligoneuron* (2) *Carex*

Physiographic features

This site occurs in depressions and drainageways on lake plains and moraines. Slopes range from 0 to 2 percent.

Some sites are subject to occasional ponding throughout the year. The ponding duration ranges from brief (2 to 7 days) to long (7 to 30 days), with depths up to 6 inches above the soil surface. These sites do not flood. The soils have an apparent seasonally high water table (endosaturation) at the surface, but the water table may drop to 35 inches during dry conditions. Some sites have a perched seasonally high water table (episaturation). Runoff is negligible to very high.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope (2) Footslope
Slope shape across	(1) Concave
Slope shape up-down	(1) Linear
Landforms	(1) Depression (2) Drainageway (3) Lake plain (4) Moraine
Runoff class	Negligible to very high
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to occasional
Elevation	591–1,099 ft
Slope	0–2%
Ponding depth	0–6 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The climate of the expansive Wisconsin and Minnesota Thin Loess and Till Plain is highly variable. The eco-climatic zone (the “Tension Zone”) that runs southeast-northwest across the state splits the MLRA. In general, the MLRA has cold winters and warm summers with an adequate amount of precipitation. Near Lake Superior, precipitation and temperature tend to increase. The far western section of the MLRA, known as the western prairie ecological landscape by the Wisconsin DNR, has warmer temperatures compared to the rest of the MLRA because it falls below the eco-climatic zone. The soil moisture regime of

MLRA is udic (humid climate). The soil temperature regime is frigid and cryic.

The average annual precipitation for this ecological site is 29 inches. The annual average maximum and minimum temperatures are 53°F and 34°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	66-116 days
Freeze-free period (characteristic range)	103-142 days
Precipitation total (characteristic range)	32-35 in
Frost-free period (actual range)	41-116 days
Freeze-free period (actual range)	86-143 days
Precipitation total (actual range)	32-37 in
Frost-free period (average)	88 days
Freeze-free period (average)	121 days
Precipitation total (average)	34 in

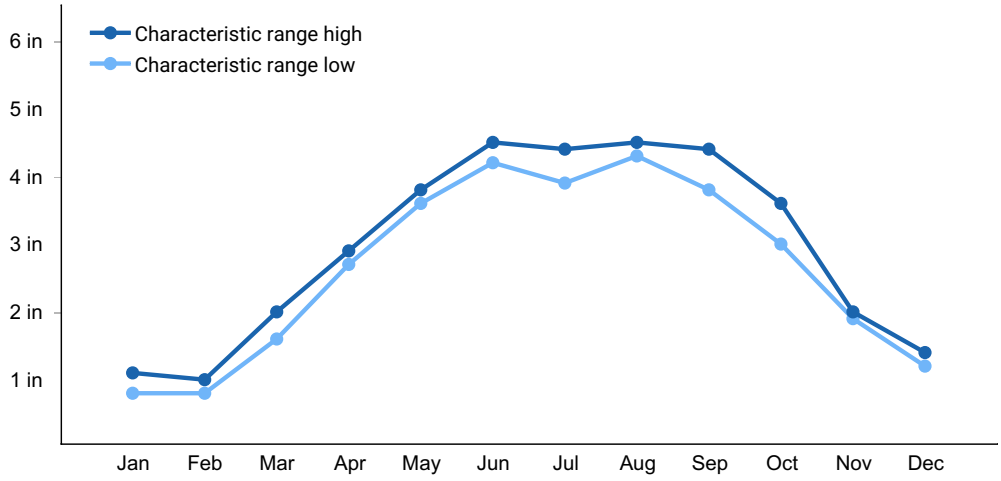


Figure 1. Monthly precipitation range

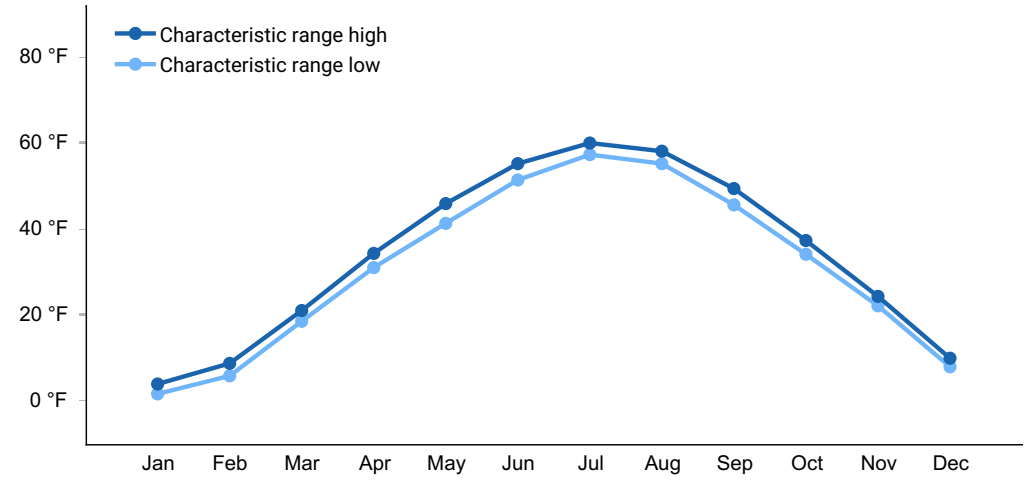


Figure 2. Monthly minimum temperature range

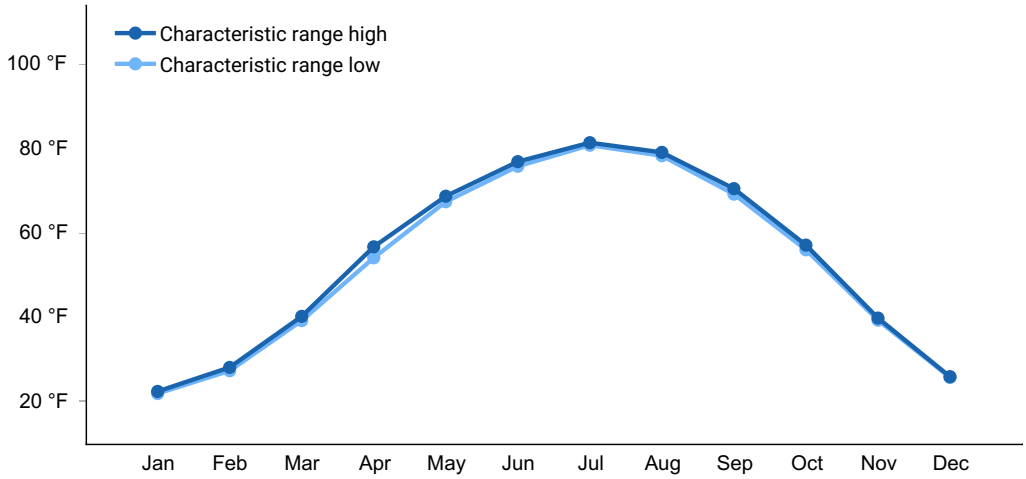


Figure 3. Monthly maximum temperature range

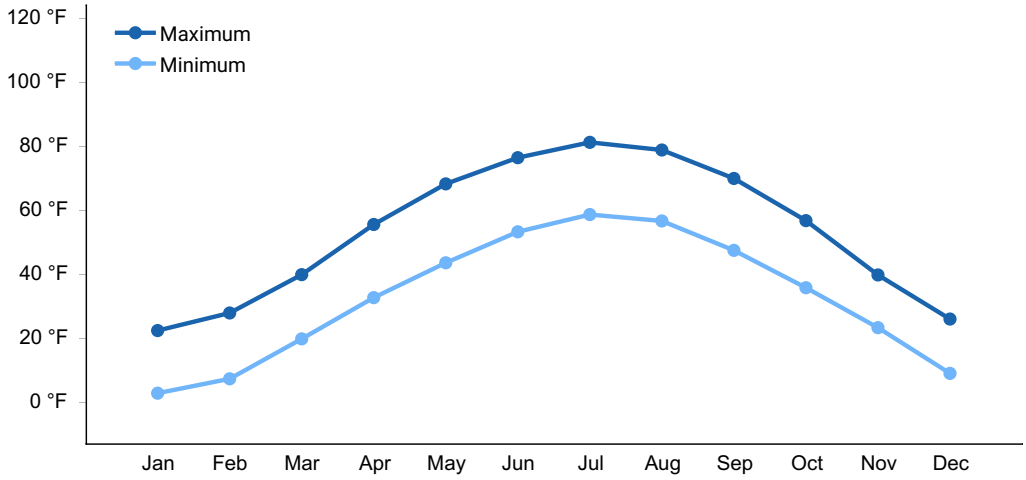


Figure 4. Monthly average minimum and maximum temperature

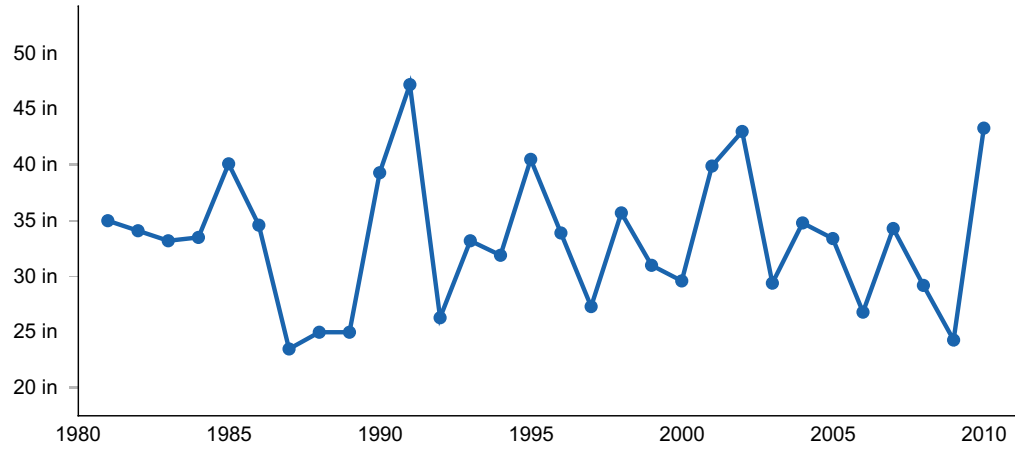


Figure 5. Annual precipitation pattern

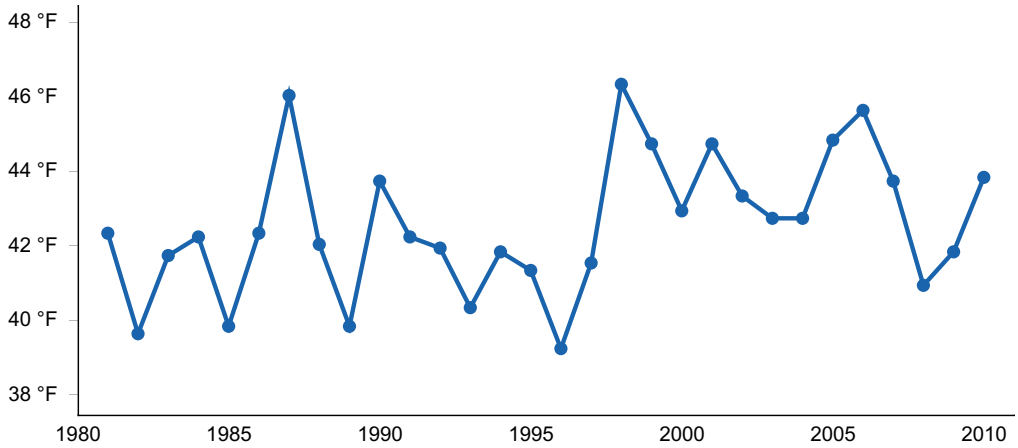


Figure 6. Annual average temperature pattern

Climate stations used

- (1) LUCK [USC00474894], Luck, WI
- (2) AMERY [USC00470175], Amery, WI
- (3) COUDERAY 7 W [USC00471847], Stone Lake, 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 evapotranspiration and groundwater recharge. These sites are wetlands.

Wetland description

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

3) Palustrine emergent, persistent, saturated

Under the Hydrogeomorphic Classification System (HGM), the wetlands can be classified as:
1) Depressional, forested/sandy, or
2) Depressional, scrub-shrub/sandy

Permeability of the soils are impermeable to very slow.
Hydrologic Group: D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PSS1B, PEM1B

Soil features

These sites are represented by Altdorf, Indus, and Wildwood soil series. Altdorf is classified as an Aeric Glossaqualf, Indus is a Vertic Epiaqualf, and Wildwood is a Histic Humaquept.

These soils formed in various parent materials including silty alluvium, loamy or clayey residuum, loess, loamy or clayey till, and clayey lacustrine. Soils are very deep. Sites are very poorly or poorly drained and remain saturated for much of the growing season. They meet hydric soil requirements.

The surface of these sites is often muck, mucky silt loam, silt loam, or clay loam. Subsurface horizons include clay loam, silt loam, silty clay, and clay textures. Soil pH ranges from very strongly acid to moderately alkaline with values of 4.6 to 7.9. This range occurs because some sites have carbonates present beginning at 25 inches and can have up to 18 percent calcium carbonates. Fragments are typically absent, but subsurface fragments less than 3 inches can be present up to 3 percent in the profile.

Table 4. Representative soil features

Parent material	(1) Lacustrine deposits (2) Till (3) Organic material (4) Eolian deposits (5) Metamorphic rock
Surface texture	(1) Mucky silt loam (2) Mucky clay
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow
Soil depth	79–98 in
Surface fragment cover <=3"	0%

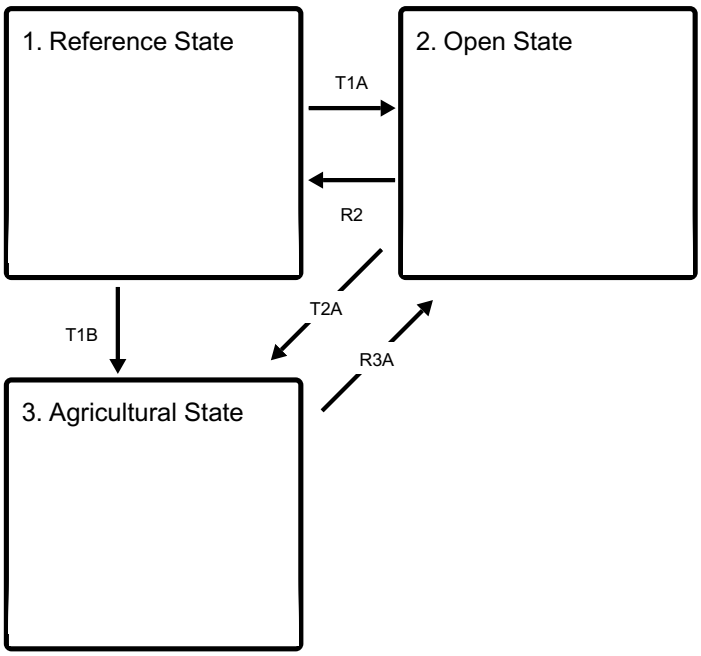
Surface fragment cover >3"	0%
Available water capacity (0-61in)	2.33–3.93 in
Calcium carbonate equivalent (0-39.4in)	0–18%
Soil reaction (1:1 water) (0-39.4in)	4.6–7.9
Subsurface fragment volume <=3" (Depth not specified)	0–3%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Because of the poorly drained soils, the historic fire disturbance has likely been less frequent and less severe than on the better drained sites. These forested wetlands are dominated by black ash (*Fraxinus nigra*) with other hardwood associates such as swamp white oak (*Quercus bicolor*) and slippery elm (*Ulmus rubra*). Trembling aspen (Populus trembuloides) is common on many sites, but cannot compete with other hardwoods that are more tolerant of shade and moisture. This community relies heavily on soil moisture and nutrient regimes. These sites can support more nutrient demanding species, and the plants must tolerate seasonal ponding. During the driest months, standing water drains, but soils remain saturated throughout the growing season. Tree species often rely on the pit-and-mound microtopography to remain above the oversaturated rooting zones to avoid prolonged anaerobic conditions. Pit-and-mound topography is caused by tree species that have shallow roots and tip from windthrow. Seasonal ponding prevents other shade-tolerant species such as sugar maple from becoming competitive on these sites.

State and transition model

Ecosystem states



T1A - Major stand replacing disturbance e.g. blow-down or clear-cutting.

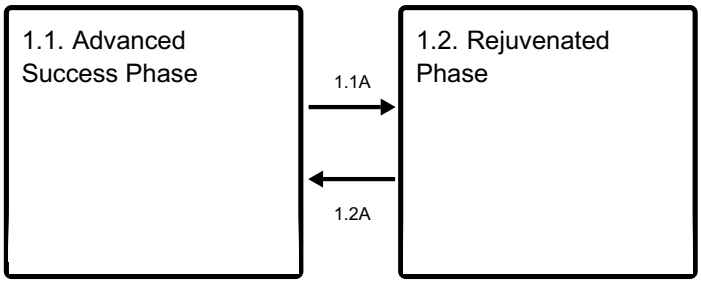
T1B - Elimination of forest cover, application of agricultural practices.

R2 - Deciduous forest community is slowly invaded by conifers.

T2A - Elimination of forest cover, application of agricultural practices.

R3A - Cessation of agricultural practices.

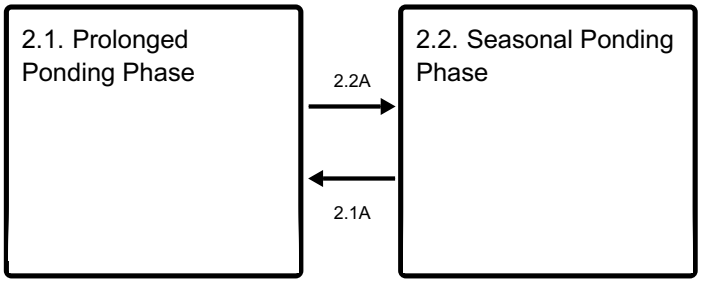
State 1 submodel, plant communities



1.1A - Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, and prolonged ponding events create openings for entry of mid-tolerant species, such as green ash.

1.2A - Time and natural succession.

State 2 submodel, plant communities



2.2A - Decreased frequency and duration ponding events, encroachment of tree species such as aspen and black ash.
2.1A - Increased frequency and duration of ponding events.

State 3 submodel, plant communities

3.1. Agricultural Phase

State 1
Reference State

Reference state is a forest community dominated by black ash with swamp white as a primary associate. Depending on disturbance history, two community phases can be distinguished largely by differences in dominance of tree species and community age structure.

Community 1.1
Advanced Success Phase

In absence of stand replacing disturbance (major blow-downs, clearcutting, or prolonged ponding event), this community is dominated by black ash in all layers of the forest from canopy to shrub layer. Black ash has a shallow and fibrous root system that to tolerate seasonal ponding of stagnant water. Long duration of ponding will cause black ash to diminish. Swamp white oak and slippery elm are common associates, both tolerant of high soil moisture, but not as tolerant as black ash. The forest floor cover is dominated by goldenrod (Solidago, spp.) and sedges (Carex, spp.), but includes many other wet species like sensitive fern (*Onoclea sensibilis*), hog-peanut (Amphicarpa bracteate), and Virginia creeper (*Parthenocissus quinquefolia*).

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- swamp white oak (*Quercus bicolor*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- sedge (*Carex*), grass
- goldenrod (*Oligoneuron*), other herbaceous

Community 1.2
Rejuvenated Phase

The canopy of the rejuvenated community is still dominate by black ash, but swamp white oak and slippery elm have entered canopy and sub-canopy to fill in canopy gaps created

by small-scale disturbances. Advanced regeneration black ash saplings may also gain considerable size. Some additional less shade tolerant species may be able to enter the community, such as Green ash (*Fraxinus pennsylvanica*).

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- swamp white oak (*Quercus bicolor*), tree
- slippery elm (*Ulmus rubra*), tree
- green ash (*Fraxinus pennsylvanica*), shrub
- sedge (*Carex*), grass
- goldenrod (*Oligoneuron*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Natural mortality in the oldest age classes, sporadic small-scale blow-downs and ice storms, and prolonged ponding create canopy openings, releasing advance regeneration and stimulating new seedling establishment. Swamp white oak and slippery elm may enter openings.

Pathway 1.2A
Community 1.2 to 1.1

Time and natural succession. Black ash tolerance to seasonal ponding and soil saturation continues its dominance as most competitive canopy species.

State 2
Open State

Open State consists of two main community phases. Phases are primarily driven by frequency and duration of ponding events that allow or deter establishment of woody, less tolerant species.

Community 2.1
Prolonged Ponding Phase

The Prolonged Ponding Phase is defined by the increased frequency and duration of ponding events. Communities are dominated by sedges and grasses that can tolerate constant saturation and long periods of standing, stagnant surface water.

Dominant plant species

- sedge (*Carex*), grass
- Grass, native (*Grass, native*), grass

Community 2.2
Seasonal Ponding Phase

The Seasonal Ponding Phase is defined by the presence of woody species, primarily trembling aspen and black ash with higher transpiration rates.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- black ash (*Fraxinus nigra*), tree
- sedge (*Carex*), grass
- goldenrod (*Oligoneuron*), other herbaceous

Pathway 2.2A
Community 2.1 to 2.2

Decreased frequency and duration of ponding events. Seasonal ponding where surface water usually drains by midsummer. Allows for establishment of less tolerant species.

Pathway 2.1A
Community 2.2 to 2.1

Increased frequency and duration of ponding events.

State 3
Agricultural State

The agricultural state in this ecological site is characterized as likely having artificial drainage and is composed of crops such as corn, soybeans, potatoes, and hay.

Community 3.1
Agricultural Phase

The agricultural state in this ecological site is characterized as likely having artificial drainage and is composed of crops such as corn, soybeans, potatoes, and hay. Agricultural production in these settings is likely to include practices such as tilling and fertilizing.

Transition T1A
State 1 to 2

Major stand-replacing disturbance, such as a blow-down or clear cutting. Removal of canopy causes water table to rise. Sites have more frequent and longer duration of ponding events.

Transition T1B
State 1 to 3

Elimination of forest cover and the application of agricultural practices, such as artificial drainage, tilling, and planting crops.

Restoration pathway R2
State 2 to 1

Deciduous forest community is slowly invaded by conifers.

Transition T2A
State 2 to 3

Elimination of forest cover and the application of agricultural practices, such as artificial drainage, tilling, and planting crops.

Restoration pathway R3A
State 3 to 2

Cessation of agricultural practices and either planting or allowing natural seeding is required for this restoration pathway. Restoration might be accelerated with removal of artificial drainage and restoring hydrology, if applicable.

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 Types.
Wetland Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to two main habitat type (due to MLRA spanning several habitat type regions others are included here as likely in the PESD): *Fraxinus nigra*-Acer rubrum/Impatiens (FnArI); *Fraxinus nigra*-Acer rubrum/Impatiens-Ilex variant (FnArI-Ix); *Fraxinus nigra*/Onoclea (FnOn); *Fraxinus nigra*-Abies balsamea-Acer rubrum/Onoclea (FnAbArOn); Abies balsamea-*Fraxinus nigra*-Thuja/Ilex (AbFnThIx); Acer rubrum-*Fraxinus nigra*/Rubus hispidus (ArFnRh)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, Eastern Cool Temperate Close Grown Crop, and Eastern Cool Temperate Pasture and Hayland
WDNR Natural Communities (WDNR, 2015):

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Approval

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Acknowledgments

NRCS contracted UWSP to write ecological sites in MLRA 90B, completed in 2021.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/21/2025
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:

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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:**
