USDA Natural Resources Conservation Service

Ecological site F090BY006WI
Wet Loamy Lowland

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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 to 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 to 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 and 90B)

USFS Subregions: Mille Lacs Uplands (212Kb), Glidden Loamy Drift Plain (212Xa), Lincoln Formation Till Plain - Hemlock Hardwoods (212Qc), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Perkinstown End Moraine (212Xe), Rib Mountain Rolling Ridges (212Qd), Brule and Paint Rivers Drumlinized Ground Moraine (212Xc), St. Croix Moraine (212Qa), Rosemont Baldwin Plains and Moraines (222Md), Central-Northwest Wisconsin Loess Plains (212Xd)

Small sections occur in Hayward Stagnation Moraines (212Xf), Green Bay Lobe Stagnation Moraine (212Ta)

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

Ecological site concept

The Wet Loamy Lowland ecological site is scattered throughout MLRA 90A and 90B in depressions and drainageways on outwash, lake, and till plains, moraines, and stream terraces. These sites are characterized by very deep, very poorly or poorly drained soils that formed primarily in loamy deposits including lacustrine, till, alluvium, and residuum. Some sites have mantles or underlying sandy or clayey material. Sites are subject to frequent ponding or occasional flooding 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, groundwater discharge, and stream inflow are the primary sources of water. Soils range from extremely acid to moderately alkaline.

Wet Loamy Lowland is differentiated from other ecological sites by its deep loamy deposits and very poorly or poorly drained soils. Other very poorly or poorly drained sites have sandy or clayey deposits. pH and available water capacity are often higher in loamy sites than sandy sites and often lower in loamy sites than clayey sites. The poor drainage of this site distinguishes it from other loamy sites.

Associated sites

F090BY002WI	**Mucky Swamp** Mucky Swamp sites consist of deep, highly decomposed herbaceous organic materials. Some sites have mineral soil contact. They are very poorly drained and are neutral to slightly acid. These sites are permanently saturated wetlands. They are wetter and occur lower on the drainage sequence than Wet Loamy Lowland.
F090BY011WI	**Moist Loamy Lowland** Moist Loamy Lowland consist of deep sandy and loamy deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. The finer textures allow the soil to stay moist - but not saturated - for sustained periods during the growing season. They are somewhat drier and occur higher on the drainage sequence than Wet Loamy Lowland.
F090BY016WI	**Loamy Upland** Loamy Upland consist of deep loamy till, alluvium, residuum, lacustrine, or eolian deposits. Sandy deposits of these parent materials, plus outwash, may also be present. The depth to the seasonally high water table ranges from as high as the surface to as low as almost two meters below the surface. A few sites are on floodplains and upland drainageways, where very brief flooding is rare but possible. They are much drier and occur higher on the drainage sequence than Wet Loamy Lowland.
F090BY021WI	**Dry Loamy Upland** Dry Loamy Upland consist of deep sandy to loamy outwash, alluvium, or till. The water table is deeper than two meters year-round. They are much drier and occur higher on the drainage sequence than Wet Loamy Lowland.

Similar sites

F090BY004WI	**Loamy Floodplain** Loamy Floodplain are found exclusively on floodplains in loamy alluvium, sometimes underlain by sandy alluvium. Soils are very poorly to moderately well drained and are subject to flooding. Some sites may be saturated for long enough for hydric conditions to occur. They share particle size and sometimes drainage capability with Wet Loamy Lowland, though their landforms are different. The vegetative communities are similar between the two sites.
F090BY005WI	**Wet Sandy Lowland** Wet Sandy Lowland consist of deep sandy deposits derived from a mixture of outwash, alluvium, and lacustrine sources. They form in seasonally ponded depressions and are saturated long enough for hydric conditions to occur. Some sites are wetlands. They are found in similar landforms with similar drainage as Wet Loamy Lowlands, though their particle sizes are coarser. Wet Sandy Lowland supports vegetative communities with lower nutrient requirements.
F090BY007WI	**Wet Clayey Lowland** Wet Clayey Lowland form in deep, loamy to clayey deposits derived from a mixture of alluvium, residuum, till, or lacustrine sources. These sites have a seasonally high water table at the surface, and some are subject to occasional ponding. Sustained saturation is enough for hydric conditions to occur. They are found in similar landforms with similar drainage as Wet Loamy Lowland, though their particle sizes are finer. The vegetative communities are similar between the two sites.
F090BY014WI	**Loamy Bedrock Upland** Loamy Bedrock Upland sites consist of sandy to clayey alluvium, till, or eolian deposits over residuum weathered from bedrock. Bedrock contact occurs within two meters of the surface. Sites have seasonally high water table within a meter of the surface. Perching of the water table may occur as a result of bedrock contact. They are somewhat drier but with similar particle sizes as Wet Loamy Lowlands. The two sites support similar vegetative communities.

Table 1. Dominant plant species

Tree	(1) *Acer rubrum* (2) *Abies balsamea*
Shrub	(1) *Corylus*
Herbaceous	(1) *Onoclea* (2) *Carex*

Physiographic features

This site occurs in depressions and drainageways on outwash, lake, and till plains, moraines, and stream terraces. Slopes range from 0 to 4 percent. Sites are in footslope and toeslope positions.

Some sites are subject to frequent ponding. The ponding duration is brief (2 to 7 days) to long (7 to 30 days), with depths up to 12 inches above the soil surface. Some sites are subject to occasional flooding with durations of brief to long. These soils have seasonally high water table at a depth of 0 to 12 inches, but the water table may drop below 80 inches during dry conditions. Runoff is negligible to low.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope (2) Footslope
Slope shape across	(1) Linear
Slope shape up-down	(1) Concave
Landforms	(1) Depression (2) Drainageway (3) Outwash plain (4) Lake plain (5) Till plain (6) Moraine (7) Stream terrace

Runoff class	Negligible to low
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	None to occasional
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	492–902 ft
Slope	0–4%
Ponding depth	0–12 in
Water table depth	0–6 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.

Table 3. Representative climatic features

Frost-free period (characteristic range)	84-108 days
Freeze-free period (characteristic range)	115-136 days
Precipitation total (characteristic range)	29-32 in
Frost-free period (actual range)	42-116 days
Freeze-free period (actual range)	87-145 days
Precipitation total (actual range)	28-35 in
Frost-free period (average)	90 days
Freeze-free period (average)	123 days
Precipitation total (average)	31 in

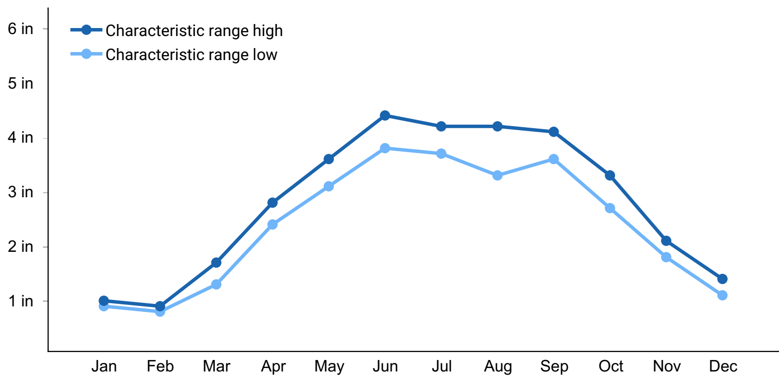


Figure 1. Monthly precipitation range

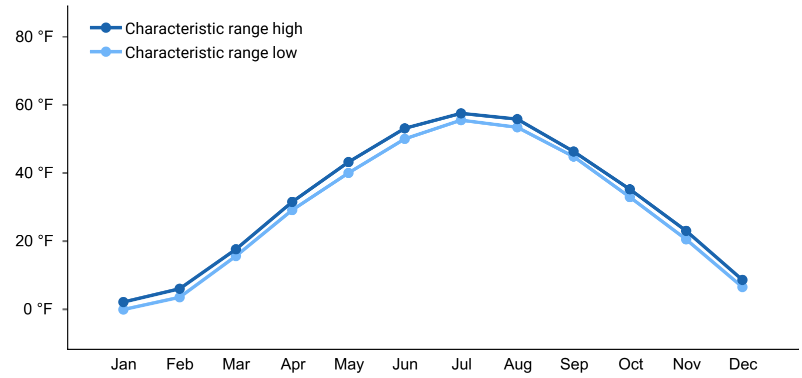


Figure 2. Monthly minimum temperature range

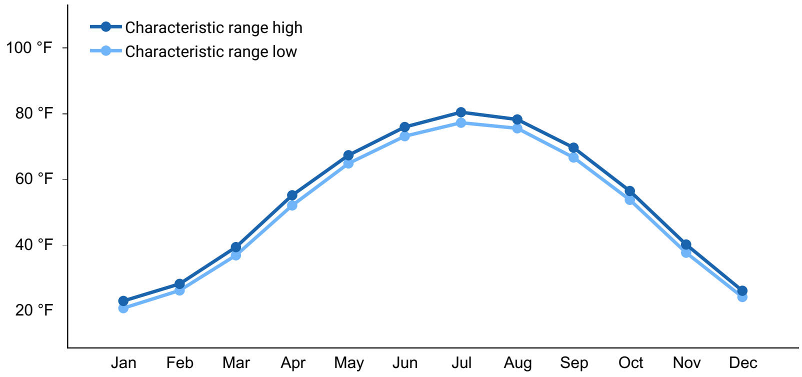


Figure 3. Monthly maximum temperature range

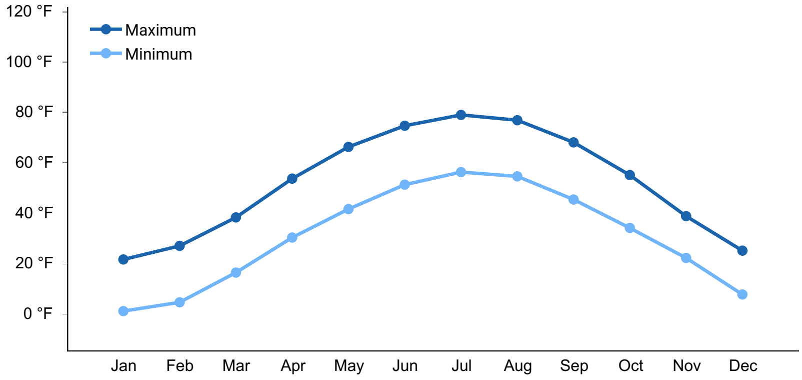


Figure 4. Monthly average minimum and maximum temperature

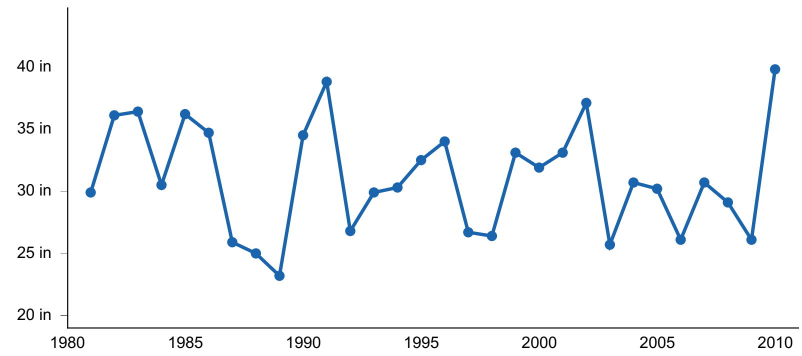


Figure 5. Annual precipitation pattern

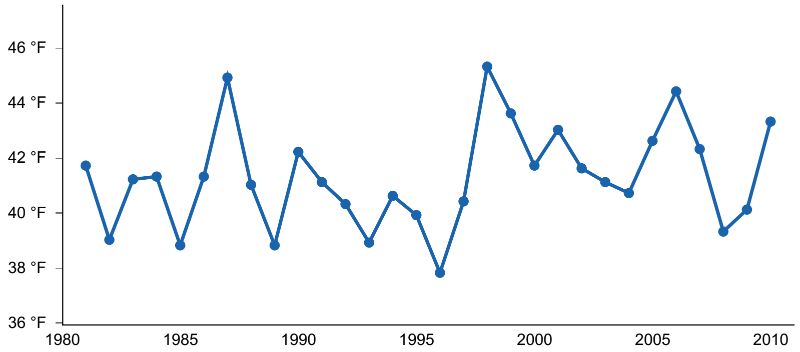


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOLCOMBE [USC00473698], Holcombe, WI
- (2) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (3) LAONA 6 SW [USC00474582], Laona, WI
- (4) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (5) PARK FALLS DNR HQ [USC00476398], Park Falls, WI
- (6) BIG FALLS HYDRO [USC00470773], Glen Flora, WI
- (7) COUDERAY 7 W [USC00471847], Stone Lake, WI
- (8) ISLE 12N [USC00214103], Isle, MN
- (9) MOOSE LAKE 1 SSE [USC00215598], Moose Lake, MN
- (10) MILACA [USC00215392], Milaca, MN

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, groundwater discharge, and less often, stream inflow. 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, forested, needle-leaved evergreen, saturated, or
3) Palustrine, scrub/shrub, broad-leaved deciduous, saturated, or
4) Palustrine emergent, persistent, saturated

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

Permeability of the soil is impermeable to moderately slow.
Hydrologic Group: D, B/D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic; Depressional, scrub-shrub/organic
Cowardin Wetland Classification: PFO1B, PFO4B, PSS1B, PEM1B

Soil features

These sites are represented by the Annriver, Barronett, Bjorkland, Bluffton, Cable, Capitola, Clyde, Dancy, Fenander, Giese, Glenflora, Lows, Mann, Marshan, Nokasippi, Rib, Roscommon Variant, Sherry, Warman Variant, and Wozny soil series. Some sites are also represented by Aquents, Aquepts, and Fluvaquents that have not been classified to series. Annriver and Rib are classified as Mollic Endoaqualfs; Lows and Roscommon Variant are Mollic Endoaquepts; Auburndale, Barronett, and Marshfield are Mollic Epiaqualfs; Warman Variant is a Mollic Epiaquept;

Cebana and Glenflora are Mollic Glossaqualfs; Roscommon is a Mollic Psammaquent; Capitola is an Aeric Epiaqualf; Pleine is a Histic Humaquept; Elmlake is a Humaqueptic Epiaquent; Veedum and Vesper are Humic Epiaquepts; Minoqua is a Typic Endoaquept; Bluffton, Clyde, and Marshan are Typic Endoaquolls; Bjorkland and Wozny are Typic Epiaqualfs; Cable is a Typic Epiaquept; Mann is a Typic Epiaquoll; Dancy is a Typic Glossaqualf; Giese is a Typic Humaquept; Sherry is a Udollic Endoaqualf; Fenander and Nokasippi are Udollic Epiaqualfs.

These soils formed in various parent materials including outwash, lacustrine deposits, loess, till, alluvium, and residuum. Most soils are very deep, but some sites have bedrock contact as high as 36 inches. These soils are very poorly or poorly drained and remain saturated for much of the growing season. They meet hydric soil requirements.

The surface horizon of these sites is muck, peat, silt loam, sandy loam, fine sandy loam, loam, and loamy coarse sand. Some sites have a very cobbly modifier at the surface. Subsurface horizons have silt loam, clay loam, sandy clay loam, silty clay loam, sandy loam, loam, loamy sand, mucky sand, sand, and clay textures. Some horizons have fine, very fine or coarse sands. Some sites have gravelly and cobbly modifiers on subsurface horizons. Soil pH is extremely acid to moderately alkaline with a range of 4.2 to 7.9. Carbonates may be present up to 18 percent within a depth range for 26 to 80+ inches

Table 4. Representative soil features

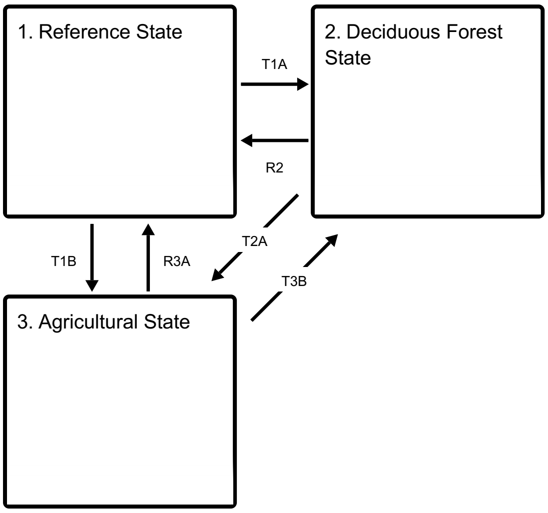
Parent material	(1) Lacustrine deposits (2) Eolian deposits (3) Outwash (4) Till (5) Alluvium (6) Granite (7) Sandstone and shale
Surface texture	(1) Peaty, mucky loamy sand (2) Peaty, mucky sandy loam (3) Peaty, mucky silt loam
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow to moderately slow
Soil depth	36–98 in
Surface fragment cover <=3"	0–7%
Surface fragment cover >3"	0–20%
Available water capacity (0-61in)	0.82–5.05 in
Calcium carbonate equivalent (0-39.4in)	0–18%
Soil reaction (1:1 water) (0-39.4in)	4.2–7.9
Subsurface fragment volume <=3" (Depth not specified)	0–46%
Subsurface fragment volume >3" (Depth not specified)	0–35%

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

Ecosystem states



T1A - Stand replacing disturbance that includes fire.

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

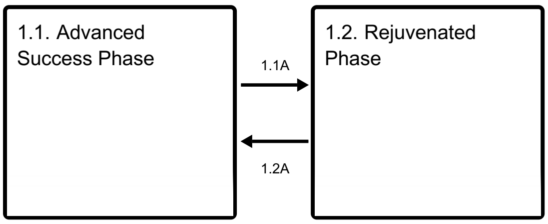
R2 - Deciduous forest community is slowly invaded by conifers.

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

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

T3B - 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 1
Reference State

Reference state is a forest community dominated by red maple (*Acer rubrum*) with groups of balsam fir (*Abies balsamea*). Depending on history of disturbance, 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 the absence of major disturbance—particularly fire—these sites are dominated by a canopy of red maple and balsam fir. Sites may have a super-canopy of large white pine that might be able to maintain itself in few numbers through regeneration in gaps. White pine (*Pinus strobus*) has a moderate shade tolerance and grow to be much larger than red maple and balsam fir at maturity and typically live longer. The shrub layer is not well developed and dominated by red maple sapling and tag alder (*Alnus incana*). The ground layer is covered by cinnamon fern (Osmunda cinamomea), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), and blueberry (Vaccinium, spp.) are common.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea*), other herbaceous

Community 1.2
Rejuvenated Phase

The canopy of the rejuvenated community is still dominated by original species, but the understory now also includes a well-established younger cohort and perhaps a few additional seedlings and saplings of less shade tolerant species. Black spruce (*Picea mariana*) may occur sporadically on sites, but is unable to compete with red maple and balsam fir with the lack of fire or other disturbance.

Dominant plant species

- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- beaked hazelnut (*Corylus cornuta*), shrub
- chokecherry (*Prunus virginiana*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea*), 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, releasing advanced regeneration and stimulating new seedling establishment. Some additional less shade tolerant species such as red oak may be able to enter the community.

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. 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
Deciduous Forest State

Pure, or mixed, aspen – paper birch community replaces the reference state community. If seed source is present, red maple and young cohorts of balsam fir readily becomes member of this community.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- birch (*Betula*), tree
- red maple (*Acer rubrum*), tree
- balsam fir (*Abies balsamea*), shrub
- beaked hazelnut (*Corylus cornuta*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea*), other herbaceous

State 3
Agricultural State

Hay or cultivated crops.

Transition T1A
State 1 to 2

Stand replacing disturbance that must include fire to create conditions for aspen and paper birch to colonize the site.

Transition T1B
State 1 to 3

Removal of forest cover and tilling for agricultural crop production.

Restoration pathway R2
State 2 to 1

Deciduous forest community is slowly invaded by conifers.

Transition T2A
State 2 to 3

Removal of forest cover and tilling for agricultural crop production.

Restoration pathway R3A
State 3 to 1

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

Transition T3B
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 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.
Forest Habitat Type Classification System for Northern Wisconsin (Kotar and Burger, 2017): The sites of this ES keyed out to three habitat types: *Abies balsamea*-Fraxinus nigra-Thuja/Ilex (AbFnThIx); *Abies balsamea*- Fraxinus nigra -Thuja-Arisaema (AbFnThAs); Fraxinus nigra-*Acer rubrum*/Impatiens (FnArI)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Laurentian-Acadian Northern Hardwoods Forest, North-Central Interior Maple-Basswood Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest, Laurentian-Acadian Herbaceous Wetlands, and Boreal White Spruce-Fir Forest
WDNR Natural Communities (WDNR, 2015):

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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	05/02/2024
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:

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:**