Ecological site F090BY021WI
Dry Loamy Upland

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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 6-24 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 and 90B)

USFS Subregions: Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), St. Croix Moraine (212Qa), Rib Mountain Rolling Ridges (212Qd), Green Bay Lobe Stagnation Moraine (212Ta), Central-Northwest Wisconsin Loess Plains (212Xd)

Small sections occur in Rosemont Baldwin Plains and Moraines (222Md), Perkinstown End Moraine (212Xe), Hayward Stagnation Moraines (212Xf)

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

Ecological site concept

The Dry Loamy Upland ecological site is scattered across MLRAs 90A and 90B, located on outwash plains, stream terraces, kames, and hills. These sites are characterized by very deep, somewhat excessively and excessively drained soils that formed in loamy deposits including outwash, alluvium, and drift. Some sites may have a sandy mantle or underlying sandy or deposits. Precipitation and runoff are the primary water sources. Soils range from very strongly acid to neutral.

Dry Loamy Upland is distinguished from other ecological sites by its deep loamy deposits and somewhat excessively and excessively drained soils. Other somewhat excessively and excessively drained sites have sandy deposits. The loamy material often has a higher pH and available water capacity than sandy material. The somewhat excessively to excessively drainage differentiates this site 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 much wetter and occur lower on the drainage sequence than Dry Loamy Upland.
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 are much wetter and occur lower on the drainage sequence than Dry Loamy Upland.
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 wetter and occur lower on the drainage sequence than Dry Loamy Upland.
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 wetter and occur lower on the drainage sequence than Dry Loamy Upland.

Similar sites

F090BY020WI	**Dry Loamy Bedrock Upland** Dry Loamy Bedrock Upland consist of silty loess, sometimes underlain by loamy till. Basalt or quartzite bedrock typically occurs within one meter of the surface. These soils show no evidence of a seasonally high water table. They are found in similar landscape positions and share both drainage class and particle size with Dry Loamy Upland but have bedrock contact within two meters of the surface.
F090BY019WI	**Dry Sandy Upland** Dry Sandy Upland consist of primarily sandy deposits of various origin. Loamy deposits are also present in many soils. They may have a seasonally high water table within two meters of the surface, though they do not remain saturated for sustained periods. They are found in similar landscape positions and share their drainage class with Dry Loamy Upland but have coarser particle sizes.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Fraxinus americana*
Shrub	(1) *Corylus* (2) *Rubus*
Herbaceous	(1) *Oligoneuron* (2) *Eurybia macrophylla*

Physiographic features

These sites formed on outwash plains, stream terraces, kames, and hills. Slopes range from 0 to 40 percent. Sites are on summit, shoulder, and backslope positions.

These sites are not subject to ponding or flooding. The water table is below 80 inches year-round because of the excessive drainage. Surface runoff ranges from negligible to very high. This range in runoff is caused by the wide range of slopes across sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Slope shape across	(1) Convex
Slope shape up-down	(1) Linear
Landforms	(1) Outwash plain (2) Stream terrace (3) Kame (4) Hill
Runoff class	Very low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	705–853 ft
Slope	0–40%
Water table depth	80–100 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 32 inches. The average annual snowfall is 49 inches. The annual average maximum and minimum temperatures are 53°F and 33°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	95-114 days
Freeze-free period (characteristic range)	129-140 days
Precipitation total (characteristic range)	29-33 in
Frost-free period (actual range)	59-117 days
Freeze-free period (actual range)	102-147 days
Precipitation total (actual range)	27-35 in
Frost-free period (average)	97 days
Freeze-free period (average)	131 days
Precipitation total (average)	31 in

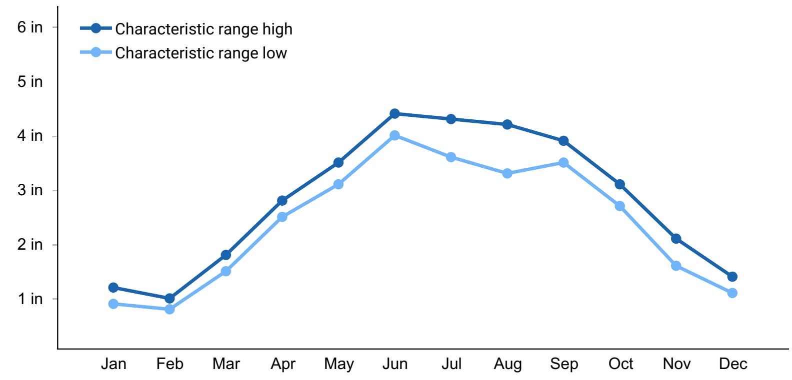


Figure 1. Monthly precipitation range

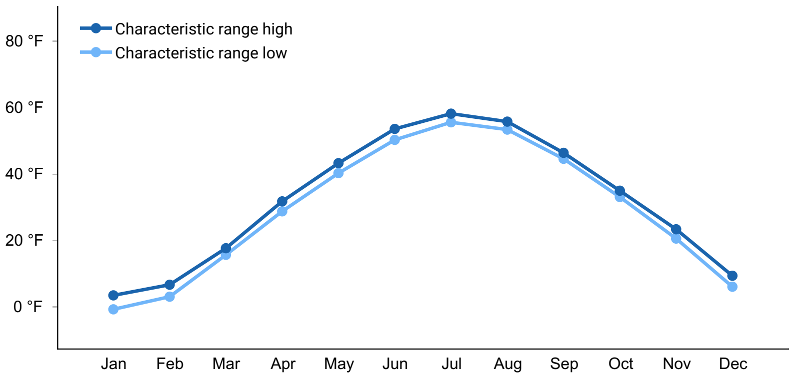


Figure 2. Monthly minimum temperature range

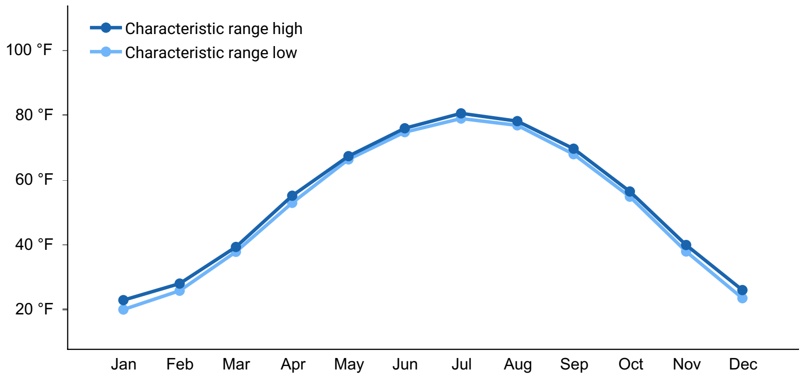


Figure 3. Monthly maximum temperature range

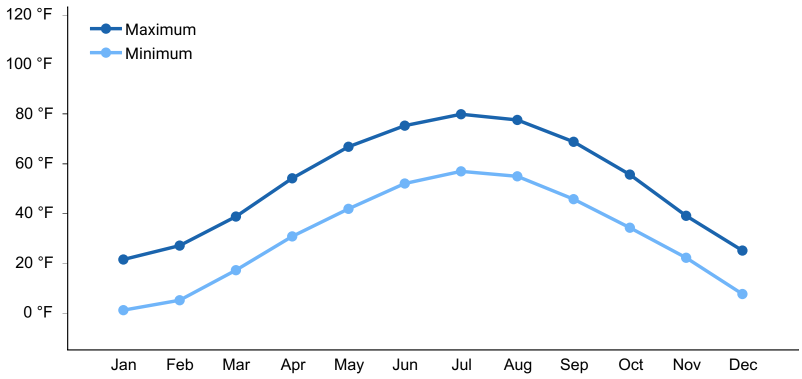


Figure 4. Monthly average minimum and maximum temperature

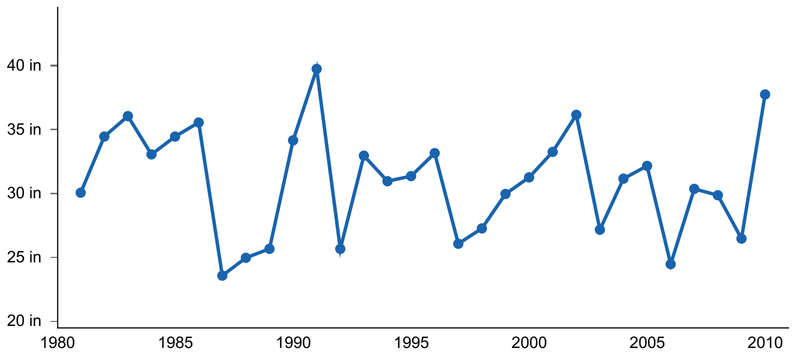


Figure 5. Annual precipitation pattern

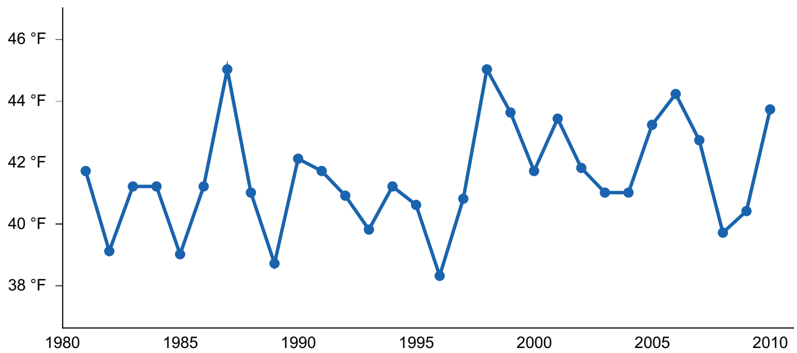


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOLCOMBE [USC00473698], Holcombe, WI
- (2) ROSHOLT 9 NNE [USC00477349], Wittenberg, WI
- (3) COUDERAY 7 W [USC00471847], Stone Lake, WI

- (4) MILACA [USC00215392], Milaca, MN
- (5) MINONG 5 WSW [USC00475525], Minong, WI
- (6) AMERY [USC00470175], Amery, WI
- (7) BRUNO 7ENE [USC00211074], Bruno, MN
- (8) AITKIN 2E [USC00210059], Aitkin, MN
- (9) LAKEWOOD 3 NE [USC00474523], Lakewood, WI
- (10) ISLE 12N [USC00214103], Isle, MN

Influencing water features

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

Wetland description

Permeability of these sites is moderately slow to moderate.
Hydrologic Group: A, B
Hydrogeomorphic Wetland Classification: None
Cowardin Wetland Classification: None

Soil features

These sites are represented by the Chetek and Richford soil series, classified as an Inceptic Hapludalfs and Arenic Hapludalfs, respectively.

These sites formed in sandy, loamy, or gravelly outwash, loamy alluvium, or loamy drift. Soils are very deep and somewhat excessively to excessively drained. They do not meet hydric soil requirements.

Surface textures of these sites are loamy sand, sandy loam, coarse sandy loam, and moderately decomposed plant material. Subsurface textures include sandy loam, coarse sandy loam, loamy sand, coarse sand, and sand. Some horizons have gravelly or very gravelly modifiers. Soil pH ranges from very strongly acid to neutral with values of 4.8 to 6.7. Carbonates are absent within 80 inches.

Table 4. Representative soil features

Parent material	(1) Outwash (2) Alluvium (3) Drift
Surface texture	(1) Loamy sand (2) Sandy loam
Family particle size	(1) Coarse-loamy
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Moderately slow to moderate
Soil depth	80–100 in
Surface fragment cover <=3"	0–7%
Surface fragment cover >3"	0–5%
Available water capacity (0-61in)	1.22–2.16 in
Calcium carbonate equivalent (0-39.4in)	0%
Soil reaction (1:1 water) (0-39.4in)	4.8–6.7

Subsurface fragment volume <=3" (Depth not specified)	13–28%
Subsurface fragment volume >3" (Depth not specified)	0–5%

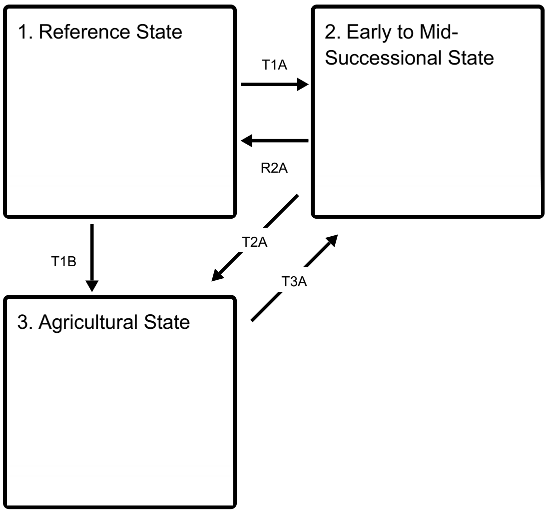
Ecological dynamics

Historically, this site was dominated by oak species in a landscape adapted to fire disturbance, thought mesic hardwoods were present in pockets. 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. Mesic hardwoods are sensitive to fire, but in its absence, the have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of sugar maple, and other mesic hardwoods. Some sites have a strong presence of red and white oak. These sites have the conditions to support shade tolerant mesic hardwoods, but these sites have dry soil moisture regime. Red and white oak can compete with the mesic hardwoods based on their ability to grow in drier soils. Historically, these sites had significant wind throw and fire disturbance that allowed for a strong presence of oak species. As long as fire is continually suppressed, maples and other mesic hardwoods will continue to dominate the canopy with oak as an associate. With some management or fire disturbance, oaks will dominate these sites.

State and transition model

Ecosystem states



T1A - Clear cutting or stand-replacing fire.

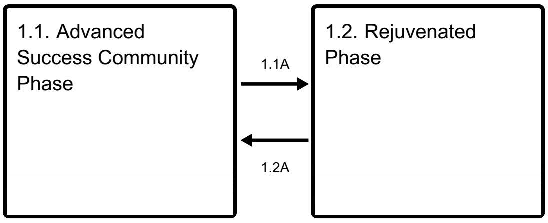
T1B - Removal of forest vegetation and tilling.

R2A - Disturbance-free period 70+ years.

T2A - Cessation of agricultural practices, natural, or artificial afforestation.

T3A - Removal of forest vegetation and tilling.

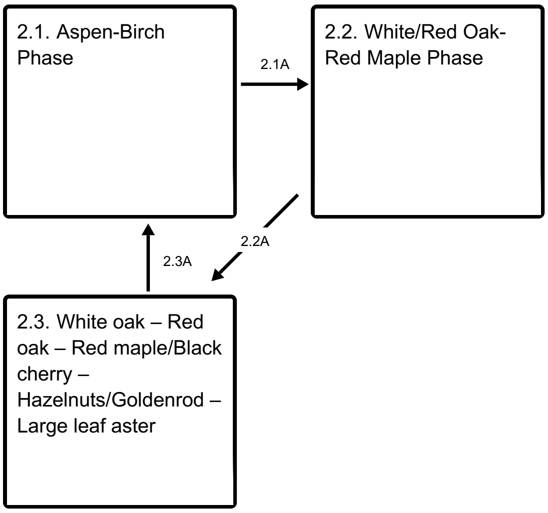
State 1 submodel, plant communities



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

1.2A - Disturbance-free period 30+ years

State 2 submodel, plant communities

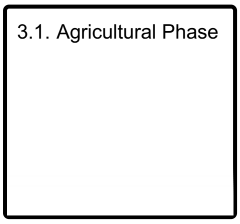


2.1A - Red oak and red maple regenerating under aspen -- paper birch canopy

2.2A - Time and natural succession.

2.3A - Major stand replacing disturbance e.g. blow-down and fire, or clear-cutting, followed by fire.

State 3 submodel, plant communities



State 1
Reference State

Reference state is a forest community dominated by sugar maple (*Acer saccharum*). 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 Community Phase

In the absence of any major disturbance, specifically fire, this community is dominated by sugar maple. Common associates include moderately shade tolerant white ash (*Fraxinus americana*), basswood (*Tilia americana*), red oak (*Quercus rubra*) and white oak (*Q. alba*). Some sites may be dominated by white and/or red oak but is unlikely without any disturbance. The shrub layer is often dominated by hazelnuts (Corylus, spp.) and blackberries (Rubus, spp.). The ground layer is dominated by large leaf aster (*Eurybia macrophylla*) and goldenrod (Solidago, spp.), with false Solomon's seal (Maianthemum racemose), Pyrola, spp., Virginia creeper (*Parthenocissus quinquefolia*), and bedstraw (Gallium, spp.) also common.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- white ash (*Fraxinus americana*), tree
- northern red oak (*Quercus rubra*), tree
- hazelnut (*Corylus*), shrub
- blackberry (*Rubus*), shrub
- goldenrod (*Oligoneuron*), other herbaceous
- bigleaf aster (*Eurybia macrophylla*), other herbaceous

Community 1.2
Rejuvenated Phase

This community is dominated by a mixture of hardwoods including white oak, red oak and red maple (Acer rurbrum). Lacking disturbance, a sub canopy of tolerant hardwoods including sugar maple and white ash may develop. The shrub and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- sugar maple (*Acer saccharum*), tree
- hazelnut (*Corylus*), shrub
- blackberry (*Rubus*), shrub
- goldenrod (*Oligoneuron*), other herbaceous
- bigleaf aster (*Eurybia macrophylla*), 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 oak and red 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 and other tolerant mesic hardwoods. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

State 2
Early to Mid-Successional State

Following disturbances described in Transition T1A a wide range of forest community phases may come into temporary existence, the three most common ones are described here.

Community 2.1
Aspen-Birch Phase

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

Dominant plant species

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

Community 2.2
White/Red Oak- Red Maple Phase

This community phase occurs by invading and succeeding a pioneer aspen-birch community. Stand structure consists of dominant white and red oak and red maple in combination with a modest, or strong presence of mature, or decaying, aspen and/or paper birch. The shrub layer, dominated by hazelnuts (Corylus, spp.), typically reaches its best development in this community phase.

Dominant plant species

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

Community 2.3
White oak – Red oak – Red maple/Black cherry – Hazelnuts/Goldenrod – Large leaf aster

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

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- red maple (*Acer rubrum*), tree
- black cherry (*Prunus serotina*), shrub
- hazelnut (*Corylus*), shrub
- goldenrod (*Oligoneuron*), other herbaceous
- bigleaf aster (*Eurybia macrophylla*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

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

Pathway 2.2A
Community 2.2 to 2.3

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

Pathway 2.3A
Community 2.3 to 2.1

Clear cutting or stand-replacing fire that allows for the reinvasion of the aspen—birch community.

State 3
Agricultural State

Indefinite period of applying agricultural practices. Primary crops include row crops, hay, and pasture.

Community 3.1
Agricultural Phase

The agricultural phase consists of planted row crops, hay, or pasture.

Transition T1A
State 1 to 2

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

Transition T1B
State 1 to 3

Clearing of land and application of tillage and other agricultural practices to establish crops, hay, or pasture.

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.

Transition T3A
State 3 to 2

Clearing of land and application of tillage and other agricultural practices to establish crops, hay, or pasture.

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.
Habitat Types of N. & S. Wisconsin (Kotar, 2002 & 1996): The sites of this ES keyed out to five habitat types: *Acer saccharum*/Caulophyllum-Circaea (ACaCi); *Acer saccharum*/Hydrophyllum (AH); Acer rubrum/Circaea (ArCi); Pinus-Acer rubrum/Vaccinium (PArV); Pinus-Acer rubrum/Vaccinium-Hamamelis (PArVHa)
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Eastern Cool Temperate Row Crop, Eastern Cool Temperate Close Grown Crop, Eastern Cool Temperate Pasture and Hayland, Developed-Low Intensity, and Developed-Medium Intensity
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	04/20/2024
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:**