Ecological site F090AY002WI
Mucky Swamp

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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): 090A–Wisconsin and Minnesota Thin Loess and Till

MLRA 90A is part of the recently glaciated till and outwash plains of central Minnesota and northern Wisconsin. The area was covered with loamy alluvium or loess after glaciation. It is in Wisconsin (56 percent), Minnesota (40 percent), and Michigan (4 percent). It makes up about 21,967 square miles (56,901 square kilometers).

This MLRA has distinct boundaries to the north where it borders tills of a dissimilar origin on the less morainic landscapes of MLRAs 88, 92, and 93A. The boundary to the west is where the MLRA transitions to the calcareous tills of the Des Moines Lobe, in MLRA 57. To the south, MLRA 90A borders MLRA 90B, which has older soils and better-defined drainage patterns, and MLRA 91, which has the distinct lower landscape relief of an outwash channel.

The part of this area in Minnesota is mostly in the Western Lake section of the Central Lowland province of the Interior Plains. Nearly all the parts in Wisconsin and Michigan are in the Superior Upland province of the Laurentian Upland. Four distinct lobes of the Laurentide Ice Sheet (Rainy, Superior, Chippewa, and Green Bay) played major roles in shaping the landscape in this area. The landscape is characterized by gently undulating to rolling, loess-mantled till plains, drumlin fields, and end moraines mixed with outwash plains associated with major glacial drainageways, swamps, bogs, and fens. In some areas lake plains and ice-walled lakes are significant. Steeper areas occur mostly as valley side slopes along flood plains and as escarpments along the margins of lakes.

Lakes, ponds, and marshes are common throughout the area, and streams generally have a dendritic pattern. The major rivers in this area are the Chippewa, St. Croix, Mississippi, and Wisconsin Rivers. Elevation ranges from 1,100 to 1,950 feet (335 to 595 meters). Local relief is mainly less than 10 feet to 20 feet (3 to 6 meters), but some major valleys and hills are 200 feet (60 meters) above the adjacent lowland.

Precambrian-age bedrock underlies most of the glacial deposits in this MLRA. The bedrock is a complex of folded and faulted igneous and metamorphic rocks. The bedrock terrain has been modified by glaciation and is covered in most areas by Pleistocene deposits and windblown silts. The glacial deposits form an almost continuous cover in most areas. The drift is several hundred feet thick in many areas. Loess covered the area shortly after the glacial ice melted.

Ground water is abundant in deep glacial deposits in most of this area. It also occurs in sedimentary and volcanic rock in the western part of the area. It is scarce where the layer of drift is thin. The water meets the domestic, agricultural, municipal, industrial, rural, and irrigation needs of the area. The content of dissolved solids in the ground water from all the various aquifers in this area is low, and the water generally is moderately hard or hard. The level of total dissolved solids in some of the water can be much higher because of a high content of limestone in some of the glacial deposits. Most of this area obtains ground water from unconsolidated glacial sand and gravel deposits on or very near the surface. Some wells tap the Cambrian sandstone in the southwestern part of the area, in Wisconsin.

In northwest Wisconsin (Ashland and Bayfield Counties) where there are no glacial deposits and in much of the part of this area in Minnesota, ground water from sedimentary and volcanic rock aquifers is used. This water is of very good quality; however, many soils have very porous layers that are poor filters of domestic waste and agricultural chemicals, so there is a risk of contamination from development and agriculture. Minor water concerns are hardness and, in some areas, high concentrations of iron. Yields of water from the glacial deposits vary.

The dominant soil orders are Alfisols, Entisols, Histosols, and Spodosols. The soils in the area have a frigid temperature regime, a udic or aquic moisture regime, and mixed mineralogy.

This area has a significant acreage of public and private forestland used to support the paper and lumber industry Sap collection from sugar maple and syrup production are important forestry enterprises. Agricultural enterprises include row crops, dairy farms, and beef operations. Crops include corn, soybeans, oats, wheat, and alfalfa. Tourism, recreation, and wildlife management are important. Hunting, fishing, snowmobiling, hiking, and skiing are popular activities because of the area's abundance of water, the many acres of national and county forests, and public hunting grounds. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

Classification relationships

Major Land Resource Area (MLRA 90A): Wisconsin and Minnesota Thin Loess and Till

USFS Subregions: Perkinstown End Moraine (212Xe), Mille Lacs Uplands (212Kb), Rib Mountain Rolling Ridges (212Qd), Glidden Loamy Drift Plain (212Xa), Hayward Stagnation Moraines (212Xf), Green Bay Lobe Stagnation Moraine (212Ta), Lincoln Formation Till Plain - Hemlock Hardwoods (212Qc), Lincoln Formation Till Plain - Mixed Hardwoods (212Qb), Central-Northwest Wisconsin Loess Plains (212Xd), Rosemont Baldwin Plains and Moraines (222Md)

Small sections occur in Central Wisconsin Moraines and Outwash (222Kb) and Bayfield Sand Plains (212Ka)

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

Ecological site concept

The Mucky Swamp ecological site occurs throughout MLRA 90A in depressions and drainageways on moraines, outwash plains, and floodplains. These sites are characterized by very deep, very poorly drained soils that formed in thick organic deposits with underlying glacial outwash. Sites are subject to frequent ponding or flooding in the spring and fall. Soils remain saturated during the growing season and meet hydric soil requirements. Precipitation, runoff from adjacent uplands, groundwater inflow, and stream inflow are the primary sources of water. Soils range from slightly acid to neutral.

Mucky Swamp sites have a relatively high pH compared to Poor fen ecological sites. These sites have more interaction with groundwater containing dissolved carbonates, and many sites have carbonates throughout the profile or in the underlying mineral material. The carbonates raise the pH and improve growing conditions (nutrient availability) over Poor fen sites.

Associated sites

F090AY006WI	**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 slightly drier and occur higher on the drainage sequence than Mucky swamps sites.
F090AY011WI	**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 drier and occur higher on the drainage sequence than Mucky swamps sites.

F090AY016WI	**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 Mucky swamps sites.
F090AY021WI	**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 Mucky swamps sites.

Similar sites

F090AY001WI	**Poor Fen** Like Mucky Swamp sites, Poor fen sites consist of herbaceous organic materials, sometimes with mineral soil contact. They are also very poorly drained, permanently saturated wetlands. Poor fen sites are more acidic because they receive less stream and groundwater. Additionally, the parent materials of adjacent sites are less calcareous than those adjacent to Mucky swamps sites. These differences are reflected in the vegetative communities, with Mucky swamps having improved growing conditions over Poor fen.
F090AY003WI	**Sandy Floodplain** Sandy Floodplain sites are found exclusively on floodplains in sandy and sometimes silty alluvium. These sites are somewhat poorly to poorly drained and are subject to flooding. Some sites may be saturated for long enough for hydric conditions to occur. The vegetative communities they support may sometimes be found on Mucky swamps sites.
F090AY004WI	**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 support similar vegetative communities as Mucky swamps sites.
F090AY006WI	**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 support similar vegetative communities as Mucky swamps sites.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Acer rubrum*
Shrub	Not specified
Herbaceous	(1) *Impatiens*

Physiographic features

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

These sites are subject to occasional to frequent ponding throughout much of the year. The ponding duration ranges from brief (2 to 7 days) and long (7 to 30 days), with depth up to 6 inches (15 cm) above the soil surface. Some sites may be subject to frequent flooding with a long duration. The soil has an apparent seasonally high water table (endosaturation) at a depth of 0 inches (0 cm) but the water table may drop below 80+ inches (200+ cm) during drought conditions. Runoff is negligible.

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Drainageway (3) Outwash plain (4) Lake plain (5) Flood plain (6) Moraine
Runoff class	Negligible
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	150–335 m
Slope	0–2%
Ponding depth	0–15 cm
Water table depth	0 cm
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)	78-114 days
Freeze-free period (characteristic range)	117-137 days
Precipitation total (characteristic range)	762-838 mm
Frost-free period (actual range)	45-116 days
Freeze-free period (actual range)	89-146 days
Precipitation total (actual range)	711-889 mm
Frost-free period (average)	91 days
Freeze-free period (average)	124 days
Precipitation total (average)	787 mm

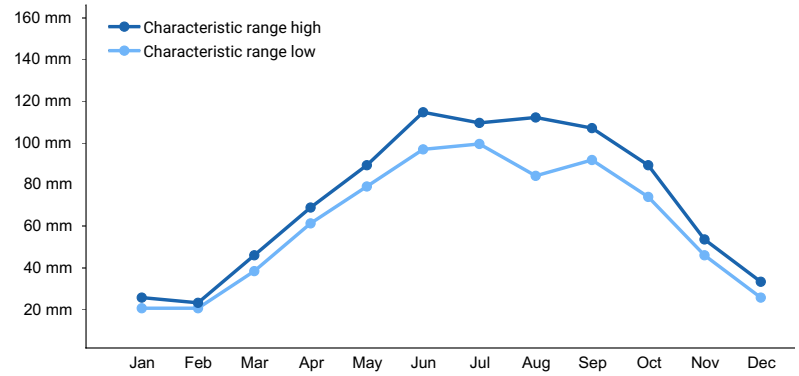


Figure 1. Monthly precipitation range

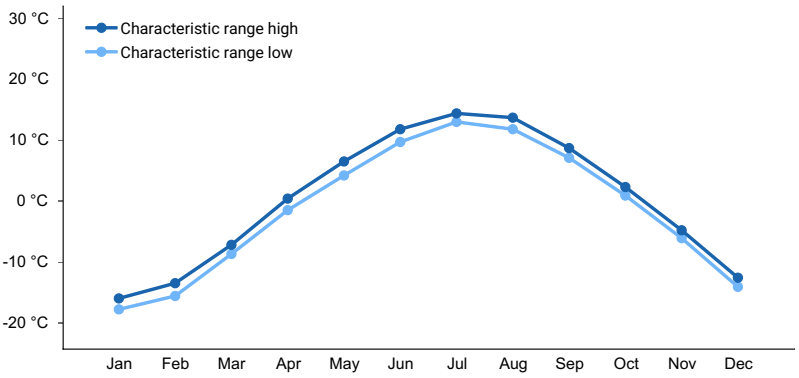


Figure 2. Monthly minimum temperature range

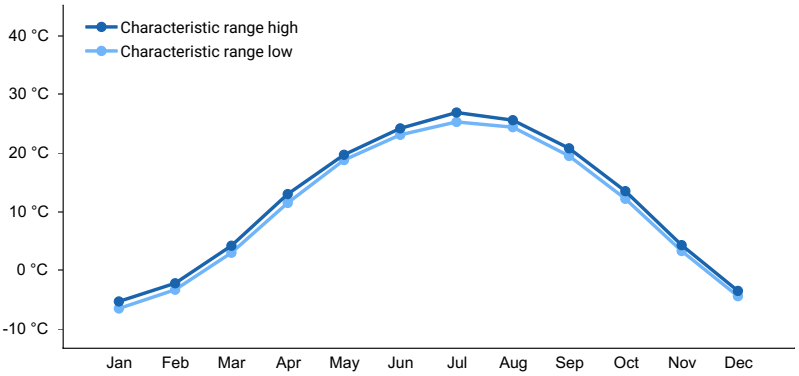


Figure 3. Monthly maximum temperature range

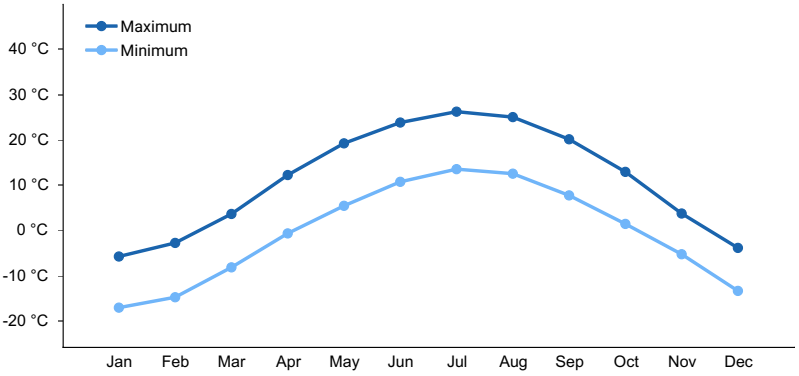


Figure 4. Monthly average minimum and maximum temperature

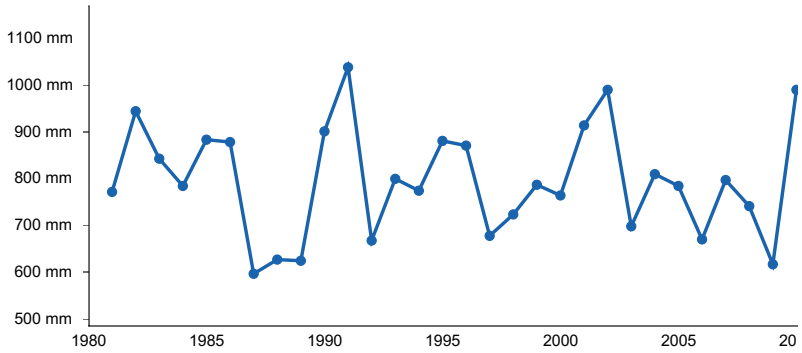


Figure 5. Annual precipitation pattern

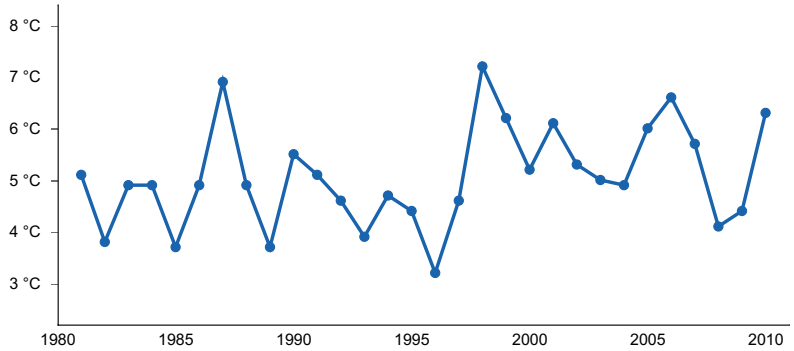


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WINTER [USC00479304], Ojibwa, WI
- (2) COUDERAY 7 W [USC00471847], Stone Lake, WI
- (3) LUCK [USC00474894], Luck, WI
- (4) AMERY [USC00470175], Amery, WI
- (5) HOLCOMBE [USC00473698], Holcombe, WI
- (6) JUMP RIVER 3E [USC00474080], Sheldon, WI
- (7) PARK FALLS DNR HQ [USC00476398], Park Falls, WI
- (8) GOODMAN SANITARY DIST [USC00473174], Goodman, WI
- (9) STAMBAUGH 2SSE [USC00207812], Iron River, MI
- (10) MOOSE LAKE 1 SSE [USC00215598], Moose Lake, MN
- (11) AITKIN 2E [USC00210059], Aitkin, MN
- (12) ISLE 12N [USC00214103], Isle, MN

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, stream inflow, and groundwater discharge. Water levels are greatly influenced by precipitation rates and runoff from upland sites. Water is lost from the site primarily through stream outflow, subsurface outflow, evapotranspiration, and ground water recharge. These sites are wetlands.

The hydrology of Organic sites significantly impacts their ecological development. These sites have a strong connection with groundwater as a primary source of water. The groundwater contribution to these sites may interact with surrounding calcareous materials that deliver dissolved carbonates to these sites. In addition, carbonates are present in the loamy substratum of some of these sites. The strong interaction with groundwater and presence of carbonates prevent drops in pH on these sites.

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, forested/organic, or
2) Depressional, scrub-shrub/organic

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

Soil features

The soils of these sites are represented by Bowstring, Cathro, Dora, Lupton, Markey, Rifle, and Seelyeville soil series. Bowstring is classified as a Fluvaquentic Haplosaprist; Cathro, Dora, and Markey are classified as Terric Haplosaprists; Lupton and Seelyeville are Typic Haplosaprists; Rifle is a Typic Haplohemist.

These soils are formed in moderately deep to very deep, highly decomposed organic material primarily of herbaceous origin. Organic deposits are 15 to over 60 inches (40 to over 150 cm) deep. Some sites may be underlain by loamy drift, or sandy or loamy outwash. These sites are very poorly drained and remain saturated throughout the year. They meet hydric soil requirements.

The surface horizon of these soils muck, peat, or mucky peat. The subsurface horizons are highly decomposed muck—sapric materials. Where mineral contact occurs, textures may be loam, sandy loam, silty clay loam, silty clay, and sand. Soil pH is slightly acid to neutral with a range from 6.40 to 7.20. Sites are commonly absent of carbonates, but some may be present at depths of 28 inches (71 cm).

Figure 7. Cathro soil series photograph courtesy of UWSP taken on 7/13/2019 in Forest County, WI.

Table 4. Representative soil features

Parent material	(1) Woody organic material (2) Herbaceous organic material (3) Drift (4) Outwash
Surface texture	(1) Mucky, peaty
Drainage class	Very poorly drained
Permeability class	Very slow to moderate

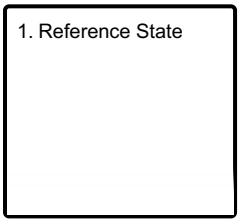
Soil depth	201–221 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–3%
Available water capacity (0-154.9cm)	11.96–30.43 cm
Calcium carbonate equivalent (0-100.1cm)	0–15%
Soil reaction (1:1 water) (0-100.1cm)	6.4–7.2
Subsurface fragment volume <=3" (Depth not specified)	0–14%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

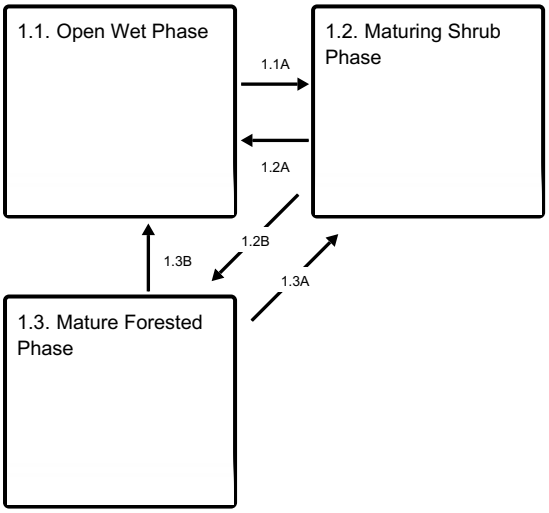
Sites in this ES may be driven to different phases by hydroperiod. Many of these locations are near floodplains or drainageways and are susceptible to some flooding or ponding. The results of this are that sites with high frequencies of flooding and longer durations of flooding lose their trees. Thus this ES represents a spectrum of flooding/ponding frequency and duration. The spectrum of vegetation varies from a black and/or green ash forest, to northern shrub (alder) thicket, to open northern wet meadow. These three states may all be considered stable as long as the hydroperiod remains consistent. Frequency and duration of flooding/ponding is the main driver as to which of these states will be achieved and maintained.

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Flooding frequency and duration decreases

1.2A - Flooding frequency and duration increases

1.2B - Very infrequent flooding

1.3B - Flooding frequency and duration increases dramatically

State 1
Reference State

Reference State is a continuum of hydroperiod influenced vegetation where flooding frequency and duration drive vegetation communities. There are three distinct phases, each being stable within a window of hydroperiod variation. Sites on or near floodplains are most likely to be in phases 1.1 and 1.2 while sites farther from streams are more likely to be in phase 1.3. The higher the frequency and more prolonged the wetness the more likely the site will be a northern wet meadow 1.1 (dominantly sedges with sporadic willows and steeplebush). As wetness frequency and duration decreases the site will become a northern shrub thicket 1.2 and speckled alder (and tag alder) will appear and begin to dominate the vegetation. If a site has very low frequency flooding/ponding that is of short duration a Black and/or Green ash forest will likely form 1.3. In some cases this forest will also include White cedar as an associate, but deer browsing has limited the regeneration of this species in this MLRA. Paper birch is another possible associate.

Community 1.1
Open Wet Phase

Figure 8. Photo courtesy of UWSP taken on 8/22/2019 in Wood County, WI.

With frequent flooding and long durations of inundation this ES will exhibit as a northern wet meadow. The vegetation will be dominated by sedges and grasses with sporadic willows and steeplebush present. Willows can be quite extensive in these sites at times. As long as the hydroperiod is consistent this is a stable state.

Dominant plant species

- steeplebush (*Spiraea tomentosa*), shrub
- willow (*Salix*), shrub
- sedge (*Carex*), grass

Community 1.2
Maturing Shrub Phase

Figure 9. Photo courtesy of UWSP taken on 6/12/2019 in Marathon County, WI.

With moderate frequency of flooding with out very long durations of inundation a shrub thicket will form on these sites. The composition of the shrubs on these sites is often dominated by Tag and/or Speckled alder but willow may occur as well. As long as the hydroperiod is consistent this is a stable state.

Dominant plant species

- speckled alder (*Alnus incana ssp. rugosa*), shrub
- gray alder (*Alnus incana*), shrub

Community 1.3
Mature Forested Phase

Figure 10. Photo courtesy of UWSP taken on 7/13/2019 in Forest County, WI.

In the absence of frequent long duration flooding a wet forest community composed of Black and/or Green ash will dominate these sites. Common associates may include Red maple, Paper birch and White cedar. Reproduction of Black and Green ash is often very successful in these stands. A shrub layer may be present in this community phase as well. The shrub layer is often composed of Tag alder. Understory plant communities may be composed of many different species including sedges, grasses, and ferns. As long as flooding frequency and duration remain low this is a stable state.

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- balsam fir (*Abies balsamea*), tree

Pathway 1.1A
Community 1.1 to 1.2

Open Wet Phase **Maturing Shrub Phase**

This transition represents a decrease in hydroperiod where flooding frequency and duration decrease enough for Tag alder and Speckled alder to establish in what was previously open sedges with Steeplebush, and a few isolated Willows.

Pathway 1.2A
Community 1.2 to 1.1

Maturing Shrub Phase **Open Wet Phase**

This transition represents an increase in the hydroperiod where flooding frequency and duration increase enough for Sedges to out compete Tag alder and Speckled alder. This could be done as a restoration effort if hydroperiod is controllable or the stream channel is made narrower causing increased frequency of flooding.

Pathway 1.2B
Community 1.2 to 1.3

Maturing Shrub Phase **Mature Forested Phase**

This transition represents a decrease in hydroperiod where flooding frequency and duration decrease enough for Black and/or Green ash to establish and out compete Tag alder and Speckled alder. This ecosystem is stable with very infrequent and/or short duration flooding. Understory species will shift to Impatiens spp., sedges, and sometimes skunk cabbage. Sites where there is little deer browse may include White cedar as an associate. Red maple and Paper birch are possible associates when seed source is present.

Pathway 1.3B
Community 1.3 to 1.1

Mature Forested Phase

Open Wet Phase

This transition represents a dramatic increase in the hydroperiod where flooding frequency and duration increase enough for Sedges to out compete Black and Gree ash and Balsam. This could be done as a restoration effort if hydroperiod is controllable or the stream channel is made narrower causing increased frequency of flooding.

Pathway 1.3A
Community 1.3 to 1.2

Mature Forested Phase

Maturing Shrub Phase

This transition represents an increase in the hydroperiod where flooding frequency and duration increase enough for Tag alder and Speckled alder to outcompete Black and Green ash.

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): All four visited sites in this ES keyed out to two habitat types: [FnOn] and [FnArI-Ix] but some sites are not well represented by this Habitat Type as they are more open sedge-meadow than forested wetland.
Biophysical Settings (Landfire, 2014): This ES is largely mapped as Boreal White Spruce-Fir Forest, Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest, and Laurentian-Acadian Pine-Hemlock Forest
WDNR Natural Communities (WDNR, 2015): Northern Hardwood Swamp

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Approval

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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	05/20/2024
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:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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:**
