USDA Natural Resources Conservation Service

Ecological site F088XY007MN
Wet Depressional Forest

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Accessed: 02/07/2025

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): 088X–Northern Minnesota Glacial Lake Basins

MLRA 88 consists of the lake beds of glacial Lakes Agassiz, Upham, and Aitkin. These vast glacial lake beds were formed by meltwaters associated with the last glaciation of the Wisconsin age. The large, flat, wet landscapes are filled with lacustrine lake sediments, wave-washed glacial till, and vast expanses of organic soils. This area is entirely in Minnesota and makes up about 11,590 square miles (30,019 square kilometers).

The western boundary of MLRA 88 with MLRA 56B is gradual. MLRA 56B is a portion of the Red River Valley that was formed by glacial Lake Agassiz and is dominantly prairie. The southern boundary of MLRA 88 with MLRA 57 consists of distinct moraines that formed from the glacial drift sediments of Late Wisconsin age. The eastern and southeastern boundaries are with portions of MLRAs 90A and 93A. These MLRAs are in a distinct glaciated region of sediments of the Rainy and Superior Lobes, and much of MLRA 93A is bedrock controlled (USDA-Ag Handbook 296, 2022).

Classification relationships

MN DNR Native Plant Community (MN DNR, 2003); the reference community of this Provisional Ecological Site is most similar to:
WFn55 Northern Wet Ash Swamp
WMn82 Northern Wet meadow/Carr

Cowardin: Palustrine, Emergent Wetland Persistent (PEMC)
United States Army Corps of Engineers (USACE) Wetland Plant Community: G; Shallow Marshes

Hydrogeomorphic System (USDA, 2008): DEPRESSION

Ecological site concept

Wet Depressional Forest sites typically occur in closed depressions and flats. These wet depressional sites are generally in narrow transition zones between uplands sites with mineral parent materials and peatland sites with organic parent material. Soil surface layers are typically mucky-modified surface textures or muck less than 8” thick over variable parent materials.

Associated sites

F088XY003MN	**Open Peatland** These sites occur on level to gently sloping surfaces. Open Peatlands have high water table levels that remain near the surface throughout the growing season, preventing the establishment of significant tree cover. These sites are typically groundwater recharged, and are highly influenced by the abundant concentration of minerals in the ground water that has percolated through the highly calcareous parent material in the region. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. The organic material ranges in decomposition from muck, mucky peat to peat textures underlain by variable parent material. The central concept soil series are Typic and Terric Histosols like Cathro, Markey, Seelyeville and Rifle but other series are included.
F088XY004MN	**Acid Peatland** These sites occur in shallow wetland basins, closed depressions and along drainage ways. Soils are occasionally ponded with standing water in spring but tend to recede by late summer. Soil and water content has a pH lower than 4.5. Soil surface layers are typically muck 8 to 16” thick over variable parent materials. The central concept soil series are Histic Humaquepts like Hamre, Haug, Sax, Sago but other series are included.
F088XY002MN	**Marsh** These sites occur on level or slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways, and adjacent to open water along lakeshore, ponds, and near streams. They are very poorly drained soils and are frequently ponded and inundated with water for very long duration. Soil surface textures are typically muck or mucky-modified surface layers over variable parent materials. The central concept soil series is Cathro, frequently ponded but other series are included.

Similar sites

F088XY006MN	**Floodplain Forest Wet** These site occur on occasionally or annually flooded sites on terraces and floodplains of streams and rivers. Soils consist of stratified alluvium which vary widely from silty to fine sandy soils on the occasionally flooded river terraces to coarser textured alluvium on the active floodplain sites. Soils on the active floodplain positions are annually flooded, somewhat poorly to poorly drained soils with grey soil color or grey-mottles shallow within the soil profile indicative of high local water tables, and are subject to scouring and deposition from floodwater. The better drained rarely to occasionally flooded river terrace sites are moderately well drained to poorly drained on river terraces along medium or large rivers. The central concept soil series is Fairdale, Fordum and Pengilly

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Thuja occidentalis*
Shrub	(1) *Acer spicatum* (2) *Corylus cornuta*
Herbaceous	(1) *Caltha palustris* (2) *Onoclea*

Physiographic features

Wet Depressional Forest sites typically occur in closed depressions and flats. These wet depressional sites are generally in narrow transition zones between uplands sites with mineral parent materials and peatland sites with organic parent material. These sites are nearly level and are frequently ponded.

Table 2. Representative physiographic features

Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Lake plain > Closed depression (2) Lake plain > Flat
Runoff class	Negligible to very low

Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Frequent
Elevation	980–1,700 ft
Slope	0–1%
Ponding depth	0–12 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 25 to 28 inches (635 to 711 millimeters). Most of the rainfall comes from convective thunderstorms during the growing season. Snowfall generally occurs from October through April. The average annual temperature is 43 to 46 degrees F (6 to 8 degrees C). The mean frost free period ranges from 83 to 110 days, with the mean freeze-free period ranging from 120 to 135 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	83-110 days
Freeze-free period (characteristic range)	120-135 days
Precipitation total (characteristic range)	25-28 in
Frost-free period (actual range)	75-112 days
Freeze-free period (actual range)	116-141 days
Precipitation total (actual range)	24-28 in
Frost-free period (average)	98 days
Freeze-free period (average)	130 days
Precipitation total (average)	26 in

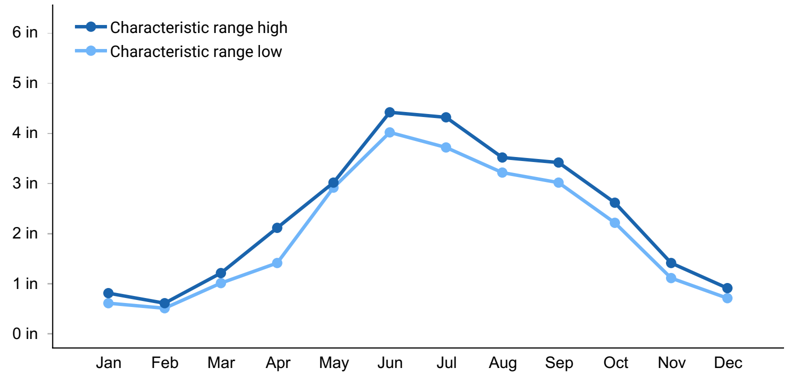


Figure 1. Monthly precipitation range

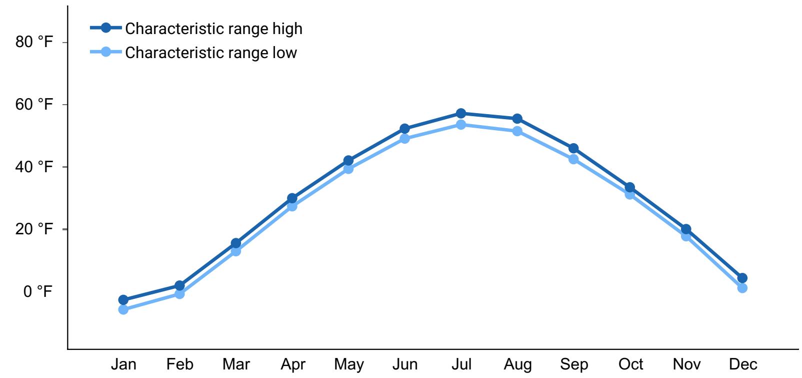


Figure 2. Monthly minimum temperature range

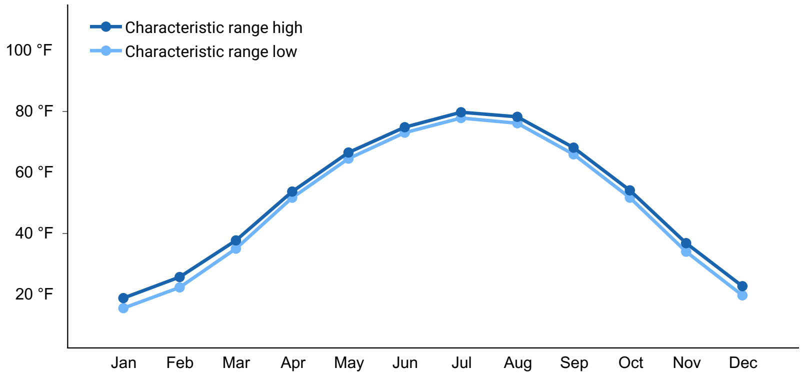


Figure 3. Monthly maximum temperature range

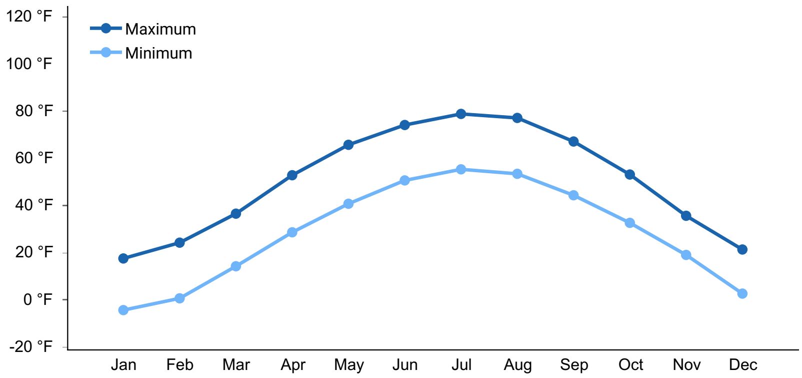


Figure 4. Monthly average minimum and maximum temperature

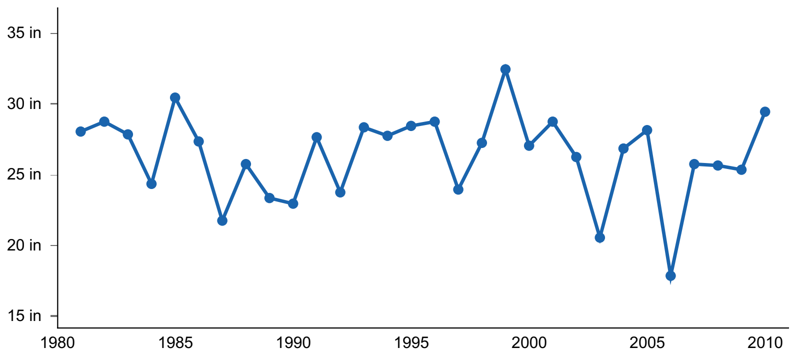


Figure 5. Annual precipitation pattern

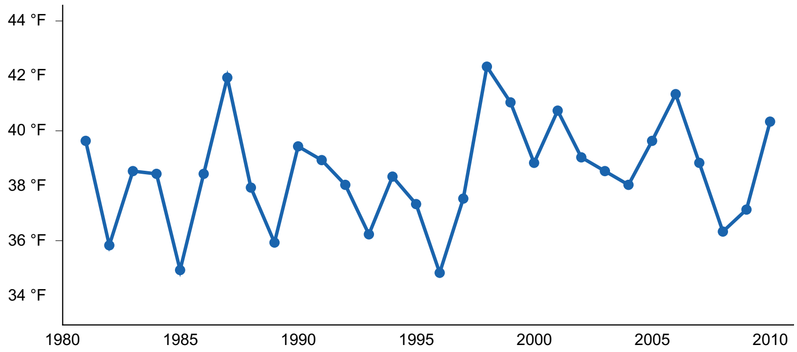


Figure 6. Annual average temperature pattern

Climate stations used

- (1) RED LAKE INDIAN AGCY [USC00216795], Ponemah, MN
- (2) LEECH LAKE [USC00214652], Bena, MN
- (3) POKEGAMA DAM [USC00216612], Cohasset, MN
- (4) GRAND RPDS FOREST LAB [USC00213303], Grand Rapids, MN
- (5) SANDY LAKE DAM LIBBY [USC00217460], McGregor, MN
- (6) FLOODWOOD 3 NE [USC00212842], Floodwood, MN
- (7) HIBBING CHISHOLM HIBBING AP [USW00094931], Hibbing, MN
- (8) EVELETH WWTP [USC00212645], Eveleth, MN
- (9) WARROAD [USC00218679], Warroad, MN
- (10) CAMP NORRIS DNR [USC00211250], Beltrami Isl State for, MN
- (11) BAUDETTE INTL AP [USW00094961], Baudette, MN
- (12) INTL FALLS INTL AP [USW00014918], International Falls, MN
- (13) LITTLEFORK 10 SW [USC00214809], Big Falls, MN
- (14) BIG FALLS [USC00210746], Big Falls, MN

Influencing water features

Water is received through precipitation and runoff from adjacent uplands. Seasonal variation in water table is the most important site factor defining Wet Depressional Forests. Water levels are greatly influenced by ground water, precipitation rates and runoff from upland sites. Water tables limit the amount of oxygen available to plant roots. Oxygen levels determine the extent to which root respiration can take place, the level of organic litter decomposition, and the release of important nutrients for uptake by plants (MN DNR, 2011). Species characteristic of this ecological site are adapted to this variation in water saturation, in comparison to species which dominate the drier uplands and wetter, less hydrologically variable peatland ecosystems.

Wetland description

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

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

Permeability of the soil is very slow to moderately slow.
Hydrologic Group: A/D, B/D, C/D
Hydrogeomorphic Wetland Classification: Depressional acidic forested/organic; Depressional acidic scrub-shrub/organic
Cowardin Wetland Classification: PFO4B, PSS4B, PSS3B, PEM1B

Soil features

The Wet Depressional Forest ecological site typically occurs in a basin or closed depression, and receives water directly from precipitation and groundwater discharge. Soils are very poorly drained and formed in organic material. Permeability is very slow and the site will be ponded most of the year. The parent materials on wet depressional sites include till, organic matter, and glaciolacustrine deposits.

Soils in the Wet Depressional Forest fall within the Alfisol, Entisol, Inceptisol, and Mollisol orders. These soils can be further classified as Mollic Endoaqualfs, Mollic Epiaqualfs, Typic Endoaqualfs, Vertic Endoaqualfs, Vertic Epiaqualfs, Mollic Endoaquents, Mollic Psammaquents, Vertic Fluvaquents, Histic Humaquepts, Typic Endoaquepts, Typic Humaquepts, Vertic Endoaquepts, Histic Endoaquolls, Typic Argiaquolls, Typic Calciaquolls, and Typic Endoaquolls.

Soils series within the Wet Depressional Forest ecological site include: Northwood, Hamre, Leafriver, Effie, Sago, Deerwood, Sax, Haug, Ratroot, Indus, WIldwood, Fayal, Hassman, Kapla, Leeora, Deford, Roscommon, Lallie, Roliss, Smiley, McDavitt, Grygla, Epoufette, Typic Ochraqualfs, Strathcona, Kratka, Augsburg, Percy, Wabanica, and Rosewood.

Table 4. Representative soil features

Parent material	(1) Till (2) Organic material (3) Glaciolacustrine deposits
Surface texture	(1) Muck (2) Mucky peat (3) Mucky loam (4) Mucky silty clay loam
Drainage class	Very poorly drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	0 in
Soil depth	60–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	5.2–9.3 in
Soil reaction (1:1 water) (0-10in)	5.1–7.8
Subsurface fragment volume <=3" (0-80in)	0–8%
Subsurface fragment volume >3" (0-80in)	0–1%

Ecological dynamics

Wet Depressional Forest are widespread throughout the entire MLRA 57, and typically occur in shallow wetland basins, closed depressions and along drainage ways. Seasonal variation in water table is the most important site factor defining Wet Depressional Forests. Water tables limit the amount of oxygen available to plant roots. Oxygen levels determine the extent to which root respiration can take place, the level of organic litter decomposition, and the release of important nutrients for uptake by plants (MN DNR, 2011). Species characteristic of this ecological site are adapted to this variation in water saturation, in comparison to species which dominate the drier uplands and wetter, less hydrologically variable peatland ecosystems.

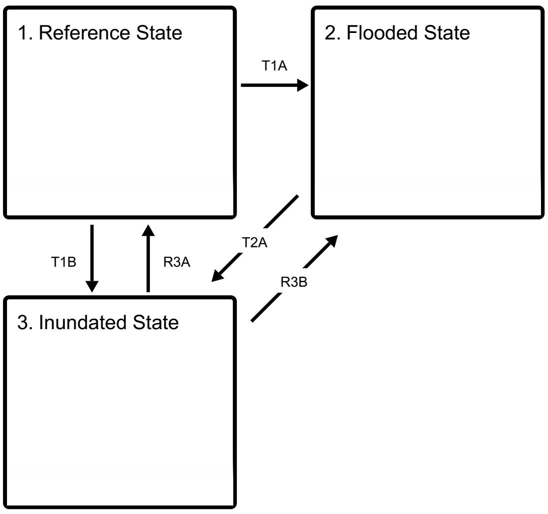
Ground flora diversity is very high in these forests. At a given location, as many as 60 or more plant species can be found on these sites. A number of site variables contribute to high diversity, such as: seasonal variation in water levels and soil saturation, dry and wet microsites created by fallen trees, and downed woody debris creating potential rooting medium.

Historically, fire was not an important disturbance factor on this ecological site, primarily because of lush vegetation with high water content. Average fire return intervals for stand replacing events have been estimated to be in excess of 1,000 years (MN DNR, 2014). In general, fire in wet forest communities was related to the surrounding matrix forest types (Landfire, 2007; Gucker, 2005). Instead, historic variability in vegetation structure was primarily related to small and moderate sized canopy openings produced from either dead/dying trees or mature and over-mature windthrown trees (MN DNR, 2014; Landfire, 2007; Gucker, 2005). Tree species common to this ecological site have shallow and spreading root systems, which is further exacerbated by a limited rooting zone resulting from frequent high water tables. As canopy trees reached the dominant canopy class they became more susceptible to relatively frequent small-scale (microburst) wind events. Climatic variation, both in terms of drought as well as excess precipitation, interacted with wind events to create these canopy openings. Drought and extended ponding can stress trees to the point of being more susceptible to disease and overall decline, and thus further weakening their ability to withstand strong winds. These fine- to moderate-scale windthrow events occurred on nearly every site in an estimated 110 year rotation, and possibly as frequent as 40 years (MN DNR, 2014; Landfire, 2007).

Community phases within the Reference State are related to scattered small and moderate sized canopy openings from dead and/or windthrown trees. Windthrown trees were primarily dominant, above the canopy, and more exposed to wind events. These trees, with shallow root systems, were likely previously weakened by either excessive drought or ponding, leaving them open to attack by forest pests (MN DNR, 2014). Standing dead trees from excessive ponding or drought may also provide these canopy openings. An estimated rotation of such events is 110 years (MN DNR, 2014; MN DNR, 2003). This produced a patchwork of young and mature forests, all dominated by black ash. Black ash is fairly shade tolerant as a seedling, and is often the only advanced regeneration present in the understory, and thus it tends to replace itself in many situations (Gucker, 2005; Erdmann et al., 1987). Black ash is also a long-lived species and can live to over 250 years old (Gucker, 2005). Without larger openings, structure and composition of mature stands can be nearly perpetual, and gradually regenerate new trees within small, one to many tree sized openings. As a result of rather frequent creation of small scale openings, stands do not often become old growth (i.e., greater than 135 years; MN DNR, 2014). On sites where old-growth does exist, canopy structure is complex, and generally includes a component of long-lived and more shade tolerant white spruce and arborvitae (known locally as northern white cedar).

State and transition model

Ecosystem states



T1A - Flooding or excess inundation on-site from beaver, roads, or other hydrological alterations within the watershed

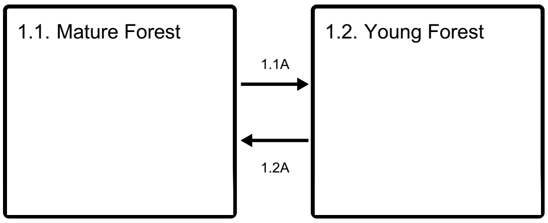
T1B - Removal of tree canopy resulting in loss of evapotranspiration and elevated water levels.

T2A - Drainage of open water/diversion of water off-site.

R3A - Absence of disturbance (75+ years), removal of non-native species, and natural regeneration/plantings.

R3B - Flooding or inundation caused by beaver, roads, or other hydrological alterations within the watershed

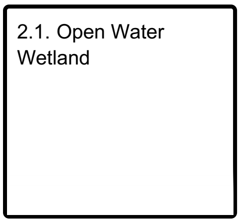
State 1 submodel, plant communities



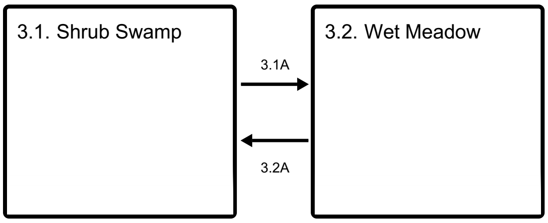
1.1A - Stand-replacing windthrow, disease, or pest outbreak.

1.2A - Succession/Time without major disturbance (75+ years)

State 2 submodel, plant communities



State 3 submodel, plant communities



3.1A - Increasing ponding and soil saturation.

3.2A - Decreasing ponding and soil saturation

State 1
Reference State

Northern white cedar and yellow birch often find their primary rooting substrate on downed woody debris associated with these openings. Both species regenerate well on mossy, rotting wood (i.e., nurse logs) that have consistent moisture (Smith, 2008 Erdmann, 1990; Johnston, 1990). Eventually, initial rooting media from downed woody debris can leave roots exposed to air and result in poorly formed trees. Northern white cedar can also regenerate by vegetation reproduction. These stems usually are developed from fallen trees and root from branches that come in contact with moist rooting media and are extremely shade tolerant (Erdmann, 1990). Hummocks and micro depressions resulting from windthrown trees are an important component of the Reference State. This variability in microsites provides opportunity for obligate wetland species in ponded micro depressions and facultative or even some upland species on the drier hummocks.

Dominant plant species

- black ash (*Fraxinus nigra*), tree
- arborvitae (*Thuja occidentalis*), tree
- yellow birch (*Betula alleghaniensis*), tree
- white spruce (*Picea glauca*), tree
- balsam poplar (*Populus balsamifera ssp. balsamifera*), tree
- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), shrub
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- willow (*Salix*), shrub
- bluejoint (*Calamagrostis canadensis*), grass

Community 1.1
Mature Forest

By stand age 75, a more characteristic, closed canopy and multi-tiered forest structure begins to develop. Stands are initially dominated by black ash, but regeneration opportunities for northern white cedar, yellow birch, and white spruce begin to increase as the forest ages. Closed canopy conditions result in a transition from obligate wetland graminoids to higher densities of facultative and facultative upland forbs (Palik et al., 2007). Also during this time down woody debris accumulates and the characteristic pit and mound micro-topography increases in areal extent; these ecological phenomena provide more sites for a greater diversity of ground flora species. Many sites will be essentially self-sustaining at this point, with periodic canopy openings keeping stands from attaining old growth status.

Community 1.2
Young Forest

The initiation of stand development follows partial canopy loss by windthrow or canopy openings developed from pockets of dead trees. Black ash advanced regeneration is the dominant regenerating tree, but is accompanied by other hardwoods, such as paper birch, balsam poplar (*Populus balsamifera*), or quaking aspen (*Populus tremuloides*). Increased light also favors some wetland shrubs and ground flora, particularly speckled alder and bluejoint. Co-dominant canopy trees generally reach a diameter of around eight inches before transitioning to a mature forest (MN DNR, 2014).

Pathway 1.1A
Community 1.1 to 1.2

Stand-replacing windthrow, disease, or pest outbreak

Pathway 1.2A
Community 1.2 to 1.1

Succession/Time without major disturbance (75+ years)

State 2
Flooded State

The Flooded State develops as a result of dammed or blocked waterways. Flooding and more permanent forms of inundation (i.e., ponding) are caused by either beaver activity or development associated with road building. Only drainageway landforms are affected, and isolated depressions do not go through this state. Sites that have blocked water drainage from roads may become perpetual open water wetlands. In natural settings, the Flooded State can last for many years, but it ultimately depends on maintenance of high quality habitat conditions for beaver to proliferate. Once a site is abandoned, dams will gradually decline and ultimately drain, thereby beginning the transition to the Inundated State. Beaver populations in North America were drastically reduced by broad scale fur trapping during the Colonial time period, into the 1800s (Mitsch and Gosselink, 2007). As a result, natural conversion of these sites to the Flooded State may be less common today than it was prior to European settlement.

Dominant plant species

- wildrice (*Zizania*), grass
- bulrush (*Bolboschoenus*), other herbaceous
- cattail (*Typha*), other herbaceous

Community 2.1
Open Water Wetland

The only community phase in this state is characterized as having dead or dying overstory trees, and being flooded and subsequently ponded by up to several feet of essentially permanent water (Figure 3). Depending on depth of water, there will be areas with emergent and submergent aquatic vegetation, as well as scattered remnants of the former vegetation.

State 3
Inundated State

Sites can transition to this state by relatively sudden and complete loss of the tree canopy, thereby losing the transpiration of water from trees that would normally occur later in the growing season to keep water tables at bay (i.e., drawdown; Slesak et al., 2014). This can happen as a result of intensive logging, forest pests, or general forest decline. Since water tables on these sites mimic annual rainfall graphs, the primary change in hydrology occurs later in the growing season, when overstory tree species would normally be causing drawdown in the Reference State. This state will likely become very common in this MLRA if the invasion of the exotic and completely destructive emerald ash borer beetle is not halted (Slesak et al., 2014; Palik et al., 2012). Plant community species composition will shift from primarily facultative wetland species to primarily obligate wetland species, such as lake sedge (Slesak et al., 2014). Other than a few scattered trees, these sites do not seem to regenerate forests well. The probability of transitioning to the Reference State is largely unknown; it will probably require many decades to produce a closed canopy forest again. There is limited evidence that these communities succeed to a forested structure within a reasonable time frame (SNF, unpublished report b), but non-forested wetland conditions may persist for decades, and even centuries (Naiman et al., 2005; Terwilliger and Pastor, 1999). Viability of black ash seeds is only 8 years (Wright and Rauscher, 1990), so that initial seedbank is extirpated from the site. And since most sites are small and isolated, there may not be a reliable seed source nearby. The loss of important mycorrhizal relationships is also likely to impede succession to forest trees. It has been shown that long-term flooding kills symbiotic mycorrhizae; these fungi form essential relationships with tree species on most ecological sites, forested wetlands included, and recolonization following draining may be inhibited (Terwilliger and Pastor, 1999), which is likely the case on this ecological site as well. All of the aforementioned factors, in combination with extreme competition for light, nutrients, and growing space with fibrous rooted resident vegetation, make succession to a forested state very difficult.

Dominant plant species

- speckled alder (*Alnus incana ssp. rugosa*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- willow (*Salix*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- sedge (*Carex*), other herbaceous
- hairy sedge (*Carex lacustris*), other herbaceous
- upright sedge (*Carex stricta*), other herbaceous
- Northwest Territory sedge (*Carex utriculata*), other herbaceous

Community 3.1
Shrub Swamp

In this phase, shrubs are greater than 25% cover (MN DNR, 2005). Dominant species are speckled alder, redosier dogwood, and willows (Salix spp.). Bluejoint and a variety of sedges are also dominant, along with a myriad of sun-loving wetland forb species. There may be scattered trees as well, but they comprise low cover and are not significant to the overall structure of the plant community. But even scattered trees have ecological value as nest trees and perches for birds or den trees for small mammals. With a continued lowering of the water table, it is possible for this phase to succeed to the Reference State if black ash and other trees can successfully establish.

Community 3.2
Wet Meadow

In this phase, shrubs are less than 25% cover (Figure 8; MN DNR, 2005). Bluejoint, sedges, and a variety of sun-loving wetland forbs dominate this phase. Hairy sedge (Lake sedge)(*Carex lacustris*), the small hummock-forming upright sedge (tussock sedge) (*C. stricta*), and Northwest Territory sedge (beaked sedge) (*C. utriculata*) are the most common sedges, and can be dominant (MN DNR, 2005). The most common shrubs are speckled alder, redosier dogwood, and willows. There may be some scattered live trees but standing dead trees are much more common. They add some structure to the site for use by wildlife.

Pathway 3.1A
Community 3.1 to 3.2

Increased ponding and soil saturation. Fire may play a role in this transition during drought years and when sites are adjacent to prairies ecological sites.

Pathway 3.2A
Community 3.2 to 3.1

Decreased ponding and soil saturation. Long period without fire.

Transition T1A
State 1 to 2

Flooding or excess inundation on-site from beaver, roads, or other hydrological alterations within the watershed.

Transition T1B
State 1 to 3

Removal of tree canopy resulting in loss of transpiration and elevated water levels. Currently, alteration of natural hydrology is the most important driver of state change in this ecological site. Insect infestations such as emerald ash borer (Agrilus planipennis) or climate change will cause state change. Hydrology can be altered is by a clearcut of the forested canopy, which can significantly reduce the transpiration of water from the site, resulting in consistently higher water tables, and ultimately preclude forest regeneration (Mitsch and Gosselink, 2007; Palik et al., 2012; Erdmann et al., 1987). This process converts the site to non-forested shrub swamps or wet meadows. This can result from poor silvicultural practices, extreme wind events, or significant insect or disease outbreaks.

Transition T2A
State 2 to 3

Drainage of open water/diversion of water off-site. Transition occurs following drainage of backed up water from beaver activity or road building. Initially, sites are wet meadows dominated by graminoids (i.e.. grasses, sedges, and rushes), eventually becoming invaded by wetland shrubs depending on level of ponding and soil saturation. These sites may have different soil characteristics depending on the extent and depth of sedimentation, which is largely dependent on how long the site was dammed (Naiman et al., 2005) and is also related to nearby land use and landscape-level soil geomorphology. More research is needed on how soil properties change following long term flooding from blocked hydrology and the potential for invasive species to establish in the Inundated State.

Restoration pathway R3A
State 3 to 1

Succession/Time without major disturbance (75+ years), plantings, chemical/mechanical removal of invasive species

Restoration pathway R3B
State 3 to 2

Flooding or excess inundation on-site from beaver, roads, or other hydrological alterations within watershed

Additional community tables

Inventory data references

Information presented was derived from Minnesota Department of Natural Resources Field Guide to the Native Plant Communities of Minnesota, USDA-NRCS soil survey information, and USDA Plants Database.

Other references

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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	02/07/2025
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:

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:**