USDA Natural Resources Conservation Service

Ecological site R057XY001MN
Marsh

Last updated: 10/03/2023
Accessed: 05/20/2024

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): 057X–Northern Minnesota Gray Drift

The Northern Minnesota Gray Drift (57) is located within the Northern Lakes Forest and Forage Region. This area is entirely in north-central Minnesota and makes up about 9,785 square miles (Figure 1). The entire area is covered by Wisconsin-age glacial drift. The glacial deposits are from four major ice lobes-Des Moines, Rainy, Superior, and Wadena. The landscape developed through a series of glaciations and the subsequent retreating and wasting of the ice sheets, which resulted in a complex pattern of moraines, outwash plains, drumlins, lake plains and drainages. Lakes, ponds and marshes are common. The thickness of the glacial till ranges from 90 to 185 meters. Some areas of these deposits are overlain by outwash or lacustrine sediments. Some depressional areas have an accumulation of organic matter. The organic deposits are more than 2.5meters thick in some areas. Elevation ranges from 300 to 500 meters across the area. (USDA-NRCS 2006)

Prior to settlement, the vegetation in this area was mainly a mixture of deciduous trees and conifers. White Pine and red pine grew on moraines. Jack pine was dominant on outwash plains and sandy lake plains. Red oak, sugar maple, and basswood grew in sheltered areas close to lakes. Forested lowlands were dominated by black spruce, tamarack, white cedar, and black ash. Wetlands that were not forested were dominated by sedge meadow communities. The western part of the area was dominated by tall prairie grasses. Most of this area is still forested today, aspen as become the most common species both in pure stands and mixed stands with birch, maple, oak, white spruce, and red pine. (USDA-NRCS 2006)

The dominant soil orders in this MLRA are Alfisols, Entisols, and Histisols. Some Mollisols are in the westernmost part of the area. The soils in the area have a frigid soil temperature regime; aquic or udic soil moisture regime, and mixed mineralogy. Their natural drainage class is related to landscape position. In general, the Alfisols formed in till on moraines, Entisols formed in outwash on moraines and outwash plains, and Histosols formed in organic material over outwash or till on moraines or outwash plains. (USDA-NRCS 2006)

Classification relationships

Major Land Resource Area (MLRA): Northern Minnesota Gray Drift (57) (USDA Handbook 296, 2006)

USFS Subregions: Northern Minnesota Drift & Lake Plain Section (212N); Chippewa Plains Subsection (212Na), Pine Moraines & Outwash Plains Subsections (212Nc), St. Louis Moraines Subsection (212Nb); Minnesota & NE Iowa Morainal Section (222M); Hardwood Hills Subsection (222Ma); Northern Superior Uplands Section (212L); Nashwauk Uplands Subsection (212Lc); Northern Minnesota & Ontario Peatlands Section (212M); Littlefork-Vermillion Uplands Subsection (212Ma) (Cleland et al. 2007).

US EPA Level IV Ecoregion: Itasca and St. Louis Moraines (50q); Chippewa Plains (50r); Nashwauk/Marcell Moraines and Uplands (50s); Alexandria Moraines and Detroit Lakes Outwash Plain (51j); McGrath Till Plain and Drumlins (51k); Wadena/Todd Drumlins and Osakis Till Plain (51l)(U.S. Environmental Protection Agency, 2013)

Ecological site concept

Marsh sites typically occurs on slightly concave landscape positions in closed depressions, shallow wetland basins, drainage ways; and adjacent to open water along lakeshore, ponds, and near streams. Soil surface textures are typically muck or mucky-modified surface layers over variable parent materials. Soils are typically saturated on all horizons, frequently ponded, and inundated with water for very long duration, at least 7 out of 12 months.

Associated sites

F057XY002MN	**Wet Depressional Forest** Wet Depressional Forest occurs in shallow wetland basins, closed depressions, and generally in narrow transition zones between mineral uplands and peatlands. Soil surface layers are typically mucky-modified surface textures or muck less than 8” thick over variable parent materials.
F057XY003MN	**Peatland** Peatland occurs 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 surface layers are typically muck 8 to 16” thick over variable parent materials.
R057XY005MN	**Open Peatland** Open Peatland occurs on level to gently sloping surfaces. Soils have greater than 16” of organic material and soil pH values are greater than 4.5. This site has a high water table that remain near the surface throughout the growing season, preventing the establishment of significant tree cover.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Typha latifolia* (2) *Calamagrostis canadensis*

Physiographic features

This site occurs in depressions adjacent to open water along lakeshore, ponds, and near streams. These sites are subject to very long to frequent ponding throughout the year. The ponding duration is very long with possible depths over 150 cm above the surface. These sites have have a stable water level and do not change seasonally, but the water table may drop during dry conditions or changes in drainage conditions. Runoff is negligible.

This MLRA is in the Western Lake Section of the Central Lowland Province of the Interior Plains. The landscape developed through a series of glaciations and subsequent retreating and wasting of the ice sheets. A complex pattern of moraines, outwash plains, drumlins, lake plains, and drainages characterizes the area. The rest of the area is drained by the Mississippi River, southward into the Gulf of Mexico. The headwaters of the Mississippi River are in the northern part of the area. The Mississippi River and its tributaries drain most of the area.

Table 2. Representative physiographic features

Slope shape across	(1) Concave (2) Linear
Slope shape up-down	(1) Concave (2) Linear
Landforms	(1) Depression
Runoff class	Very low
Flooding frequency	None
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	Frequent
Elevation	180–649 m

Slope	0–1%
Ponding depth	30–61 cm
Water table depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

In general, MLRA 57 has cold winters and warm summers. About 65 percent of the annual precipitation falls as rain during the 5-month growing season (May through September), and an additional 18 percent falls as snow.

Table 3. Representative climatic features

Frost-free period (characteristic range)	97-114 days
Freeze-free period (characteristic range)	125-142 days
Precipitation total (characteristic range)	686-737 mm
Frost-free period (actual range)	80-125 days
Freeze-free period (actual range)	120-153 days
Precipitation total (actual range)	660-762 mm
Frost-free period (average)	106 days
Freeze-free period (average)	135 days
Precipitation total (average)	711 mm

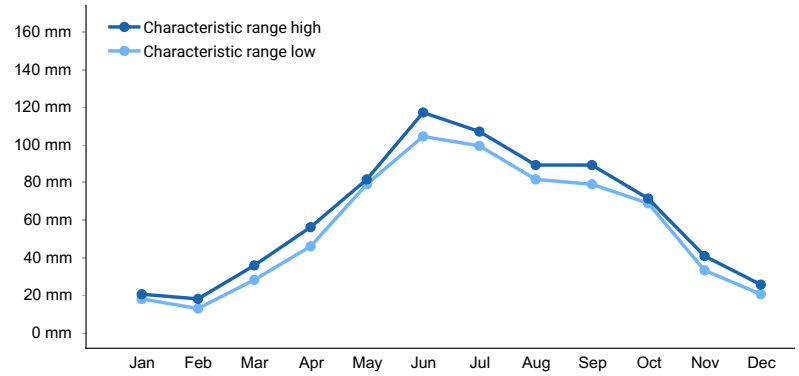


Figure 1. Monthly precipitation range

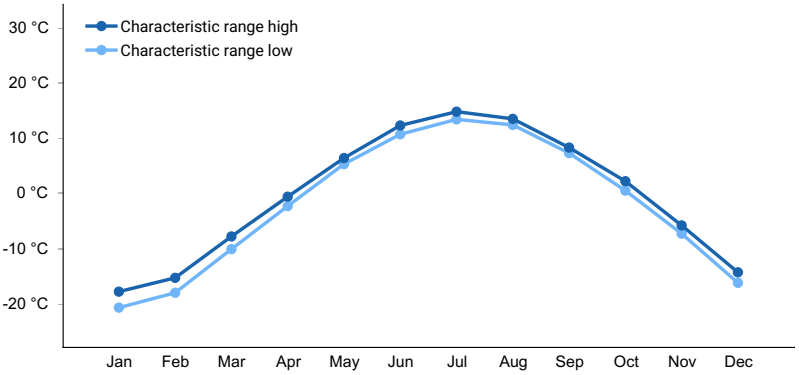


Figure 2. Monthly minimum temperature range

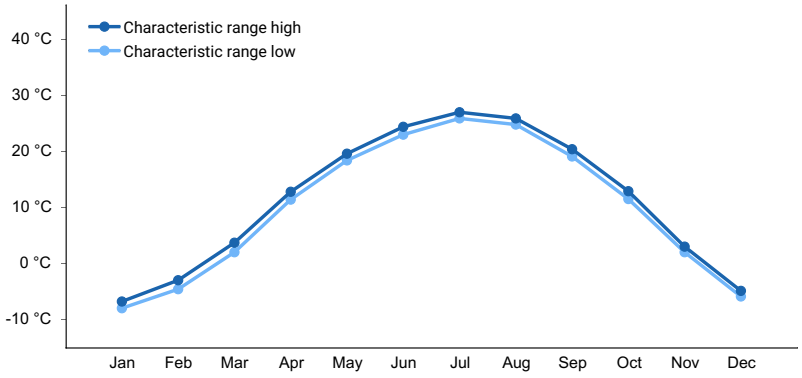


Figure 3. Monthly maximum temperature range

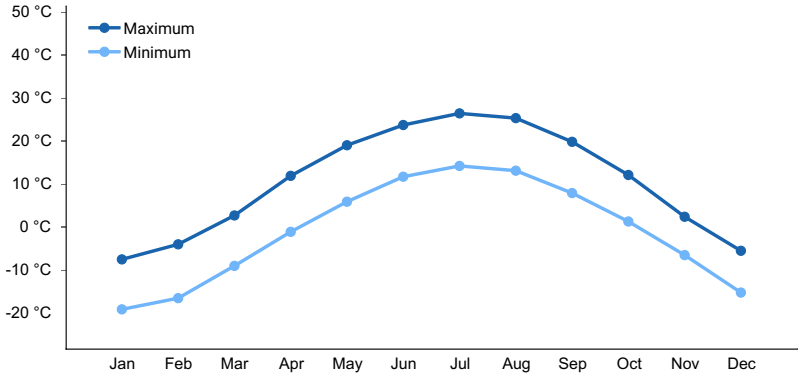


Figure 4. Monthly average minimum and maximum temperature

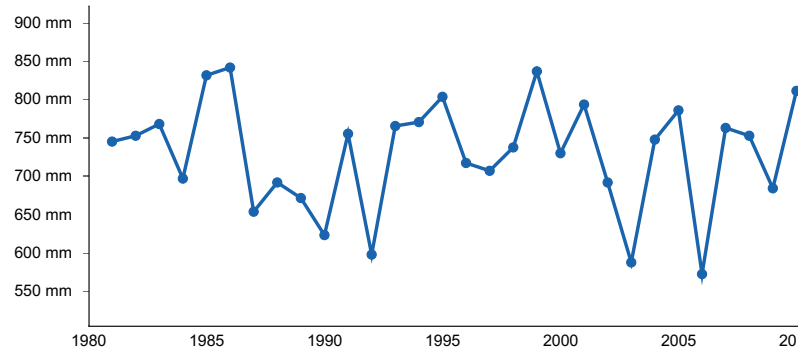


Figure 5. Annual precipitation pattern

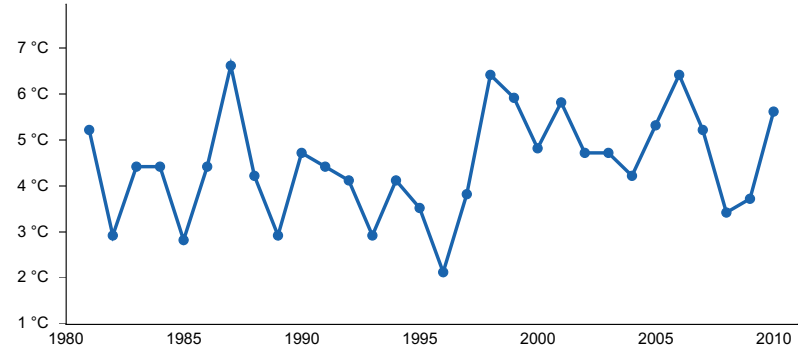


Figure 6. Annual average temperature pattern

Climate stations used

- (1) COLLEGEVILLE ST JOHN [USC00211691], Avon, MN
- (2) LONG PRAIRIE [USC00214861], Long Prairie, MN
- (3) NEW YORK MILLS [USC00215902], New York Mills, MN

- (4) TAMARAC WILDLIFE REF [USC00218191], Rochert, MN
- (5) GRAND RPDS FOREST LAB [USC00213303], Grand Rapids, MN
- (6) DEEP PORTAGE [USC00212050], Backus, MN
- (7) WALKER AH GWAH CHING [USC00218618], Walker, MN
- (8) CASS LAKE [USC00211374], Cass Lake, MN
- (9) BEMIDJI [USC00210643], Bemidji, MN
- (10) BLACKDUCK [USC00210809], Blackduck, MN
- (11) MARCELL 5NE [USC00215175], Bigfork, MN

Influencing water features

Water is received through precipitation, runoff from adjacent uplands, and groundwater. Water levels are greatly influenced by ground water, precipitation rates and runoff from upland sites. Water leaves the site primarily through evapotranspiration and groundwater recharge. These sites are wetlands. The hydrology of Marsh sites significantly impacts their ecological development.

Wetland description

Under the Cowardin System of Wetland Classification, or National Wetlands Inventory (NWI), the wetlands can be classified as:
1) Palustrine, emergent, persistent, saturated or

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

Permeability of the soil is very slow.
Hydrologic Group: A/D, B/D, C/D
Hydrogeomorphic Wetland Classification: Depressional, forested/organic, or
Cowardin Wetland Classification: PEM1B

Soil features

The Marsh 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 central concept soil series is Seelyeville, Cathro, Rifle and Haslie, but other series are included. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship.

Table 4. Representative soil features

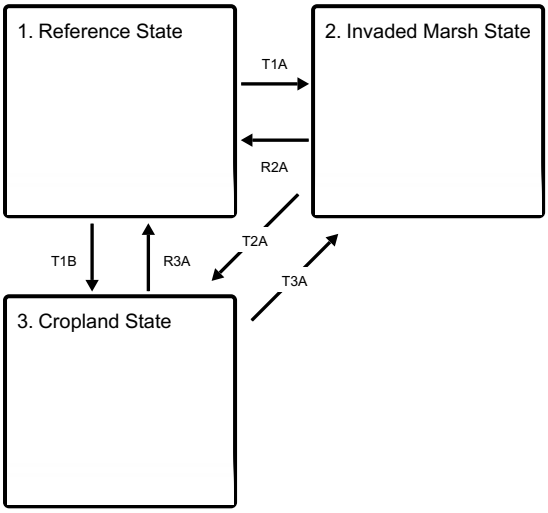
Parent material	(1) Organic material
Surface texture	(1) Muck
Drainage class	Very poorly drained
Permeability class	Slow to moderately slow
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	31.75–44.96 cm
Soil reaction (1:1 water) (0-101.6cm)	5.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Marsh sites typically occurs 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. Soils are typically endosaturated, frequently ponded, and inundated with water for very long duration, at least 7 out of 12 months. Vegetation can be found rooting on floating mats (MNDNR 2003). Water sources include precipitation, surface flow, lateral flow, and groundwater discharge. The fluctuation of water levels on site are fairly stable (due to groundwater influences) and do not change seasonally, but can vary with drought or changes to drainage across the watershed.

State and transition model

Ecosystem states



T1A - Altered hydrology/invasion of exotic species

T1B - Little or no spring ponding/drought.

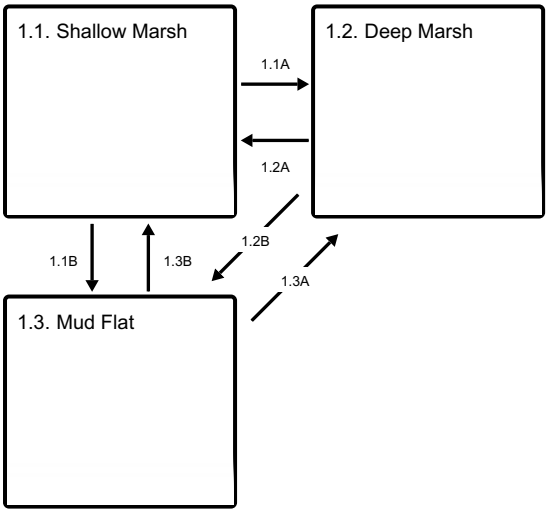
R2A - Complete hydrologic restoration of wetland basin, invasive species management, seeding, muskrat re-establishment.

T2A - Tile drainage, tilling, seeding, herbicides.

R3A - Complete hydrologic restoration of wetland basin, invasive species management, seeting, muskrat re-establishment.

T3A - Partial or complete hydrologic restoration of wetland basin; agricultural abandonment.

State 1 submodel, plant communities



1.1A - Increased water depth and duration/excessive precipitation years.

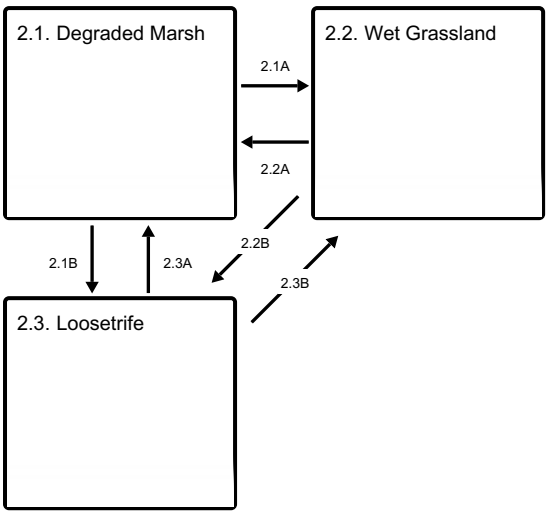
1.2A - Decreased water depth and duration, cattail dominance.

1.2B - Decreased water depth and duration; Little or no spring ponding/drought.

1.3B - Increased water depth and duration/excessive precipitation years.

1.3A - Increased water depth and duration/excessive precipitation years.

State 2 submodel, plant communities



2.1A - Draw-down or partial drainage.

2.1B - Invasion of exotic purple loosestrife

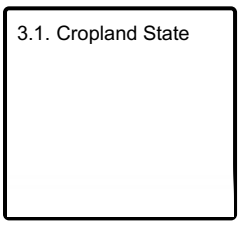
2.2A - Increased water depth and duration/excessive precipitation years.

2.2B - Invasion of exotic purple loosestrife.

2.3A - Chemical, mechanical removal of purple loosestrife, and use of biocontrol.

2.3B - Chemical, mechanical removal of purple loosestrife, and use of biocontrol.

State 3 submodel, plant communities



State 1
Reference State

This state identifies the condition of Marsh prior to European settlement. Community phases within the Reference State are dependent upon ponding during the spring months. During drier times of the year, this site would burn regularly with the prairie fires that were common in the region. Woody species and upland grasses were kept from proliferating mainly by saturated conditions. The plants that dominate these community phases are adapted to long periods of inundation, having stems, leaves, and roots that diffuse oxygen from the air and store it in specialized cells (aerenchyma) (MN DNR 2003). Dominant species in this state include broadleaf cattail, river bulrush, softstem bulrush, giant bur-reed and water knotweed (Cowardin 2013). While extensive acres of Marsh may still be found in MLRA 57, of those that still exist, it is likely that the hydrology has at least been slightly modified due to road development, tile drainage, ditching, and channelization elsewhere in the watershed(s), and invasion by exotic species is common (see State 2).

Dominant plant species

- river bulrush (*Bolboschoenus fluviatilis*), grass
- softstem bulrush (*Schoenoplectus tabernaemontani*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- broadleaf cattail (*Typha latifolia*), other herbaceous
- water knotweed (*Polygonum amphibium*), other herbaceous

Community 1.1
Shallow Marsh

Cattails, bulrushes, and arrowheads establish in rising water levels, utilizing rhizomes, aerenchyma, and taller vegetation structures to remain established on-site as water levels rise. If water levels remain stable for a long period of time, this phase can lose diversity and may become comprised of only one or two species, usually cattail.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), other herbaceous
- bluejoint (*Calamagrostis canadensis*), other herbaceous
- woolgrass (*Scirpus cyperinus*), other herbaceous

Community 1.2
Deep Marsh

As water levels rise and remain persistently high, floating species such as duckweeds and common white water lily become more frequent, as well as submerged species such as bladderworts, common coontail, and Canadian elodea (MN DNR 2003). In areas with more wave action, such as along stream beds or lakeshores, spikerushes, pondweeds, and watermilfoils may be more common (MN DNR 2003). Graminoids typically are found in patches, and can have variable cover across the site, interspersed by open water, and can include softstem bulrush, hard stem bulrush, river bulrush, slender bulrush, and Small's spikerush (MN DNR 2003).

Dominant plant species

- bulrush (*Schoenoplectus*), other herbaceous
- common spikerush (*Eleocharis palustris*), other herbaceous
- river bulrush (*Bolboschoenus fluviatilis*), other herbaceous
- American white waterlily (*Nymphaea odorata*), other herbaceous
- duckweed (*Lemna*), other herbaceous

Community 1.3
Mud Flat

Water level drawdowns occur due to drought or diversion of water off-site due to beaver activity. Beggarticks and smartweeds germinate rapidly and prolifically on freshly exposed substrates and may find refuge on floating mats once water levels rise. Most of the submerged and floating species present in 1.2 are not resistant to desiccation and will disappear in this phase.

Dominant plant species

- water knotweed (*Polygonum amphibium*), other herbaceous
- beggarticks (*Bidens*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Increased water depth and duration/excessive precipitation years which cause higher energy water and wave action.

Pathway 1.1B
Community 1.1 to 1.3

Little or no spring ponding/drought. One example of where this can occur is on the dry side of beaver dam construction.

Pathway 1.2A
Community 1.2 to 1.1

Decreased water depth and duration, cattail dominance which causes Lower energy water and wave action.

Pathway 1.2B
Community 1.2 to 1.3

Decreased water depth and duration; Little or no spring ponding/drought. One example of where this can occur is on the dry side of beaver dam construction. Also, potentially severe drought could create mudflats if the marsh is primarily fed by runoff/precipitation with limited groundwater inputs.

Pathway 1.3B
Community 1.3 to 1.1

Increased water depth and duration/excessive precipitation years.

Pathway 1.3A
Community 1.3 to 1.2

Increased water depth and duration/excessive precipitation years.

State 2
Invaded Marsh State

Sites in this state may be in set-aside conservation easements. Areas not in a conservation program are assumed to be jurisdictional wetlands, making it very unlikely they will be transitioned to the Cropland State due to various wetland programs and laws, including the Swampbuster provision of the Food Security Act of 1985 (P.L. 99-198, as amended by P.L. 115-25) and the Minnesota Wetland Conservation Act (WCA) of 1991 (M.R. 8420.0100, as amended in 2009).

Community 2.1
Degraded Marsh

Common reed is considered an invasive species, even though it has been present in North American wetlands for over 3,000 years, because its aggressive expansion, usually attributed to disturbances, has greatly increased over the last 50 years (Mitsch, 2015). The presence of invasive cattails or common reed is usually an indicator of altered hydrology and increases in salinity and nutrients. Burning and herbicide application are used for control. There are some desirable varieties of common reed, so managers need to be aware of the distinctions in haplotypes and how to identify them (Mitsch, 2015). Hybrid cattail and common reed have been more problematic in this region, in that they both have expanded more aggressively by replacing bulrushes and giant bur-reed as dominants (Eggers, 1997). narrow-leaved cattail tolerates more mixosaline and calcareous waters than broadleaf cattail. Narrow-leaved cattail tolerates higher levels of nutrient inputs, usually from agricultural runoff. Broad-leaved and narrow-leaved cattail freely hybridize to form the hybrid, Typha x glauca Gordon (Eggers, 1997).

Dominant plant species

- common reed (*Phragmites australis*), other herbaceous
- hybrid cattail (*Typha ×glauca*), other herbaceous
- narrowleaf cattail (*Typha angustifolia*), other herbaceous

Community 2.2
Wet Grassland

Disturbances such as artificial drainage, plowing, mechanized land-clearing, road construction, excessive sediment and/or nutrient inputs, allow reed canary grass to outcompete native plants and form monocultures, reducing diversity and ecosystem function. Shrubs can also invade in this phase of lowered water levels and altered hydrology.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), other herbaceous

Community 2.3
Loosetrife

Purple loosestrife has spread across much of North American marshes in the late 20th century, displacing literally every other native plant on-site, including Typha sp. (Mitsch 2015). It is often associated with wetlands that have been disturbed by agricultural use, drainage, pasturing, siltation, or water level fluctuations (Eggers, 1997). This is of great concern to managers, who care about the functions of the site for water quality and wildlife habitat, which is dependent upon a diversity of plant species present on-site.

Dominant plant species

- purple loosestrife (*Lythrum salicaria*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Drawdown of water levels due to water diversion or use throughout the watershed, partial drainage of the site due to ditching, or other impediments to water flow into the site

Pathway 2.1B
Community 2.1 to 2.3

Invasion of exotic purple loosestrife

Pathway 2.2A
Community 2.2 to 2.1

Increased water flow into site or ponding on site.

Pathway 2.2B
Community 2.2 to 2.3

Invasion of exotic purple loosestrife.

Pathway 2.3A
Community 2.3 to 2.1

Chemical (herbicide approved for use in wetlands), mechanical removal of purple loosestrife, use of biocontrol (loosestrife beetles)

Pathway 2.3B
Community 2.3 to 2.2

Chemical (herbicide approved for use in wetlands), mechanical removal of purple loosestrife, use of biocontrol (loosestrife beetles)

State 3
Cropland State

In the Cropland State, most ecological functions have been destroyed, converted, or otherwise removed from the system. In farmed conditions, dynamic soil properties such as bulk density, structure, organic carbon content and saturated hydraulic conductivity can change quickly because of various agricultural practices. Many of these sites are and will likely continue to be in corn and soybean production. There are certain management practices that are proven to be destructive, not only to the individual field, but to the watershed.

Community 3.1
Cropland State

Certain practices can mediate the destructive effect of traditional agricultural practices on the soil resource. Conservation tillage that minimizes soil disturbance is more sustainable than traditional methods. Corn and/or soybean plantings with a cover crop rotation can help to build soil structure, improve infiltration rates, reduce runoff and erosion and have a comparatively positive effect on the overall environment.

Transition T1A
State 1 to 2

Hydrologic alterations can, over time, transition the reference depressional marsh community into an invaded marsh state. A variety of invasive woody plants and grasses can become established and spread, shading out native species. Common non-native species that invade this state include narrowleaf cattail, hybrid cattail, reed canarygrass, common reed, purple loosestrife, and various small woody plants.

Transition T1B
State 1 to 3

To transition to the cropland state, subsurface tile drainage of the site must be utilized, as well as tillage, herbicide use, and seeding.

Restoration pathway R2A
State 2 to 1

Complete hydrologic restoration of wetland basin, invasive species management, seeding, muskrat re-establishment.

Transition T2A
State 2 to 3

To transition to the cropland state, subsurface tile drainage of the site must be utilized, as well as tillage, herbicide use, and seeding.

Restoration pathway R3A
State 3 to 1

Complete hydrologic restoration of wetland basin, invasive species management, seeting, muskrat re-establishment.

Restoration pathway T3A
State 3 to 2

From an abandoned Crop Production state, it may only take several years to transition to this state. This transition involves partial or complete hydrologic restoration of the wetland basin, and agricultural abandonment.

Additional community tables

Table 5. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bluejoint	CACA4	*Calamagrostis canadensis*	–	–	25–
rice cutgrass	LEOR	*Leersia oryzoides*	–	–	25–
Forb/Herb					
water knotweed	POAM8	*Polygonum amphibium*	–	–	25–
broadleaf cattail	TYLA	*Typha latifolia*	–	–	25–
bulblet-bearing water hemlock	CIBU	*Cicuta bulbifera*	–	–	25–

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.

Relationship to Other Established Classifications:
MN DNR Native Plant Community (MN DNR, 2003); the reference community of this Provisional Ecological Site is most similar to:
MRn83 Northern Mixed Cattail Marsh
MRn93 Northern Bulrush-Spikerush Marsh
Cowardin: Palustrine, Emergent Wetland Persistent (PEMC)
United States Army Corps of Engineers (USACE) Wetland Plant Community: G; Shallow Marshes
Hydrogeomorphic System (USDA, 2008): DEPRESSION (discharge)

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Contributors

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Approval

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MLRA 57 technical team completed in 2022.

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)	
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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:**

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17. **Perennial plant reproductive capability:**
