Ecological site F093AY006MN
Depressional Wet Hardwood Forest

Last updated: 9/06/2024
Accessed: 08/28/2026

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

MLRA notes

Major Land Resource Area (MLRA): 093A–Superior and Rainy Stony and Rocky Till Plains and Moraines

The Superior Stony and Rocky Loamy Plains and Hills, Western Part is located and completely contained in northeastern Minnesota. This area has both the highest and lowest elevations in the state, as well as some of the state's most rugged topography (Ojakangas and Matsch, 1982). The MLRA was glaciated by numerous advances of the Superior, Rainy, and Des Moines glacial lobes during the Wisconsin glaciation as well as pre-Wisconsin glacial periods. The geomorphic surfaces in this MLRA are geologically very young (i.e., 10,000 to 20,000 years) and dominated by drumlin fields, moraines, small lake plains, outwash plains, and bedrock-controlled uplands (USDA-NRCS, 2022). There are thousands of lakes scattered throughout the region that were created by these glacial events. Most of these lakes are bedrock-controlled in comparison to adjacent glaciated regions where glacial drift deposits are much thicker and the lakes occur in depressions atop the glacial drift (Ojakangas and Matsch, 1982). In contrast to adjacent MLRAs, the depth to the predominantly crystalline or sandstone bedrock in MLRA 93A is relatively shallow because the most recent glacial events were more erosional than depositional (Ojakangas and Matsch, 1982).

Classification relationships

Major Land Resource Area (MLRA): Superior Stony and Rocky Loamy Plains and Hills, Western Part (93A) USFS Subregions: Northern Superior Uplands Section (212L); North Shore Highlands Subsection (212Lb)

Ecological site concept

Depressional Wet Hardwood Forests are widespread throughout the distribution of the Superior Lobe glacial advance within MLRA 93A. These sites are developed primarily from low lying mineral soils, but can have up to sixteen inches (41 centimeters) of organic surface. They occur on small to moderate sized closed depressions and shallow, low gradient drainage networks, surrounded by an upland forest matrix. Later in the growing season ponded usually recedes, but they will again pond during moderate to heavy rainfall events. Hummocks from fallen trees create unique micro-topography, with micro-depressions that may hold water all year and adjacent root wads that shed water. Relative to other forested wetland communities in the MLRA, Depressional Wet Hardwood Forests are comparatively richer, and have a diverse assemblage of ground flora. Wetland species are almost always present. Interestingly, the drier conditions on hummocks allow a number of common upland species to persist. In contrast, the adjacent wet micro-depressions often host obligate wetland species that are characteristic of more permanent wetlands.

Associated sites

F093AY013MN	**Loamy Upland** This ecological site is surrounded by upland soils and landforms. There are often rims of somewhat poorly and poorly drained soils of the same parent material adjacent to this site. In some cases, these are isolated depressions that are completely surrounded by a till upland mesic hardwood forest matrix. In other cases, shallow drainageways meander back-and-forth through many adjacent ecological sites.

Similar sites

F093AY005MN	**Wet Floodplain** Soils wet layer depth is 0 - 15 inches (0 - 38 centimeters) and frequent flooding can occur in many areas. Dominant tree species include silver maple, black ash, green ash, and American elm.

Table 1. Dominant plant species

Tree	(1) *Fraxinus nigra* (2) *Thuja occidentalis*
Shrub	(1) *Alnus incana* (2) *Acer spicatum*
Herbaceous	(1) *Glyceria striata* (2) *Caltha palustris*

Physiographic features

Wet Depressional Hardwood Forests are located on depressions, end moraines, ground moraines, outwash plains and inter-drumlins associated with the Automba and Nickerson phases of the Superior Lobe glacial advance (Table 2). The most common landforms are depressions (ponded or closed) and subtle, concave areas. They can also occur in shallow, low gradient drainageways that may receive concentrated flow (e.g., incipient drainage ways). Slope shape can be either linear or concave up slope, and is always concave across slope. Individual sites can be quite small in size, ranging from less than one acre, to ten acres.

These sites are ponded throughout the spring and early summer months, and generally dry out by August, and pond again in low to moderate rain events. During dry times the water table is generally within 10 inches, but can be as low as 24 inches. These sites receive very low to low runoff and lateral subsurface flow from adjacent, upslope ecological sites. They also produce very low to low runoff and lateral subsurface flow downslope, to streams, rivers, and large peatland basins. Elevation is mainly above 1,000 feet and below 1,600 feet.

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Drainageway (3) Moraine (4) Closed depression (5) Outwash plain (6) Interdrumlin (7) Depression
Runoff class	Very low to low
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)

Ponding frequency	Occasional to frequent
Elevation	310 – 490 m
Slope	0 %
Ponding depth	0 – 20 cm
Water table depth	0 – 60 cm
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 26-32 inches (66 to 81 centimeters). Measurable climatic variation (due to the lake effect) near some of Lake Superior may alter temperature and precipitation (Hillman & Nielsen, 2023). About 65 percent of the precipitation falls as rain during the growing season (May through September) and about 21 percent falls as snow. The freeze-free period averages about 130 days and ranges from 97 to 150 days (USDA-NRCS, 2022).

Table 3 Representative climatic features

Frost-free period (characteristic range)	90-110 days
Freeze-free period (characteristic range)	120-140 days
Precipitation total (characteristic range)	740-790 mm
Frost-free period (actual range)	30-110 days
Freeze-free period (actual range)	70-150 days
Precipitation total (actual range)	660-810 mm
Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	740 mm

- (1) GRAND PORTAGE [USC00213296], Grand Portage, MN
- (2) WOLF RIDGE ELC [USC00219134], Finland, MN

- (3) DULUTH [USW00014913], Duluth, MN
- (4) ELY 25E [USC00212555], Ely, MN
- (5) KETTLE FALLS [USC00214306], Voyageurs Natl Park, MN
- (6) KABETOGAMA [USC00214191], Orr, MN
- (7) BRIMSON 2S [USC00210989], Brimson, MN

Influencing water features

These sites can be incipient drainage networks, with small perennial streams, or they can be in closed, isolated depressions. Seasonal ponding is most prominent during March through June and October through November. Water tables and water table recharge closely mimics annual rainfall graphs. They are either at or above the surface much of the year and may drop to a low of low of 12 inches (30 centimeters) during the dry months. In addition to precipitation inputs, these sites receive surface and subsurface water from surrounding sites. They also discharge water to lower elevation ecological sites, and ultimately to rivers, lakes, or large peatland basins.

In these relatively young morainic landscapes, well established dendritic drainage networks have not yet been developed. Instead, these sites exhibit water flow though after significant rainfall events. Landforms behave like closed depressions until an overflow threshold is achieved, wherein they begin to behave like drainageways. It is a complex interaction that is dependent upon factors like relative elevation and degree of incision. Stream orders associated with these sites are first, second, third, and fourth (SNF, unpublished report b). These sites also provide deep percolation for water table recharge.

Depressional Wet Hardwood Forests are classified as a Palustrine System, Forested Wetland Class, and depending on the State of vegetation, either a Broadleaf Deciduous or Dead Subclass, as described by Cowardin et al. (1979).

Wetland description

N/A

Soil features

The parent material for these soils includes loamy till, as well as outwash, from the Superior lobe glacial advance (Table 4). Although these are primarily mineral soils, up to 16 inches (41 centimeters) of organic parent material may be on the surface. On a given site, organic deposits (if existing) will be thickest near the center of the landform. In some cases there may be deeper organic surfaces that classify as true Histosols, but this is not typical condition of these landforms, and may be a relic of a past climatic or hydrologic time period. These soils are ponded, and as a result, are very poorly drained. However, wetness varies seasonally on these soils, which is a primary site factor defining this ecological site. Due to concave landforms and very poorly drained and ponded soils, soil textural classes are not a significant site factor for vegetation.

Surface texture is loam or sandy loam, and subsurface textures range from loam to very gravelly coarse sand. Soil pH on contributes to the rich nature of these plant communities, and ranges from 5.5 (moderately acid) to 6.5 (slightly acid), which is relatively high when compared to other wetland ecological sites in the MLRA. Soil orders are Inceptisols, and taxonomic classes are either Typic or Histic Humaquepts. Giese, Twig, Wahbegon, and Hulligan are all representative soil series for this ecological site.

Table 4. Representative soil features

Parent material	(1) Ablation till − gabbro (2) Outwash − sandstone (3) Lodgment till − basalt
Surface texture	(1) Very gravelly loam (2) Sandy loam
Family particle size	(1) Loamy
Drainage class	Very poorly drained

Permeability class	Slow to rapid
Soil depth	200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	1.91 – 12.7 cm
Soil reaction (1:1 water) (0-101.6cm)	5.5 – 6.5
Subsurface fragment volume <=3" (Depth not specified)	10 – 70 %
Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

Seasonal variation in water table is the most important site factor defining Depressional Wet Hardwood Forests. Water tables limit the amount of oxygen available to plant roots; and 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). Fires are not a significant disturbance factor in Depressional Wet Hardwood Forests in MLRA 93A. 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). Currently, the dynamics of plant communities in this ecological site are similar to what they were historically. Although these sites are broadly distributed, they are generally small in size, and are part of a broader matrix of various upland forest types.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
black ash	FRNI	*Fraxinus nigra*	Native	4.9-24.4	50-75	20.3-38.1	–
arborvitae	THOC2	*Thuja occidentalis*	Native	4.9-15.2	5-25	30.5-50.8	–
yellow birch	BEAL2	*Betula alleghaniensis*	Native	4.9-12.2	5-25	12.7-25.4	–
balsam fir	ABBA	*Abies balsamea*	Native	4.9-12.2	1-5	7.6-20.3	–

white spruce	PIGL	*Picea glauca*	Native	4.9-12.2	1-5	7.6-20.3		–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
fowl mannagrass	GLST	*Glyceria striata*	Native	0-0.9	10-50
bluejoint	CACA4	*Calamagrostis canadensis*	Native	0-0.9	10-50
bluejoint	CACA4	*Calamagrostis canadensis*	Native	0-0.9	10-50
bristlystalked sedge	CALE10	*Carex leptalea*	Native	0-0.6	5-15
greater bladder sedge	CAIN12	*Carex intumescens*	Native	0-0.6	1-10
awlfruit sedge	CAST5	*Carex stipata*	Native	0-0.3	1-10
graceful sedge	CAGR2	*Carex gracillima*	Native	0-0.3	1-10
softleaf sedge	CADI6	*Carex disperma*	Native	0-0.3	1-10
fringed brome	BRCI2	*Bromus ciliatus*	Native	0-0.6	1-5
Forb/Herb					
yellow marsh marigold	CAPA5	*Caltha palustris*	Native	0-0.3	10-50
northern bugleweed	LYUN	*Lycopus uniflorus*	Native	0-0.3	5-25
dwarf red blackberry	RUPU	*Rubus pubescens*	Native	0-0.3	5-15
blue skullcap	SCLA2	*Scutellaria lateriflora*	Native	0-0.3	5-15
touch-me-not	IMPAT	*Impatiens*	Native	0-0.9	5-15
purplestem aster	SYPUP	*Symphyotrichum puniceum var. puniceum*	Native	0-0.9	5-15
parasol whitetop	DOUMU	*Doellingeria umbellata var. umbellata*	Native	0-0.9	1-10
wild sarsaparilla	ARNU2	*Aralia nudicaulis*	Native	0-0.6	1-5
starflower	TRBO2	*Trientalis borealis*	Native	0-0.3	1-5
arctic sweet coltsfoot	PEFR5	*Petasites frigidus*	Native	0-0.3	1-5
spotted joe pye weed	EUMA9	*Eutrochium maculatum*	Native	0-0.9	1-5
naked miterwort	MINU3	*Mitella nuda*	Native	0-0.3	1-5
harlequin blueflag	IRVE2	*Iris versicolor*	Native	0-0.6	1-5
tall bluebells	MEPA	*Mertensia paniculata*	Native	0-0.3	1-5
woodland horsetail	EQSY	*Equisetum sylvaticum*	Native	0-0.3	1-5
threeleaf goldthread	COTR2	*Coptis trifolia*	Native	0-0.3	1-5
Jack in the pulpit	ARTR	*Arisaema triphyllum*	Native	0-0.6	1-5
small enchanter's nightshade	CIAL	*Circaea alpina*	Native	0-0.3	1-5
giant goldenrod	SOGI	*Solidago gigantea*	Native	0-0.9	1-5
eastern swamp saxifrage	SAPE8	*Saxifraga pensylvanica*	Native	0-0.6	1-5
wood anemone	ANQU	*Anemone quinquefolia*	Native	0-0.3	1-5
Canada mayflower	MACA4	*Maianthemum canadense*	Native	0-0.3	1-5
bunchberry dogwood	COCA13	*Cornus canadensis*	Native	0-0.3	1-5
purple meadow-rue	THDA	*Thalictrum dasycarpum*	Native	0-0.9	1-2
Fern/fern ally					
common ladyfern	ATFI	*Athyrium filix-femina*	Native	0-0.6	5-25
intermediate woodfern	DRIN5	*Dryopteris intermedia*	Native	0-0.3	5-15
sensitive fern	ONSE	*Onoclea sensibilis*	Native	0-0.6	5-15
western oakfern	GYDR	*Gymnocarpium dryopteris*	Native	0-0.3	1-5
ostrich fern	MAST	*Matteuccia struthiopteris*	Native	0-0.9	1-5
long beechfern	PHCO24	*Phegopteris connectilis*	Native	0-0.3	1-5

Shrub/Subshrub					
speckled alder	ALINR	*Alnus incana ssp. rugosa*	Native	0.3-4.9	25-75
redosier dogwood	COSE16	*Cornus sericea*	Native	0.3-3	1-15
beaked hazelnut	COCO6	*Corylus cornuta*	Native	0.3-3	1-15
American fly honeysuckle	LOCA7	*Lonicera canadensis*	Native	0.3-1.5	1-5
American cranberrybush	VIOPA2	*Viburnum opulus var. americanum*	Native	0.3-1.5	1-5
red currant	RITR	*Ribes triste*	Native	0.3-1.5	1-5
Tree					
mountain maple	ACSP2	*Acer spicatum*	Native	0.3-4.9	5-25
American red raspberry	RUID	*Rubus idaeus*	Native	0.3-3	1-15
black ash	FRNI	*Fraxinus nigra*	Native	0.3-3	1-15
chokecherry	PRVI	*Prunus virginiana*	Native	0.3-3	1-5

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Inventory data references

A total of 12 integrated plots, ranging from Tier 2 to Tier 3 intensity, were used as a basis for this ecological site. Three of these were Type Locations representing the data-supported Community Phase 1.1 in the state-and-transition model, and included all necessary data elements for a Tier 3 dataset. No other community phases were supported with quantitative data analysis. All 12 plots had soil pedon and site data collected by a professional soil scientist using a form equivalent to SF-232. Pits were hand-dug using spade shovels, sharpshooters, and/or bucket augers. Of the 12 plots, two were located at established MN DNR relevé points, obtained and used with permission from the MN DNR County Biological Survey. List of MN DNR relevé plots used with verified soils data: 3475 and 8301.

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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	08/28/2026
Approved by	
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:**

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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:**