USDA Natural Resources
Conservation Service

Ecological site F096XB024MI
Wet Sandy Depression

Last updated: 9/11/2024
Accessed: 05/12/2025

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.

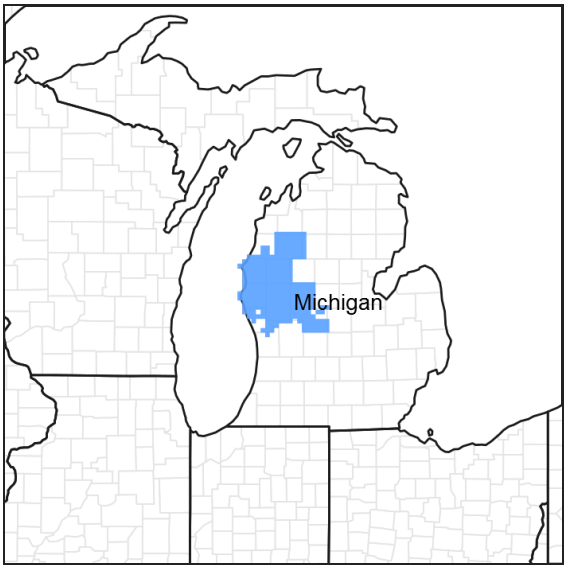


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 096X–Northwestern Michigan Fruit Belt

This area is dominated by outwash plains and moraines. Lake plains, till plains, drumlins, and sand dunes are found locally across the area. The terrain is steep on stream carved moraines, ice contact ridges, and sand dunes, and flat on outwash plains and lake plains. Elevation ranges from 177 to 369 m (580 to 1210 ft). Local topographic relief averages 11 m (35 ft) in the south to 20 m (65 ft) in the north and ranges up to a maximum of 158 m (520 ft) at Empire Bluff (Sleeping Bear Dunes). Much of the area rises sharply from the lakeshore to the adjoining hilltops. The Manistee River is the longest river in this area. Its trout fishery is maintained by constant inflow of cool ground water from the porous sand dominated landscape. The Pine and Pere Marquette Rivers also occur in this MLRA. Surficial topography are formed of glacial deposits except for local areas with dune building near Lake Michigan. Most of the bedrock surface is at or below the elevation of Lake Michigan, and is exposed in only in limited extents near Charlevoix. The bedrock, all Paleozoic in age, is the Traverse Group and the Dundee Limestone. These Silurian-Devonian rocks are mostly limestone and dolomite with some interbedded shale, chert, and anhydrite stringers. The drumlin belts in the northern portion of the area is the most affected by the limestone nearer to the surface in terms of carbonates in the till.

About two-thirds of this area is in small, privately owned holdings, and one-third consists mostly of State forests. The forests are used mainly for timber production and recreation. The growth of orchard crops and other crops and dairy and beef operations are important enterprises in the area. Forage and feed grains for dairy and other livestock

are the principal crops. Asparagus, wheat, oats, corn, and hay are commonly grown in the area. Orchard products include sweet and tart cherries, apples, plums, and peaches. The Manistee National Forest and Sleeping Bear Dunes National Lakeshore are among the more notable conservation lands in the area. Nordhouse Dunes Wilderness Area is within the Manistee National Forest. Sections of the Pere Marquette, Pine, and Manistee Rivers, and Bear Creek have been designated as National Wild and Scenic Rivers.

Summary of existing land use:
Upland Forest (52%)
Hardwood (38%)
Conifer (11%)
Agricultural (15%)
Swamps and Marshes (13%)
Developed (13%)

Classification relationships

According to the USFS (Bailey) system of ecoregions, the site is located mostly within 212Ha (Oceana Sandy Lake Plains and Dunes) and 212Hb (Manistee Sandy Outwash Plain) subsections. According to the EPA (Omernik) system of ecoregions, the site is located in 50ag (Newaygo Barrens) and northern 56d (Michigan Lake Plain) level IV ecoregions. This site is outside the environmental range of the Kotar system. This site corresponds to the Mineral Wetland, ecological land type phase, 73, in the USFS Ecological Land Type system.

Ecological site concept

The central concept of Wet Sandy Depression is lowlands with hydric soil (poorly drained to very poorly drained) and a soil pH of upper 50 cm greater than 5.5, or high base saturation, including mollisols, and euic great groups and families. Site occurs on sandy drift (outwash, ice contact, or lake plains) where soil textures are sand or loamy sand (upper 50 cm >70% sand). Site in moderate annual snowfall belt, mostly south of Manistee River, where fire was locally important. Area has a more southern flora than sites further north. Vegetation trending towards swamp forest with a calciphilic species composition.

Associated sites

F096XB021MI	**Acidic Sandy Depression**
F096XB023MI	**Sandy Depression**

Similar sites

F096XA011MI	**Snowy Wet Sandy Depression**

Table 1. Dominant plant species

Tree	(1) *Tsuga canadensis* (2) *Betula alleghaniensis*
Shrub	(1) *Rubus pubescens*
Herbaceous	Not specified

Physiographic features

Site occurs on coarse textured ice contact, glacial till, outwash, and lake plain deposits. Landforms are gently sloping lower slope positions and depressions.

Table 2. Representative physiographic features

Landforms	(1) Kame (2) Outwash plain (3) Lake plain

Runoff class	Negligible to low
Elevation	176–366 m
Water table depth	0–25 cm
Aspect	Aspect is not a significant factor

Climatic features

Mean annual temperatures are 7.1 to 8.5 °C (45 to 47 °F). The warmest six months average 15.5 to 16.5 °C (60 to 62 °F). Mean July temperatures range from 20.0 to 21.1 °C (68 to 70 °F). Mean January temperatures range from -6.7 to -3.9 °C (20 to 25 °F). The maximum monthly average daily highs are 25.5 to 28.1 °C (78 to 83 °F). The minimum monthly average daily lows are -11.2 to -7.3 °C (12 to 19 °F). Mean annual precipitation ranges from 850 to 920 mm (33 to 36 in). Prevailing winds pick up moisture from the Great Lakes in the form of lake effect rain and snow showers during fall and winter seasons, and in the form of fog during spring and summer. Thunderstorm intensity is reduced by temperature inversions over the lake during the spring and early summer when lake water is cools the air flowing over it. Average 0 °C (32 °F) frost-free season ranges from 108 to 161 days. Average -2 °C (28 °F) freeze-free season is 141 to 194 days increasing in length from north to south and decreasing in length from the lakeshore inward. Mean annual snowfall ranges from 1.6 to 2.5 m (60 to 100 in). Mean annual extreme minimum temperatures range from -29 to -18.9 °C (-20 to -2 °F), or hardiness zones 4b to 6b.

Table 3. Representative climatic features

Frost-free period (characteristic range)	95-114 days
Freeze-free period (characteristic range)	127-138 days
Precipitation total (characteristic range)	864-889 mm
Frost-free period (actual range)	90-121 days
Freeze-free period (actual range)	120-148 days
Precipitation total (actual range)	838-914 mm
Frost-free period (average)	105 days
Freeze-free period (average)	133 days
Precipitation total (average)	889 mm

Climate stations used

- (1) MANISTEE 3SE [USC00205065], Manistee, MI
- (2) MONTAGUE 4 NW [USC00205567], Montague, MI
- (3) HESPERIA 4 WNW [USC00203769], Hesperia, MI
- (4) BALDWIN [USC00200446], Baldwin, MI
- (5) HART 3 WSW [USC00203632], Hart, MI

Influencing water features

Site has seasonal high water table of minerotrophic groundwater within 25 cm of the surface.

Soil features

Soils are very poorly drained to poorly drained sands. They are commonly classified Mollic Psammaquents, Typic Haplaquolls, and Mollic Haplaquents, and commonly mapped as Roscommon, Kingsville, and Granby series or components. The top 50 cm has a typical pH of 6.4 and is 90% sand and 2.1% organic matter. At depth, pH ranges up to 7, and texture averages 90% sand and 5% clay. Depth to impeded hydraulic conductivity or root restrictive layers averages >200 cm. Depth to carbonates averages 160 cm.

Table 4. Representative soil features

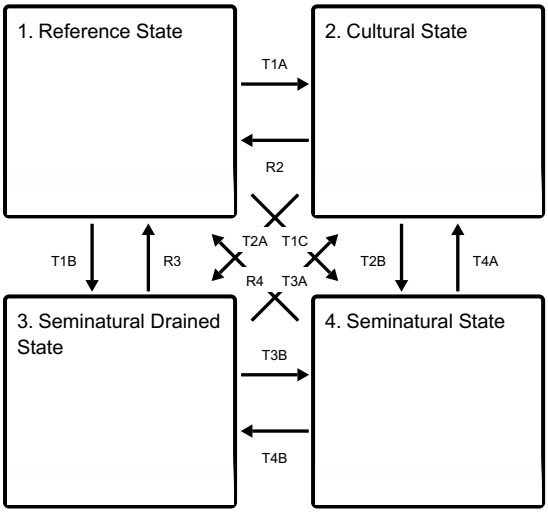
Parent material	(1) Outwash
Surface texture	(1) Sand
Drainage class	Very poorly drained to poorly drained
Permeability class	Slow to moderately rapid
Soil depth	201 cm
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0%
Available water capacity (0-100.1cm)	3.99–10.01 cm
Soil reaction (1:1 water) (0-50cm)	5.5–7
Subsurface fragment volume <=3" (0-150.1cm)	0–10%
Subsurface fragment volume >3" (0-150.1cm)	0–5%

Ecological dynamics

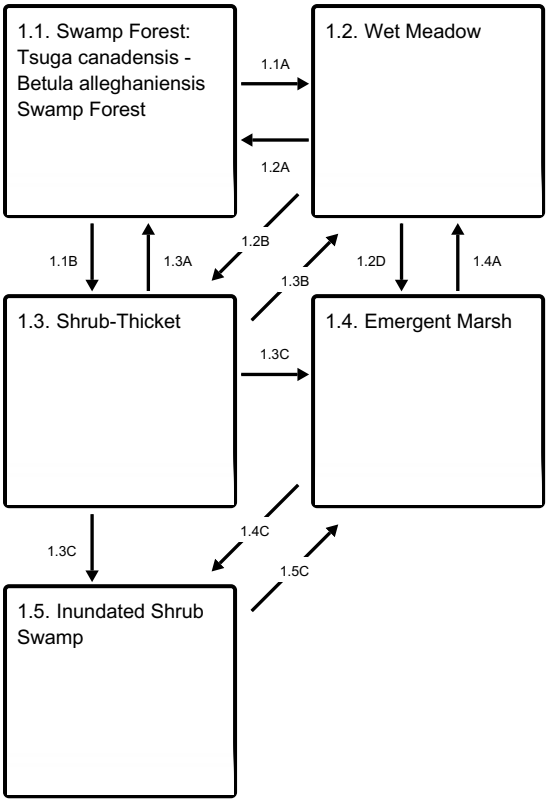
Wet Sandy Depression tends to share the same ecological dynamics as Natureserve/Landfire system, Laurentian-Acadian Alkaline Conifer-Laurentian-Acadian Wet Meadow-Shrub Swamp. Stand replacing fires occurred every 250-950 years, with light surface fires every 140-550 years. Overstory was dominated by late successional, moisture loving species, tolerant of low nitrogen availability, like hemlock (*Tsuga canadensis*) and yellow birch (*Betula alleghaniensis*). Understory is composed of moisture loving species such as dwarf raspberry (*Rubus pubescens*).

State and transition model

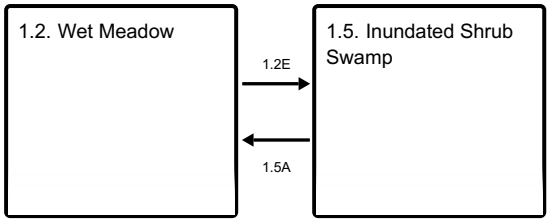
Ecosystem states



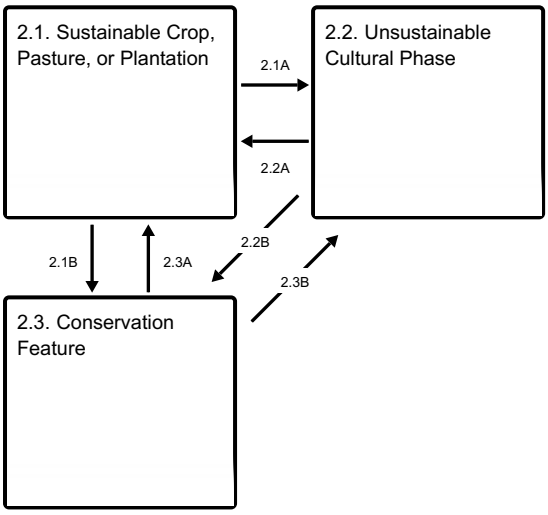
State 1 submodel, plant communities



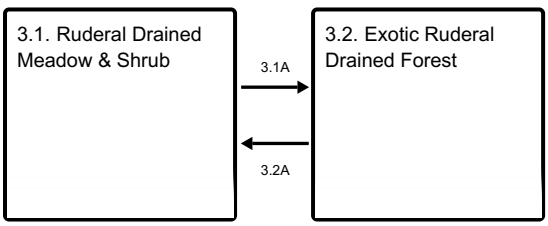
Communities 2 and 5 (additional pathways)



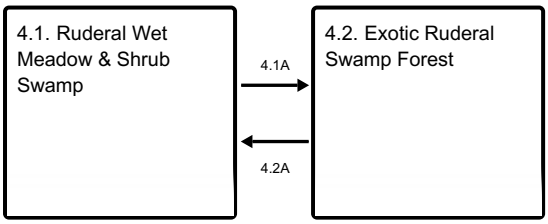
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Reference State

Dominant plant species

- eastern hemlock (*Tsuga canadensis*), tree
- yellow birch (*Betula alleghaniensis*), tree
- dwarf red blackberry (*Rubus pubescens*), shrub

Community 1.1
Swamp Forest: Tsuga canadensis - Betula alleghaniensis Swamp Forest

Community 1.2
Wet Meadow

Community 1.3
Shrub-Thicket

Community 1.4
Emergent Marsh

Community 1.5
Inundated Shrub Swamp

Pathway 1.1A
Community 1.1 to 1.2

Temporary prolonged inundation.

Pathway 1.1B
Community 1.1 to 1.3

Clearcut/Blowdown.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.2A
Community 1.2 to 1.1

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.2B
Community 1.2 to 1.3

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.2D
Community 1.2 to 1.4

Permanent inundation.

Pathway 1.2E
Community 1.2 to 1.5

Shrub establishment; permanent inundation.

Conservation practices

Tree/Shrub Establishment

Pathway 1.3A
Community 1.3 to 1.1

Succession.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Pathway 1.3B
Community 1.3 to 1.2

Temporary prolonged inundation.

Pathway 1.3C
Community 1.3 to 1.4

Permanent inundation.

Pathway 1.3C
Community 1.3 to 1.5

Permanent inundation.

Pathway 1.4A
Community 1.4 to 1.2

Drop water table.

Pathway 1.4C
Community 1.4 to 1.5

Temporary drop water table; shrub establishment.

Pathway 1.5A
Community 1.5 to 1.2

Drop water table; shrub mortality.

Conservation practices

Brush Management

Pathway 1.5C
Community 1.5 to 1.4

Temporary drought; shrub mortality.

State 2
Cultural State

Community 2.1
Sustainable Crop, Pasture, or Plantation

Community 2.2
Unsustainable Cultural Phase

Community 2.3
Conservation Feature

Can be a grassed waterway, conservation reserve, a small patch pollinator garden, or other land taken out of its primary cultural production to mitigate or reduce impacts of adjacent land use, and is not by itself a permanent restoration of a complete native biological community and associated ecosystem services.

Pathway 2.1A
Community 2.1 to 2.2

Revert to unsustainable cultural practices.

Pathway 2.1B
Community 2.1 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.2A
Community 2.2 to 2.1

Implement sustainable cultural practices.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management
Integrated Pest Management (IPM)

Pathway 2.2B
Community 2.2 to 2.3

Establish conservation feature.

Conservation practices

Conservation Cover
Grassed Waterway

Pathway 2.3A
Community 2.3 to 2.1

Implement sustainable cultural practices.

Conservation practices

Conservation Crop Rotation
Cover Crop
Nutrient Management
Integrated Pest Management (IPM)

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable cultural practices.

State 3
Seminatural Drained State

Community 3.1
Ruderal Drained Meadow & Shrub

Community 3.2
Exotic Ruderal Drained Forest

Pathway 3.1A
Community 3.1 to 3.2

Succession

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

State 4
Seminatural State

Community 4.1
Ruderal Wet Meadow & Shrub Swamp

Community 4.2
Exotic Ruderal Swamp Forest

Pathway 4.1A
Community 4.1 to 4.2

Succession.

Pathway 4.2A
Community 4.2 to 4.1

Blowdown/clearcut.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Transition T1A
State 1 to 2

Drain; clear vegetation; cultivate domesticated species.

Transition T1B
State 1 to 3

Drain; clear vegetation, invasive species introduced.

Transition T1C
State 1 to 4

Clear vegetation, invasive species introduced.

Restoration pathway R2
State 2 to 1

Restore hydrology; remove domesticated species; restore native species.

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Wetland Restoration
Herbaceous Weed Control

Transition T2A
State 2 to 3

Abandon, succession.

Transition T2B
State 2 to 4

Restore hydrology; abandon; succession.

Conservation practices

Wetland Restoration

Restoration pathway R3
State 3 to 1

Restore hydrology; control invasive species; restore native species

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Wetland Restoration
Herbaceous Weed Control

Transition T3A
State 3 to 2

Clear vegetation; cultivate domesticated species.

Transition T3B
State 3 to 4

Restore hydrology.

Conservation practices

Wetland Restoration

Restoration pathway R4
State 4 to 1

Control invasive species; restore native species.

Conservation practices

Brush Management
Restoration and Management of Rare and Declining Habitats
Wetland Wildlife Habitat Management
Herbaceous Weed Control

Transition T4A
State 4 to 2

Drain; clear vegetation; cultivate domesticated species.

Transition T4B

State 4 to 3

Drain.

Additional community tables

Other references

A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a major land resource area (MLRA) based on the similarities in response to management. A provisional ecological site is a first approximation based on a cursory literature review, personal experience, and limited field reconnaissance. As more adequate literature review, expert opinion, and intensive plot data are collected, the site concept is subject to shifting, broadening, narrowing, subdivision, or re-aggregation in definition. Likewise, the community dynamics will be more elaborate in content, and may also change in structure, upon reaching approved status.

Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the project plan are to be conducted by the Ecological Site Technical Team.

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Contributors

Gregory J. Schmidt

Approval

Greg Schmidt, 9/11/2024

Acknowledgments

The following individuals made substantive comments regarding the development of the Provisional Ecological Sites: Randy Swaty, The Nature Conservancy; Trevor Hobbs, USFS; Richard A. Corner, USFS; Andy Henriksen, NRCS; Dan Zay, NRCS.

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	05/12/2025
Approved by	Greg Schmidt
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:**
