USDA Natural Resources Conservation Service

Ecological site F099XY002MI
Shallow Limestone Drift

Last updated: 1/25/2024
Accessed: 05/19/2024

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.

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): 099X–Erie-Huron Lake Plain

This area is in the Eastern Lake Section of the Central Lowland Province of the Interior Plains (USDA-NRCS 2022). It is a nearly level glacial lake plain with a few scattered ridges of sand that represent past shorelines and moraines. The Saginaw, Clinton, and Huron Rivers empty into the Great Lakes in the part of the area in Michigan. The southern half of this area is covered with glacial deposits of till, lake sediments, and outwash from the Wisconsin and older glacial periods. The area also has some low moraines. Mississippian- to Silurian-age shale, limestone, and dolomite rocks are at or near the surface close to Lake Erie and Lake Huron. Sandstone comes near the surface in the Thumb area east of Saginaw Bay, and a sandstone headland exists on a short stretch of Lake Huron shoreline. An extensive swamp in proximity the Maumee River prevented overland travel prior to its drainage by early settlers. Remnant marshes are near the Lake Erie shore.

The dominant soils in this MLRA are Alfisols, Inceptisols, Mollisols, and Spodosols. The soils in the area dominantly have a mesic soil temperature regime, an aquic soil moisture regime, and mixed or illitic mineralogy. Most soils in MLRA 99 are very deep, generally somewhat poorly drained to very poorly drained, and loamy or clayey. Epiaqualfs (Blount, Hoytville, Nappanee, and Shebeon series) and Glossudalfs (Capac series) formed in till (some of which is dense) on till plains, moraines, and lake plains. Epiaquepts formed in loamy till on till plains and moraines (Kilmanagh series) and in lacustrine deposits on lake plains (Lenawee and Paulding series). Endoaquepts formed in lacustrine deposits on lake plains (Latty and Toledo series) and in loamy till on moraines (Parkhill series).

Endoaquolls formed in outwash deposits on outwash plains and lake plains, in drainageways (Granby series), and in loamy till on till plains and moraines (Tappan series). Endoaquods (Pipestone series) formed in outwash deposits on outwash plains, lake plains, and beach ridges. Epiaquods (Wixom series) formed in sandy sediments over till or lacustrine deposits on till plains, outwash plains, and lake plains.

Broad flat areas of somewhat poorly drained soils support Landfire (2017) systems: North-Central Interior Beech-Maple Forest, with wetter patches of North-Central Interior Wet Flatwoods, and Central Interior and Appalachian Swamp. Sandy beach ridges and thin sand flats have Landfire (2017) systems: North-Central Interior Dry-Mesic Oak Forest and Woodland and Great Lakes Wet-Mesic Lakeplain Prairie. Central Interior and Appalachian Floodplain Systems occur adjacent to rivers that flow through the area. To the north, oak systems decline in coverage. Thin sandy flats in the north have Laurentian-Acadian Pine-Hemlock-Hardwood Forest. The north and south are best separated as ecological inference areas due to floristic and dominant vegetation contrasts which also correspond to generally lower summer and winter temperatures northward. This north-south break is approximated by the drainage divide between the Lake Huron and Lake Erie/Lake St. Clair basins.

Nearly three-fourths of this MLRA is in farms. About three-fifths of the area is cropland. The rest of the farmland is mostly in small farm woodlots, but some of the farmland is used for permanent pasture or other purposes. Cash crops are important. Corn, winter wheat, soybeans, and hay are the major crops. Sugar beets and canning crops also are important. Some fruit and truck crops are grown on the coarse textured soils. Dairying is an important enterprise on some farms near the larger cities. Almost one-fifth of the area is used for urban development. Shiawassee National Wildlife Refuge, Cedar Point National Wildlife Refuge, Oak Openings Preserve Metropark (Ohio) are among the more notable conservation lands.

Summary of existing land use (South):
Upland Forest (7%)
Hardwood (6%)
Agricultural (60%)
Developed (28%)

Summary of existing land use (North):
Upland Forest (14%)
Hardwood (13%)
Agricultural (58%)
Developed (13%)
Swamps and Marshes (13%)

Classification relationships

The USFS ecoregion classification (Cleland et al., 2007) for the majority of MLRA 99 is the Humid Temperate, Hot Continental Division, Midwest Broadleaf Forest Province 222, Lake Whittlesey Glaciolacustrine Plain Section 222U. The ecoregion subsection composition is 222Ud (Sandusky Lake Plain) and 222Ue (Saginaw Clay Lake and Till Plain) in the north near Lake Huron and Saginaw Bay. In the south near Lake Erie, the area is composed of subsections 222Ua (Maumee Lake Plain), 222Ub (Paulding Plains), and 222Uc (Marblehead Drift/Limestone Plain). A mix of interlobate deposits extends into MLRA 99 as subsection 222Jf (Lum Interlobate Moraine) of South Central Great Lakes Section 222J. Sandy deposits extend south from adjacent MLRA are part the Warm Continental Division, Laurentian Mixed Forest Province 212, Northern Lower Peninsula Section 212H, subsection 212Hh (Gladwin Silty Lake Plain).

The Saginaw Bay and Lake Huron lake plains is coextensive with EPA ecoregion 57e (Saginaw Lake Plain) (Omernik and Griffith, 2014). The majority of the Lake Erie or Maumee Lake Plain includes EPA ecoregion 57a (Maumee Lake Plain), extending east to include 57d (Marblehead Drift/Limestone Plain). Large inclusions of sand are delineated as ecoregion 57b (Oak Openings). A significant area of higher clay is designated as 57c (Paulding Plains).

Ecological site concept

The central concept of Shallow Limestone Drift is uplands with shallow to limestone bedrock soils. Sites often occur on topographic highs where underlying bedrock ruptures the till and lacustrine deposits. Vegetation consists of

prairie due to shallow rooting depth leading to higher drought and fire frequency.

Associated sites

F099XY004MI	**Warm Dry Sandy Ridge**
F099XY007MI	**Lake Plain Flats**

Similar sites

F098XA024MI	**Limestone Drift Plains**

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Clinopodium arkansanum*

Physiographic features

Site occurs where glacial drift is the thinnest over limestone or dolostone bedrock. Site is often a topographic high above the general level of the lake plain.

Table 2. Representative physiographic features

Landforms	(1) Lake plain
Runoff class	Low to high
Elevation	173–268 m
Water table depth	99 cm
Aspect	Aspect is not a significant factor

Climatic features

This ecological site experiences a humid continental climate with mild summers and cold winters. Precipitation is moderately well distributed through the year with higher amounts during the growing season than the winter.

Temperature extremes are moderated in immediate proximity to the Great Lakes, but this moderation has minimal effect inland due to prevailing winds blowing mainly offshore. Mean annual extreme minimum temperatures range from -26.6 to -18.8 °C (-16 to -2 °F), which falls within hardiness zones 5a to 6a (USDA, 2009). In general, temperatures are cooler northward, though local city heat island effects may interrupt this pattern.

The lack of significant topographic relief and general downwind direction to the Great Lakes likely contribute to this MLRA having lower annual precipitation and snowfall compared to the MLRA to the west. Mean annual snowfall ranges from 0.7 to 1.5 m (25 to 55 in). In general, snowfall is highest northward.

Table 3. Representative climatic features

Frost-free period (average)	161 days
Freeze-free period (average)	188 days
Precipitation total (average)	914 mm

Climate stations used

- (1) HOYTVILLE 2 NE [USC00333874], Cygnet, OH
- (2) TOLEDO EXPRESS AP [USW00094830], Monclova, OH
- (3) MONROE [USC00205558], Monroe, MI
- (4) FREMONT [USC00332974], Fremont, OH
- (5) SANDUSKY [USW00014846], Sandusky, OH
- (6) FREMONT AG STN [USC00332976], Fremont, OH

Influencing water features

Site is well drained with no water table within 100 cm of the surface.

Soil features

Soils are well drained shallow over limestone or dolostone. They are commonly classified Eutrochreptic Rendolls, Mollic Hapludalfs, and Typic Hapludalfs, and commonly mapped as Castalia, Dunbridge, and Milton series or components. Sites may include lithic soils and rock outcrops that were not extensive enough to map, despite distinctive vegetation and rare plant potential.

Table 4. Representative soil features

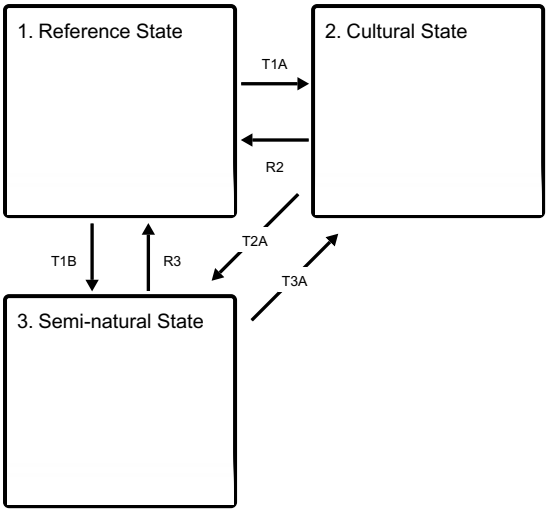
Parent material	(1) Drift (2) Residuum–limestone and dolomite
Surface texture	(1) Loam (2) Sand
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	0–150 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-100.1cm)	0.99–22 cm
Soil reaction (1:1 water) (0-50cm)	6–8
Subsurface fragment volume <=3" (0-150.1cm)	5–35%
Subsurface fragment volume >3" (0-150.1cm)	0–15%

Ecological dynamics

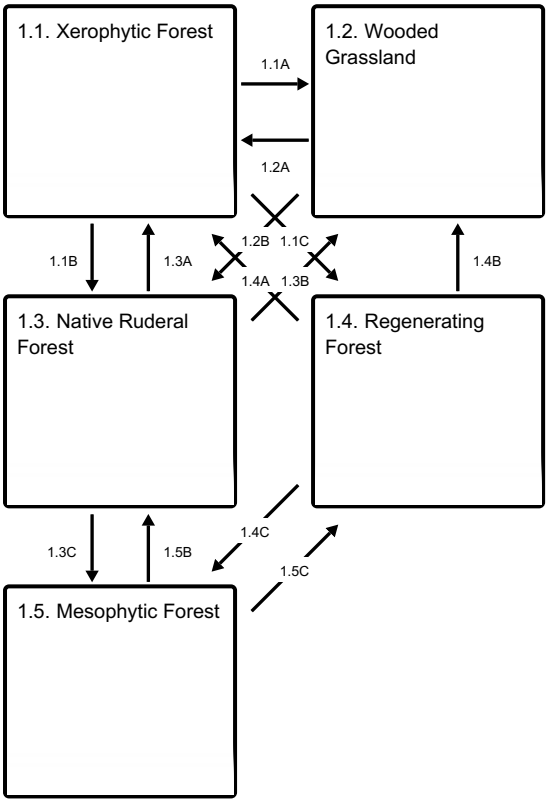
Shallow Limestone Drift tends to share the same ecological dynamics as Natureserve/Landfire system, Central Tallgrass Prairie (Landfire, 2017). Stand replacing fires occurred every 2-6 years. Shallow soil areas tend to have higher vegetation cover than exposed bedrock glades. Prairie barrens vegetation can form where shallow mineral soil allows for a continuous vegetation coverage. Over long fire free intervals, organic matter can accumulate over the glades and support more continuous vegetation. Because the shallow organic matter dries out quickly during rain free intervals, trees are able to survive only where roots can penetrate deeper crevices in the bedrock. Fire can consume the thin layer of organic matter, setting succession back to bedrock glade conditions. Prairie grasses like little bluestem (*Schizachyrium scoparium*) occur in the thin soil areas with calcium-loving forbs like limestone calamint (*Clinopodium arkansanum*). With longer fire return intervals, overstory species like eastern redcedar (*Juniperus virginiana*) can invade.

State and transition model

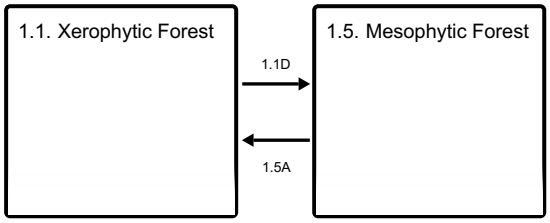
Ecosystem states



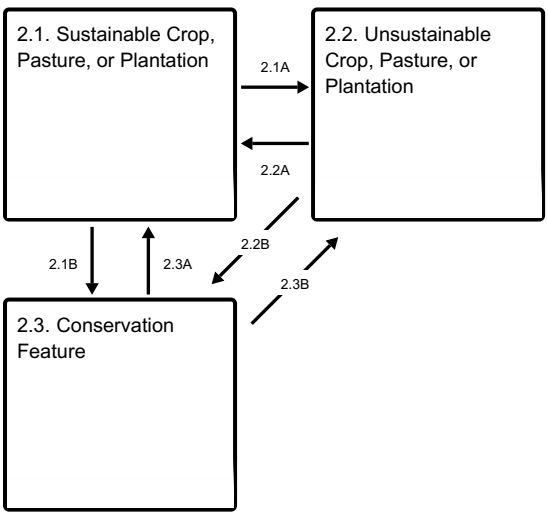
State 1 submodel, plant communities



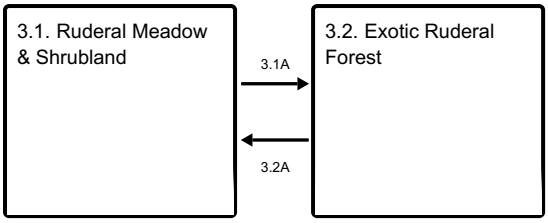
Communities 1 and 5 (additional pathways)



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The Reference State consists of plant-community-types in settings where natural ecological processes are operating that are unmanaged or only minimally-managed by land use conditioning, e.g., ranging from old-growth plant community-types (sometimes construed as mature, or pre-settlement vegetation) to inherent transitional ruderal plant community-type phases.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- limestone calamint (*Clinopodium arkansanum*), other herbaceous

Community 1.1
Xerophytic Forest

Community 1.2
Wooded Grassland

Community 1.3
Native Ruderal Forest

Community 1.4
Regenerating Forest

Community 1.5
Mesophytic Forest

Pathway 1.1A
Community 1.1 to 1.2

Blowdown; increased fire/drought.

Conservation practices

Prescribed Burning
Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.1B
Community 1.1 to 1.3

Blowdown/clearcut

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.1C
Community 1.1 to 1.4

Blowdown/clearcut

Conservation practices

Forest Stand Improvement

Pathway 1.1D
Community 1.1 to 1.5

Succession; decreased fire/drought

Pathway 1.2A
Community 1.2 to 1.1

Succession

Pathway 1.2B
Community 1.2 to 1.3

Decreased fire/drought; succession

Pathway 1.3A
Community 1.3 to 1.1

Succession

Pathway 1.3B
Community 1.3 to 1.2

Blowdown; increased fire/drought.

Pathway 1.3C
Community 1.3 to 1.5

Succession; decreased fire/drought.

Pathway 1.4A
Community 1.4 to 1.1

Succession.

Pathway 1.4B
Community 1.4 to 1.2

Blowdown; increased fire/drought.

Pathway 1.4C
Community 1.4 to 1.5

Succession; decreased fire/drought.

Pathway 1.5A

Community 1.5 to 1.1

Increased fire/drought with mortality.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.5B
Community 1.5 to 1.3

Blowdown/clearcut.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Pathway 1.5C
Community 1.5 to 1.4

Blowdown/clearcut

Conservation practices

Forest Stand Improvement

State 2
Cultural State

The Cultural State includes settings where natural ecological processes are absent or eclipsed by significant land conditioning and the conversion/transformation of plant cover is considered as Cultivated/Pasture/Plantation.

Community 2.1
Sustainable Crop, Pasture, or Plantation

Community 2.2
Unsustainable Crop, Pasture, or Plantation

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

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable cultural practices.

State 3
Semi-natural State

The Semi-natural State consists of plant community-types in settings where natural ecological processes are primarily still operating but with some land conditioning in the past or present, e.g., varieties of managed sites with replacement plant community-types such as results of harvests or planting, or settings that possess a significant artifact of land management e.g., predominately invasive plants.

Community 3.1

Ruderal Meadow & Shrubland

Community 3.2
Exotic Ruderal Forest

Pathway 3.1A
Community 3.1 to 3.2

Succession.

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut.

Transition T1A
State 1 to 2

Clear vegetation; cultivate domesticated species

Transition T1B
State 1 to 3

Clear vegetation, invasive species introduced

Restoration pathway R2
State 2 to 1

Remove domesticated species; restore native species.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Transition T2A
State 2 to 3

Abandoned, succession.

Restoration pathway R3
State 3 to 1

Control invasive species; restore native species

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment

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

Restoration pathway T3A
State 3 to 2

Clear vegetation; cultivate domesticated species

Additional community tables

Inventory data references

Future work, as described in a future 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.

Other references

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Contributors

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Approval

Nels Barrett, 1/25/2024

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	01/25/2024
Approved by	Nels Barrett
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:**
