Ecological site F098XA024MI
Limestone Drift Plains

Last updated: 1/12/2024
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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): 098X–Southern Michigan and Northern Indiana Drift Plains

This area is in the Eastern Lake Section of the Central Lowland Province of the Interior Plains. It is a broad glaciated plain that is deeply mantled by till in the north and outwash to the south. Much of the area is nearly level to gently rolling. Elevation ranges from 183 to 391 m (600 to 1285 ft). Local topographic relief averages 9 m and ranges up to 74 m (30 to 245 ft). Highest relief occurs adjacent to river valleys eroded through moraines. Topography is more subdued south of the Atlantic/Gulf drainage divide near the Michigan/Indiana state line, elevations ranging from 185 to 280 m (605 to 920 ft). Local topographic relief in the south averages 4 m and ranges up to 49 m (10 to 160 ft). The surface of this area is covered by 30 to 150 m (100 to 500 ft) of glacial drift in most areas. At the northern edge of the area, the drift is more than 100 meters (300 ft) thick. From the Grand River basin northward, most of the drift consists of till from the Saginaw Lobe of the Wisconsin Ice Sheet. From the Kalamazoo River basin southward, there are significant deposits of unconsolidated sand and gravel outwash formed between major lobes of the receding Wisconsin Ice Sheet. The outwash deposits are reworked as sand dunes in the Kankakee River basin. The bedrock beneath the glacial deposits in this area is deformed in the shape of a basin. The center of this basin is in the north-central part of the area. Pennsylvanian-age sandstone are in the center of the basin, and Mississippian-age sandstone and shale beds form the outer rings of the basin. In a few areas the drift deposits are less than 2 m (6 ft) thick, where glacial outwash channels have eroded to limestone bedrock in Grand Rapids, and where sandstone bedrock cuestas peak in elevation in near Hillsdale, Michigan. A sandstone cliff 15 m high (50 ft) occurs along a short stretch of the Grand River in Grand Ledge, Michigan. Most of the rivers in this area are short because of their proximity to the Great Lakes east and west of the area. The largest watersheds, the St. Joseph River, Grand River, and Kalamazoo River drain into Lake Michigan. The southern extent of the MLRA is drained by the Kankakee River of the Mississippi River watershed.

Classification relationships

Among the USFS ecoregional framework (Cleland et al., 2007), most of MLRA 98 is represented by the Humid Temperate Domain (200), Hot Continental Division (220), Midwest Broadleaf Forest Province (222), South Central Great Lakes Section (222J), subsections 222Jc, 222Jg, 222Jh, and 222Jf. Similar sites within the portion of MLRA 98 that overlap the Prairie Division (250) and Prairie Parkland Province (251) are treated as separate ecological sites. MLRA 98 recently was adjusted to exclude portions of Warm Continental Division (210), Laurentian Mixed Forest Province (212) to the north, and subsections 222Ja and 222Jb to the northwest. Among the EPA ecoregional framework (Omernik and Griffith, 2014), most of MLRA 98 falls within Eastern Temperate Forests (Level I: 8), Mixed Wood Plains (Level II: 8.1), Southern Michigan/Northern Indiana Drift Plains (Level III: 56), and Level IV: 56b, 56g, and 56h. Similar sites within the portion of MLRA 98 that overlap the Central USA Plains (Level II: 8.2) and Central Corn Belt Plains (Level III: 54) are treated as separate ecological sites. MLRA 98 recently was adjusted to exclude portions of Northern Forests (Level I: 5), Mixed Wood Shield (Level II: 5.2), Northern Lakes and Forests (Level III: 50) to the north, and level IV: 56d and 56f to the northwest.

Ecological site concept

The central concept of the Limestone Drift Plains is a less than 150 cm of either till or outwash over sandstone bedrock. Limestone may ameliorate effects of low pH of the overburden. The shallow depth to bedrock is root limiting and favors drought tolerant vegetation like oak barrens.

Associated sites

F098XA015MI	**Dry Loamy Drift Plains**

Similar sites

F098XA023MI	**Sandstone Drift Plains**

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus macrocarpa*
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii*

Physiographic features

Site most often found in outwash channels eroded to limestone bedrock.

Table 2. Representative physiographic features

Landforms	(1) Strath terrace
Runoff class	Low to high
Elevation	180 – 390 m
Slope	0 – 20 %
Water table depth	100 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 by the Great Lakes compared to other inland continental locations, though not as much as MLRAs directly bordering the Great Lakes. Mean annual extreme minimum temperatures range from -26.6 to -20.8°C (-16 to -5°F), which falls within hardiness zones 5a to 6a. Annual snowfall is enhanced by the Great Lakes, mainly on the western half of the MLRA.

Table 3 Representative climatic features

Frost-free period (characteristic range)	120-130 days
Freeze-free period (characteristic range)	150-170 days

Precipitation total (characteristic range)	810-970 mm
Frost-free period (actual range)	120-140 days
Freeze-free period (actual range)	150-170 days
Precipitation total (actual range)	810-1,040 mm
Frost-free period (average)	130 days
Freeze-free period (average)	160 days
Precipitation total (average)	890 mm

- (1) SAINT JOHNS [USC00207280], Saint Johns, MI
- (2) THREE RIVERS [USC00208184], Three Rivers, MI
- (3) BATTLE CREEK KELLOGG AP [USW00014815], Battle Creek, MI
- (4) LAPORTE [USC00124837], La Porte, IN
- (5) CHARLOTTE [USC00201476], Roscommon, MI
- (6) FLINT 7 W [USC00202851], Flushing, MI
- (7) HASTINGS [USC00203661], Hastings, MI
- (8) FLINT BISHOP INTL AP [USW00014826], Flint, MI
- (9) COLDWATER ST SCHOOL [USC00201675], Coldwater, MI
- (10) EAST LANSING 4 S [USC00202395], Holt, MI
- (11) GULL LK BIOLOGICAL STN [USC00203504], Augusta, MI
- (12) HILLSDALE [USC00203823], Hillsdale, MI
- (13) GRAND RAPIDS [USW00094860], Grand Rapids, MI
- (14) PRAIRIE HEIGHTS [USC00127102], LaGrange, IN
- (15) ALMA [USC00200146], Alma, MI
- (16) HOWELL WWTP [USC00203947], Howell, MI
- (17) IONIA 2SSW [USC00204078], Ionia, MI
- (18) OWOSSO WWTP [USC00206300], Owosso, MI
- (19) JACKSON REYNOLDS FLD [USW00014833], Jackson, MI
- (20) LANSING CAPITAL CITY AP [USW00014836], Lansing, MI
- (21) WANATAH 2 WNW [USC00129222], Valparaiso, IN
- (22) DOWAGIAC 1 W [USC00202250], Dowagiac, MI
- (23) GREENVILLE 2 NNE [USC00203429], Greenville, MI

Influencing water features

None

Soil features

Soils are well drained to moderately well drained loams over limestone bedrock. They are commonly classified as Mollic Hapludalfs and Typic Hapludalfs, and commonly mapped as Winneshiek and Whalan series.

Table 4. Representative soil features

Parent material	(1) Drift (2) Residuum – limestone and dolomite
Surface texture	(1) Loam
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	30 – 150 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-100.1cm)	2.01 – 20 cm
Soil reaction (1:1 water) (0-50cm)	6.5 – 10
Subsurface fragment volume <=3" (0-150.1cm)	10 – 40 %
Subsurface fragment volume >3" (0-150.1cm)	0 – 20 %

Ecological dynamics

Shallow substrates of relatively moderate available water holding capacity and high bases support drought tolerant bur oaks. Fire may have been relatively frequent adjacent to savanna ecosystems. In more sheltered landscapes, succession may have proceeded towards oak-hickory and beech-maple systems. The reference community may include white oak (Quercus alba) and bur oak (Quercus macrocarpa). In open stands, the understory may be grassy and include such tallgrass species as big bluestems (Andropogon gerardii).

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 1.2 plant community composition

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

Table 7. Community 1.3 plant community composition

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

Table 8. Community 1.4 plant community composition

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

Table 9. Community 1.5 plant community composition

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

Table 10. Community 2.1 plant community composition

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

Table 11. Community 2.2 plant community composition

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

Table 12. Community 2.3 plant community composition

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

Table 13. Community 3.1 plant community composition

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

Table 14. Community 3.2 plant community composition

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

Inventory data references

Site Development and Testing Plan Future work is needed, as described in a future project plan, to validate the information presented in this provisional ecological site description. Future work includes field sampling, data collection and analysis by qualified vegetation ecologists and soil scientists. As warranted, annual reviews of the project plan can be conducted by the Ecological Site Technical Team. A final field review, peer review, quality control, and quality assurance reviews of the ESD are necessary to approve a final document.

Other references

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Contributors

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Approval

Nels Barrett, 1/12/2024

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Matt Bromley and Andy Henriksen reviewed the narratives. Matt Bromley reviewed associated soil map units.

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	09/08/2026
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:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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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:**
