USDA Natural Resources Conservation Service

Ecological site F103XY029MN
Footslope/Drainageway Forests

Last updated: 10/04/2023
Accessed: 05/04/2024

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): 103X–Central Iowa and Minnesota Till Prairies

MLRA 103 is in Minnesota (56 percent) and Iowa (44 percent) and consists of approximately 18 million acres. It is in the Western Lake Section of the Central Lowland Province of the Interior Plains in an area known as the "Des Moines Lobe" of the Wisconsin-age ice sheet. The MLRA is mostly on a young, nearly level to gently rolling, glaciated till plain that has moraines and glacial lake plains in some areas. The plain is covered with glacial till, outwash, and glacial lake deposits. Recent alluvium consisting of clay, silt, sand, and gravel fill the bottoms of most of the major river valleys. Paleozoic bedrock sediments, primarily shale and limestone, underlie the glacial deposits in most of the area.

The annual precipitation increases from northwest to southeast. Most of the rainfall occurs as high-intensity, convective thunderstorms during the summer. Two-thirds or more of the precipitation falls during the freeze-free period. Snowfall is common in winter. Ground water supplies are adequate for the domestic, livestock, municipal, and industrial needs. Nearly all of this area is farmland, and about four-fifths is cropland.

Classification relationships

Major Land Resource Area (MLRA): Central Iowa and Minnesota Till Prairies (103) (USDA Handbook 296, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Upper Minnesota River-Des Moines Lobe (251BA) and Southern Des Moines Lobe (251Be) Subsections (Cleland et al. 2007)

Relationship to Other Established Classifications:
This ecological site shares similarities to Minnesota Department of Natural Resources MHs39 Southern Mesic Maple-Basswood Forest

Ecological site concept

The Footslope/Drainageway Forests ecological site is located in drainageways and on footslopes in the northeastern portion of MLRA 103. Soil drainage class is somewhat poorly drained to well drained. This site does not flood or pond.

Associated sites

F103XY030MN	**Wet Footslope/Drainageway Forests** The Wet Footslope/Drainageway Forest ecological site is on poorly drained to somewhat poorly drained soils on base slopes, head slopes, footslopes, toeslopes and drainageways.

F103XY025MN	**Loamy Upland Forests** The Loamy Upland Forests ecological site occurs on uplands and on soils which are derived from loamy till and have a thin or moderately thick dark (mollic) surface layer. The drainage class ranges from somewhat poorly drained to well drained.

Table 1. Dominant plant species

Tree	(1) *Acer saccharum* (2) *Celtis occidentalis*
Shrub	(1) *Sambucus racemosa*
Herbaceous	(1) *Laportea canadensis*

Physiographic features

The Footslope/Drainageway Forests ecological site is located primarily in the Big Woods ecoregion of Minnesota. The site occurs on drainageways, end moraines, lateral moraines, and valleys. Landform positions include footslopes and drainageways that are linear to slightly concave both horizontally and vertically. Fire intolerant forests became established in the northeastern part of MLRA 103 due to the combination of relatively rough topography, a high concentration of wet depressions, and a higher annual rainfall than areas to the west.

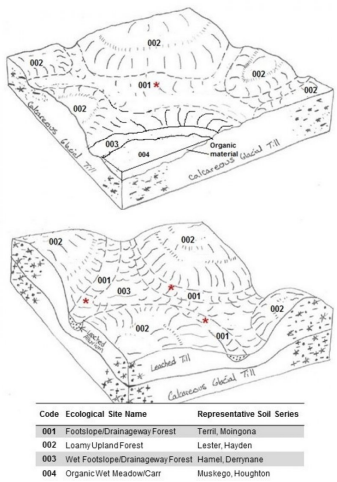


Figure 1. Block diagrams of the representative Footslope/Drainageway Forests and associated ecological sites.

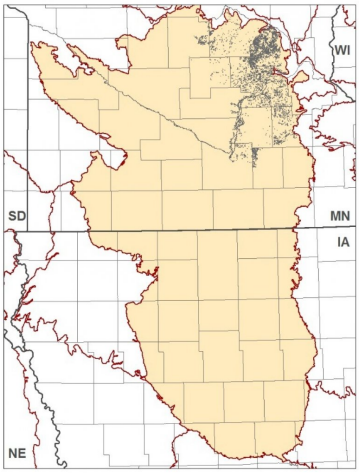


Figure 2. Distribution of the Footslope /Drainageway Forests ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

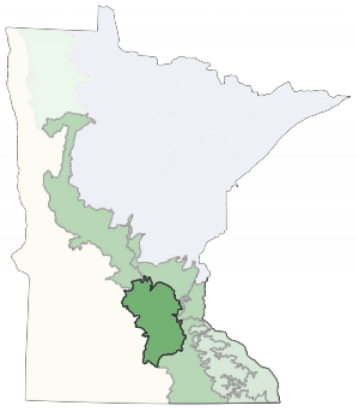


Figure 3. The state of Minnesota with the Big Woods ecoregion shaded in dark green. (Minnesota Department of Natural Resources)

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope
Landforms	(1) End moraine (2) Lateral moraine (3) Valley (4) Drainageway
Runoff class	Negligible to low
Elevation	699–1,574 ft
Slope	0–14%
Water table depth	12–60 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The soil temperature regime of MLRA 103 is classified as “mesic” (i.e., mean annual soil temperature between 46 and 59°F). The average mean annual precipitation is 32 inches. The average frost free period is 127 days and the average freeze free period is 148 days. Cold air drainage, a lower water table, and the fact that dry soils are generally warmer than wet soils make this site often warmer than adjacent, downslope areas.

Table 3. Representative climatic features

Frost-free period (characteristic range)	123-134 days
Freeze-free period (characteristic range)	136-160 days
Precipitation total (characteristic range)	31-32 in
Frost-free period (actual range)	113-136 days
Freeze-free period (actual range)	134-161 days
Precipitation total (actual range)	31-33 in
Frost-free period (average)	127 days
Freeze-free period (average)	148 days
Precipitation total (average)	32 in

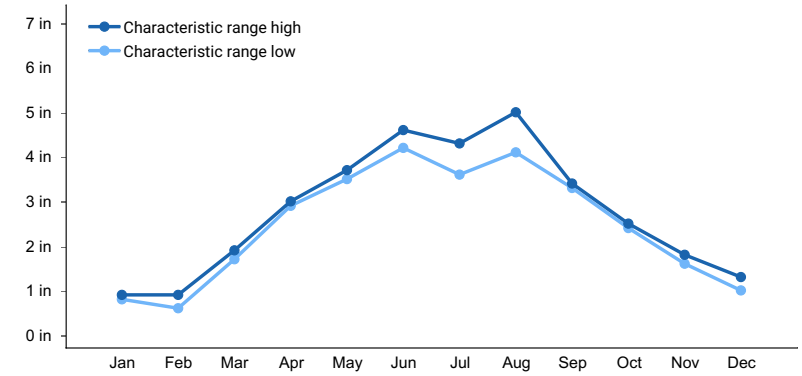


Figure 4. Monthly precipitation range

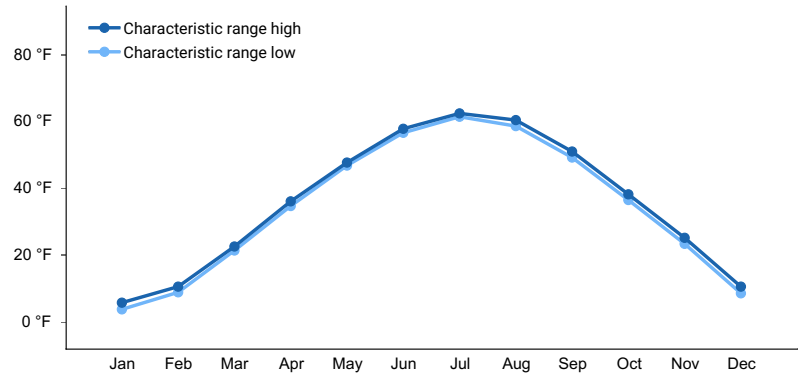


Figure 5. Monthly minimum temperature range

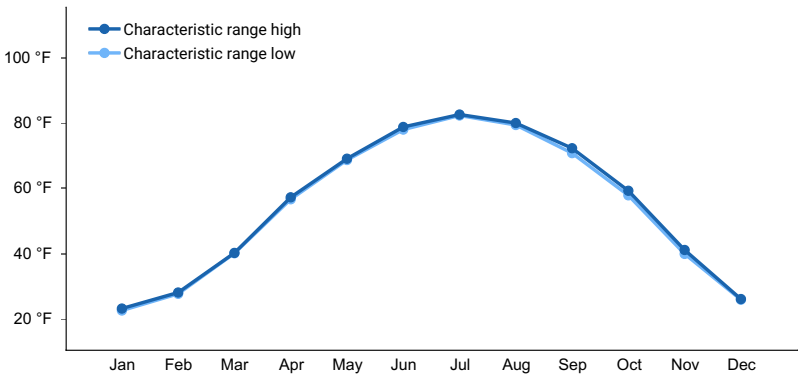


Figure 6. Monthly maximum temperature range

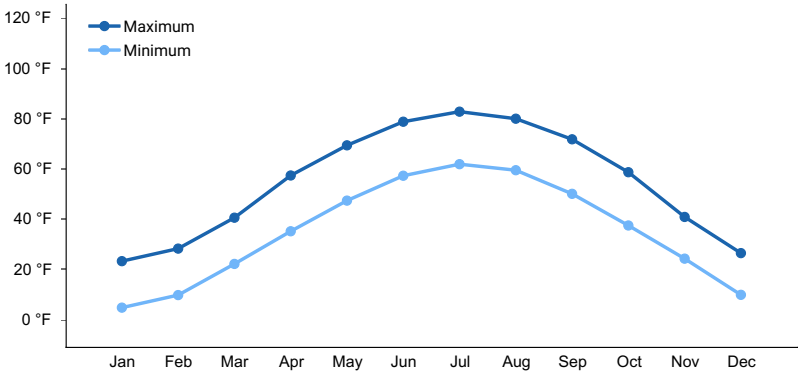


Figure 7. Monthly average minimum and maximum temperature

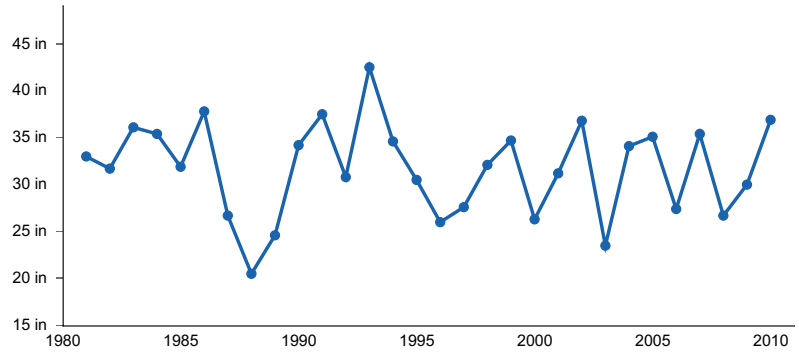


Figure 8. Annual precipitation pattern

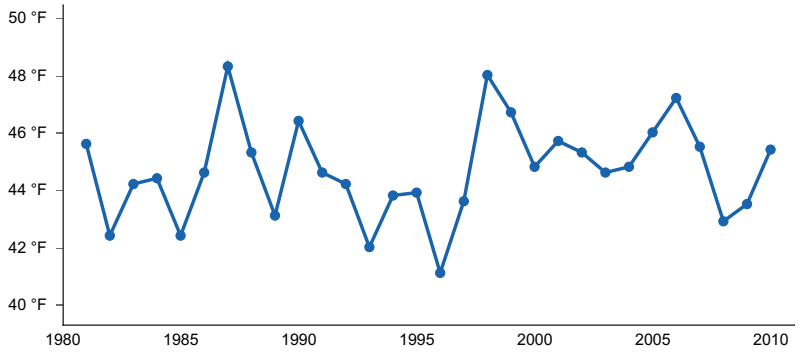


Figure 9. Annual average temperature pattern

Climate stations used

- (1) OWATONNA [USC00216287], Owatonna, MN
- (2) GAYLORD [USC00213076], Gaylord, MN
- (3) CHANHASSEN WSFO [USC00211448], Chanhassen, MN
- (4) CHASKA [USC00211465], Chaska, MN
- (5) JORDAN 1SSW [USC00214176], Jordan, MN
- (6) DELANO [USC00212088], Delano, MN

Influencing water features

The Footslope/Drainageway Forests ecological site receives water from precipitation, lateral subsurface flow, and runoff. This site is a recharge area, and spring is the wettest time of the year. Soils of this site are classified as endosaturated. The depth to saturation for the central concept soil components is between 30 and 50 cm during the spring months and may drop to as low as six or more feet (200+cm) later in the growing season during dry periods.

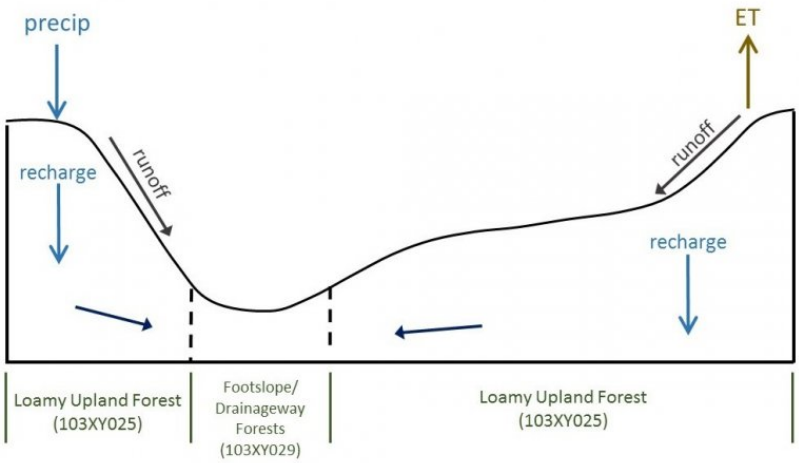


Figure 10. Representation of hydrologic factors in a typical area of Footslope/Drainageway Forests and associated ecological sites on the Des

Moines Lobe (MLRA 103).

Soil features

The Footslope/Drainageway Forests ecological site is located predominantly on Moingona, Terril, Forestcity, and Hamel soils. These soils developed under deciduous forest vegetation and are classified as Typic Argiudolls or Cumulic Hapludolls. In the Argiudolls, clay particles were illuviated from higher in the profile and accumulated deeper. Argillic horizons form readily in Des Moines Lobe materials after leaching of all carbonates from the upper portion of the soil takes place (Grimm, 1984).

Soils are very deep (>60 inches to bedrock), and the drainage class is somewhat poorly drained, moderately well drained, or well drained. Soil parent material is loamy slope alluvium and loamy glacial till. Soil textures include loam, clay loam, fine sandy loam, sandy clay loam, sandy loam, and silty clay loam. The soil family particle size class is fine loamy. Course fragments are 0 to 9 percent by volume. Soil pH classes are moderately acid to moderately alkaline throughout the series control section.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Colluvium (3) Till
Surface texture	(1) Clay loam (2) Loam (3) Silty clay loam (4) Fine sandy loam (5) Sandy clay loam (6) Sandy loam
Drainage class	Somewhat poorly drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–5%
Available water capacity (0-60in)	8.9–11.8 in
Calcium carbonate equivalent (0-40in)	0–25%
Soil reaction (1:1 water) (0-40in)	5.6–8.4
Subsurface fragment volume <=3" (0-40in)	0–5%
Subsurface fragment volume >3" (0-40in)	0–5%

Ecological dynamics

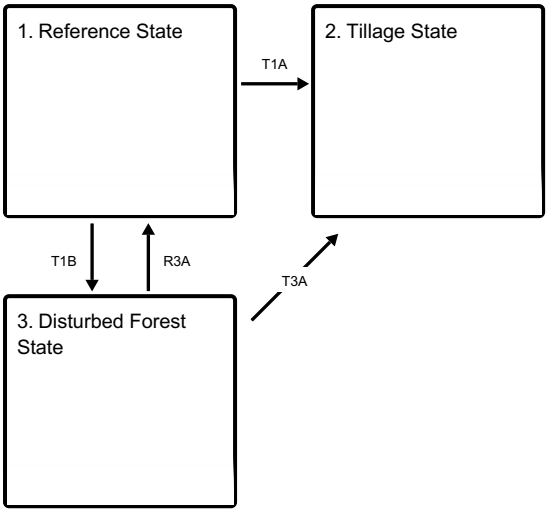
The Footslope/Drainageway Forests ecological site reference state is a mesic hardwood forest. This site is predominantly in northeastern sections of MLRA 103 where fires were historically suppressed by topography and density of waterbodies. Following European settlement, most areas were cleared of their trees and converted to agriculture. Currently, the dominant land use is corn and soybean production.

The state and transition model consists of the Reference State, Tillage State, and the Degraded Woodland State. The Reference State describes a site with wet tolerant native grasses and scattered hardwoods. State 2 is the Tillage State which describes land transitioned to agricultural production. This is the most common state in MLRA 103 for this site. A few areas within this State have been reseeded to native warm season or cool-season grasses. State 3 is a Disturbed Forest State in which human disturbances have modified the plant community composition

and structure. Lack of natural fire, hydrological alterations, unmanaged grazing, and invasive species are common triggers transitioning a site to State 3.

State and transition model

Ecosystem states



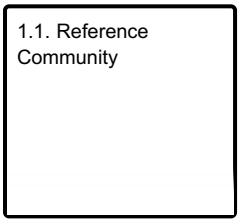
T1A - Site is cleared, tilled, seeded, and managed for crop production

T1B - Site incurs large-scale disturbance and altered plant community

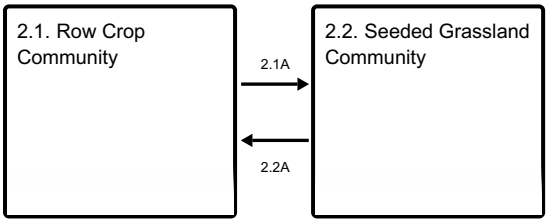
R3A - Restoration of natural hydrology; establishment of desired species; exclusion of anthropogenic disturbances; eradication of invasive species; long-term timber stand management

T3A - Site cleared, soil tillage, crop establishment, and continued agriculture management

State 1 submodel, plant communities



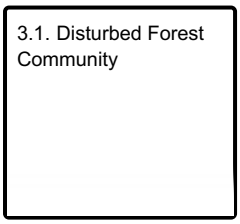
State 2 submodel, plant communities



2.1A - Seeding and management of warm-season or cool-season grasses.

2.2A - Site preparation, soil tillage, crop establishment, weed control

State 3 submodel, plant communities



State 1

Reference State

The Footslope/Drainageway Forests reference state is a mature, deciduous forest that includes sugar maple, hackberry, elm, and basswood. The shrub layer often consists of red elderberry, chokecherry, and various tree saplings. The understory on high-quality sites are diverse and boasts a variety of native herbaceous species. Dense patches of wood nettle may be present. In absence of large-scale natural or anthropogenic disturbances, this ecological site is generally stable. Small gap regeneration occurs commonly. Species in the successional stage communities will be influenced by site slope, aspect, drainage, and seed sources. Common early-successional species are quaking aspen and sugar maple. Mid-successional dominants often are sugar maple and American elm.

Resilience management. Resilience management practices include monitoring for invasive vegetation, applying herbicides as needed, and excluding grazing and logging.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- common hackberry (*Celtis occidentalis*), tree
- red elderberry (*Sambucus racemosa*), shrub
- Canadian woodnettle (*Laportea canadensis*), other herbaceous

Community 1.1
Reference Community

This ecological site is a mesic hardwood forest. Canopy dominants include sugar maple, hackberry, basswood, and elm. Subcanopy, shrubs and herbaceous cover will vary depending on slope and drainage. Spring ephemerals are characteristic. High-quality sites will have an array of native understory species. Reference communities are now rare in MLRA 103 as many of the existing wooded sites have been disturbed by human activities (State 3). Many sites have been transitioned to agricultural production (State 2).

Resilience management. Resilience management practices include monitoring for invasive vegetation, applying weed control methods as needed, and excluding disturbances such as grazing and large-scale timber harvesting.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- common hackberry (*Celtis occidentalis*), tree
- red elderberry (*Sambucus racemosa*), shrub
- Canadian woodnettle (*Laportea canadensis*), other herbaceous

State 2
Tillage State

The Tillage State contains the Row Crop Community and the Seeded Grassland Community. This state describes areas currently in crop production or areas that were tilled but now are seeded to grass. Pathway mechanisms include preparing the site, planting desired species, applying herbicide, applying fertilizer, and harvesting. Hydrological modifications (tiling and ditching) may be installed to improve drainage. Soil tillage is the primary trigger to State 2. Tillage alters dynamic soil properties, including bulk density, structure, organic carbon content, and saturated hydraulic conductivity. Intensive tillage negatively impacts soil ecological functions. Conservation practices can help mediate soil health impacts. Conservation tillage minimizes soil disturbance and improves soil structure and soil health. A cover crop rotation builds soil structure, improves infiltration rates, reduces erosion, and protects water quality. Some areas within this ecological site have been converted to a warm-season grasses under conservation programs such as the NRCS Conservation Reserve Program (CRP). Plantings usually perennial warm-season grasses and native forbs to benefit wildlife and pollinators. Non-native, cool-season grasses are also feasible. Common species are reed canarygrass and Kentucky bluegrass. Seed mix selection will depend on the site characteristics and landowner objectives. Although not as biologically diverse as native grasslands; seeded grasslands still offer ecological benefits for wildlife, water quality protection, and soil health.

Resilience management. Prescribed fire is a resilience management practice on warm-season grasslands. Seeding, fertilizing, and controlling weeds and brush are resilience management practices for cool-season

grasslands.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 2.1
Row Crop Community

Community 2.1 consists of intensive row crop agriculture. This is a primary use of this ecological site. Soil tillage and intentional plant establishment are the primary triggers. The most common crops are corn and soybeans on an annual rotation. A secondary trigger is drainage modifications (ditching and tiling), which may be installed to improve soil drainage.

Resilience management. Resilience management practices include preparing the sites, planting, fertilizing, controlling weeds, and harvesting. The maintenance of the desired vegetation community is controlled by the intensity, frequency, duration, and timing of agricultural practices.

Dominant plant species

- corn (*Zea mays*), grass
- soybean (*Glycine max*), other herbaceous

Community 2.2
Seeded Grassland Community

The Seeded Grassland Community grows in areas that were previously tilled and used for agricultural production, but have been transitioned to either warm-season or cool-season grasses. The primary trigger is the intentional establishment of a grass species. Many of these areas are eventually transitioned back to annual crop production.

Resilience management. The resilience management practices may include planting desired species, managing grazing, mowing, fertilizing, and controlling unpalatable plant species. Prescribed fire is a resilience management practice for warm-season grasslands. The controlled application of fire modifies vegetation structure and influence ecological processes.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass

Pathway 2.1A
Community 2.1 to 2.2

This pathway converts Community 2.1 (row crops) to Community 2.2 (seeded grassland). The primary mechanism of change is the seeding of desired grass species. This pathway is commonly triggered in conjunction with a conservation program such as the NRCS Conservation Reserve Program (CRP). The site is removed from crop production and seeded with warm-season grasses which benefit wildlife, soil health, and water quality. A small percentage of sites are utilized as cool season grasslands.

Conservation practices

Forage and Biomass Planting

Pathway 2.2A
Community 2.2 to 2.1

This pathway describes the site transitioning from a seeded grassland to row crop agriculture. This is a common pathway throughout MLRA 103 as sites are placed in crop production. The mechanisms of change are tillage and

intentional plant establishment (crop seeding).

State 3
Disturbed Forest State

This state describes a wooded site that has been disturbed and exhibits altered forest species composition. Numerous ruderal woodland and forest plant communities may occur on this ecological site depending on the type and severity of disturbance and available seed sources. Invasive, non-native shrubs, grasses, and herbaceous plants are often common on disturbed sites and may dominate if left unmanaged.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- bur oak (*Quercus macrocarpa*), tree
- common buckthorn (*Rhamnus cathartica*), tree
- Kentucky bluegrass (*Poa pratensis*), grass

Community 3.1
Disturbed Forest Community

Community 3.1 is an altered forest community caused by previous or ongoing human disturbances. Invasive, non-native plant species are common in this community. Canopy composition varies depending on the severity and type of disturbance and the availability of seed sources. Invasive, non-native species are common on these sites and will continue to increase without management intervention.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- common buckthorn (*Rhamnus cathartica*), tree
- bur oak (*Quercus macrocarpa*), tree
- Kentucky bluegrass (*Poa pratensis*), grass

Transition T1A
State 1 to 2

Transition T1A is the conversion of the reference state to agriculture. The triggers are site clearing, soil tillage, and intentional plant establishment (crop seeding). Resilience management practices include common agricultural practices such as seeding, fertilizing, and managing invasive plants with herbicides or field cultivation. Hydrological modifications, such as ditching and tiling, may be installed depending on drainage.

Constraints to recovery. Site clearing and soil tillage preclude recovery of the former state.

Transition T1B
State 1 to 3

Transition T1B is a transition from a mature deciduous forest to a disturbed (ruderal) forest. Triggers include timber harvest, grazing, and introduction of non-native species. The native plant community is altered, and these areas do not exhibit the ecological function or native vegetative composition of State 1.

Restoration pathway R3A
State 3 to 1

Restoration to the reference state may be feasible for some sites with long-term management inputs including restoration of natural hydrology (if altered), establishment of desired species, forest stand management, and control of invasive species. Management includes intentional plant establishment (planting desired species), absence of disturbance (site protected from grazing and other site altering disturbances), timber stand improvement, and eradication of invasive plant species.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Forest Stand Improvement

Transition T3A
State 3 to 2

Transition T3A is the transition of a disturbed forest state to agriculture production. This is a common pathway in MLRA 103. The mechanisms of change include clearing of woody species, site preparation, tillage, and intentional plant establishment (crop seeding). Drainage alterations may be installed.

Constraints to recovery. Soils tillage and the transition to agriculture preclude recovery of the former state.

Additional community tables

Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in ecological site description.

Other references

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Contributors

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Approval

Suzanne Mayne-Kinney, 10/04/2023

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	05/04/2024
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):

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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:**
