USDA Natural Resources Conservation Service

Ecological site F103XY030MN
Wet 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

U.S. Department of Agriculture (USDA)
Land Resource Regions and Major Land Resource Areas (USDA_NRCS, 2006)
Major Land Resource Area (MLRA): Central Iowa and Minnesota Till Prairies (103)

U.S. Forest Service (USFS)
National Hierarchical Framework of Ecological Units (Cleland et al., 2007)
Section: North central Glaciated Plains (251B)
Subsections: Upper Minnesota River-Des Moines Lobe (251BA) and Southern Des Moines Lobe (251Be)

International Vegetation Classification Hierarchy
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland

Relationship to Other Established Classifications:
The reference state shares similarities with Minnesota Department of Natural Resources MHs49 Southern Wet-Mesic Hardwood Forest

Ecological site concept

The Wet Footslope/Drainageway Forest ecological site is located in drainageways and on footslopes in northeastern MLRA 103. Soils saturation is at or very near the soil surface during the spring months but may drop to as low as six feet during dry periods. Soil drainage class is somewhat poorly drained to poorly drained.

Associated sites

F103XY029MN	**Footslope/Drainageway Forests** The Footslope/Drainageway Forest 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 generally does not flood or pond.
F103XY025MN	**Loamy Upland Forests** The Loamy Upland Forests ecological site occurs on upland 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.
R103XY017MN	**Organic Wet Meadow/Carr** The Organic Wet Meadow/Carr ecological site occurs in low wetland areas. These sites are often ponded, have a high-water table (i.e. endosaturated) and are classified as very poorly drained. Water-tolerant vegetation such as cattails, bulrushes, and sedges are common.
R103XY014MN	**Recharge Depressions** The Recharge Depressions ecological site has a high water table and is ponded in a natural state. Soils are poorly drained. This site has a hydrologic interaction with adjacent sloping ground and is classified as a recharge wetland.

Similar sites

F103XY027MN	**Loamy Wet Forests** The Loamy Wet Forests ecological site is located on footslopes and toeslopes. The soils have a dark surface layer (mollic epipedon) and are poorly drained. Soils on this site are derived from fine loamy till, so have a loamy surface texture.

Table 1. Dominant plant species

Tree	(1) *Ulmus americana* (2) *Acer saccharum*
Shrub	(1) *Prunus virginiana*
Herbaceous	(1) *Elymus hystrix*

Physiographic features

This ecological site occurs on wet footslopes and drainageways. Landforms include end moraines, lateral moraines, ground moraines, and drainageways. The slope shape is linear to slightly concave both vertically and horizontally. This site is predominantly located in the Big Woods ecoregion of northeastern MLRA 103.

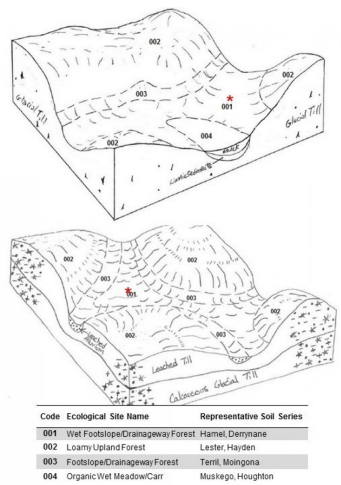


Figure 1. Block diagrams of the representative Wet Footslope/Drainageway and associated ecological sites.

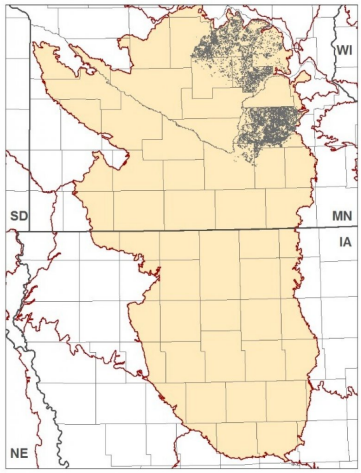


Figure 2. Distribution of the Wet Footslope/Drainageway ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

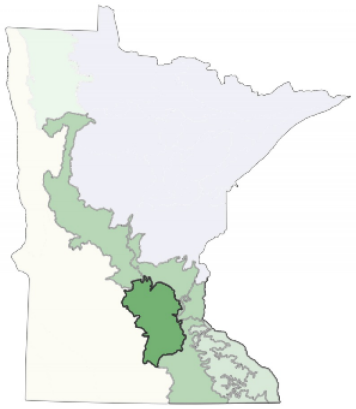


Figure 3. The state of Minnesota with the Big Woods ecoregion shaded in dark green. (Minnesota Department of Natural Resources)

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Landforms	(1) End moraine (2) Lateral moraine (3) Ground moraine (4) Drainageway
Runoff class	Negligible to high
Elevation	698–1,601 ft
Slope	0–4%
Water table depth	0–71 in
Aspect	Aspect is not a significant factor

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 freeze-free period for this ecological site is 158 days, while the frost-free period is 136 days. Cold air drainage and the fact that wet soils are colder than dry soils make this ecological site slightly colder than adjacent sloping landforms.

Table 3. Representative climatic features

Frost-free period (characteristic range)	134-138 days
Freeze-free period (characteristic range)	151-164 days
Precipitation total (characteristic range)	31-33 in
Frost-free period (actual range)	133-140 days
Freeze-free period (actual range)	150-169 days
Precipitation total (actual range)	30-33 in
Frost-free period (average)	136 days
Freeze-free period (average)	158 days
Precipitation total (average)	32 in

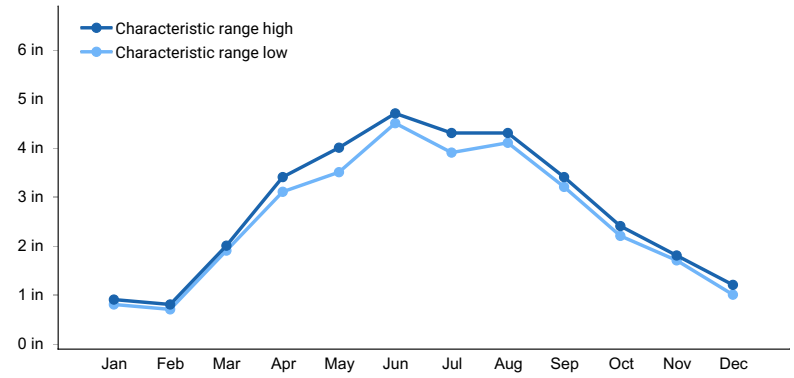


Figure 4. Monthly precipitation range

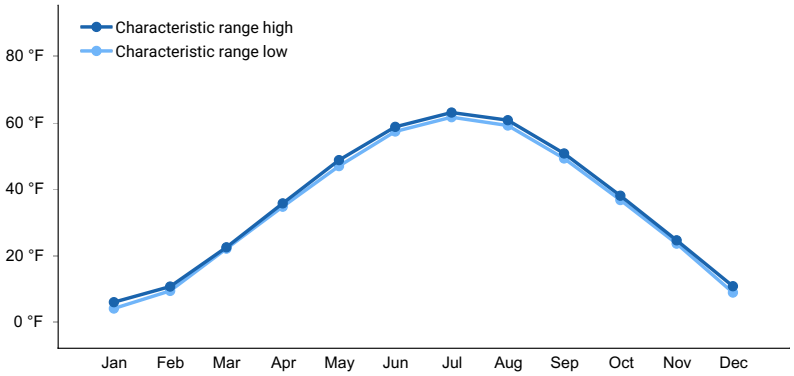


Figure 5. Monthly minimum temperature range

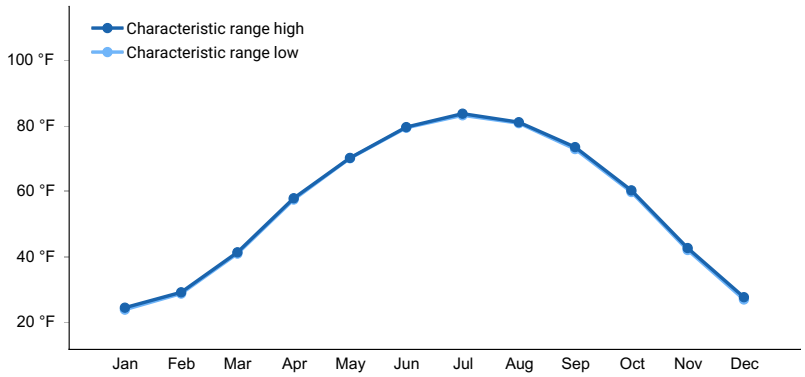


Figure 6. Monthly maximum temperature range

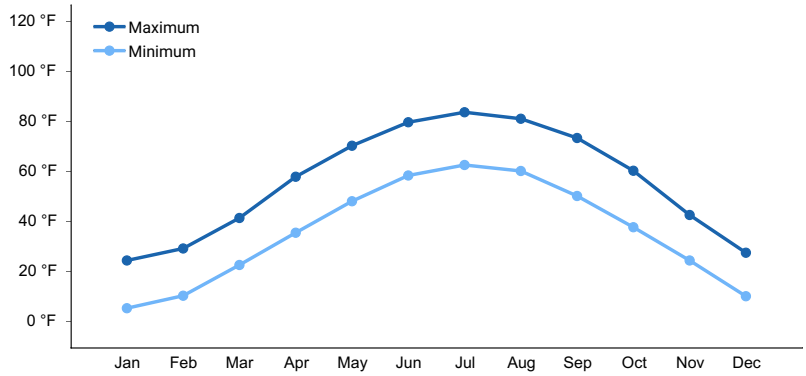


Figure 7. Monthly average minimum and maximum temperature

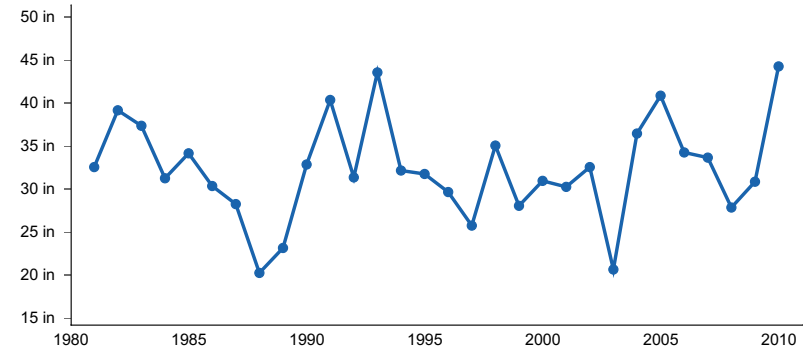


Figure 8. Annual precipitation pattern

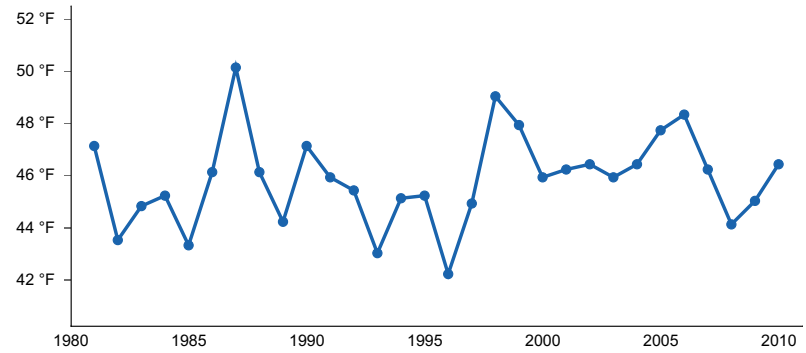


Figure 9. Annual average temperature pattern

Climate stations used

- (1) STEWART [USC00218025], Brownton, MN
- (2) WINNEBAGO [USC00219046], Winnebago, MN
- (3) FAIRMONT [USC00212698], Fairmont, MN

Influencing water features

The Wet Footslope/Drainageway Forests ecological site may receive water through precipitation, runoff, and lateral subsurface flow, and can serve as a groundwater recharge areas. Spring is the wettest time of the year for this site. The soils are classified as endosaturated. The soil saturation is at or very near the soil surface during the spring months and may drop to as low as six feet during drier periods.

In the hydrogeomorphic (HGM) classification system, Wet Footslope-Drainageway Prairies are considered Slope wetlands, producing recharge to adjacent Provisional Ecological Sites (USDA-NRCS, 2008; Gilbert et al., 2006). This site has a Saturated Cowardin Hydrologic Regime of Palustrine; Forested, Broad-Leaved Deciduous. It also has a United States Army Corps of Engineers (USACE) Wetland Plant Community of C; Hardwood Swamps, Shrub-Carrs and Alder Thickets (Mineral Soils) (USACE; Wetland Plants and Plant Communities of Minnesota and Wisconsin).

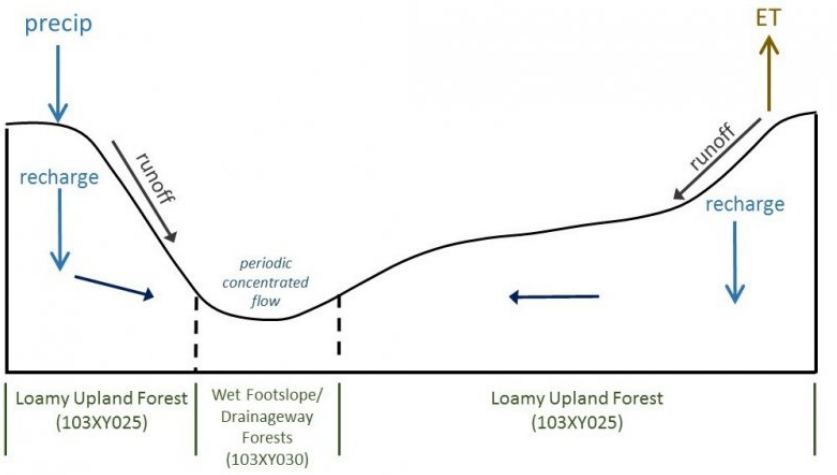


Figure 10. Hydrologic representation of a typical Des Moines Lobe (MLRA 103) Wet Footslope/ Drainageway Forest and associated Provisional Ecological Sites.

Soil features

This ecological site is located on Hamel, Derrynane, Forestcity, and Mazaska soils. These soils formed under deciduous forest vegetation and are classified as Typic Argiaquolls or Cumulic Vertic Endoaquolls. Because of their positions on the landscape, these soils accumulated slope alluvium from adjacent areas resulting in a soil profile with a thick, dark, epipedon.

These soils also formed under saturated conditions that produced anaerobic conditions during at least part of the year. Organic matter tends to mask the redoximorphic features that are used to determine seasonal high depth to saturation. The primary hydric soil indicator is Thick Dark Surface (A12; USDA-NRCS, 2010).

Soils of this ecological site are very deep (>60 inches to bedrock), and the drainage class is poorly drained to somewhat poorly drained, with a seasonal high water table that ranges from 0 to 30cm. Soil textures include loam, clay loam, silty clay loam, fine sandy loam or silt loam. The soil family particle size class is fine loamy or fine. Coarse 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) Loam (2) Clay loam (3) Silty clay loam (4) Fine sandy loam (5) Silt loam
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Moderately slow to moderately rapid
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	8.7–11.9 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)	0–12%
Subsurface fragment volume >3" (0-40in)	0–5%

Ecological dynamics

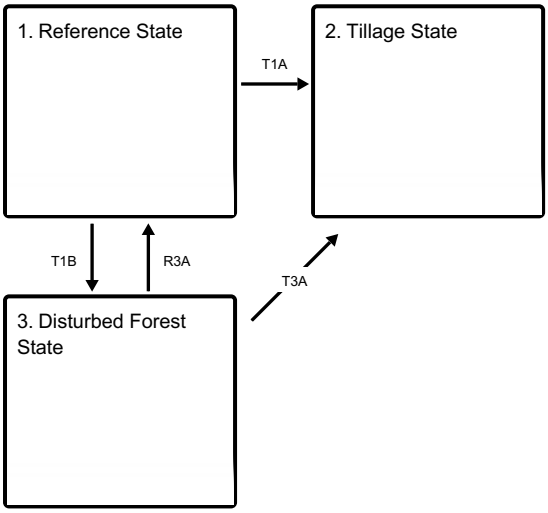
The reference state is a mature deciduous forest with multiple co-dominant tree species. The site is found predominantly in the northeastern part of MLRA 103 where fires were historically suppressed by topography and density of waterbodies. This ecological site is generally stable in absence of large-scale natural or anthropogenic disturbances.

Three states are included in the state and transition model at this time. The Reference State, the Tillage State, and the Disturbed Forest State.

Following European settlement, most areas were cleared of their trees and converted to agriculture. Currently, the dominant land use is corn and soybean production. Remaining unfarmed areas include forested preserves and other miscellaneous land uses.

State and transition model

Ecosystem states



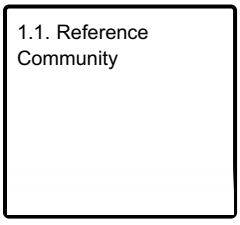
T1A - Site is cleared, tilled, seeded, and managed for crop production

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

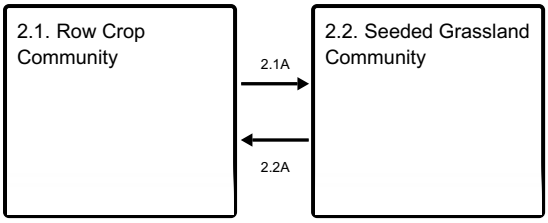
R3A - Restoration of natural hydrology; establishment of desired species; exclusion of anthropogenic disturbances; eradication of invasive species; long-term timber stand management

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

State 1 submodel, plant communities



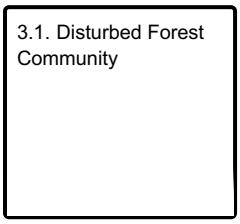
State 2 submodel, plant communities



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

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

State 3 submodel, plant communities



State 1
Reference State

The Wet Footslope/Drainageway Forests reference state is a mature, hardwood forest with multiple canopy species including American elm, sugar maple, slippery elm, and ash. The understory on high-quality sites is diverse and boasts a variety of native herbaceous and grass species. In absence of large-scale natural or anthropogenic disturbances, this ecological site is generally stable. Small gap regeneration occurs commonly. Common species in early and mid-successional stage communities include maple, elm, and ash.

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

Dominant plant species

- American elm (*Ulmus americana*), tree
- sugar maple (*Acer saccharum*), tree
- slippery elm (*Ulmus rubra*), tree
- chokecherry (*Prunus virginiana*), shrub
- eastern bottlebrush grass (*Elymus hystrix*), grass

Community 1.1
Reference Community

Canopy dominants include American elm, sugar maple, slippery elm, and ash. Common shrub species include chokeberry. High-quality reference sites are now rare in MLRA 103 and many of the existing wooded sites have been disturbed by human activities (State 3) or transitioned to agricultural production (State 2).

Resilience management. Resilience management practices include monitoring for invasive vegetation, applying control methods as needed, and excluding disturbances such as grazing.

Dominant plant species

- American elm (*Ulmus americana*), tree
- sugar maple (*Acer saccharum*), tree
- slippery elm (*Ulmus rubra*), tree
- chokecherry (*Prunus virginiana*), shrub
- eastern bottlebrush grass (*Elymus hystrix*), grass

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) are commonly installed to improve drainage. Soil 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 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 runoff and erosion, and protects water quality. Some areas have been converted to a warm-season grasses under a NRCS conservation program. Plantings may include native grasses and forbs that benefit wildlife and pollinators. Non-native, cool-season grasses are also feasible for this site. Common species include reed canarygrass (Phalaris arunidinacea L.), and Kentucky bluegrass (*Poa pratensis* L.). Seed mix selection will depend on site characteristics and landowner objectives. Seeded grasslands are not as species rich or biologically diverse as native grasslands; however, they still offer ecological benefits to wildlife, water quality, 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. Many crops, however, are feasible for these areas. A secondary trigger is drainage modifications (ditching and tiling), which are often installed to improve soil drainage. Conservation tillage practices may be implemented to reduce soil erosion while still maintaining a crop rotation. These practices protect the soil surface from erosion and allow water to infiltrate instead of running off. Examples include no-till or ridge-till, which leave residue on the surface of the field. Additional soil health benefits can be gained by adding alternative crops to fields that are already in conservation tillage. By diversifying the crop rotation, landowners take additional management steps to improve soil health and protect water quality. Species may include legumes, clovers, beans, turnips, or small grains such as ryegrass, oats, rapeseed, winter wheat, winter rye, and buckwheat.

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. Warm-season grasses are commonly planted through a NRCS conservation program. Seed mix selection depends on site specifics and landowner objectives. Many cool-season grasses can be planted, depending on landowner goals. Management inputs include seeding, fertilizing, and controlling weeds and brush.

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. Commercial vegetative seed mixes commonly include a variety of native grasses and forbs to enhance wildlife habitat and to benefit native pollinators. 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. Multiple resilience management practices may be utilized after warm-season grass establishment. Examples include prescribed fire, brush management, and herbaceous weed treatment. Prescribed burning is often utilized to reduce the extent of woody vegetation, reduce the buildup of dead plant material, and promote the regeneration of grasses and forbs. Cool-season grasses may be planted. Species include Kentucky bluegrass, reed canarygrass, tall fescue, perennial rye, and timothy. Legumes, such as white clover and red clover, are commonly incorporated to improve forage nutrition. A small percentage of MLRA 103 currently supports cool-season grasses. Resilience management practices for cool-season grass sites include planned grazing, invasive plant management, and harvest management (hay production).

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). Resilience management practices include weed control (herbicide application), disturbance management (field cultivating), and harvest management.

State 3
Disturbed Forest State

This state describes a wooded site that has been disturbed and exhibits altered forest species composition. Numerous ruderal communities may occur on this ecological site depending on the type and severity of disturbance, the length of disturbance, available seed sources, ongoing disturbances (selective harvest, grazing), and management activities. Fast-growing, shade tolerant trees are typical. Tree species often include maple, box elder, hackberry, ash, and elms. Invasive non-native species are often present and can become dominant without management intervention.

Dominant plant species

- maple (*Acer*), tree
- ash (*Fraxinus*), tree
- common buckthorn (*Rhamnus cathartica*), tree
- elm (*Ulmus*), tree

Community 3.1

Disturbed Forest Community

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

Dominant plant species

- maple (*Acer*), tree
- ash (*Fraxinus*), tree
- common buckthorn (*Rhamnus cathartica*), tree
- elm (*Ulmus*), tree

Transition T1A
State 1 to 2

Transition T1A is the conversion of the Reference State to agriculture. The triggers are site clearing, hydrological modifications (ditching/tiling), 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.

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 altered hydrology, timber harvest, surface site disturbance, grazing, and introduction of non-native species. The native plant community is altered, and these areas do not exhibit the ecological function or 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, establishment of desired species, forest stand management (selective thinning), and control of invasive species. Triggers include intentional plant establishment (planting desired species), absence of disturbance (site protected from grazing and other site altering disturbances), timber stand improvement inputs, 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 site clearing, hydrological modifications (ditching/tiling), site preparation, tillage, and intentional plant establishment (crop seeding). Continued resilience management practices are necessary and include weed control (herbicide application), disturbance management (field cultivating), and harvest management.

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

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC.

Gilbert, M.C., P.M. Whited, E.J. Clairain, Jr., and D.R. Smith. 2006. A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes. ERDC/EL TR-06-5, U.S. Army Corps of Engineers, Vicksburg, MS.

Minnesota Department of Natural Resources. 2005. Field Guide to the Native Plant Communities of Minnesota: the Prairie Parkland and Tallgrass Aspen Parklands Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. St. Paul, Minnesota.

Ojakangas, R.W. and C.L. Matsch. 1982. Minnesota's Geology. University of Minnesota Press. Minneapolis, MN.

USDA-NRCS. 2010. Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineating Hydric Soils, Version 7.0. Washington, DC.

USDA-NRCS. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190–8–76. Washington D.C.

Wetlands Subcommittee, (Cowardin et. al 1979). 2013. Classification of Wetlands and Deepwater Habitats of the United States. Federal Geographic Data Committee, Reston, VA.

Contributors

Clayton Johnson (Clayton.Johnson@usda.gov), Soil Survey Office Leader, USDA-NRCS, Albert Lea, MN
Myles Elsen (Myles.Elsen@usda.gov), Soil Scientist, USDA-NRCS, Albert Lea, MN
Anita Arends (anita.arends@usda.gov), USDA-NRCS, Springfield, IL

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):**

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:**

---

17. **Perennial plant reproductive capability:**
