USDA Natural Resources Conservation Service

Ecological site R103XY012MN
Wet Footslope/Drainageway Prairies

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

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:
The reference state shares similarities with Minnesota Department of Natural Resources WPs54b Southern Wet Prairie

Biophysical Setting (Landfire, 2009), Central Tallgrass Prairie (4214210)

Ecological site concept

The Wet Footslope/Drainageway Prairies ecological site is located mainly on footslopes, toeslopes, and upland drainageways. The site concept incurs frequent to occasional flooding. Soils drainage class is poorly drained.

Associated sites

R103XY001MN	**Loamy Wet Prairies** The Loamy Wet Prairies ecological site is located on inter-depressional linear slopes and slight depressions on till plains, moraines, and short-lived lakeplains. Soil parent materials are loamy till and lacustrine materials. The drainage class is poorly drained but the site does not flood or pond.

R103XY004MN	**Loamy Upland Prairies** The Loamy Upland Prairies ecological site is located on uplands extensively throughout MRLA 103. Soils are formed from fine loamy till and medium textured lacustrine materials. Soil drainage is somewhat poorly drained to well drained. This site does not flood or pond and is extensive throughout MLRA 103.
R103XY020MN	**Loamy Upland Savannas** The Loamy Upland Savannas ecological site is characterized by a savanna-prairie plant community complex. Soils are derived from medium-textured till and lacustrine materials. Drainage class ranges from well to somewhat poorly drained.

Similar sites

R103XY001MN	**Loamy Wet Prairies** The Loamy Wet Prairies ecological site is located on inter-depressional linear slopes and slight depressions on till plains, moraines and short-lived lakeplains. Soil parent materials are loamy till and lacustrine materials. Sites do not flood or pond, and the drainage class is poorly drained.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amorpha canescens*
Herbaceous	(1) *Spartina pectinata* (2) *Oligoneuron rigidum*

Physiographic features

The Wet Footslope/Drainageway Prairies ecological site is widespread in MRLA 103. This site can occur in two basic settings: dissected valleys and till plains/ground moraines. Slope shapes are concave to linear horizontally and vertically. Sites are on lower drainageways, footslopes, toeslopes, head slopes, and base slopes. The water table is usually at or near the soils surface during the spring; however, it can drop to as low as 6’ during dry periods.

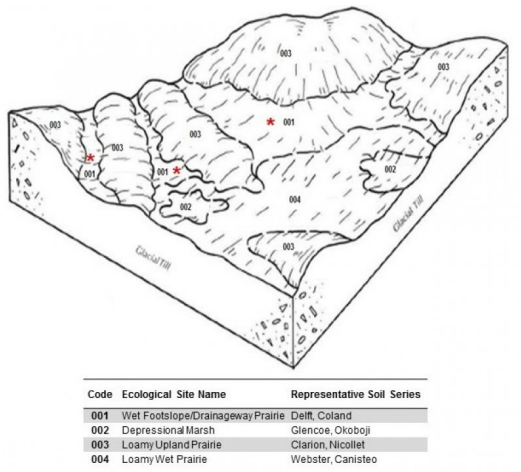


Figure 1. Block diagrams of the representative Wet Footslope/Drainageway Prairies and associated ecological sites.

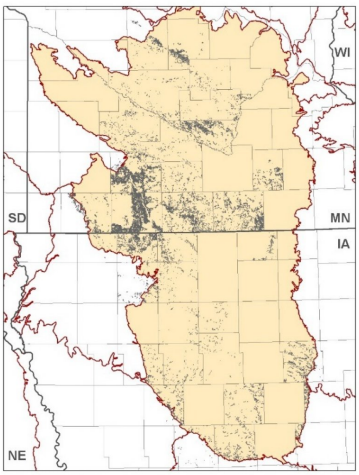


Figure 2. Distribution of the Wet Footslope / Drainagway ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Landforms	(1) Till plain (2) Ground moraine (3) Valley
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	Occasional
Elevation	700–1,640 ft
Slope	0–5%
Water table depth	0–72 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 freeze-free period of this site is 156 days, while the frost-free period is 133 days. The average mean annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall. Cold air drainage from above and the fact that wet soils are generally colder than dry soils make this site colder than adjacent, upslope areas. As a result, snow and frost remain longer in the spring, thus resulting in shorter growing seasons than the adjacent uplands.

Table 3. Representative climatic features

Frost-free period (characteristic range)	127-137 days
Freeze-free period (characteristic range)	150-161 days
Precipitation total (characteristic range)	30-34 in
Frost-free period (actual range)	127-139 days
Freeze-free period (actual range)	149-169 days
Precipitation total (actual range)	29-35 in
Frost-free period (average)	133 days
Freeze-free period (average)	156 days

Precipitation total (average)	32 in

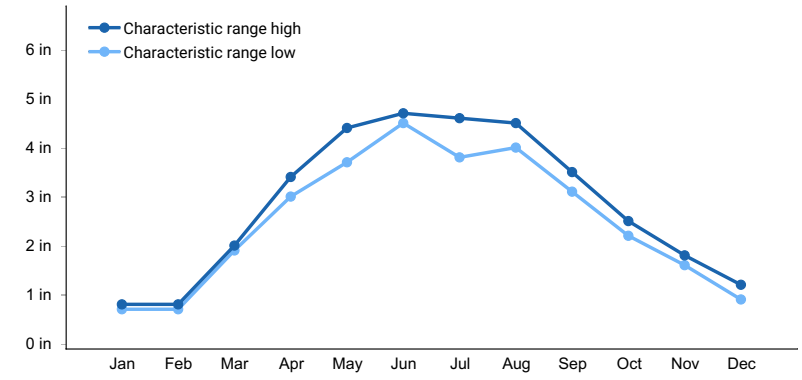


Figure 3. Monthly precipitation range

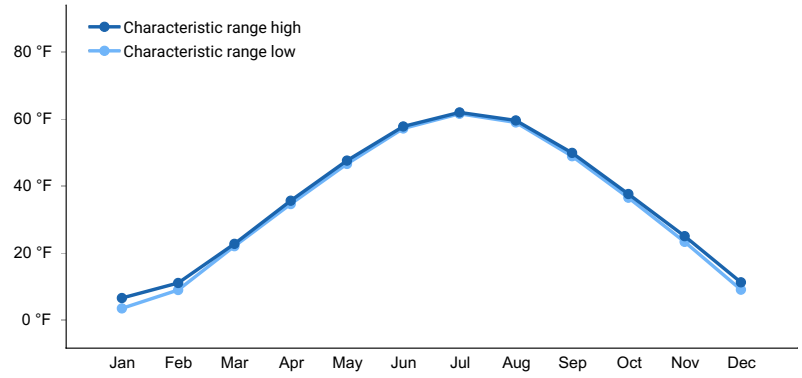


Figure 4. Monthly minimum temperature range

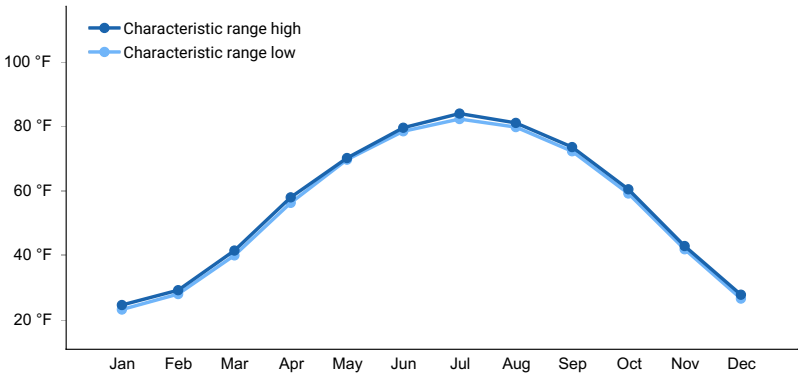


Figure 5. Monthly maximum temperature range

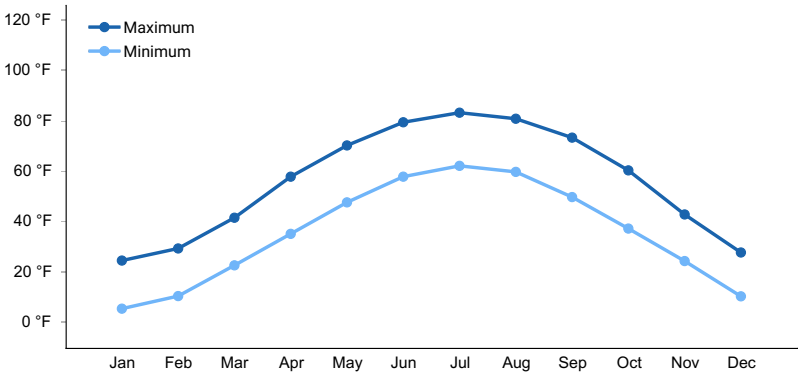


Figure 6. Monthly average minimum and maximum temperature

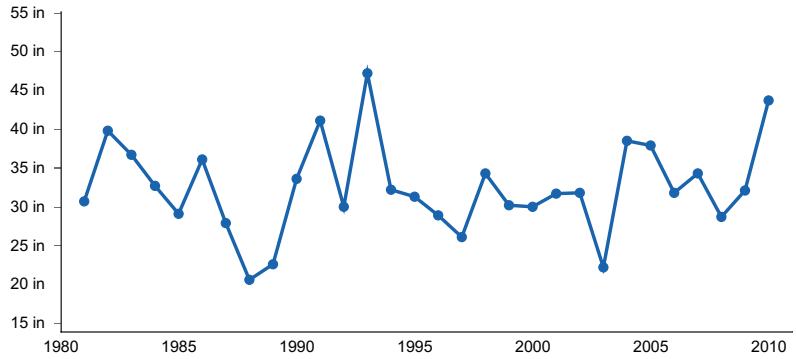


Figure 7. Annual precipitation pattern

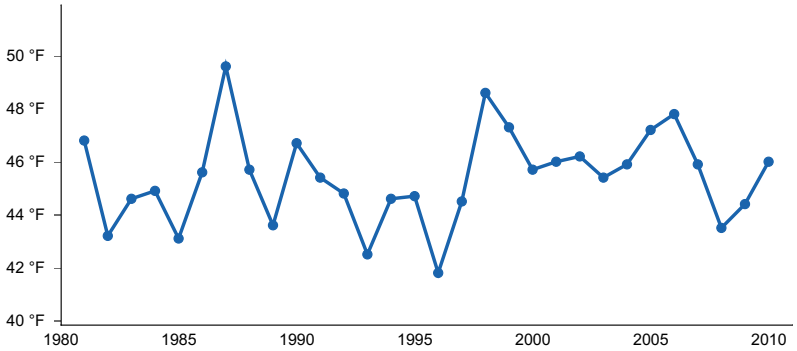


Figure 8. Annual average temperature pattern

Climate stations used

- (1) LAKEFIELD 2NE [USC00214453], Lakefield, MN
- (2) WINNEBAGO [USC00219046], Winnebago, MN
- (3) FAIRMONT [USC00212698], Fairmont, MN
- (4) STEWART [USC00218025], Brownton, MN
- (5) WEBSTER CITY [USC00138806], Webster City, IA

Influencing water features

The Wet Footslope-Drainageway Prairies ecological site receives water from three sources: subsurface flow, direct precipitation, and runoff. Some areas within this ecological site may flood for very brief periods. These areas may be associated with first-order streams that are fed by adjacent footslopes and headslopes. Soils are classified as endosaturated. The water table is at or near the soil surface during the spring months; however, during dry periods, the water table will drop to as low as six feet.

In the hydrogeomorphic (HGM) classification system, this site is considered slope wetlands, producing discharge to adjacent sites (USDA-NRCS, 2008; Gilbert et al., 2006). This site also has a Saturated Cowardin Hydrologic Regime of Palustrine; Persistent Emergent Wetlands, and has a United States Army Corps of Engineers (USACE) Wetland Plant Community of D; Fresh (wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils).

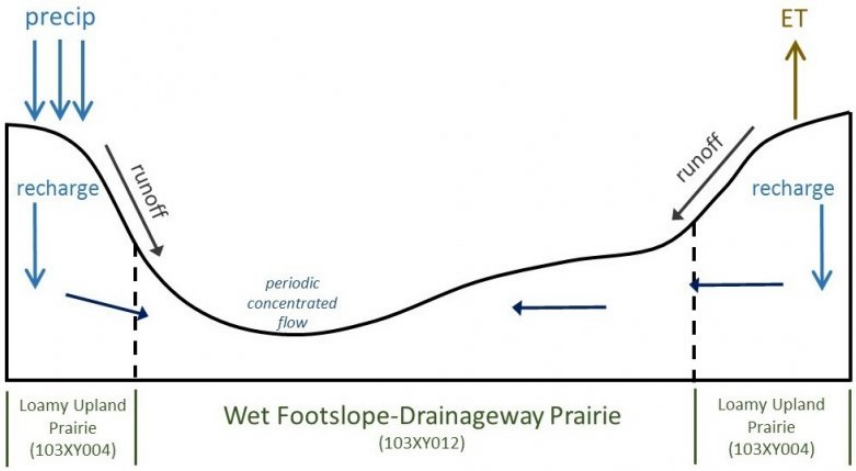


Figure 9. Representation of hydrological factors in a typical area of the (NAME) and associated ecological sites on the Des Moines Lobe (MLRA 103).

Soil features

The Wet Footslope/Drainageway Prairies ecological site occurs on soils rich in organic matter which historically developed under prairie vegetation. Since these soils are in a receiving position, over time they naturally accumulate soil materials from adjacent upland slopes. As a result, dark mollic epipedons tend to be thicker than typical prairie soils. Common surface textures are clay loam and silty clay loam. The common subsurface textural group is fine-loamy (with 18 to 35 percent clay). These soils formed under saturated conditions that produced anaerobic conditions during part of the year. Because organic matter tends to mask the soil features used to identify seasonal high water table depths, these soils may or may not key out as hydric. In cases where they do, the primary hydric soil indicator is Thick Dark Surface (A12; USDA-NRCS, 2010). The majority of these soils are classified as Typic Endoaquolls, indicating an apparent water table. Soil series associated with this ecological site are Coland, Colo, Danielson, Delft, Lura, and Mayer. Delft and Coland are the most extensive and central concept soil series for this ecological site.

Table 4. Representative soil features

Parent material	(1) Colluvium (2) Slope alluvium (3) Alluvium
Surface texture	(1) Clay loam (2) Loam
Drainage class	Poorly drained
Permeability class	Slow to moderate
Depth to restrictive layer	80 in
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–1%
Available water capacity (0-60in)	9–13 in
Calcium carbonate equivalent (0-40in)	0–30%
Soil reaction (1:1 water) (0-40in)	5.6–8.4
Subsurface fragment volume <=3" (0-40in)	0–10%

Subsurface fragment volume >3" (0-40in)	0–1%

Ecological dynamics

The Wet Footslope/Drainageway ecological site is characterized by three states: the Reference State (native prairie), the Tillage State, and the Woodland State.

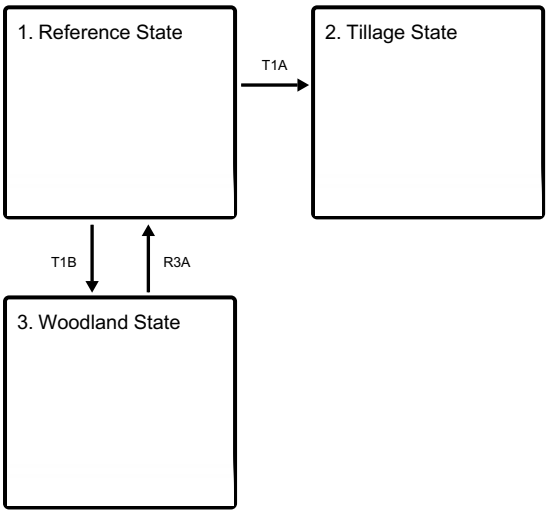
In this model, two plant communities exist in the Reference State and are characterized by different fire return intervals. The first community is the High Diversity Prairie, which is characterized by a fire return interval of approximately 4 years or less. The second community is the Old Growth Prairie, which is characterized by a longer fire return interval. The Old Growth Prairie exhibits a continuing increase in woody vegetation. The mechanism of change between communities is fire frequency and the resulting effects fire has on the plant community. Grazing can also be a trigger for change on this ecological site.

The Tillage State describes sites that have been tilled and generally have modified hydrology (ditching, tiling). Two communities make up the Tillage State: the Row Crop Community and the Seeded Grassland Community. Transition mechanisms are traditional agriculture practices such as preparing the site, planting desired species, applying herbicide (weed control), applying fertilizer, and harvesting.

Some areas of this ecological site are in a Woodland State. Sites that lack a natural fire regime or managed grazing will eventually revert to a woodland. Sites may have other disturbances such as unmanaged grazing and non-native species. Dominant trees on these sites will vary depending on the hydrology, disturbances, and seed sources. State 3 in this model describes a woodland dominated by green ash, boxelder, cottonwood, and willow; however, community structure and composition will depending upon seed sources and the disturbance type and severity.

State and transition model

Ecosystem states

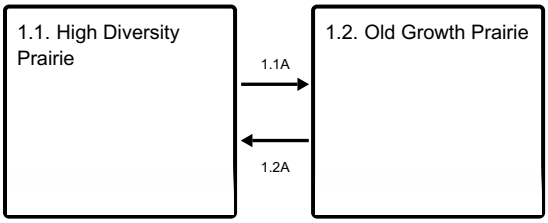


T1A - Transition to agriculture; tillage; seeding; continued management

T1B - Absence of fire coupled with excessive grazing pressure

R3A - Restoration of hydrologic function and natural disturbance regimes

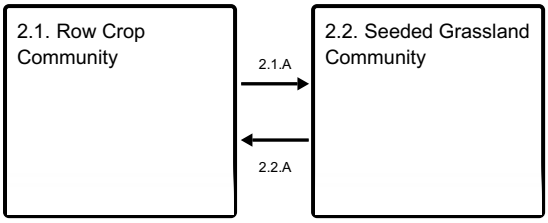
State 1 submodel, plant communities



1.1A - Fire-free period greater than 3 years.

1.2A - Fire-free period 3 years or less

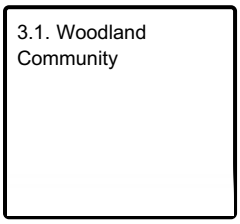
State 2 submodel, plant communities



2.1.A - Grass seeding; grassland management

2.2.A - Tillage; crop production

State 3 submodel, plant communities



State 1
Reference State

The Wet Footslopes/Drainageway Prairies reference state is a native prairie that has a diversity of wet-tolerant grasses and forbs. Community phases within the Reference State are dependent upon the influences of the frequency of fire events. Fire is a natural trigger that promotes continued herbaceous vegetation dominance. Fire removes plant litter, helps cycle nutrients, and allows light to reach the seedbed. Frequent fire maintains the community in a grassland state, by keeping fire-sensitive woody species from proliferating. A secondary trigger is grazing. Overgrazing will reduce the extent of highly palatable species thereby allowing the growth of less desirable plants to increase. Reference plant communities are characterized as native tallgrass prairie, with a diversity of grasses, sedges, and forbs characteristic of poorly drained conditions. Variation in water table allows both wetland and non-wetland species to thrive. Prairie cordgrass (*Spartina pectinata* Bosc ex Link) is a common dominant species. Other grasses include big bluestem (*Andropogon gerardii* Vitman) and Indiangrass (*Sorghastrum nutans* (L.) Nash). Sedges are an important component, particularly in wetter areas. Several species are possible. The most noteworthy species are Bicknell's sedge (*Carex bicknellii* Britton), woolly sedge (*Carex pellita* Muhl ex. Willd.), and Buxbaum's sedge (*Carex buxbaumii* Whalenb.). Tussock-forming species like Hayden's sedge (*Carex haydenii* Dewey) and upright sedge (*Carex stricta* Lam.) may be on site. Shrub cover is variable and includes leadplant (*Amorpha canescens* Pursh), willows (Salix L.) and dogwoods (Cornus L.), which quickly spread in the absence of frequent fire. Today, high-quality, unplowed areas are extremely uncommon. Most remaining natural areas that are managed for tallgrass prairie were once tilled and utilized for agricultural production. It is therefore likely that many of the historic native prairie species are extirpated even from these sites.

Resilience management. Prescribed fire and managed grazing are key resilience management practices. This is a stable plant community when grazing and fire are adequately managed. Prescribed fire is the controlled application of fire to modify vegetation structure and influence ecological processes. Prescribed grazing incorporates periods of grazing rest during the growing season which benefits tallgrass maintenance. Excessive grazing can quickly impact the vegetative composition and negatively impact soil stability.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- stiff goldenrod (*Oligoneuron rigidum*), other herbaceous

Community 1.1
High Diversity Prairie

This plant community consists of native wet-tolerant native grasses and a variety of native forbs. Frequent fire reduces the extent of woody species and maintains the natural dominance and diversity of native grasses and forbs. Fire stimulates seed regeneration and reduces the amount of thatch.

Resilience management. Prescribed fire and managed grazing are key resilience management practices.

Dominant plant species

- prairie cordgrass (*Spartina pectinata*), grass
- big bluestem (*Andropogon gerardii*), grass
- sedge (*Carex*), grass
- stiff goldenrod (*Oligoneuron rigidum*), other herbaceous

Community 1.2
Old Growth Prairie

This plant community is characterized by a longer fire-free period than that of Community 1.1. Grass species are dominant, but more woody species are present due to the longer fire return times. Thatch and dead plant residue are denser than in Community 1.1.

Resilience management. Prescribed fire and grazing are resilience management practices. Although this community has a longer fire return interval than Community 1.1, it also relies on fire and grazing to maintain vegetation community structure.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- dogwood (*Cornus*), shrub
- willow (*Salix*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- big bluestem (*Andropogon gerardii*), grass
- sedge (*Carex*), grass

Pathway 1.1A
Community 1.1 to 1.2

A longer (greater than 3 years) is the primary factor controlling the transition from Community 1.1 and Community 1.2.

Pathway 1.2A
Community 1.2 to 1.1

This pathway consists of a fire return interval of less than 3 years. Fire intolerant woody species are set back, and the amount of dead plant material that can slow new vegetative growth is reduced through burning.

State 2
Tillage State

Soil tillage is the primary mechanism affecting the transition to this state. Tillage affects dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity. Hydrological modifications (tiling and ditching) are commonly installed to improve drainage, so natural hydrology is also altered. Most areas in this state will remain in use for crop production in the foreseeable future. Certain practices can mitigate the impacts of traditional agricultural practices on soil health. Conservation tillage minimizes soil disturbance and can improve soil structure and overall soil health. Corn or soybean plantings and a cover crop rotation can build soil structure, improve infiltration rates, and protect water quality. A small percentage of this ecological sites have been seeded to grass. Some previously tilled areas have been converted to warm-season grasslands under an NRCS conservation

program. Species seeded will depend upon the hydrology of the site. Cool-season grasses are also feasible. The most common cool-season grasses are non-native species, such as reed canarygrass (Phalaris arunidinacea) and Kentucky bluegrass (*Poa pratensis*). Although cool-season grasslands are not biologically diverse, they still offer soil health and wildlife benefits. Some tilled sites may revert to a woodland through abandonment; however, this is a small percentage of acres within MLRA 103 so is not currently given a community in this model.

Resilience management. Disturbance management and harvest management are resilience management practices. The maintenance of this state requires that the intensity, frequency, duration, and timing of agricultural practices (disturbances) be managed to control or modify vegetation structure.

Dominant plant species

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

Community 2.1
Row Crop Community

This plant community typically consists of intensively produced, traditional row crops. Tillage and intentional plant establishment (crop seeding) are the primary triggers for this community. A secondary trigger is hydrological modifications (ditching and tiling), which are commonly installed to improve soil drainage. The most common crops are corn and soybeans on an annual rotation.

Resilience management. The maintenance of the desired vegetation community requires management of the intensity, frequency, duration, and timing of disturbances caused by agricultural practices.

Dominant plant species

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

Community 2.2
Seeded Grassland Community

This community is in areas that were previously tilled and used for agricultural production but have been transitioned to either warm-season or cool-season grasses. Warm-season grasses are commonly planted through NRCS conservation programs. Also feasible are cool-season grass species such as reed canarygrass and Kentucky bluegrass. Many of these areas are eventually transitioned to annual crop production.

Resilience management. Resilience management practices include invasive plant management and a program of planned grazing. Prescribed fire is a resilience management practice on warm-season grasslands. The controlled application of fire modifies vegetation structure and influence ecological processes.

Dominant plant species

- prairie cordgrass (*Spartina pectinata*), grass
- big bluestem (*Andropogon gerardii*), grass

Pathway 2.1.A
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. Both warm-season or cool-season grasses are feasible for these sites. Species selection will depend upon specific site characteristics and landowner objectives.

Conservation practices

Forage and Biomass Planting

Pathway 2.2.A
Community 2.2 to 2.1

This pathway converts seeded grassland to cropland. This is a pathway as areas are placed in crop production. The mechanisms of change are tillage and hydrological modifications.

State 3
Woodland State

In the absence of a natural fire or management, this site will transition toward the Wooded State. Disturbances such as unmanaged grazing, altered hydrology, and invasive species are often present. Vegetative composition and characteristics will vary depending on the age of the community and the type and severity of disturbances. Dominant tree species will vary, but commonly include eastern cottonwood, black willow, green ash, and boxelder. Reed canarygrass may be dense in open areas. Cool-season grasses such as Kentucky bluegrass and smooth brome may be present. A small percentage of acres within MLRA 103 are in this State. Some remaining areas are conservation easements. Areas not in a conservation programs may be jurisdictional wetlands, making it very unlikely they will be transitioned to State 2 due to various wetland programs and laws, including the Swampbuster provision of the Food Security Act of 1985 (P.L. 99-198, as amended by P.L. 115-25) and the Minnesota Wetland Conservation Act (WCA) of 1991 (M.R. 8420.0100, as amended in 2009).

Dominant plant species

- eastern cottonwood (*Populus deltoides*), tree
- black willow (*Salix nigra*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- boxelder (*Acer negundo*), tree
- dogwood (*Cornus*), shrub

Community 3.1
Woodland Community

This site is a woodland plant community usually consisting of various species of trees, shrubs, and often, non-native species. Common trees include eastern cottonwood, willows, green ash, boxelder, and dogwood. Open areas may be dominated by reed canarygrass and other cool-season, non-native grasses. Plant community composition will be determined by past disturbances, seed sources, and the type and severity of current disturbances.

Dominant plant species

- eastern cottonwood (*Populus deltoides*), tree
- black willow (*Salix nigra*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- boxelder (*Acer negundo*), tree
- dogwood (*Cornus*), shrub

Transition T1A
State 1 to 2

Transition T1A is the conversion of the reference state to agriculture. The triggers are tillage and intentional plant establishment (crop seeding). Hydrological modifications, such as ditching and tiling, are often also installed. Resilience management practices include continual agricultural practices such as seeding, fertilizing, and managing invasive plants with herbicides or field cultivation.

Constraints to recovery. Tillage and long-term intensive agricultural production generally preclude a return to State 1. Areas in row crop production may be placed in conservation programs and seeded with warm-season grasses, but will not exhibit the natural species diversity or ecological resiliency of State 1. Some tilled areas may be abandoned and return to woodland, but this is a small percentage of acres and not currently given a community in this model. Most acres converted to agriculture will stay as such for the foreseeable future.

Transition T1B
State 1 to 3

Plant community succession via the lack of natural fire and/or grazing. Brush and trees will increase and plant community structure will begin to move from a prairie to a woodland. Disturbances such as overgrazing and non-native vegetation may influence the plant community composition and structure.

Restoration pathway R3A
State 3 to 1

Sites that have not been tilled and still have natural hydrologic functions may be feasible to restore back to a reference community. Soil structure is intact and remnant plant communities may still exist on site. Previously tilled sites (State 2) may revert to a woodland through abandonment; however, the soil function has been altered through tillage and intensive crop production. This site will not be the same ecologically as a true reference site.

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.

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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	05/05/2024
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:**

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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:**
