USDA Natural Resources Conservation Service

Ecological site R103XY004MN
Loamy Upland Prairies

Last updated: 10/04/2023
Accessed: 05/17/2024

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)

International Vegetation Classification Hierarchy
Class: 2. Shrub & Herb Vegetation
Subclass: 2.B. Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2. Temperate Grassland & Shrubland
Division: 2.B.2.Nb. Central North American Grassland & Shrubland
Macrogroup: M054. Central Lowlands Tallgrass Prairie

Relationship to Other Established Classifications:
The reference state shares similarities to Minnesota Department of Natural Resources UPs23 Southern Mesic Prairie

Ecological site concept

The Loamy Upland Prairies ecological site is located on loamy, upland soils formed in glacial till and lacustrine materials. Soils were formed under native prairie and have a dark surface layer (mollic epipedon). Characteristic vegetation includes leadplant, big bluestem, and a diversity of native forbs. This site does not flood or pond.

Associated sites

R103XY011MN	**Footslope/Drainageway Prairies** The Footslope/Drainageway Prairies ecological site is located mainly on footslopes, toeslopes, and upland drainageways. The most common soil drainage class is moderately well-drained. The site incurs frequent to occasional extremely brief and very brief flooding.
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.
R103XY003MN	**Sandy Upland Prairies** The Sandy Upland Prairies ecological site is located on uplands including outwash plains and valley trains along modern river valleys. Soils are formed from sandy and course loamy outwash and loamy-mantled outwash. Sites do not flood or pond. The reference state site concept is a mesic native prairie.
F103XY032MN	**Loamy Floodplains** The Loamy Floodplains ecological site is located on medium textured alluvium throughout MRLA 103. Soils textures include loam, silt loam, sandy loam and fine sandy loam. Some areas within this ecological site will exhibit long-term flooding (7-30 days).
R103XY012MN	**Wet Footslope/Drainageway Prairies** The Footslope/Drainageway Prairies ecological site are located on mainly on footslopes, toeslopes, and upland drainageways. The site concept incurs frequent to occasional extremely brief and very brief flooding. Soils drainage class is poorly drained. Reference vegetation is a wet prairie.

Similar sites

R103XY005MN	**Clayey Upland Prairies** The Clayey Upland Prairies ecological site is located on uplands, including lakeplains, ground moraines, and till plains. Soils in this ecological site have a dark surface layer (mollic epipedon) and clayey textures. This site is not subject to flooding or ponding.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amorpha canescens*
Herbaceous	(1) *Andropogon gerardii* (2) *Dalea candida*

Physiographic features

The Loamy Upland Prairies ecological site is located on loamy, upland soils on ground moraines and till plains. This site is mapped primarily on backslope positions, but also occurs on summits and shoulders. The slope positions are linear to convex both vertically and horizontally.

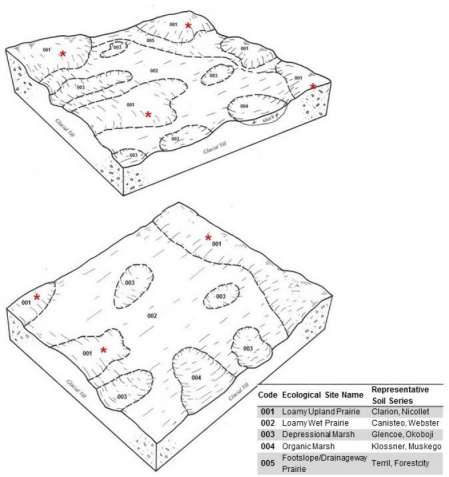


Figure 1. Representative block diagrams of Loamy Upland Prairies and associated Provisional Ecological Sites.

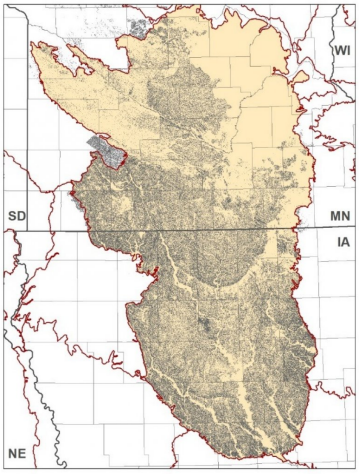


Figure 2. Distribution of Loamy Upland Prairies within MLRA 103. In many cases, data is not spatially consistent across political boundaries due to the method with which soils were mapped; e. g. county subsets.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Summit (3) Shoulder
Landforms	(1) Ground moraine (2) Till plain
Runoff class	Low to very high
Elevation	210–560 m
Slope	0–65%
Water table depth	30–203 cm
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 freeze-free period of this site is 159 days, while the frost-free period is 135 days. The average mean annual precipitation is 32.0 inches, which includes rainfall plus the water equivalent from snowfall. Sloping soils are generally warmer than lower, more concave soils, which makes this site warmer than adjacent, downslope ecological sites. As a result, snow and frost melt sooner in the spring, thus resulting in longer growing seasons than the adjacent depressions.

Table 3. Representative climatic features

Frost-free period (characteristic range)	132-135 days
Freeze-free period (characteristic range)	153-163 days
Precipitation total (characteristic range)	762-914 mm
Frost-free period (actual range)	129-144 days
Freeze-free period (actual range)	150-172 days
Precipitation total (actual range)	737-914 mm
Frost-free period (average)	135 days
Freeze-free period (average)	159 days
Precipitation total (average)	813 mm

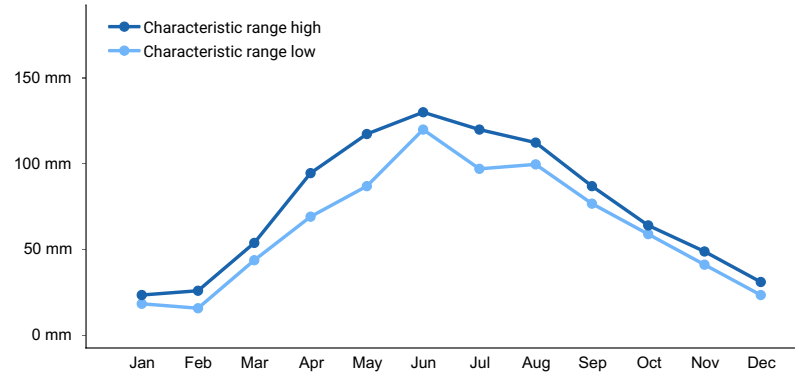


Figure 3. Monthly precipitation range

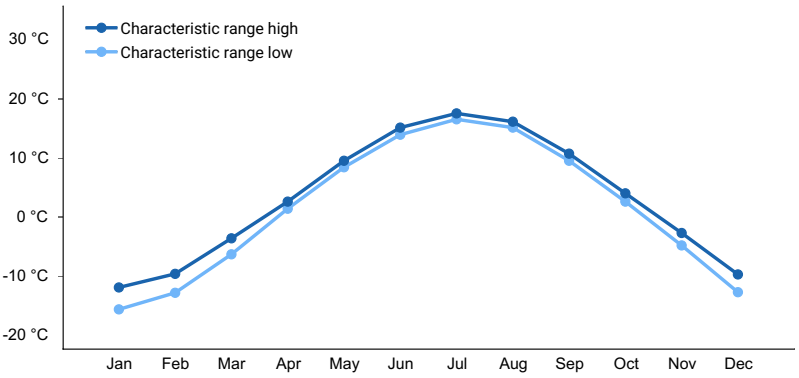


Figure 4. Monthly minimum temperature range

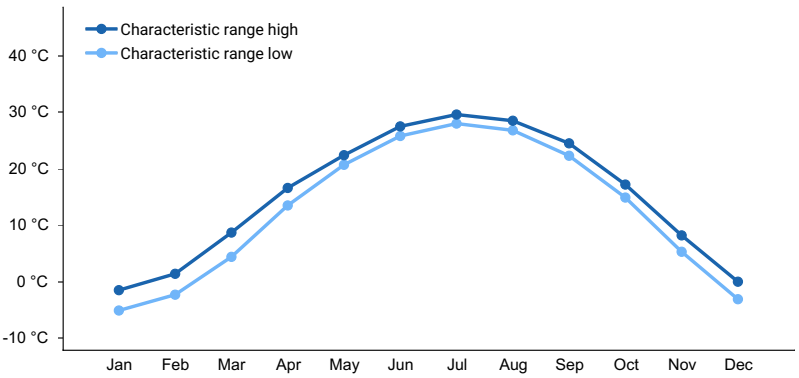


Figure 5. Monthly maximum temperature range

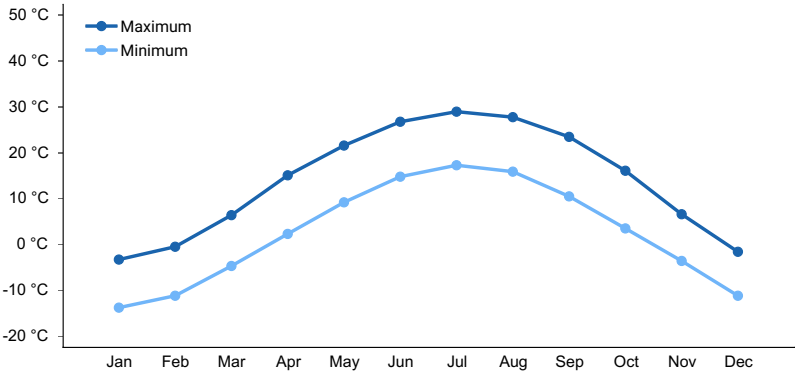


Figure 6. Monthly average minimum and maximum temperature

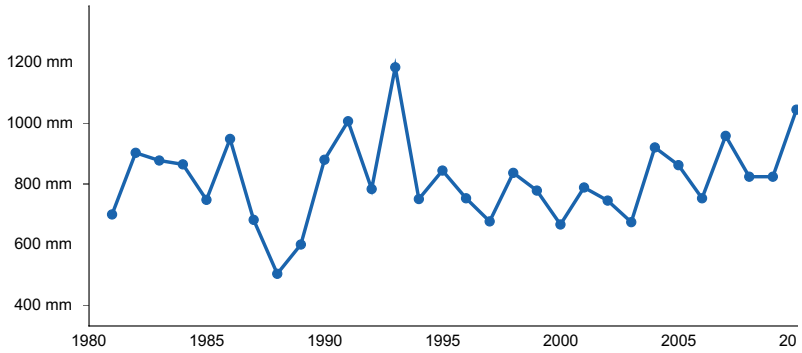


Figure 7. Annual precipitation pattern

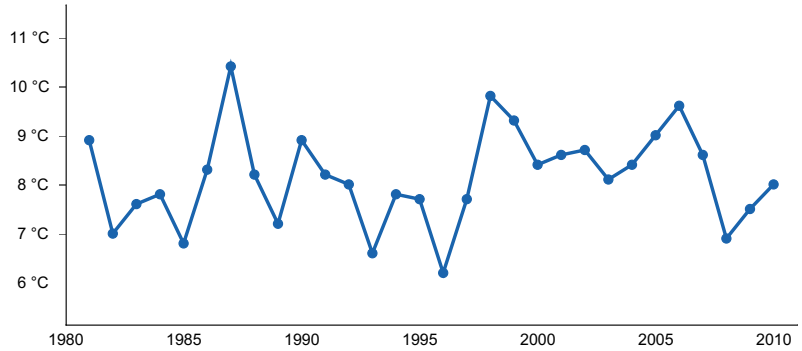


Figure 8. Annual average temperature pattern

Climate stations used

- (1) BUFFALO 2NE [USC00211107], Buffalo, MN
- (2) WILLMAR WWTP [USC00219004], Willmar, MN
- (3) MARSHALL [USC00215204], Marshall, MN
- (4) NEW ULM 2 SE [USC00215887], New Ulm, MN
- (5) ALBERT LEA 3 SE [USC00210075], Albert Lea, MN
- (6) LAKE PARK [USC00134561], Lake Park, IA
- (7) FT DODGE 5NNW [USC00132999], Fort Dodge, IA
- (8) DES MOINES WSFO-JOHNSTON [USC00132209], Johnston, IA
- (9) JEFFERSON [USC00134228], Jefferson, IA
- (10) ANKENY [USC00130241], Ankeny, IA

Influencing water features

The Loamy Upland Prairies ecological site can receive subsurface flow and runoff from higher adjacent sloping ground, but the site primarily receives water from precipitation. This site provides recharge and runoff to adjacent downslope ecological sites. There is no flooding or ponding. Spring is the wettest time of the year with the highest water table. Soils are classified as endosaturated (i.e., the water table comes from below). The water table is typically between 12 to 80 inches during the spring but drops below the series control section in the growing season during dry periods.

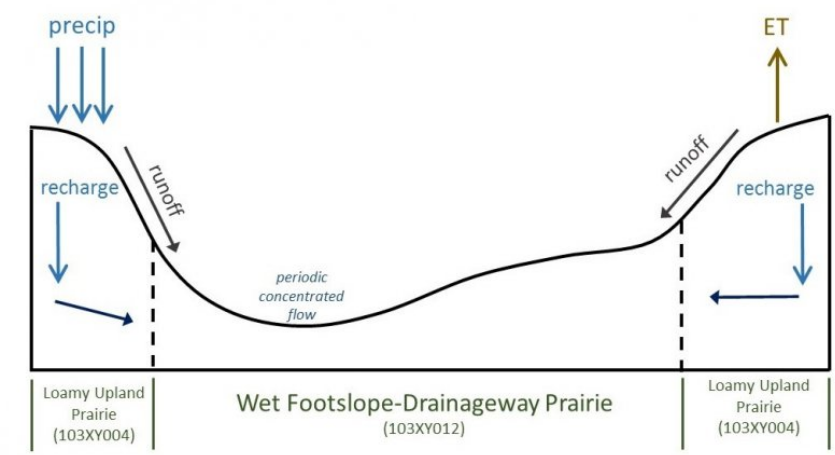


Figure 9. Representation of hydrological factors in a typical area of the Loamy Upland Prairies and associated ecological sites on the Des Moines Lobe (MLRA 103)

Soil features

The soils associated with the Loamy Upland Prairie ecological site were form in glacial till or lacustrine deposits. They have a drainage class and moisture status that makes them drier than hydric. The included soils are mostly Hapludolls in Typic, Oxyaquic or Aquic subgroups. Some Eutrudepts are included. Soil drainage class varies from somewhat poorly drained to well drained. Soils are generally characterized by a silty clay loam or silt loam surface texture and a subsurface layer of loamy materials derived mostly from original unsorted Des Moines lobe materials. Soil series associated with this ecological site are Arkton, Augusta Lake, Bode, Clarion, Crippin, Crooksford, Farrar, Fostoria, Gardencity, Garmore, Grogan, Grovecity, Kingston, Lakefield, Linder, Nicollet, Normania, North Twin, Ocheyedan, Omsrud, Ottosen, Tara, Truman, Wadenill, Walnut Grove, Waubay, and Wilmonton.

Table 4. Representative soil features

Parent material	(1) Till (2) Lacustrine deposits
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Fine-loamy
Drainage class	Somewhat poorly drained to well drained
Permeability class	Very slow to rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	17.78–27.94 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Soil reaction (1:1 water) (0-101.6cm)	5.1–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–5%
Subsurface fragment volume >3" (0-101.6cm)	0–5%

Table 5. Representative soil features (actual values)

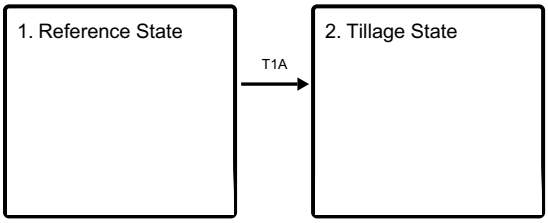
Drainage class	Not specified
Permeability class	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	12.7–33.02 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	Not specified
Subsurface fragment volume <=3" (0-101.6cm)	Not specified
Subsurface fragment volume >3" (0-101.6cm)	Not specified

Ecological dynamics

The Loamy Upland Prairies ecological site is characterized by two states: the Reference State (mixed tallgrass prairie) and the Tillage State. Two plant communities exist in the Reference State are characterized by different fire return intervals. 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 these sites. Two communities make up the Tillage State: the Row Crop Community and the Seeded Grassland Community. The Tillage State describes sites that have been tilled and either are currently used for intensive row crop production or were seeded to a grassland plant community. Most areas of the Loamy Upland Prairies ecological site are used for row crop production.

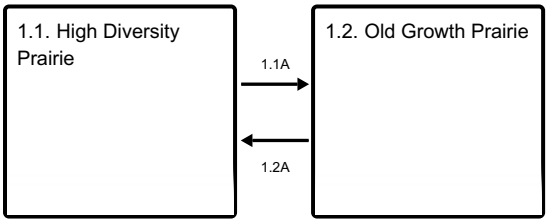
State and transition model

Ecosystem states



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

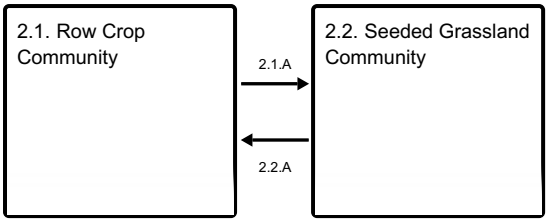
State 1 submodel, plant communities



1.1A - Fire return interval 3-5 years.

1.2A - Fire return interval less than 3 years

State 2 submodel, plant communities



2.1.A - Grass seeding; grassland management

2.2.A - Tillage; crop production

State 1
Reference State

The Loamy Upland Prairies ecological site reference plant community is a native tallgrass prairie that includes a diversity of native grasses and forbs. Community phases in the model are generally dependent upon the impacts of fire events. Fire is a trigger that promotes continued herbaceous vegetation dominance and removes dense thatch thereby allowing for seedling regeneration. 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 and gaining dominance. A secondary trigger is grazing. Intensive grazing can reduce the extent of highly palatable species thereby allowing the growth of less desirable plants to increase. Grazing management guidelines vary by site depending on specific site characteristics. Today, reference sites are extremely uncommon. Most remaining prairie areas were once utilized for agricultural production. It is therefore likely that many historically present prairie species are extirpated even from these sites.

Resilience management. Prescribed fire and managed grazing are key resilience management practices. 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. Prescribed fire is the controlled application of fire to modify vegetation structure and influence ecological processes.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- big bluestem (*Andropogon gerardii*), grass
- white prairie clover (*Dalea candida*), other herbaceous

Community 1.1
High Diversity Prairie

This plant community is composed of multiple native grasses along with a variety of native forbs. The vegetative composition is influenced primarily by fire return intervals of less than 3 years. Frequent fire will reduce the extent of woody species and will maintain the natural dominance and diversity of native grasses and forbs. Fire also stimulates seed regeneration and reduces the amount of thatch. Grazing can also be a key trigger influencing the plant composition of this site and grazing management inputs will dictate plant composition and community structure.

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

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- big bluestem (*Andropogon gerardii*), grass
- white prairie clover (*Dalea candida*), other herbaceous
- Canada goldenrod (*Solidago canadensis*), other herbaceous

Community 1.2
Old Growth Prairie

This plant community is characterized by a fire return interval longer than that of Community 1.1. Native grasses are still dominant, but more woody species are present. 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
- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass

Pathway 1.1A
Community 1.1 to 1.2

Fire is the primary trigger that affects the plant community composition. The frequency of fire is the primary factor affecting the transition from Community 1.1 and Community 1.2. Pathway 1.1A consists of a fire free period of 3 to 5 years. It allows for an increase in woody species and thatch. Secondary triggers are grazing and drought.

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 herbaceous growth is reduced.

State 2
Tillage State

In the Tillage State, the dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity are altered by agricultural practices. 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 with a cover crop rotation can build soil structure, improve infiltration rates, reduce runoff and erosion, and protect water quality. Some areas in this ecological site are not appropriate for intensive crop production due to slope. Where the gradient exceeds 20 percent row crop production is not feasible due to limitations on farm machinery. A few areas within the Loamy Upland Prairies ecological site have been seeded back to grass. Under conservation programs, such as the NRCS Conservation Reserve Program (CRP), previously farmed areas have been converted to warm-season grasslands. Cool-season grasses are also feasible. Species selection will depend on the landowner's objectives and site specifics.

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 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. The most common crops are corn and soybeans on an annual rotation.

Resilience management. Disturbance management and harvest management are resilience management practices.

Dominant plant species

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

Community 2.2
Seeded Grassland Community

This plant 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 grassland community. Warm-season grasses are commonly planted through conservation programs. Landowners may choose to establish cool-season grass species. Many of these areas are eventually transitioned to crop production.

Resilience management. Grassland resilience management practices include prescribed fire, invasive plant management, and/or prescribed grazing.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), 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. Commercial vegetative seed mixes commonly include a variety of native grasses plus 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 taken out of crop production and seeded with warm-season grasses to benefit wildlife, soil health, and water quality.

Conservation practices

Forage and Biomass Planting

Pathway 2.2.A
Community 2.2 to 2.1

This pathway converts seeded grassland to cropland. The mechanisms of change are tillage and intentional plant establishment (crop seeding).

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). Resilience management practices include continual agricultural practices such as seeding, fertilizing, and managing invasive plants with herbicides or field cultivation. Hydrological modifications, such as ditching and tiling, may also be installed.

Constraints to recovery. Tillage and long-term intensive agricultural production generally preclude a return to State 1.

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.

Gleason, H.A. 1913. The Relation of Forest Distribution and Prairie Fires in the Middle West. Torreya 13:8, 173-181.

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. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean and the Pacific Basin. United States Department of Agriculture Handbook 296.

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), EIS Specialist, 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	05/17/2024
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:**