USDA Natural Resources Conservation Service

Ecological site R103XY003MN
Sandy Upland Prairies

Last updated: 10/04/2023
Accessed: 05/19/2024

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. Groundwater 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 community shares similarities with MN DNR Native Plant Community UPs13 Southern Dry Prairie

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

Ecological site concept

The Sandy Upland Prairies ecological site is located on sandy, upland soils. This site is often sloping so are dry throughout the year. this site was characterized by native prairie vegetation prior to European settlement and was subject to frequent fires. Characteristic vegetation includes native prairie species including leadplant, little bluestem, and porcupinegrass.

Associated sites

F103XY032MN	**Loamy Floodplains** The Loamy Floodplains ecological site is located on loamy textured soils in floodplains. Soil drainage class ranges from somewhat poorly drained to well drained. This site may incur flooding with durations ranging from brief to long.
R103XY015MN	**Depressional Marsh** The Depressional Marsh ecological site is in concave small- to medium-sized depressions. This site is very poorly drained and ponded throughout the early part of the growing season in most years (i.e. seasonal wetlands). Vegetation includes cattails, bulrushes, sedges and other emergent wetland species.
R103XY007MN	**Sandy Wet Prairies** The Sandy Wet Prairie ecological site concept is areas on sandy, endosaturated soils located on outwash plains, valley trains, and glacial terraces associated with major river valleys. Soils contain sandy and gravelly outwash parent materials and often have a loamy mantle of 20 to 40 inches deep. Drainage class is poorly drained.
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.
F103XY031MN	**Sandy Floodplains** The Sandy Floodplains ecological site is located on sandy-textured Mollisol soils in floodplains and drainageways throughout MLRA 103. Soils drainage class ranges from moderately well drained to excessively drained. Brief flooding may occur on areas within this ecological site.

Similar sites

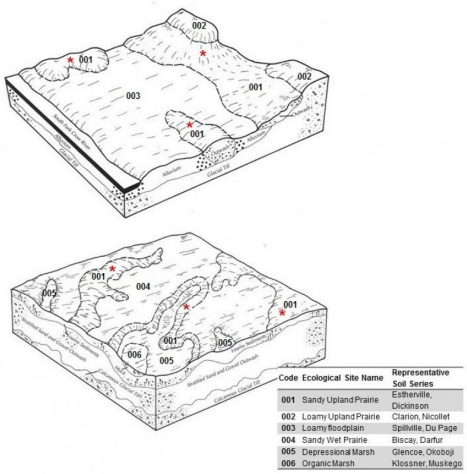
R103XY002MN	**Calcareous Upland Prairies** The Calcareous Upland Prairies ecological site is located on upland calcareous soils that do not flood or pond. Soils developed under prairie vegetation, and the soil drainage class include somewhat poorly drained to well drained.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Amorpha canescens*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Hesperostipa spartea*

Physiographic features

The Sandy Upland Prairies ecological site occurs throughout MLRA 103 predominately on ground moraines, outwash plains, and river valleys. This site is often located on backslope positions which are linear to convex both vertically and horizontally. Slopes range from 0-65%, so aspect and slope will impact plant community composition.



Code	Ecological Site Name	Representative Soil Series
001	Sandy Upland Prairie	Estherville, Dickinson
002	Loamy Upland Prairie	Clarion, Nicollet
003	Loamy floodplain	Spillville, Du Page
004	Sandy Wet Prairie	Biscay, Darfur
005	Depressional Marsh	Glencoe, Okoboji
006	Organic Marsh	Klossner, Muskego

Figure 1. Block diagrams of the representative Sandy Upland Prairies and associated ecological sites.

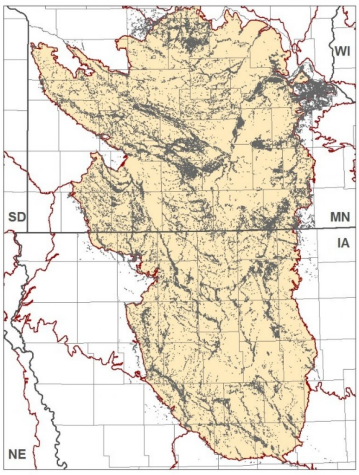


Figure 2. Distribution of the Sandy Upland Prairies ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Summit (3) Shoulder
Landforms	(1) Till plain > Outwash plain (2) Upland > Ground moraine (3) Upland > River valley
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
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 147 days, while the frost-free period is 127 days. The average mean annual precipitation is 31.0 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)	123-130 days
Freeze-free period (characteristic range)	141-151 days
Precipitation total (characteristic range)	737-813 mm
Frost-free period (actual range)	118-135 days
Freeze-free period (actual range)	135-159 days
Precipitation total (actual range)	737-864 mm
Frost-free period (average)	127 days
Freeze-free period (average)	147 days
Precipitation total (average)	787 mm

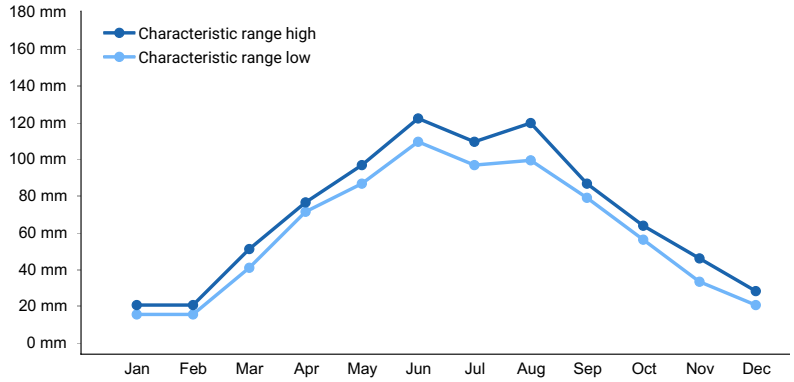


Figure 3. Monthly precipitation range

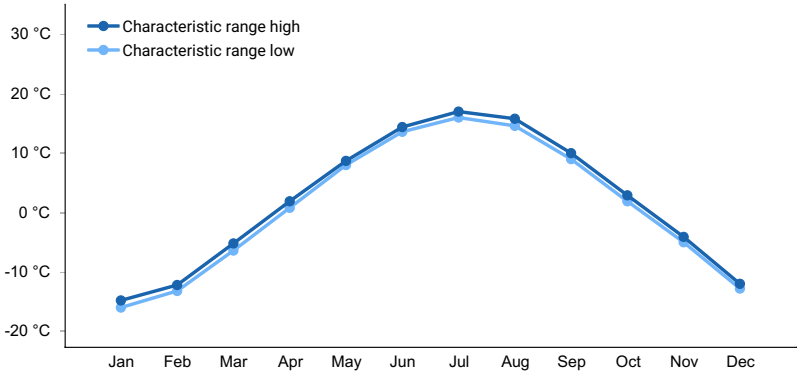


Figure 4. Monthly minimum temperature range

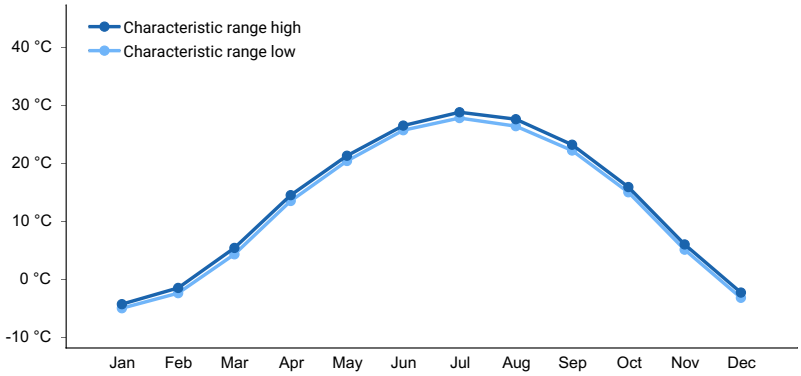


Figure 5. Monthly maximum temperature range

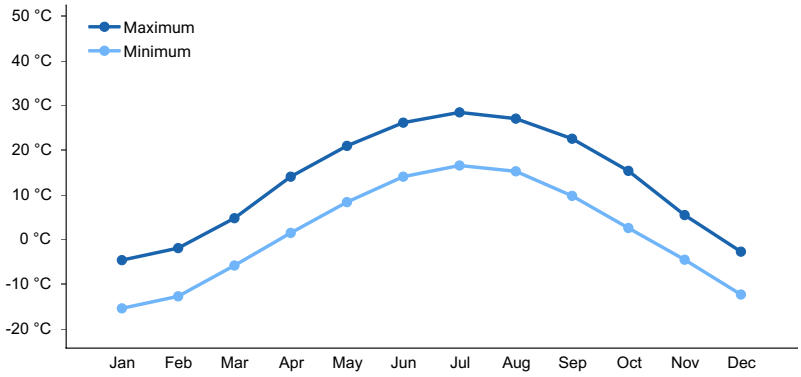


Figure 6. Monthly average minimum and maximum temperature

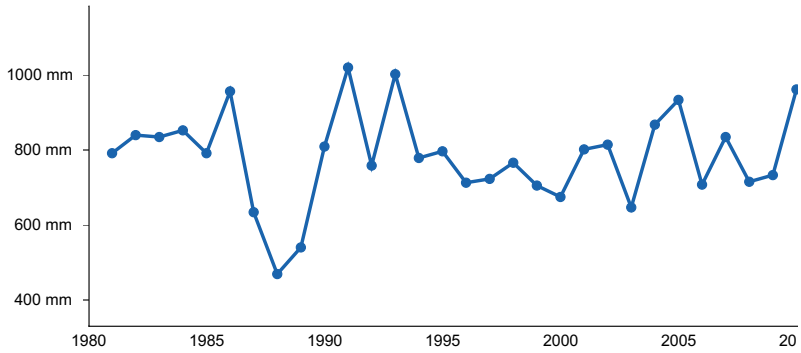


Figure 7. Annual precipitation pattern

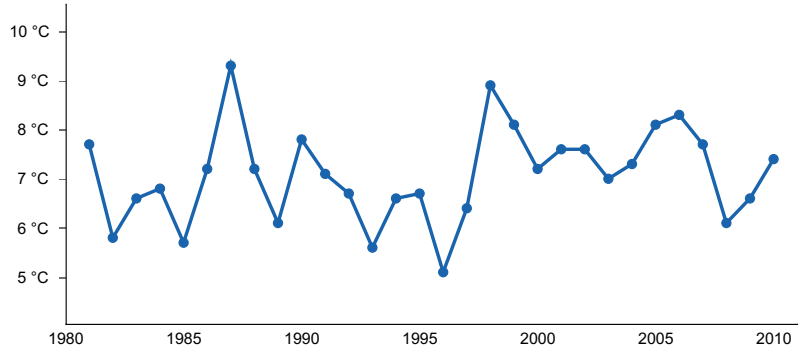


Figure 8. Annual average temperature pattern

Climate stations used

- (1) LAKEFIELD 2NE [USC00214453], Lakefield, MN
- (2) ALBERT LEA 3 SE [USC00210075], Albert Lea, MN
- (3) CHASKA [USC00211465], Chaska, MN

- (4) LITCHFIELD [USC00214778], Litchfield, MN
- (5) REDWOOD FALLS [USC00216839], Redwood Falls, MN
- (6) ST PETER [USC00217405], Saint Peter, MN
- (7) FARIBAULT [USC00212721], Faribault, MN

Influencing water features

The Sandy Upland Prairies ecological site can receive water from precipitation, subsurface flow, and runoff. The site primarily receives water from precipitation and provides recharge and runoff to adjacent downslope ecological sites. This site does not flood or pond. Soils are classified as endosaturated, and the water table is typically between 12 to 80 inches. Spring is the wettest time of the year with the highest water table.

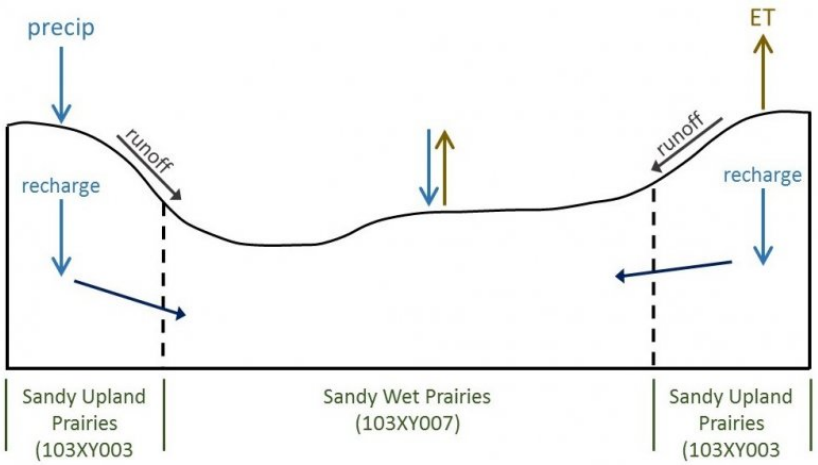


Figure 9. Representation of hydrological factors in a typical area of the Sandy Upland Prairies and associated ecological sites on the Des Moines Lobe (MLRA 103).

Soil features

The soils in the Sandy Upland Prairies ecological site were mostly formed in a loamy glaciofluvial mantle overlying sandy and gravelly glacial outwash. These soils have a drainage class and moisture status that makes them drier than hydric. The included soils are mostly Typic Hapludolls. Pachic, Entic, Oxyaquic, Calcic, and Aquic subgroups are also included, as well as Typic Udipsamments, such as Sartell, Plainfield, and Hawick.

Soils are characterized by a sandy surface texture and a subsurface layer of course-loamy or fine-loamy materials derived mostly from original unsorted Des Moines lobe materials. All soils in this group are drier than hydric. Soil drainage class varies from somewhat poorly drained to excessively drained; however, the most common soil drainage classes are somewhat excessively drained to excessively drained.

The soil series associated with this ecological site are Arvilla, Bolan, Buckney, Cylinder, Dickinson, Dickman, Estherville, Fairhaven, Fedji, Flagler, Fordville, Hawick, Hoopeston, Kanaranzi, Lasa, Linder, Litchfield, Lowlein, Minneopa, Pilot Grove, Plainfield, Ridgeport, Round Lake, Sartell, Saude, Sparta, Sverdrup, Wadena, Waukegan, and Zenor.

Table 4. Representative soil features

Parent material	(1) Glaciofluvial deposits
Family particle size	(1) Coarse-loamy (2) Fine-loamy (3) Sandy
Drainage class	Somewhat poorly drained to excessively drained
Permeability class	Slow to very rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%

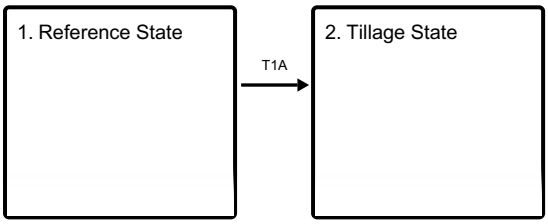
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	5.08–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Soil reaction (1:1 water) (0-101.6cm)	5.1–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–70%
Subsurface fragment volume >3" (0-101.6cm)	0–10%

Ecological dynamics

The Sandy Upland Prairies ecological site is characterized by two states: the Reference State (native prairie) and the Tillage State. Two plant communities exist in the Reference State are characterized by different fire return intervals. Grazing can also be a trigger for plant community changes on this site. The Tillage State describes sites that have been tilled and either are currently used for intensive row crop production or were previously tilled and are currently seeded to a grassland plant community. Most areas of the Sandy Upland Prairies ecological site are used for row crop production, specifically a corn-soybean rotation.

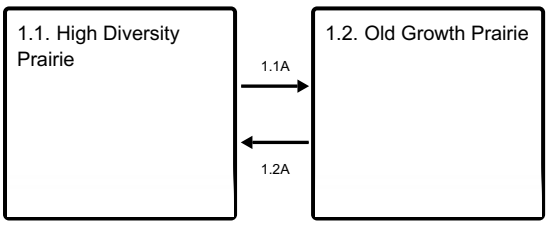
State and transition model

Ecosystem states



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

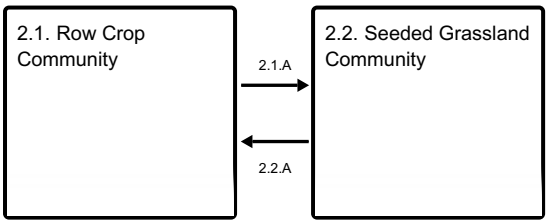
State 1 submodel, plant communities



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 Sandy Upland Prairies ecological site reference plant community is a dry sandy prairie that consists of drought-tolerant native grasses and forbs. Community phases within the Reference State are influenced by fire and grazing. 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 for maintenance or conversion 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 and management objectives. High-quality, untilled areas of the Sandy Upland Prairies ecological site are extremely uncommon. Most remaining prairie areas that are managed for tallgrass prairie were once utilized for agricultural production. It is therefore likely that many historically-present, 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 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
- little bluestem (*Schizachyrium scoparium*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- western silver aster (*Symphyotrichum sericeum*), other herbaceous

Community 1.1
High Diversity Prairie

This plant community consists of dry-tolerant native grasses and a variety of native forbs. Common reference species include leadplant, little bluestem, and porcupinegrass. The vegetative composition is influenced primarily by fire return intervals of less than 3 years.

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.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- western silver aster (*Symphyotrichum sericeum*), other herbaceous

Community 1.2
Old Growth Prairie

This plant community is characterized by a longer fire return interval. Native grasses are still 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
- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), 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.

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 growth is reduced.

State 2
Tillage State

Tillage is the primary mechanism to the Tillage State. In this state, dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity are altered by agricultural practices. Most areas in this state will remain in use for crop production in the foreseeable future – primarily in an intensive corn and soybean rotation. 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, 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 Sandy Upland Prairies ecological site have been seeded back to grass. Under conservation programs such as the NRCS Conservation Reserve Program (CRP), previously tilled areas have been converted to warm-season grasslands. Native forbs are commonly included in seed mixes to benefit wildlife and pollinators. Although highly beneficial to wildlife, these sites generally lack the diversity of species in the Reference State. Depending on the management objectives of the landowner, cool-season grasses are also feasible for some areas within this ecological site. Species selection will depend on the landowner's objectives and site specifics. Although cool-season grasslands are not as species rich or biologically diverse as warm-season grasslands, they still offer various soil health benefits and some ecological benefits for grassland bird species.

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*), other herbaceous
- 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. Multiple crops, however, are feasible for these areas with appropriate management. Dryness will be a limiting factor on some areas within this ecological site. Conservation tillage practices may be implemented to reduce the hazard of erosion while still maintaining a corn and soybean rotation. These practices can help 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. Agriculture practices will be limited by slope on many areas within this ecological site as slopes range from 0% to over 60%.

Resilience management. Disturbance management and harvest management are resilience management practices. 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 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, such as the NRCS Conservation Reserve Program (CRP). Included in the planting is native forbs that benefit wildlife and pollinators. Numerous native grasses and forbs are suitable for these areas. Seed mix selection depends on landowner objectives and site-specific characteristics. Poor grazing management practices on warm season grasslands can lead to soil erosion and invasion by cool-season grasses such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Resilience management practices include prescribed fire, invasive plant management, and a program of planned grazing that manages the intensity, frequency, and duration of grazing and the number of grazing animals. Less common than warm-season species, but still feasible, are cool-season grass species such as Kentucky bluegrass and reed canarygrass. Many cool-season grasses can be planted, depending on landowner goals. Management inputs include site preparation, seeding, and weed control. Many of these areas are eventually transitioned to annual crop production.

Resilience management. 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

- little bluestem (*Schizachyrium scoparium*), grass
- porcupinegrass (*Hesperostipa spartea*), 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.

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 common pathway throughout MLRA 103 as areas 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), field cultivation, fertilizer application, and harvest management.

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 be installed.

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.

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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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	05/19/2024
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:

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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:**
