USDA Natural Resources Conservation Service

# Ecological site R103XY023MN
# Clayey Wet Savannas

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. 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)

## Ecological site concept

The Clayey Wet Savannas ecological site is characterized by poorly drained, fine-textured soils that developed under a mix of native wet tolerant grasses and scattered trees. No flooding or ponding occurs on this site, but the seasonal high depth to soil saturation is between 0-30 cm. Grazing, drought, and periodic fires are important disturbance triggers that influence plant community structure and composition.

## Associated sites

| | |
|---|---|
| R103XY021MN | **Clayey Upland Savannas**<br>The Clayey Upland Savannas ecological site is characterized by a savanna community on soils derived from clayey till and lacustrine materials. Drainage class ranges from moderately well to somewhat poorly drained. |

## Similar sites

| | |
|---|---|
| R103XY022MN | **Loamy Wet Savannas**<br>The Loamy Wet Savannas ecological site is located on soils that are derived from fine loamy till. Soils are classified as poorly drained. This site occurs on morainal ridges or in slight concavities and linear segments with a slope of less than 2 percent. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Populus tremuloides* |
| Shrub | Not specified |
| Herbaceous | (1) *Andropogon gerardii*<br>(2) *Carex pellita* |

## Physiographic features

The Clayey Wet Savannas ecological site occurs adjacent to the Big Woods ecoregion in northeastern MLRA 103. Landform positions are depressions, low gradient linear slopes, or toeslopes. These positions are linear to slightly concave both vertically and horizontally.

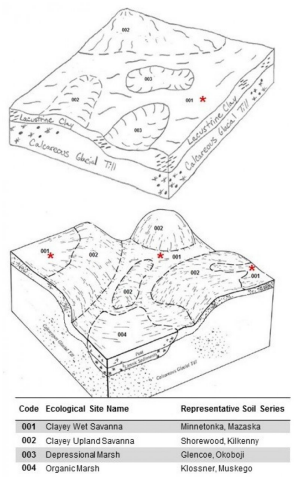



**Figure 1. Block diagrams of the representative Clayey Wet Savannas and associated ecological sites.**

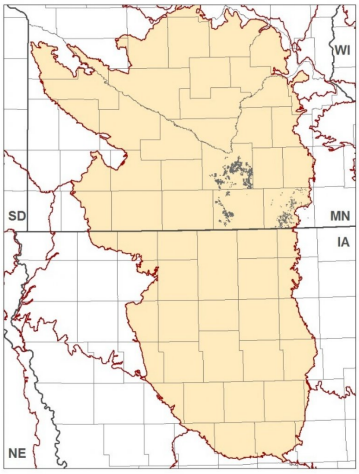



**Figure 2. Distribution of the Clayey Wet Savannas ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.**

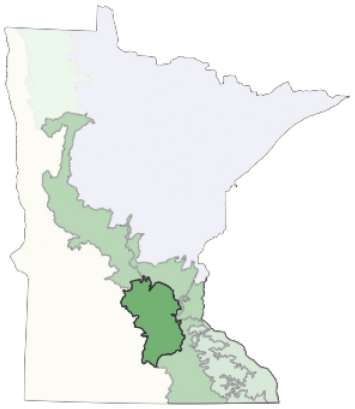


**Figure 3. The Big Woods ecoregion in dark green. (Minnesota Department of Natural Resources)**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Hillslope profile | (1) Toeslope |
| Landforms | (1) Ground moraine<br>(2) Lateral moraine<br>(3) End moraine<br>(4) Lake plain<br>(5) Depression |
| Runoff class | Very low to low |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 213–480 m |
| Slope | 0–3% |
| Water table depth | 0–119 cm |
| 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 157 days, while the frost-free period is 129 days. The average mean annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall. 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) | 126-133 days |
| Freeze-free period (characteristic range) | 153-161 days |
| Precipitation total (characteristic range) | 787-838 mm |
| Frost-free period (actual range) | 123-136 days |
| Freeze-free period (actual range) | 152-161 days |
| Precipitation total (actual range) | 787-864 mm |
| Frost-free period (average) | 129 days |
| Freeze-free period (average) | 157 days |
| Precipitation total (average) | 813 mm |

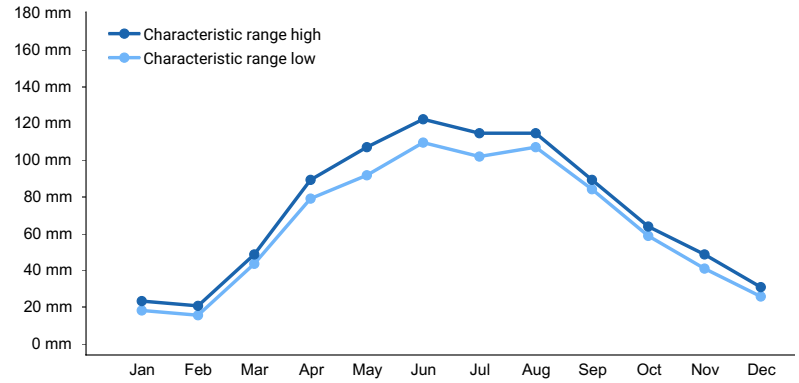



**Figure 4. Monthly precipitation range**

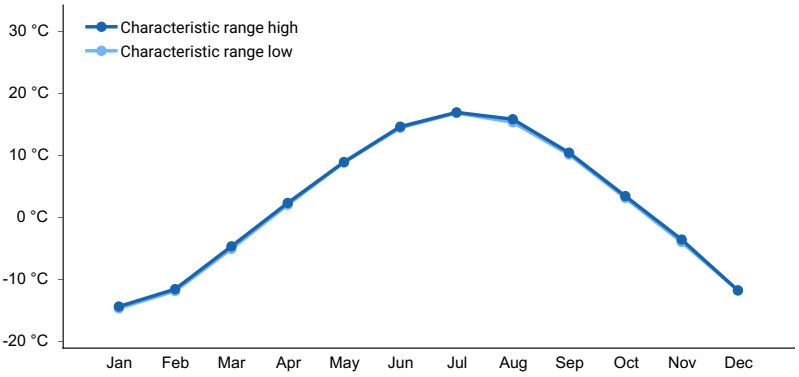



**Figure 5. Monthly minimum temperature range**

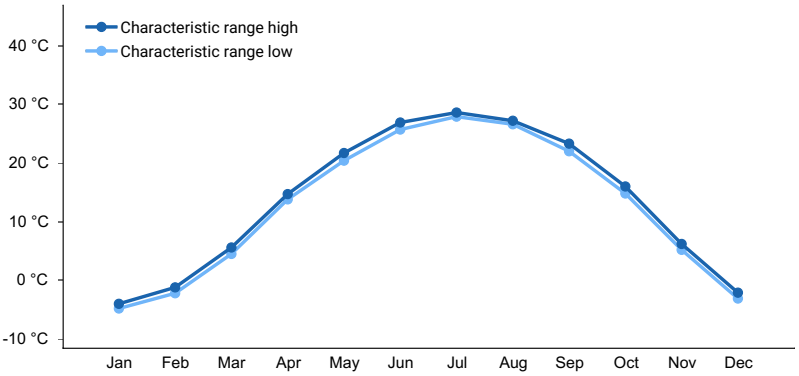



**Figure 6. Monthly maximum temperature range**

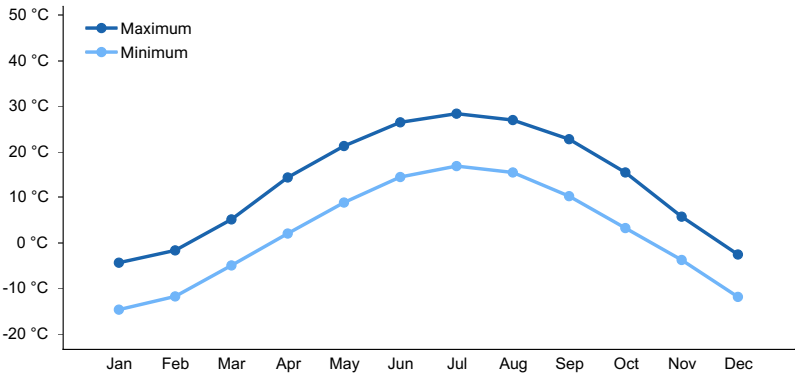



**Figure 7. Monthly average minimum and maximum temperature**

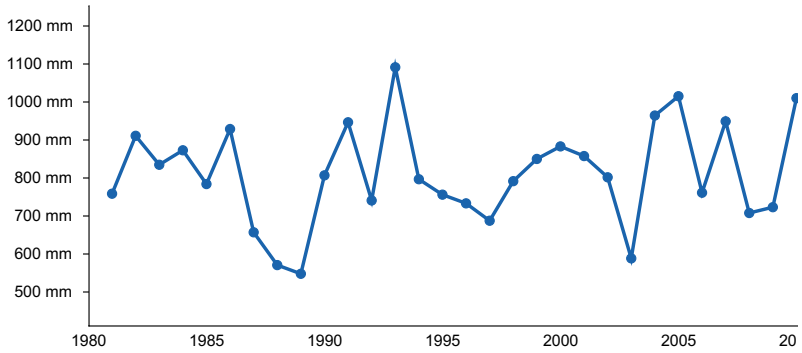



**Figure 8. Annual precipitation pattern**

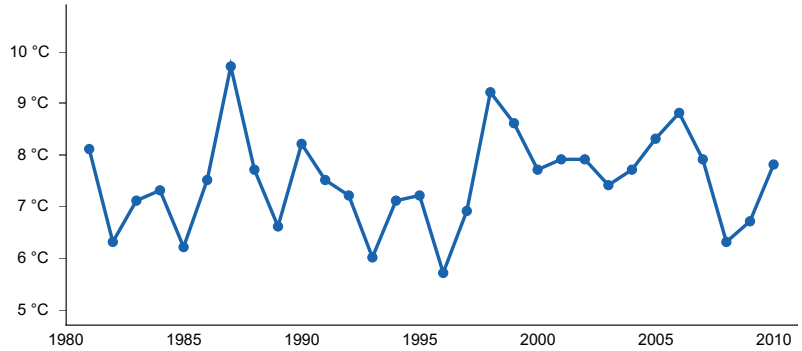



**Figure 9. Annual average temperature pattern**

## Climate stations used

- (1) AMBOY [USC00210157], Amboy, MN
- (2) CHANHASSEN WSFO [USC00211448], Chanhassen, MN
- (3) ALBERT LEA 3 SE [USC00210075], Albert Lea, MN
- (4) WELLS [USC00218808], Wells, MN

## Influencing water features

The Clayey Wet Savannas ecological site receives water via precipitation, lateral subsurface flow, and runoff. Since some of these components have little for contributing area, direct precipitation may be the only water source that some of them receive. Spring is the wettest time of the year in the region.

The Clayey Wet Savannas ecological site is primarily a groundwater recharge area. Soil components that make up the central concept of this site are poorly drained (Minnetonka series) with a seasonal high water table is at or very near the soil surface. Soils are classified as endosaturated. Soil saturation is at or very near the soil surface during the spring months and may drop to as low as four feet later in the growing season. In the hydrogeomorphic (HGM) classification system, this site is considered a Mineral Flat wetland, producing ground water recharge to adjacent ecological sites. (USDA-NRCS, 2008; Gilbert et al., 2006). This site has a Cowardin Hydrologic classification of Palustrine Emergent Wetland. It also has a United States Army Corps of Engineers Wetland Plant Community of B; Fresh (wet) Meadows.

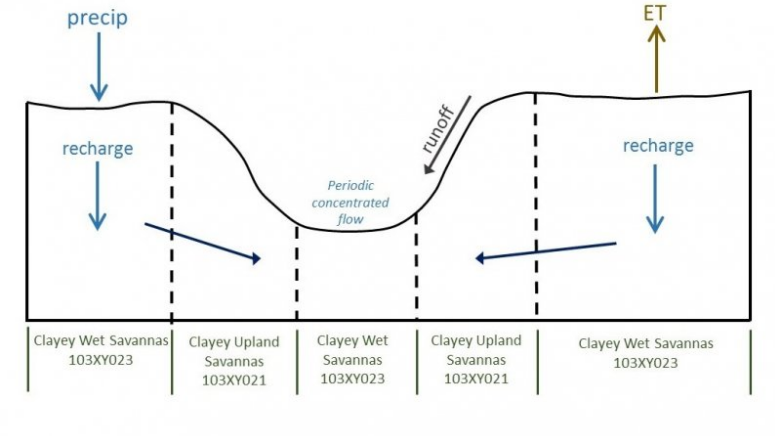



**Figure 10. Representation of hydrological factors in a typical area of the Clayey Wet Savannas and associated ecological sites on the Des Moines Lobe (MLRA 103).**

## Soil features

The soils associated with the Clayey Wet Savannas ecological site developed under scattered trees and grasslands. The soils are often in slight depressions and accumulated slope alluvium. As a result, dark surface epipedons (at times thicker than many prairie soils) formed in these savanna areas. Also, clay particles were illuviated from albic horizons higher in the profile and accumulated deeper. Argillic horizons form readily in Des Moines Lobe materials after leaching of all carbonates from the upper portion of the soil takes place (Grimm, 1984). The soils are classified as Vertic Argiaquolls.

These soils 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). The parent materials are lacustrine or lacustrine materials over loamy glacial till. The soils are very deep (>60 inches to bedrock). The drainage class is poorly drained, with a seasonal high water table that is at or very near the surface.

Typical surface textures are silty clay loam and silty clay. The soil family particle size class is fine. Coarse fragments are between 0 and 11 percent by volume. Soil pH classes are very moderately acid to moderately alkaline throughout the series control section. The most dominant soil series correlated to this ecological site is Minnetonka.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Lacustrine deposits<br>(2) Till |
| Surface texture | (1) Silty clay loam<br>(2) Silty clay |
| Drainage class | Poorly drained |
| Permeability class | Very slow to moderate |
| Soil depth | 203 cm |
| Surface fragment cover <=3" | 0% |
| Surface fragment cover >3" | 0% |
| Available water capacity (0-152.4cm) | 26.42–27.69 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0–20% |
| Soil reaction (1:1 water) (0-101.6cm) | 5.6–8.2 |

| | |
|---|---|
| Subsurface fragment volume <=3" (0-101.6cm) | 0% |
| Subsurface fragment volume >3" (0-101.6cm) | 0% |

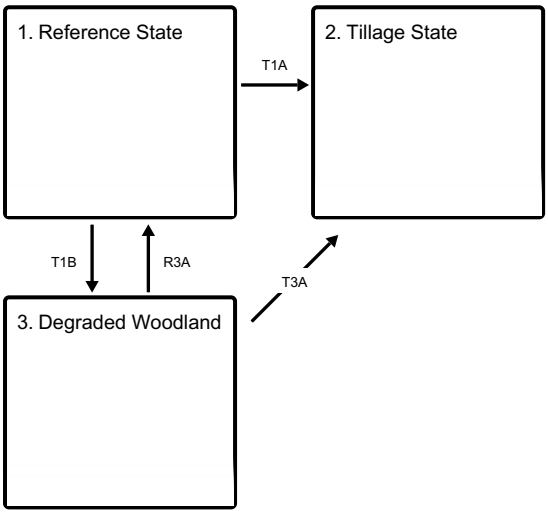
## Ecological dynamics

The Clayey Wet Savannas ecological site is primarily located in areas adjacent to the Big Woods ecoregion and near rivers and streams, which partially protected the site from fire. Natural fire disturbance was suppressed but not eliminated in these areas resulting in a savanna landscape.

The state and transition model (STM) consists of three states: Reference State, Tillage State, and the Degraded Woodland State. The Reference State describes a site with wet tolerant native grasses and scattered hardwoods. State 2 is the Tillage State which describes land transitioned to agricultural production. This is the most common state in MLRA 103 for this site. Some areas within this State have been reseeded to warm-season or cool-season grasses. State 3 is a Degraded Woodland State in which disturbances have modified the plant community composition and structure. Lack of natural fire, hydrological alterations, unmanaged grazing, and invasive species are common triggers transitioning a site to State 3.

## State and transition model

**Ecosystem states**



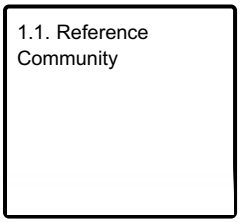

**T1A** - Tillage, drainage, planting crops

**T1B** - Absence of natural fire regime, increase in woody vegetation, and invasion of non-native species

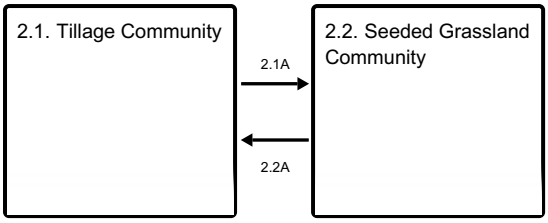
**R3A** - Restoration activities

**T3A** - Tillage, drainage, planting crops

**State 1 submodel, plant communities**



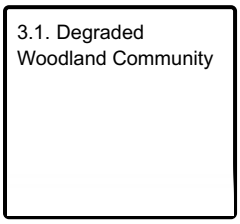
**State 2 submodel, plant communities**




**2.1A** - Establishment of grass species

**2.2A** - Transition to row crop agriculture

**State 3 submodel, plant communities**




## State 1
## Reference State

The Clayey Wet Savannas ecological site reference state exhibits a diversity of wet-tolerant native grasses and forbs along with scattered hardwood species. Plant community structure and composition within the reference state are variable and dependent upon the impacts of drought, grazing, fire events, and human disturbance. Fire was historically present on these savanna sites but to a lesser degree than the prairie ecological sites. This reduced occurrence of fire resulted in a plant community that included more woody vegetation and scattered trees. A secondary trigger for maintenance or conversion of this ecological site is grazing. Intensive grazing can reduce the extent of highly palatable species thereby allowing the growth of less desirable plants to increase. Characteristic vegetation includes big bluestem, prairie cordgrass, woolly sedge, and native forbs. Aspen and other hardwoods are present. High-quality, untilled areas of the Clayey Wet Savannas ecological site are uncommon in MLRA 103 as most sites have been transitioned to agricultural production.

### Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass
- woolly sedge (*Carex pellita*), grass

## Community 1.1
## Reference Community

The Wet Clayey Savannas ecological site is characterized by a diversity of wet-tolerant native grasses, forbs, and scattered hardwoods. Common reference species include big bluestem, prairie cordgrass, woolly sedge, and an array of forbs. Interspersed trees include aspen and other hardwoods. The vegetative composition is influenced primarily by drought, grazing, fire, and human disturbances. Variations within the plant community structure and composition will occur on these sites depending on the disturbance regime. Fire events will reduce the extent of woody species and increase native grasses.

### Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- big bluestem (*Andropogon gerardii*), grass
- prairie cordgrass (*Spartina pectinata*), grass
- woolly sedge (*Carex pellita*), grass

## State 2
## Tillage State

Soil tillage is the primary mechanism to transition a site to the Tillage State. Tillage alters dynamic soil properties such as bulk density, structure, organic carbon content, and saturated hydraulic conductivity. Certain conservation 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. Drainage modifications such as ditching and tiling are often present. A few areas within this ecological site have been seeded to grass. Under NRCS conservation programs, some previously tilled areas have been converted to warm-season grasses. Native forbs are commonly included in seed mixes to benefit wildlife and pollinators. Cool-season grasses are also feasible. Species selection will depend on the landowner's objectives and site specifics. Common species include reed canarygrass and Kentucky bluegrass. Although cool-season grasslands are not as species rich or biologically diverse as warm-season grasslands, they still offer soil health and wildlife benefits. Most areas in this state will remain in use for crop production in the foreseeable future – primarily in an intensive corn and soybean rotation.

**Dominant plant species**

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

## Community 2.1
## Tillage Community

The Tillage Community typically consists of intensively produced, traditional row crops. Tillage, hydrological modifications, 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.

**Dominant plant species**

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

## Community 2.2
## Seeded Grassland Community

The primary mechanism of change to this community is the seeding of desired grass species. This pathway may be triggered in conjunction with a NRCS conservation program through the planting of warm-season grasses such as big bluestem and Indiangrass. A few areas within this ecological site have been seeded to cool-season grasses. Common cool-season species including Kentucky bluegrass and reed canarygrass.

**Resilience management.** Multiple resilience management practices may be needed after establishment of warm-season grasses. Examples include prescribed fire, brush management, and herbaceous weed treatment. Resilience management practices for cool-season grass sites include planned grazing, invasive plant management, and appropriate disturbance/harvest management.

**Dominant plant species**

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- reed canarygrass (*Phalaris arundinacea*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

## Pathway 2.1A
## Community 2.1 to 2.2

The mechanism of change is the seeding of grass species. Warm-season or cool-season grasses may be planted

depending on the landowner's objectives.

**Conservation practices**

| |
|---|
| Forage and Biomass Planting |

### Pathway 2.2A
### Community 2.2 to 2.1

The site is transitioned back to cropland through tillage and seeding.

### State 3
### Degraded Woodland

This State is characterized by a disturbed and degraded woodland. Characteristics include an increase in shrubs and hardwood trees (no longer a true savanna community), the presence of invasive plant species, and a reduction in the diversity of native understory species. Hardwood trees have increased and invasives, such as Kentucky bluegrass and common buckthorn, may dominant the understory. As the tree and shrub density increases, the ground layer plant diversity decreases and transitions to more shade-tolerant species.

**Dominant plant species**

- quaking aspen (*Populus tremuloides*), tree
- Kentucky bluegrass (*Poa pratensis*), grass
- common buckthorn (*Rhamnus cathartica*), grass

### Community 3.1
### Degraded Woodland Community

This plant community exhibits an increase in woody species and invasive plants. Native plant diversity is decreasing. Due to the increasing shade levels, ground flora is transitioning to more shade-tolerant species. The community is no longer a savanna but a woodland.

**Dominant plant species**

- quaking aspen (*Populus tremuloides*), tree
- Kentucky bluegrass (*Poa pratensis*), grass
- common buckthorn (*Rhamnus cathartica*), grass

### Transition T1A
### State 1 to 2

The site is transitioned to agricultural production through tillage, drainage, and seeding of desired crops.

### Transition T1B
### State 1 to 3

Transition mechanisms include absence of a natural fire regime, invasion of non-native plant species, and a continual increase in woody species. The community transitions from a open savanna to a more closed, shaded woodland.

### Restoration pathway R3A
### State 3 to 1

Long-term restoration of the site to include non-native vegetation control, woody vegetation removal, establishment of desired native species. Natural hydrology must be present for a full restoration.

### Transition T3A

### State 3 to 2

Site is transitioned to agricultural production via tillage, drainage, and seeding of desired crops.

## Additional community tables

### Inventory data references

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

## Other references

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## Contributors

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## Approval

Suzanne Mayne-Kinney, 10/04/2023

## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

| | |
|---|---|
| Author(s)/participant(s) | |
| Contact for lead author | |
| Date | 05/19/2024 |
| 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:**

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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:

---

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:**

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