# Ecological site R115XC011IL
# Sand Prairie

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## 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): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

## LRU notes

The Central Mississippi Valley Wooded Slopes, Northern part (Land Resource Unit (LRU) 115XC) encompasses the Wyaconda River Dissected Till Plains, Mississippi River Hills, and Mississippi River Alluvial Plain (Schwegman et al. 1973; Nelson 2010). It spans three states – Illinois (73 percent), Iowa (6 percent), and Missouri (21 percent) – comprising about 13,650 square miles (Figure 1). The elevation ranges from 420 feet above sea level (ASL) along the Mississippi River floodplains to 885 feet on the upland ridges. Local relief varies from 10 to 20 feet but can be as high as 50 to 100 feet along drainageways and streams and the bluffs on the major rivers reaching 250 feet above valley floors. Wisconsin-aged loess covers the uplands, while Illinoian glacial drift lies directly below. The loess and drift deposits are underlain by several bedrock systems, including the Cretaceous, Pennsylvania, Mississippian, Silurian, Devonian, and Ordovician Systems. Wisconsin outwash deposits and sandy eolian material occur along stream terraces of major tributaries (USDA-NRCS 2006).

The vegetation across the region has undergone drastic changes over time. At the end of the last glacial episode – the Wisconsinan glaciation – the evolution of vegetation began with the development of tundra habitats, followed by a phase of spruce and fir forests, and eventually spruce-pine forests. Not until approximately 9,000 years ago did the climate undergo a warming trend which prompted the development of deciduous forests dominated by oak and hickory. As the climate continued to warm and dry, prairies began to develop approximately 8,300 years ago. Another shift in climate that resulted in an increase in moisture prompted the emergence of savanna-like habitats from 8,000 to 5,000 years before present (Taft et al. 2009). During the most recent climatic shifts, forested ecosystems maintained footholds on steep valley sides and wet floodplains. Due to the physiography of the MLRA, forests were the dominant ecosystems and were affected by such natural disturbances as droughts, wind, lightning, and occasional fire (Taft et al. 2009).

## Classification relationships

USFS Subregions: Central Dissected Till Plains (251C)Section; Western Mississippi River Hills (251Ce), Mississippi River and Illinois Alluvial Plains (251Cf), Eastern Mississippi River Hills (251Ci), Galesburg Dissected Till Plain (251Cj), and Wyaconda River Dissected Till Plain (251Cm) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Upper Mississippi River Alluvial Plain (72d), River Hills (72f), and Western Dissected Illinoian Till Plain (72i) (USEPA 2013)

National Vegetation Classification – Ecological Systems: North-Central Interior Sand and Gravel Tallgrass Prairie (CES202.695) (NatureServe 2018)

National Vegetation Classification – Plant Associations: Schizachyrium scoparium – Sorghastrum nutans – Andropogon gerardii – *Lespedeza capitata* Sand Grassland (CEGL002210) (Nature Serve 2018)

Biophysical Settings: North-Central Interior Sand and Gravel Tallgrass Prairie (BpS 4214120) (LANDFIRE 2009)

Illinois Natural Areas Inventory: Dry-mesic sand prairie, Mesic sand prairie (White and Madany 1978)

Missouri Terrestrial Natural Communities: Sand Prairie (Nelson 2010)

## Ecological site concept

Sand Prairies are located within the green areas on the map (Figure 1). They occur on uplands and high stream terraces. The soils are Mollisols and Entisols that are somewhat poorly to excessively drained and very deep, formed in eolian sands, eolian deposits, or outwash. These coarse-loamy soils are droughty and low in nutrients and organic matter.

The historic pre-European settlement vegetation on this ecological site was dominated by drought-adapted herbaceous species. Little bluestem (Schizachyrium scoparium (Michx.) Nash) and flaxleaf whitetop aster (Ionactis linariifolius (L.) Greene) are the dominant and diagnostic species on the site, respectively (White and Madany 1978). Other grasses present can include Indiangrass (Sorghastrum nutans (L.) Nash), porcupinegrass (Hesperostipa spartea (Trin.) Barkworth), and big bluestem (Andropogon gerardii Vitman) (White and Madany 1978; NatureServe 2018). Forbs typical of an undisturbed plant community associated with this ecological site include tall blazing star (Liatris aspera Michx.), showy goldenrod (Solidago speciosa Nutt.), and birdfoot violet (Viola pedata L.) (Taft et al. 1997). Fire is the primary disturbance factor that maintains this ecological site, while sand blow outs, periodic drought and large mammal grazing are secondary factors (LANDFIRE 2009; Taft et al. 2009; NatureServe 2018).

## Associated sites

| | |
|---|---|
| R115XC012IL | **Wet Sand Prairie**<br>Eolian sands, eolian deposits, and outwash that are shallow to a high-water table including Maumee, Selma, Selmass, Udolpho, and Will soils |

## Similar sites

| | |
|---|---|
| R115XC002IL | **Loess Upland Prairie**<br>Loess Upland Prairies are a similar vegetation type but the parent material is loess and loess-covered substrates |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | (1) *Schizachyrium scoparium*<br>(2) *Ionactis linariifolius* |

## Physiographic features

Sand Prairies occur on uplands and high stream terraces. They are situated on elevations ranging from approximately 341 to 1948 feet ASL. The site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites .

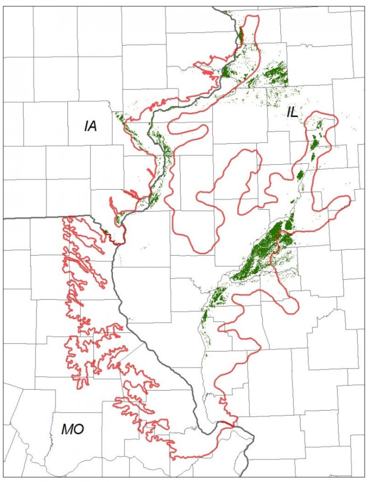



**Figure 1. Location of Sand Prairie ecological site within LRU 115XC.**

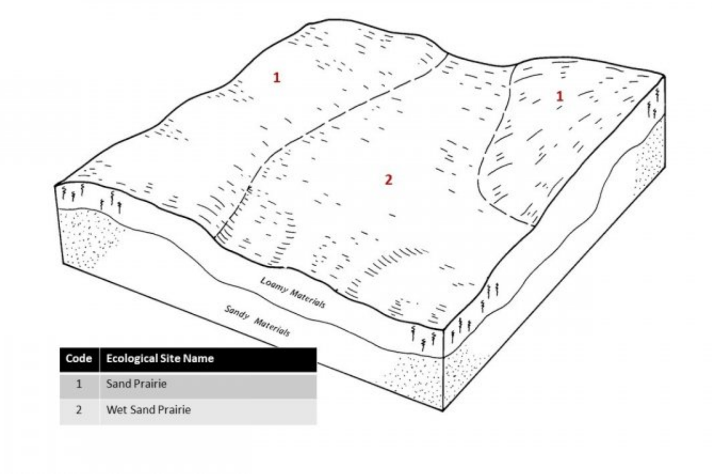



**Figure 2. Representative block diagram of Sand Prairie and associated ecological sites.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Slope shape across | (1) Convex |
| Slope shape up-down | (1) Convex |
| Landforms | (1) Upland<br>(2) River valley > Stream terrace |
| Runoff class | Very low to medium |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 104–594 m |
| Slope | 0–15% |
| Water table depth | 46–203 cm |
| Aspect | W, NW, N, NE, E, SE, S, SW |

## Climatic features

The Central Mississippi Valley Wooded Slopes, Northern Part falls into the humid subtropical (Cfa) and hot-summer humid continental climate (Dfa) Köppen-Geiger climate classifications (Peel et al. 2007). The two main factors that drive the climate of the MLRA are latitude and weather systems. Latitude, and the subsequent reflection of solar input, determines air temperatures and seasonal variations. Solar energy varies across the seasons, with summer receiving three to four times as much energy as opposed to winter. Weather systems (air masses and cyclonic storms) are responsible for daily fluctuations of weather conditions. High-pressure systems are responsible for settled weather patterns where sun and clear skies dominate. In fall, winter, and spring, the polar jet stream is responsible for the creation and movement of low-pressure systems. The clouds, winds, and precipitation associated with a low-pressure system regularly follow high-pressure systems every few days (Angel n.d.).

The soil temperature regime of LRU 115XC is classified as mesic, where the mean annual soil temperature is between 46 and 59°F (USDA-NRCS 2006). Temperature and precipitation occur along a north-south gradient, where temperature and precipitation increase the further south one travels. The average freeze-free period of this ecological site is about 179 days, while the frost-free period is about 146 days. The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is 37 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 42 and 62°F, respectively.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 138-153 days |
| Freeze-free period (characteristic range) | 170-185 days |

| | |
|---|---|
| Precipitation total (characteristic range) | 914-991 mm |
| Frost-free period (actual range) | 135-166 days |
| Freeze-free period (actual range) | 169-198 days |
| Precipitation total (actual range) | 889-1,016 mm |
| Frost-free period (average) | 146 days |
| Freeze-free period (average) | 179 days |
| Precipitation total (average) | 940 mm |

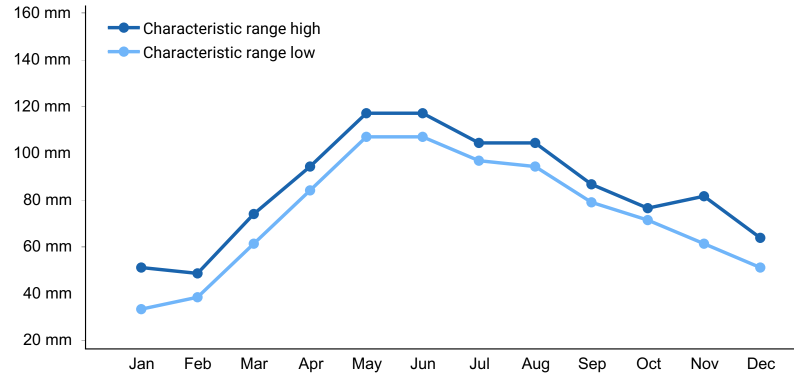



**Figure 3. Monthly precipitation range**

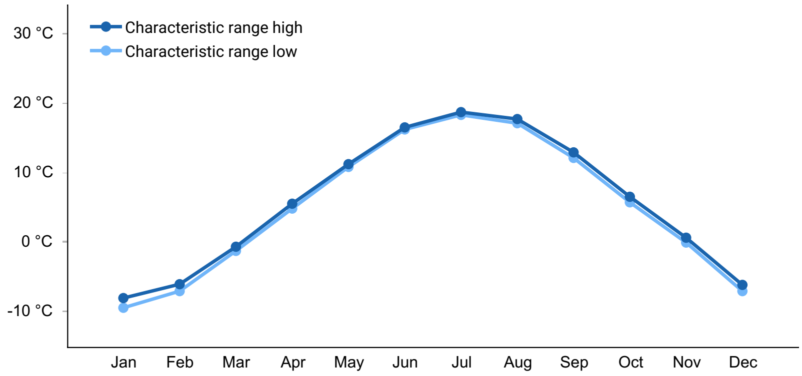



**Figure 4. Monthly minimum temperature range**

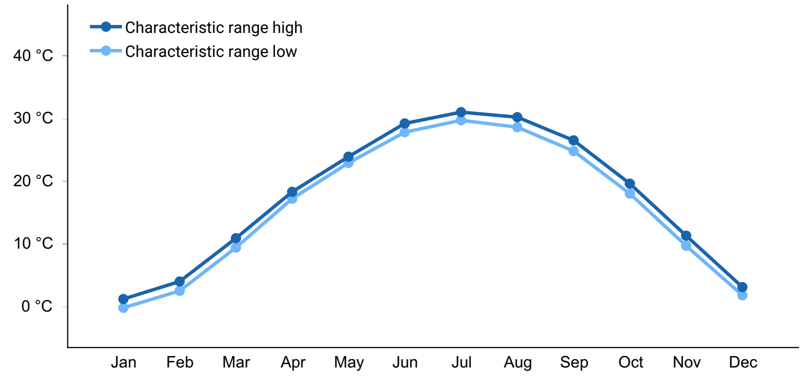



**Figure 5. Monthly maximum temperature range**

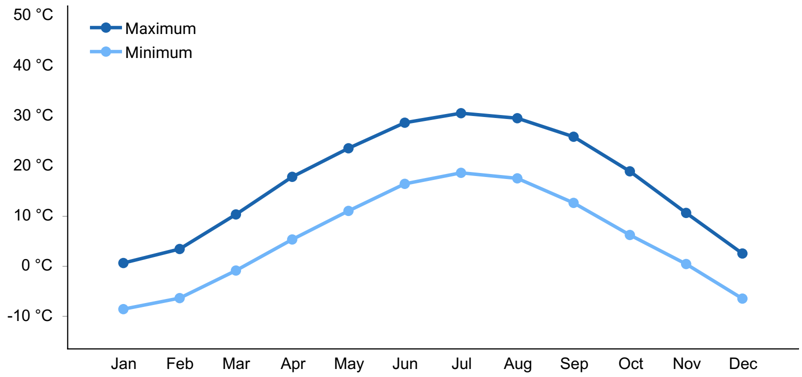



**Figure 6. Monthly average minimum and maximum temperature**

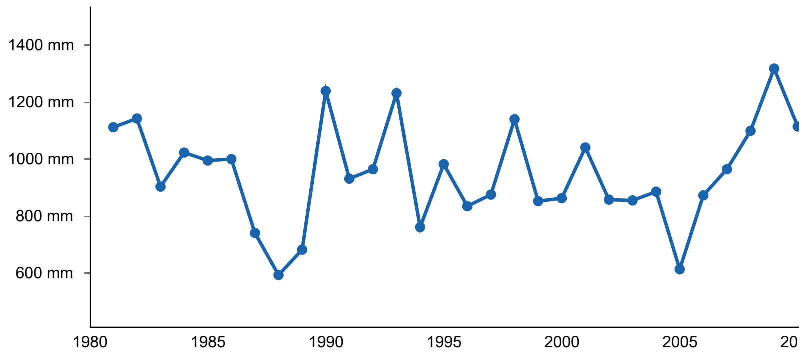



**Figure 7. Annual precipitation pattern**

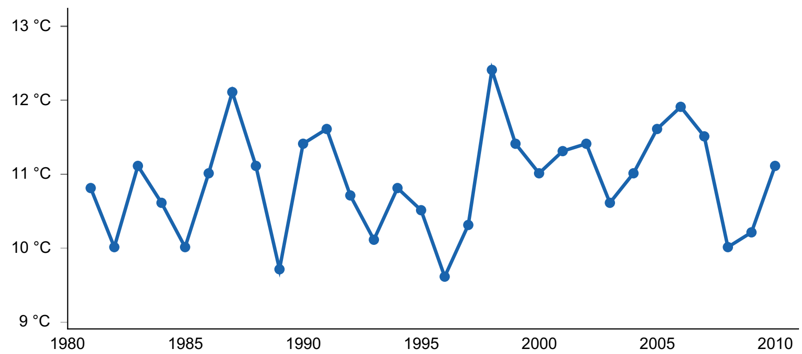



**Figure 8. Annual average temperature pattern**

## Climate stations used

- (1) CLINTON #1 [USC00131635], Camanche, IA
- (2) GLADSTONE DAM 18 [USC00113455], Burlington, IL
- (3) HAVANA [USC00113940], Lewistown, IL
- (4) LACON 1N [USC00114805], Lacon, IL

## Influencing water features

Sand Prairies are not influenced by wetland or riparian water features. Precipitation is the main source of water for this ecological site. Infiltration is moderate to high (Hydrologic Groups A and B), and surface runoff is very low to moderate. Surface runoff contributes some water to downslope ecological sites.

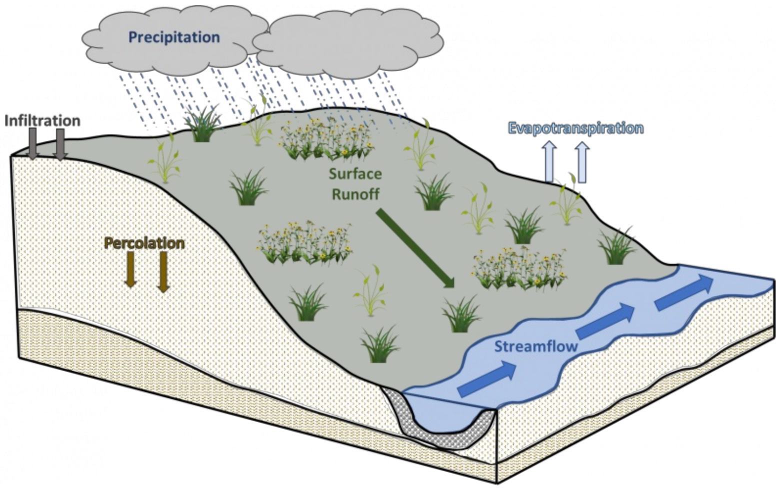



**Figure 9. Hydrologic cycling in Sand Prairie ecological site.**

## Soil features

Soils of Sand Prairies are in the Mollisols and Entisols orders, further classified as Aquic Argiudolls, Aquic Hapludolls, Entic Hapludolls, Lamellic Argiudolls, Pachic Hapludolls, Typic Argiudolls, Typic Hapludolls, and Typic Udipsamments with moderate to high infiltration and very low to moderate runoff potential. The soil series associated with this site includes Ade, Chute, Cresent, Dakota, Dickinson, Disco, Hoopeston, Jasper, Onarga, Plainfield, Psamments, Ridgeville, Sparta, Watseka, and Wea. The parent material is eolian sands, eolian deposits, or outwash, and the soils are somewhat poorly to excessively drained and very deep. Soil pH classes are very strongly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site.

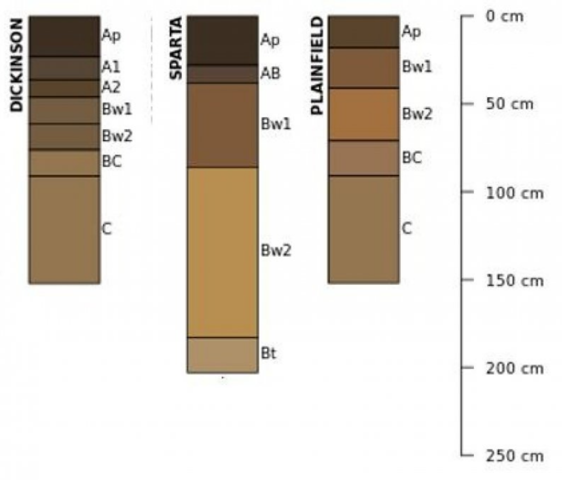



**Figure 10. Profile sketches of soil series associated with Sand Prairie.**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Eolian sands<br>(2) Eolian deposits<br>(3) Outwash |
| Family particle size | (1) Coarse-loamy<br>(2) Sandy |
| Drainage class | Somewhat poorly drained to excessively drained |
| Permeability class | Moderate to rapid |
| Depth to restrictive layer | 203 cm |
| Soil depth | 203 cm |
| Surface fragment cover <=3" | 0% |
| Surface fragment cover >3" | 0% |

| | |
|---|---|
| Available water capacity (Depth not specified) | 5.08–22.86 cm |
| Calcium carbonate equivalent (Depth not specified) | 0–35% |
| Electrical conductivity (Depth not specified) | 0–2 mmhos/cm |
| Soil reaction (1:1 water) (Depth not specified) | 5.6–7.8 |
| Subsurface fragment volume <=3" (Depth not specified) | 0–28% |
| Subsurface fragment volume >3" (Depth not specified) | 0–2% |

## Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The MLRA lies within the tallgrass prairie ecosystem of the Midwest, but a variety of environmental and edaphic factors resulted in a landscape that historically supported upland hardwood forests, lowland mixed forests, and scattered grass and sedge meadows. Sand Prairies form an aspect of this vegetative continuum. This ecological site occurs on uplands and high stream terraces on somewhat poorly to excessively drained coarse soils. Species characteristic of this ecological site consist of drought-adapted herbaceous vegetation.

Fire is a critical disturbance factor that maintains Sand Prairies. Fire intensity typically consisted of periodic, low-intensity surface fires occurring every 1 to 5 years (LANDFIRE 2009). Ignition sources included summertime lightning strikes from convective storms and bimodal, human ignitions during the spring and fall seasons. Native Americans regularly set fires to improve sight lines for hunting, driving large game, improving grazing and browsing habitat, agricultural clearing, and enhancing vital ethnobotanical plants (Barrett 1980).

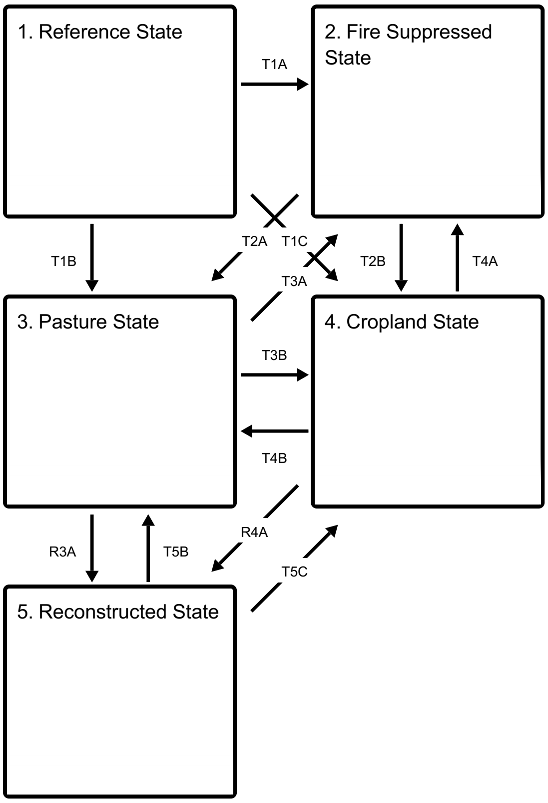
Sand blowouts are another disturbance factor that shape this ecological site. The high sand content coupled with increasing slopes allows for localized erosion and shifting from high wind events or following a recent fire. The resulting substrate exposures results in a temporarily reduced vegetative canopy cover, leaving a plant community that resembles a sand barren. Over time site stability increases and the community will shift back to sand prairie (NatureServe 2018).

Drought and grazing by native ungulates have also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the well-drained soils have favored the proliferation of plant species tolerant of such conditions. Drought can also slow the growth of plants and result in dieback of certain species. Large mammals, specifically prairie elk (Cervus elaphus), bison (Bos bison), and white-tailed deer (Odocoileus virginianus), likely occurred in low densities resulting in limited impacts to plant composition and dominance (LANDFIRE 2009). When coupled with fire, periods of drought and herbivory can greatly delay the establishment of woody vegetation (Pyne et al. 1996).

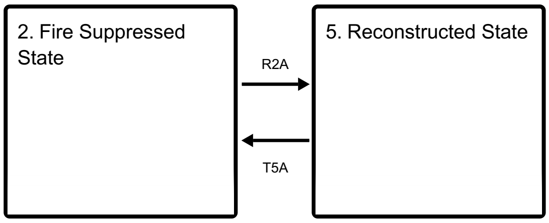
Today, Sand Prairies are limited in their extent, having been reduced as a result of land conversion to agricultural or livestock production. Remnants that do exist show evidence of indirect anthropogenic influence as woody species and non-native species are present in the community composition. A return to the historic plant community may not be possible following extensive land modification, but long-term conservation agriculture or prairie reconstruction efforts can help to restore some biotic diversity and ecological function. The state-and-transition model that follows provides a detailed description of each state, community phase, pathway, and transition. This model is based on available experimental research, field observations, literature reviews, professional consensus, and interpretations.

## State and transition model

**Ecosystem states**




**States 2 and 5 (additional transitions)**




**T1A** - Fire suppression

**T1B** - Practices to enhance forage quality and quantity

**T1C** - Conversion to agriculture

**T2A** - Practices to enhance forage quality and quantity

**T2B** - Conversion to agriculture

**R2A** - Site preparation, invasive species control, and seeding native species

**T3A** - Fire suppression; land abandonment

**T3B** - Transition to agriculture

**R3A** - Site preparation, invasive species control, and seeding native species

**T4A** - Fire suppression; land abandonment

**T4B** - Practices to enhance quality and quantity of forage

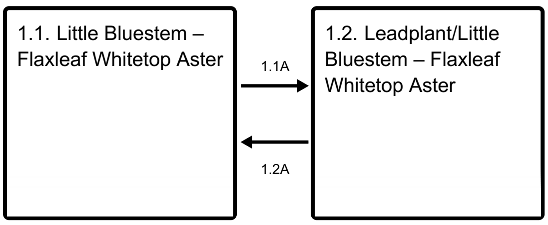
**R4A** - Site preparation, invasive species control, and seeding native species

**T5A** - Fire suppression; land abandonment

**T5B** - Practices to enhance forage quality and quantity

**T5C** - Conversion to agriculture

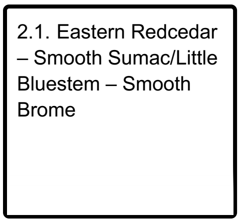
**State 1 submodel, plant communities**



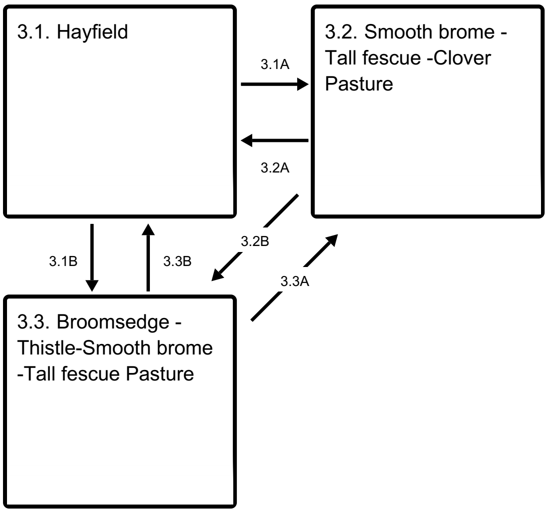

**1.1A** - Increase fire return interval

**1.2A** - Reduced fire return interval

**State 2 submodel, plant communities**




**State 3 submodel, plant communities**




**3.1A** - Grazing; proper forage to animal balance

**3.1B** - Grazing; overutilization

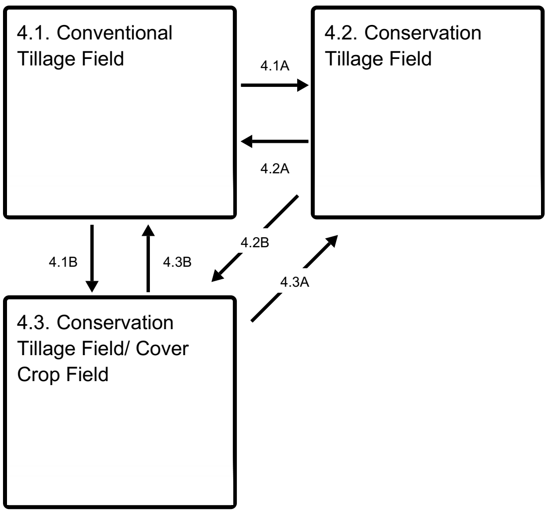
**3.2A** - Mechanical harvesting

**3.2B** - Grazing; overutilization

**3.3B** - Mechanical harvesting

**3.3A** - Grazing; proper animal to forage balance

**State 4 submodel, plant communities**




**4.1A** - Less tillage, residue management

**4.1B** - Less tillage, residue management, and implementation

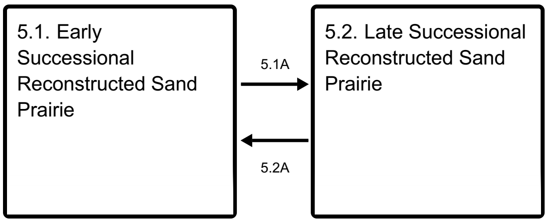
**4.2A** - Intensive tillage; remove residue; monoculture row cropping

**4.2B** - Implementation of cover cropping

**4.3B** - Intensive tillage; remove residue; monoculture row cropping

**4.3A** - Remove cover cropping

**State 5 submodel, plant communities**




**5.1A** - Restoration plan implemented

**5.2A** - Setback in restoration

## State 1
## Reference State

The reference plant community is categorized as a prairie community, dominated by herbaceous vegetation. The two community phases within the reference state are dependent on fire and sand blowouts. Short fire return intervals and occasional slope failures alters species composition, cover, and extent, while regular fire intervals keep woody species from dominating. Drought and grazing have more localized impacts on the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

### Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- flaxleaf whitetop aster (*Ionactis linariifolius*), grass

## Community 1.1
## Little Bluestem – Flaxleaf Whitetop Aster

Sites in this reference community phase are dominated by a mix of grasses and forbs. Vegetative cover is patchy to continuous (61 to 100 percent) and plants can reach heights greater than 3 feet tall (LANDFIRE 2009). Little bluestem, Indiangrass, porcupinegrass, and big bluestem are the dominant grasses. Characteristic forbs include flaxleaf whitetop aster, roundhead lespedeza (*Lespedeza capitata* Michx), Carolina puccoon (*Lithospermum caroliniense* (Walter ex J.G. Gmel.) MacMill.), and white heath aster ( *Symphyotrichum ericoides* (L.) G.L. Nesom) (NatureServe 2018). Fires every 3 to 4 years or periodic sand blowouts will maintain this phase, but an extended fire return interval would shift the community to phase 1.2 (LANDFIRE 2009).

### Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- flaxleaf whitetop aster (*Ionactis linariifolius*), other herbaceous

## Community 1.2
## Leadplant/Little Bluestem – Flaxleaf Whitetop Aster

This reference community phase represents natural succession as a result an extended fire return interval. The lack of fire allows low shrubs, such as leadplant (*Amorpha canescens* Pursh), to develop. Shrubs are relatively sparse and scattered throughout the community. The understory remains relatively similar to community phase 1.1. Small scale fires every 4 to 5 years will maintain this phase, but a large scale fire would shift the community back to phase 1.1 (LANDFIRE 2009).

### Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- flaxleaf whitetop aster (*Ionactis linariifolius*), other herbaceous

## Pathway 1.1A

## Community 1.1 to 1.2

Natural succession following an extended fire return interval.

## Pathway 1.2A
## Community 1.2 to 1.1

Natural succession following a large scale fire.

## State 2
## Fire Suppressed State

Long-term fire suppression can transition the reference sand prairie community into a woody-invaded shrub-prairie. This state is evidenced by a well-developed shrub layer and sparse trees (LANDFIRE 2009). Proximity to lands that have been altered provide opportunities for non-native invasive species to readily colonize this state, thereby reducing the native biodiversity and changing the vegetative community.

### Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- smooth sumac (*Rhus glabra*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- smooth brome (*Bromus inermis*), grass

## Community 2.1
## Eastern Redcedar – Smooth Sumac/Little Bluestem – Smooth Brome

This community phase represents the early stages of long-term fire suppression. In the absence of fire, woody species encroach into the native sand prairie. Shrubs are less than 6 feet tall and can exceed 30 percent cover. Common shrubs likely to be encountered include eastern redcedar (*Juniperus virginiana* L.) and smooth sumac (*Rhus glabra* L.). These tall shrubs shade out the understory, reducing the biodiversity. The shade also promotes a moister soil environment, providing suitable condition for invasion by non-native species, such as smooth brome (*Bromus inermis* L.) (Howard 1996).

### Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- smooth sumac (*Rhus glabra*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

## State 3
## Pasture State

The pasture state occurs when the reference state is converted to a farming system that emphasizes domestic livestock production known as grassland agriculture. Fire suppression, periodic cultural treatments (e.g., clipping, drainage, soil amendment applications, planting new species and/or cultivars, mechanical harvesting) and grazing by domesticated livestock transition and maintain this state (USDA-NRCS 2003). Early settlers seeded non-native species, such as smooth brome (*Bromus inermis* Leyss.), tall fescue ( Festuca arundinacea) and Kentucky bluegrass (*Poa pratensis* L.), to help extend the grazing season (Smith 1998). Over time, as lands were continuously harvested or grazed by herds of cattle, the non-native species were able to spread and expand across the landscape, reducing the native species diversity and ecological function.

### Dominant plant species

- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

## Community 3.1
## Hayfield

Sites in this community phase consist of forage plants that are planted and mechanically harvested. Mechanical harvesting removes much of the aboveground biomass and nutrients that feed the soil microorganisms (Franzluebbers et al. 2000; USDA-NRCS 2003). As a result, soil biology is reduced leading to decreases in nutrient uptake by plants, soil organic matter, and soil aggregation. Frequent biomass removal can also reduce the site's carbon sequestration capacity (Skinner 2008).

#### Dominant plant species

- smooth brome (*Bromus inermis*), grass
- timothy (*Phleum pratense*), grass
- orchardgrass (*Dactylis glomerata*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

## Community 3.2
## Smooth brome -Tall fescue -Clover Pasture

This community is characterized by seeded cool-season grass and forbs. Species will depend upon landowner goals and objectives and may include many different grasses and forbs. Common species include smooth brome (*Bromus inermis*), tall fescue (Festuca arundinacea), Kentucky bluegrass ( *Poa pratensis*), timothy (*Phleum pratense*), red clover ( *Trifolium pratense*) and white clover (*Trifolium repens* L.). Management inputs include control of weeds and brush. These sites are managed to ensure a proper forage/animal balance. Plants are not overutilized and have adequate rest and recovery

#### Dominant plant species

- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- red clover (*Trifolium pratense*), other herbaceous
- white clover (*Trifolium repens*), other herbaceous

## Community 3.3
## Broomsedge -Thistle-Smooth brome -Tall fescue Pasture

Overutilization of the pasture will result in a shift to include more undesirable species such as thistle (Cirsium spp.), broomsedge (*Andropogon virginicus* L.), ironweed (*Vernonia gigantea*), buttercup (Ranunculus spp.), ragweed (Ambrosia spp.) and blackberries (Rubus spp.). Many woody and weed species may be present depending on seed sources and level of soil disturbance. This community reflects an improper forage-to-animal balance which will negatively impact forage productivity and reproduction, soil health, and water quality. Ecological resiliency is compromised under these conditions.

#### Dominant plant species

- broomsedge bluestem (*Andropogon virginicus*), grass
- smooth brome (*Bromus inermis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- thistle (*Cirsium*), other herbaceous
- ironweed (*Vernonia*), other herbaceous
- buttercup (*Ranunculus*), other herbaceous
- ragweed (*Ambrosia*), other herbaceous

## Pathway 3.1A
## Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock grazing.

### Pathway 3.1B
### Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock grazing. Forage plants are overutilized.

### Pathway 3.2A
### Community 3.2 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

### Pathway 3.2B
### Community 3.2 to 3.3

Grazing of livestock with overutilization of the forage plants.

### Pathway 3.3B
### Community 3.3 to 3.1

Domestic livestock are removed, and mechanical harvesting is implemented.

### Pathway 3.3A
### Community 3.3 to 3.2

Forage plants are not overutilized and the site has a proper forage-to-animal balance.

### State 4
### Cropland State

The continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) has effectively eliminated the reference community and many of its natural ecological functions in favor of crop production. Corn and soybeans are the dominant crops for the site, and oats (Avena L.) and alfalfa (*Medicago sativa* L.) may be rotated periodically. These areas are likely to remain in crop production for the foreseeable future.

#### Dominant plant species

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

### Community 4.1
### Conventional Tillage Field

Sites in this community phase typically consist of monoculture row-cropping maintained by conventional tillage practices. They are cropped in either continuous corn or corn-soybean rotations. The frequent use of deep tillage, low crop diversity, and bare soil conditions during the non-growing season negatively impacts soil health. Under these practices, soil aggregation is reduced or destroyed, soil organic matter is reduced, erosion and runoff are increased, and infiltration is decreased, which can ultimately lead to undesirable changes in the hydrology of the watershed (Tomer et al. 2005).

#### Dominant plant species

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

### Community 4.2
### Conservation Tillage Field

This community phase is characterized by rotational crop production that utilizes various conservation tillage methods to promote soil health and reduce erosion. Conservation tillage methods include strip-till, ridge-till, vertical-till, or no-till planting systems. Strip-till keeps seedbed preparation to narrow bands less than one-third the width of the row where crop residue and soil consolidation are left undisturbed in-between seedbed areas. Strip-till planting may be completed in the fall and nutrient application either occurs simultaneously or at the time of planting. Ridge-till uses specialized equipment to create ridges in the seedbed and vegetative residue is left on the surface in between the ridges. Weeds are controlled with herbicides and/or cultivation, seedbed ridges are rebuilt during cultivation, and soils are left undisturbed from harvest to planting. Vertical-till systems employ machinery that lightly tills the soil and cuts up crop residue, mixing some of the residue into the top few inches of the soil while leaving a large portion on the surface. No-till management is the most conservative, disturbing soils only at the time of planting and fertilizer application. Compared to conventional tillage systems, conservation tillage methods can improve soil ecosystem function by reducing soil erosion, increasing organic matter and water availability, improving water quality, and reducing soil compaction.

**Dominant plant species**

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

## Community 4.3
## Conservation Tillage Field/ Cover Crop Field

Community Phase 4.3 Conservation Tillage Field/Alternative Crop Field – This community phase applies conservation tillage methods as described above as well as adds cover crop practices. Cover crops typically include nitrogen-fixing species (e.g., legumes), small grains (e.g., rye, wheat, oats), or forage covers (e.g., turnips, radishes, rapeseed). The addition of cover crops not only adds plant diversity but also promotes soil health by reducing soil erosion, limiting nitrogen leaching, suppressing weeds, increasing soil organic matter, and improving the overall soil ecosystem. In the case of small grain cover crops, surface cover and water infiltration are increased, while forage covers can be used to graze livestock or support local wildlife. Of the three community phases for this state, this phase promotes the greatest soil sustainability and improves ecological functioning within a cropland system.

**Dominant plant species**

- rye (*Secale*), grass
- wheat (*Triticum*), grass
- oat (*Avena hybrida*), grass
- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous
- alfalfa (*Medicago*), other herbaceous
- clover (*Trifolium*), other herbaceous

## Pathway 4.1A
## Community 4.1 to 4.2

Tillage operations are greatly reduced, crop rotation occurs on a regular interval, and crop residue remains on the soil surface.

## Pathway 4.1B
## Community 4.1 to 4.3

Tillage operations are greatly reduced or eliminated, crop rotation occurs on a regular interval, crop residue remains on the soil surface, and cover crops are planted following crop harvest.

## Pathway 4.2A
## Community 4.2 to 4.1

Intensive tillage is utilized, and monoculture row-cropping is established.

## Pathway 4.2B
## Community 4.2 to 4.3

Cover crops are implemented to minimize soil erosion.

## Pathway 4.3B
## Community 4.3 to 4.1

Intensive tillage is utilized, cover crops practices are abandoned, monoculture row-cropping is established, and crop rotation is reduced or eliminated.

## Pathway 4.3A
## Community 4.3 to 4.2

Cover crop practices are abandoned.

## State 5
## Reconstructed State

Prairie reconstructions have become an important tool for repairing natural ecological functions and providing habitat protection for numerous grassland dependent species. Because the historic plant and soil biota communities of the tallgrass prairie were highly diverse with complex interrelationships, historic prairie replication cannot be guaranteed on landscapes that have been so extensively manipulated for extended timeframes (Kardol and Wardle 2010; Fierer et al. 2013). Therefore, ecological restoration should aim to aid the recovery of degraded, damaged, or destroyed ecosystems. A successful restoration will have the ability to structurally and functionally sustain itself, demonstrate resilience to the natural ranges of stress and disturbance, and create and maintain positive biotic and abiotic interactions (SER 2002). The reconstructed prairie state is the result of a long-term commitment involving a multi-step, adaptive management process. Diverse, species-rich seed mixes are important to utilize as they allow the site to undergo successional stages that exhibit changing composition and dominance over time (Smith et al. 2010). On-going management via prescribed fire and/or light grazing can help the site progress from an early successional community dominated by annuals and some weeds to a later seral stage composed of native, perennial grasses, forbs, and a few shrubs. Establishing a prescribed fire regimen that mimics natural disturbance patterns can increase native species cover and diversity while reducing cover of non-native forbs and grasses. Light grazing alone can help promote species richness, while grazing accompanied with fire can control the encroachment of woody vegetation (Brudvig et al. 2007).

### Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass

## Community 5.1
## Early Successional Reconstructed Sand Prairie

Community Phase 5.1 Early Successional Reconstructed Sand Prairie – This community phase represents the early community assembly from prairie reconstruction and is highly dependent on the seed mix utilized and the timing and priority of planting operations. The seed mix should look to include a diverse mix of cool-season and warm-season annual and perennial grasses and forbs typical of the reference state (e.g., little bluestem, porcupinegrass, roundhead lespedeza). Cool-season annuals can help provide litter that promotes cool, moist soil conditions to the benefit of the other species in the seed mix. The first season following site preparation and seeding will typically result in annuals and other volunteer species forming a majority of the vegetative cover. Control of non-native species, particularly perennial species, is crucial at this point to ensure they do not establish before the native vegetation (Martin and Wilsey 2012). After the first season, native warm-season grasses should begin to become more prominent on the landscape.

### Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass

### Community 5.2
### Late Successional Reconstructed Sand Prairie

Appropriately timed disturbance regimes (e.g., prescribed fire) applied to the early successional community phase can help increase the beta diversity, pushing the site into a late successional community phase over time. While prairie communities are dominated by grasses, these species can suppress forb establishment and reduce overall diversity and ecological function (Martin and Wilsey 2006; Williams et al. 2007). Reducing accumulated plant litter from perennial bunchgrasses allows more light and nutrients to become available for forb recruitment, allowing greater ecosystem complexity (Wilsey 2008).

**Dominant plant species**

- little bluestem (*Schizachyrium scoparium*), grass
- flaxleaf whitetop aster (*Ionactis linariifolius*), other herbaceous

### Pathway 5.1A
### Community 5.1 to 5.2

Selective herbicides are used to control non-native species, and prescribed fire and/or light grazing helps to increase the native species diversity and control woody vegetation.

### Pathway 5.2A
### Community 5.2 to 5.1

Reconstruction experiences a decrease in native species diversity from drought or improper timing of management actions (e.g., reduced fire frequency, use of non-selective herbicides).

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

Long-term fire suppression transitions the site to the fire-suppressed scrub state (2).

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

Cultural treatments to enhance forage quality and yield transitions the site to the pasture state (3).

### Transition T1C
### State 1 to 4

Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

### Transition T2A
### State 2 to 3

Cultural treatments to enhance forage quality and yield transitions the site to the pasture state (3).

### Transition T2B
### State 2 to 4

Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

### Restoration pathway R2A
### State 2 to 5

Site preparation, invasive species control, and seeding native species transition this site to the reconstructed sand prairie state (5).

### Transition T3A
### State 3 to 2

Land abandonment transitions the site to the fire-suppressed scrub state (2).

### Restoration pathway T3B
### State 3 to 4

Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

### Restoration pathway R3A
### State 3 to 5

Site preparation, invasive species control, and seeding native species transition this site to the reconstructed sand prairie state (5).

### Transition T4A
### State 4 to 2

Land abandonment transitions the site to the fire-suppressed state (2).

### Transition T4B
### State 4 to 3

Cultural treatments to enhance forage quality and yield transitions the site to the pasture state (3).

### Restoration pathway R4A
### State 4 to 5

Site preparation, invasive species control, and seeding native species transition this site to the reconstructed sand prairie state (5).

### Transition T5A
### State 5 to 2

Land abandonment transitions the site to the fire-suppressed state (2).

### Transition T5B
### State 5 to 3

Cultural treatments to enhance forage quality and yield transition the site to the pasture state (3).

### Transition T5C
### State 5 to 4

Tillage, seeding of agricultural crops, and non-selective herbicide transition this site to the cropland state (4).

## 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 this ecological site description.

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## 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 | 01/10/2025 |
| 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:**