United States Department of Agriculture

# LOESS UPLAND PRAIRIE

## *Provisional Ecological Site Description*

An ecological site description (ESD) at the provisional status represents the lowest tier of documentation that is releasable to the public. The ESD contains a grouping of units based on site scale, soils, and ecology within a major land resource area that respond similarly to ecological processes. It has 1) enough information to distinguish it from similar and associated ecological sites and 2) a draft state-and-transition model capturing the ecological processes, vegetative states, and plant communities as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. However, little, if any, field level data have been collected. It is expected that the provisional ESD will continue to be refined towards an approved status.

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## General Information

**Ecological Site Name:**

**Abiotic:** Loess Upland Prairie

**Biotic:** *Andropogon gerardii – Schizachyrium scoparium*

**Ecological Site ID:** R108DY860IA

**Hierarchical Framework Relationships:**

**Major Land Resource Area (MLRA):** Illinois and Iowa Deep Loess and Drift, Western Part (108D)

**USFS Subregions:** Central Dissected Till Plains Section (251C); Loess Hills (251Cb) and Central Dissected Till and Loess Plain (251Cc) Subsections (Cleland et al, 2007)

**Relationship to Other Established Classifications:**

**NatureServe Classification:** Ecological System: Central Tallgrass Prairie (7134); Ecological Association: Central Tallgrass Big Bluestem Loess Prairie (NatureServe, 2013)

**Landfire Biophysical Setting:** Central Tallgrass Prairie (4314210) (Landfire, 2009)

**MLRA Notes:**

The Illinois and Iowa Deep Loess and Drift, Western Part MLRA covers parts of both Iowa and Missouri and is known locally as part of the Southern Iowa Drift Plain. A silty loess deposit of varying thickness (5 to 20 feet) covers a series of glacial advances known collectively as pre-Illinoisan till. This till, deposited more than half a million years ago, was subjected to multiple instances of extreme erosion as well as periods of subdued erosion and intense weathering. The loess is thickest in the western part of the MLRA and generally thins eastward. In some areas, the loess has been removed and the older weathered till, called a "paleosol," entirely exposed. These highly weathered soils, or paleosols, have a high content of clay, which slows the downward movement of water through the profile and causes water to move laterally instead of vertically. Wet areas, or "side-hill seeps," commonly form where these paleosols become exposed along hillsides (Prior, 1991).

The dominant soil orders in this MLRA are Mollisols and Alfisols and, to a lesser extent, Entisols and Inceptisols. Most of the soils are Udolls or Udalfs. Aquolls are on the flatter interfluves. The soils in the area dominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, well drained to poorly drained, and silty, loamy, or clayey. These soils on uplands include somewhat poorly drained, nearly level Argiudolls (Macksburg series); moderately well drained, gently sloping to strongly sloping Argiudolls (Sharpsburg series); poorly drained, nearly level Argiaquolls (Winterset series); and well drained strongly, sloping to steep Hapludalfs (Gara, Lindley, Ladoga, and Armstrong series) (USDA-NRCS, 2006).

The western part of the Illinois and Iowa Deep Loess and Drift is a segment of three other MLRAs within the Central Feed Grains and Livestock Region. The other areas are: the West-Central part (108C), the East-Central part (108B) and the Eastern part (108A).

**Ecological Site Concept:**

Loess Upland Prairies are within the red areas on the map (Figure 1). These sites formed in loess parent material and are on ridges, interfluves, and hillslopes on uplands. There is no bedrock within a depth of 80 inches. Loess thickness is greater than 1 foot. Slopes are less than 15 percent. Typically, these sites are located upslope from till ecological sites. Soils are typically Mollisols, characterized by deep, dark-colored surface horizons that have a high content of organic matter due to the dominant prairie vegetation and have no rooting restrictions.

Historic plant communities consisted of mostly grasses and a few forbs. Shrubs and trees are nearly absent at these sites. Plants endemic to the site include *Andropogon gerardii* and *Sorghastrum nutans,* which typically exceed 1 meter in height. *Schizachyrium scoparium*, which is also very common, is shorter. Other species that are commonly found in this community include *Solidago canadensis*, *Dichanthelium acuminatum,* and *Coreopsis tripteris*. Common invasive plants include *Poa pratensis* and *Bromus inermis*.

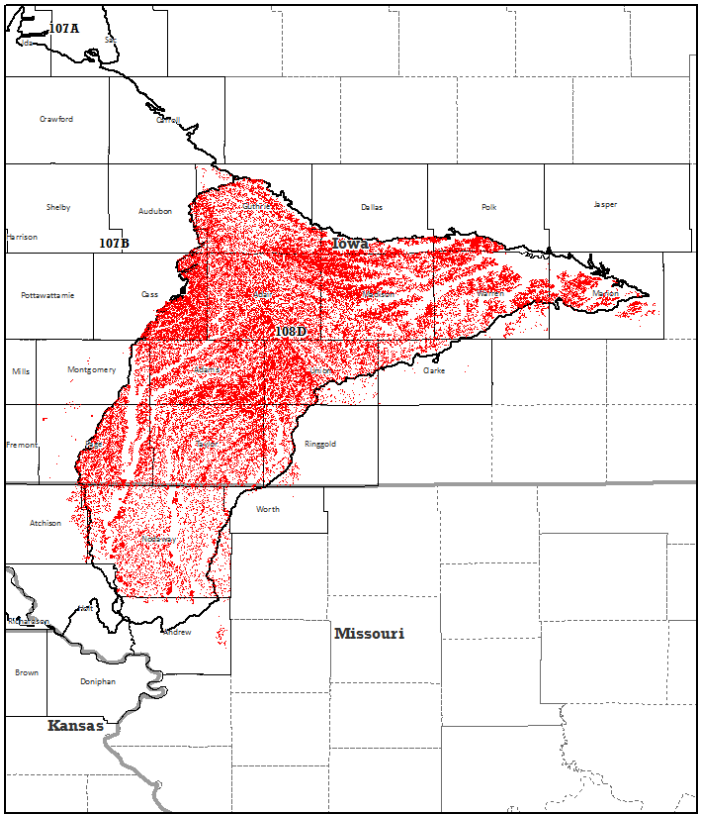



**Figure 1.** Distribution of Loess Upland Prairie within MLRA 108D.

## Physiographic Features

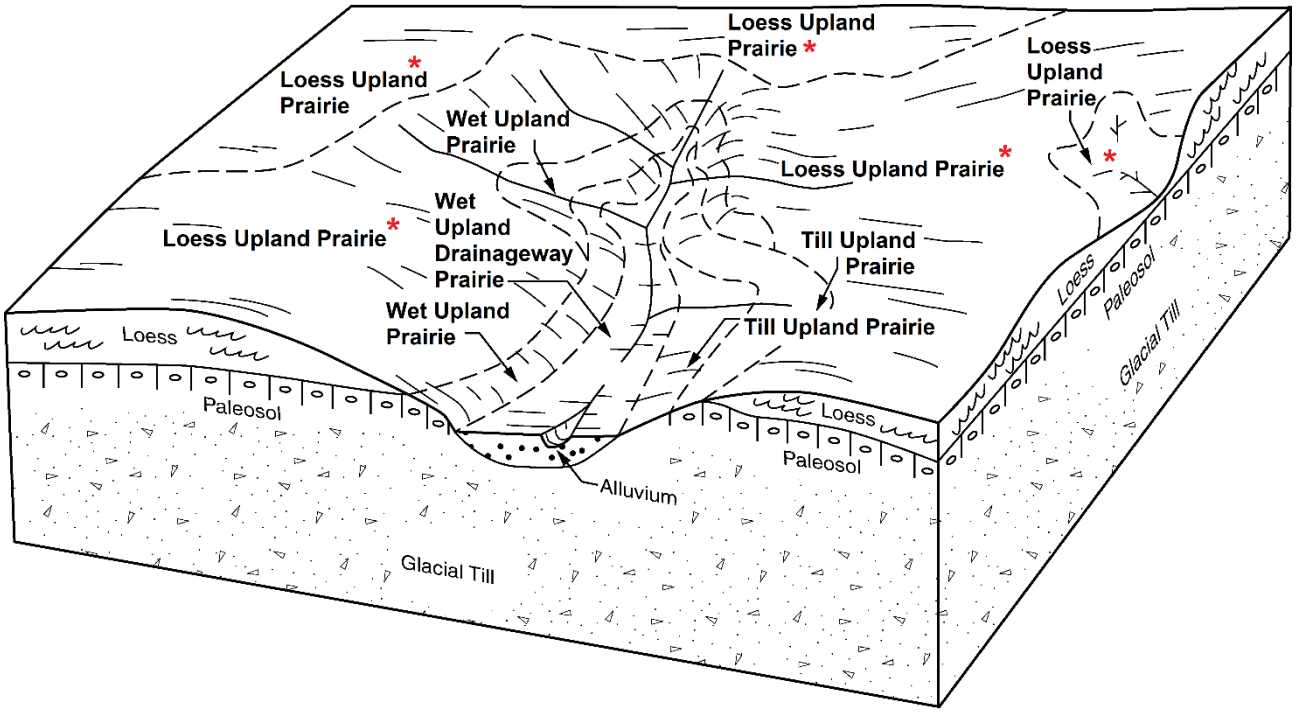
Loess Upland Prairie is a common site across MLRA 108D. It occurs on ridges, interfluves, and side slopes (Table 1) in uplands within dissected till plain landscapes (Figure 2). Slopes are generally less than 14 percent. The soils range from well drained (on narrow summits and shoulders) to somewhat poorly drained (on broader interfluves with slightly less relief).

**Table 1.** Physiographic features of Loess Upland Prairies. (Data were obtained from the National Soil Information System.)

| | Minimum | Maximum |
|---|---|---|
| **Elevation (ft.)** | 712 | 1512 |
| **Slope (percent)** | 0 | 14 |
| **Water Table Depth (in.)** | 12 | 72 |
| **Flooding** | none | none |
| **Ponding** | none | none |

**Landforms:** Ridges, interfluves, and side slopes
**Hillslope Positions:** Summits, shoulders, and backslopes
**Slope Shape:** Convex to linear (both up and across slope)

**A)**


Loess Upland Prairie *
Loess Upland Prairie *
Wet Upland Prairie
Loess Upland Prairie *
Loess Upland Prairie *
Wet Upland Drainageway Prairie
Till Upland Prairie
Wet Upland Prairie
Till Upland Prairie
Loess
Paleosol
Alluvium
Glacial Till
Loess
Paleosol
Loess
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Glacial Till

**B)**

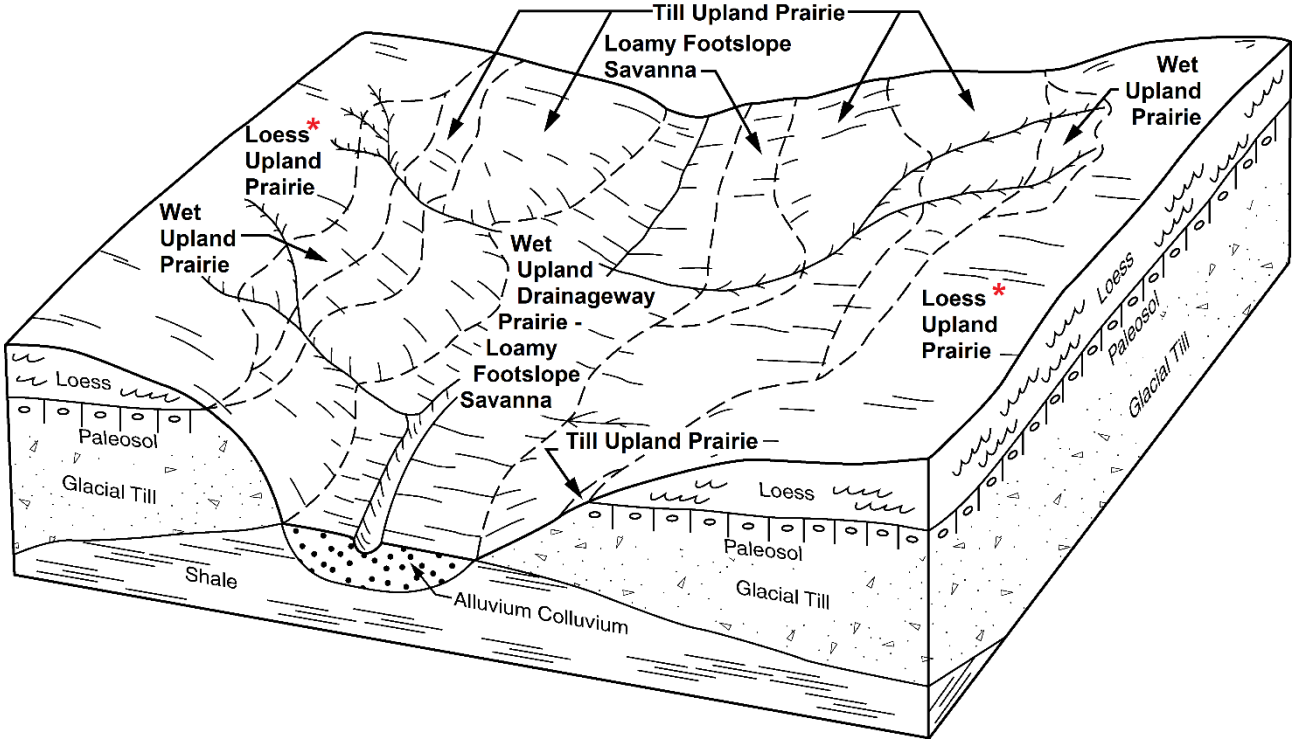

Till Upland Prairie
Loamy Footslope Savanna
Wet Upland Prairie
Loess * Upland Prairie
Wet Upland Prairie
Wet Upland Drainageway Prairie - Loamy Footslope Savanna
Loess * Upland Prairie
Till Upland Prairie
Loess
Paleosol
Glacial Till
Shale
Alluvium Colluvium
Loess
Paleosol
Glacial Till
Loess
Paleosol
Glacial Till

**Figure 2.** Block diagrams representing typical soil-landform sequences in A) loess ridges and B) loess ridges and glacial till side/footslopes. Red asterisks identify soil components correlated to Loess Upland Prairies.

## Climatic Features

The soil temperature regime of MLRA 108D is classified as mesic, i.e., the mean annual soil temperature is between 46 and 59 °F (Soil Survey Staff, 2014). The average freeze-free period of this ecological site is about 178 days, while the frost-free period is about 152 days (Table 2). Average annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 39 and 61 °F, respectively. Climate data and analyses are derived from 30-year averages gathered from 11 National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site (Table 4).

**Table 2.** Frost-free and freeze-free days.
(Data were obtained from NOAA weather stations within the range of this ecological site, using 30-year averages.)

| | Average days |
|---|---|
| **Frost-free period** (32.5 °F or greater, 90% probability) | 152 |
| **Freeze-free period** (less than 28.5 °F, 90% probability) | 178 |

**Table 3.** Monthly and annual precipitation and temperature in the range of Loess Upland Prairie.
(Data were obtained from NOAA weather stations within the range of this ecological site, using 30-year averages.)

| Monthly Moisture (Inches) and Temperature (°F) Distribution | | | | | |
|---|---|---|---|---|---|
| | ----------Precipitation---------- | | | ----------Temperature---------- | |
| | **Low** | **Med** | **High** | **Average Low** | **Average High** |
| **January** | 0.50 | 0.80 | 1.19 | 12.2 | 31.7 |
| **February** | 0.62 | 1.02 | 1.50 | 16.4 | 36.6 |
| **March** | 1.04 | 2.03 | 3.33 | 27.1 | 49.1 |
| **April** | 2.08 | 3.45 | 4.70 | 38.3 | 62.1 |
| **May** | 3.32 | 4.80 | 6.17 | 49.9 | 72.1 |
| **June** | 2.80 | 4.30 | 6.46 | 59.8 | 81.2 |
| **July** | 2.72 | 4.31 | 5.91 | 64.4 | 85.3 |
| **August** | 1.94 | 3.30 | 5.38 | 62.1 | 83.8 |
| **September** | 1.85 | 2.93 | 4.83 | 52.3 | 76.5 |
| **October** | 1.25 | 2.39 | 3.89 | 40.4 | 64.1 |
| **November** | 1.22 | 1.95 | 2.76 | 28.2 | 48.6 |
| **December** | 0.63 | 1.19 | 1.87 | 16.0 | 34.4 |
| **Annual** | - | 32.47 | - | 38.9 | 60.5 |

**Table 4.** NOAA climate stations used for data analysis, located within the range of this ecological site.

| Climate Station ID | Location (County) | From | To |
|---|---|---|---|
| BEDFORD, IA US [USC00130576] | Taylor (IA), 50833 | 1981 | 2010 |
| CLARINDA, IA US [USC00131533] | Page (IA), 51632 | 1981 | 2010 |
| CORNING, IA US [USC00131833] | Adams (IA), 50841 | 1981 | 2010 |
| CRESTON 2 SW, IA US [USC00131962] | Union (IA), 50801 | 1981 | 2010 |
| DES MOINES INTERNATIONAL AIRPORT, IA US [USW00014933] | Polk (IA), 50321 | 1981 | 2010 |
| GREENFIELD, IA US [USC00133438] | Adair (IA), 50849 | 1981 | 2010 |
| GUTHRIE CENTER, IA US [USC00133509] | Guthrie (IA), 50115 | 1981 | 2010 |
| INDIANOLA 2 W, IA US [USC00134063] | Warren (IA), 50125 | 1981 | 2010 |
| KNOXVILLE, IA US [USC00134502] | Marion (IA), 50138 | 1981 | 2010 |
| MARYVILLE 2 E, MO US [USC00235340] | Nodaway (MO), 64468 | 1981 | 2010 |
| WINTERSET 1 S, IA US [USC00139132] | Madison (IA), 50273 | 1981 | 2010 |

## Influencing Water Features

This ecological site is not influenced by wetland or riparian water features. Drainage is well to somewhat poor. Permeability is moderate to very slow. The site contains hydrologic groups C, D, and C/D (Hydrologic Soil Group, 2016). Land capability class is 1 for level areas and ranges to 4e for areas on the steepest slopes (Land Capability Classification, 2016). The water source is direct precipitation because there are no upslope contributing sites. Depth of endosaturation ranges from as little as 1 to 4 feet in the spring to greater than 6.5 feet during the rest of the year. Redoximorphic features are present in the soil and can be seen as depletions at depths of as little as 1.5 feet beneath the soil surface. Depletions may exist at shallower depths, but the dark colors of the soil can mask the visibility of these features. It is also important to note that some redoximorphic features which occur above a depth of 40 inches may be related to precipitation events occurring in abnormal years.

## Representative Soil Features

These soils have no major rooting restriction. The soils formed under prairie vegetation and have dark, organic-rich surface horizons. Parent material is loess. The soils have silt loam and silty clay loam surface horizons (Table 5). Subsoils are silty clay loam to silty clay. Some soils are affected by seasonal wetness in spring months. Soil series associated with this site include Arthur, Givin, Hedrick, Ladoga, Lineville, Macksburg, Nira, Northboro, Pershing and Sharpsburg.

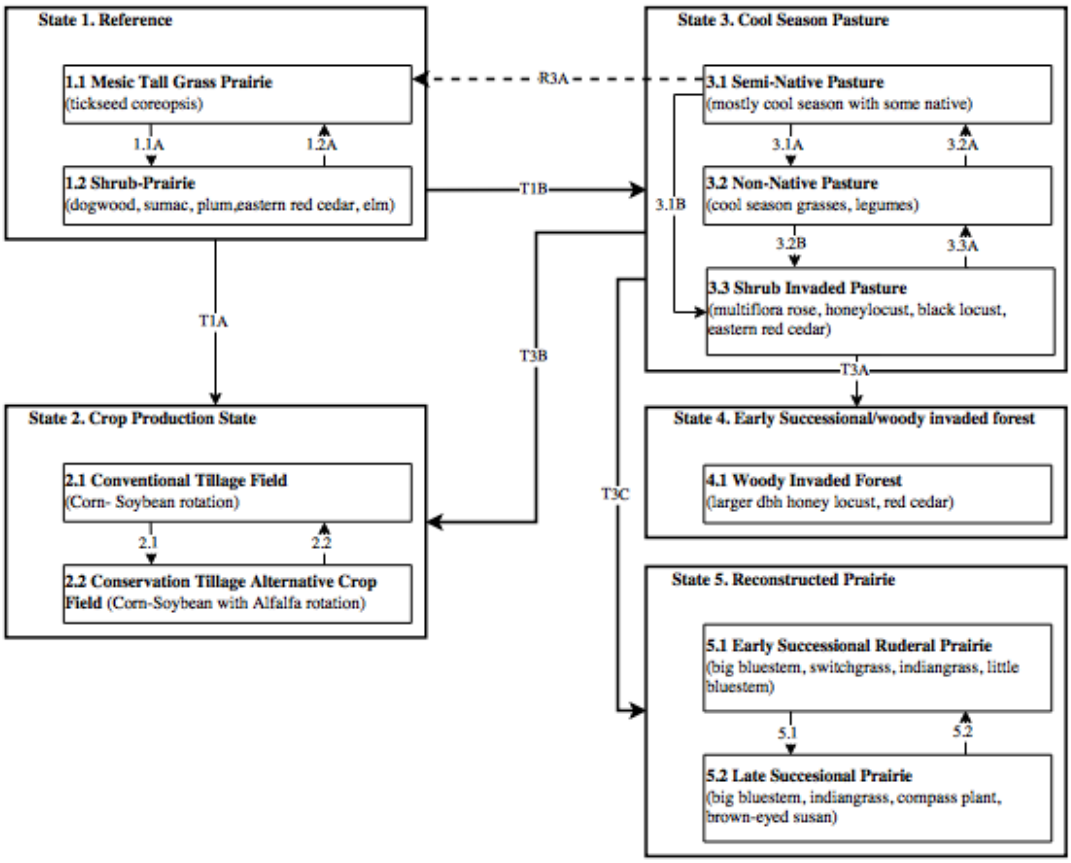
**Table 5.** Representative soil features of Loess Upland Prairies.
(Data were obtained from the National Soil Information System.)

| | Minimum | Maximum |
|---|---|---|
| **Surface Fragments less than 3" (percent cover)** | 0 | 0 |
| **Surface Fragments greater than 3" (percent cover)** | 0 | 0 |
| **Subsurface Fragments less than 3" (percent volume)** | 0 | 6 |
| **Subsurface Fragments greater than 3" (percent volume)** | 0 | 0 |
| **Drainage Class** | Somewhat Poorly | Well |
| **Permeability Class (most limiting layer)** | Very Slow | Moderate |
| **Soil Depth** | 80 | 80+ |
| **Soil Reaction/pH (1:1 water)** | 5.6 | 6.7 |
| **Available Water Capacity (inches in 60")** | 7.7 | 8.7 |
| **Calcium Carbonate Equivalent** | 0 | 0 |

**Parent Material – Kind:** Loess
**Surface Texture:** Silt loam and silty clay loam
**Surface Texture Modifier**: none
**Subsurface Group:** Fine and fine-silty
**Soil Series:** Arthur, Givin, Hedrick, Ladoga, Lineville, Macksburg, Nira, Northboro, Pershing, and Sharpsburg

## States and Community Phases

### R108DY860IA Loess Upland Prairie




| Code | Process |
|---|---|
| 1.1A | Lack of surface fire (8+ yrs), no grazing. |
| 1.2A | Grazing/browsing, frequent orhigher intensity fires (<3yrs). |
| T1A | Tillage/seeding/herbicide. |
| 2.1 | Less Tillage; residue management; crop rotation. |
| 2.2 | Intensive Tillage; less residue; monoculture cropping. |
| 3.1A | Herbicide, inter-seeding. |
| 3.2A | Overgrazing, lack ofseeding/herbicide. |
| 3.1B, 3.2B | Abandonment. |
| 3.3A | Brush management/herbicide/seeding. |
| T3A | Abandonment (20+yrs). |
| T3B | Sodbuster, tillage, seeding. |
| R3A | Prescribed fire (spring/earlysummer)/grazing, reduce cool season grasses, selective grass herbicides. |
| T3C | Site preparation, herbicide, brush management, seeding, tillage. |
| T1B | Plowing, seeding; overgrazing. |
| 5.1 | Natural forb reseeding or by mechanical planting/seeding. |
| 5.2 | Forb failure due to drought and/or poor seeding methods. |

**Figure 3.** State-and-transition diagram for Loess Upland Prairie provisional ecological site.

**Ecological Dynamics**

The reference plant community is categorized as an upland prairie and includes grasses, sedges, forbs, and shrubs. Species composition is typically indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Canada goldenrod (*Solidago canadensis*), *Sporobolus asper,* tapered rosette grass (*Dichanthelium acuminatum*), and tall tickseed (*Coreopsis tripteris*).

Fire, grazing, and drought are all disturbances influencing the dynamics at this site. These sites likely burned 3 to 5 times every 10 years. Grazing by whitetail deer and prairie elk was common, and bison may have also grazed to a lesser extent. Disturbances from these animals removed thatch and litter and reduced the proliferation of small trees and shrubs (Mutel, 2008)

As this region was settled, these prairies were typically altered to better suit agricultural needs. Corn and soybean production is common in these areas today. Very few small remnants of this prairie exist now.

**STATE 1 – REFERENCE STATE**

As a mesic tallgrass prairie, this state has a reference plant community which is categorized as upland prairie and includes grasses, sedges, forbs, and shrubs. Species composition is typically indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Canada goldenrod (*Solidago canadensis*), *Sporobolus asper*, tapered rosette grass (*Dichanthelium acuminatum*), and tall tickseed (*Coreopsis tripteris*). Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) are common invasive species. Extended periods with no fire and no grazing can cause this state to shift into a shrub-prairie (Figure 3). Shrubs include multiflora rose (*Rosa multiflora*), smooth sumac (*Rhus glabra*), roughleaf dogwood (*Cornus drummondii*), poison ivy (*Toxicodendron radicans*), *Rubus allegheniensis,* and *Vitis riparia*. Conversely, grazing and browsing accompanied by frequent or high-intensity fires can ultimately shift this phase back towards the reference community (Rosburg, 2014).

**STATE 2 – CROP PRODUCTION STATE**

This state is the most common. Tillage, seeding, and herbicide have destroyed all of the original prairie. Corn and soybeans are the principal crops. Variation in management within this state creates a wide range of soil properties and can be detrimental to the environment. Reduced tillage or no tillage, alternative crops, and crop rotations will shift this state to another and improve these soil properties.

**STATE 3 – COOL-SEASON PASTURE STATE**

This state is a native reference state transformed into a cool-season pasture due to a suppression of fire and heavy grazing by livestock. Because there were very little inputs to the original reference state, this state has possibility for restoration to the reference state. This path would need prescribed fire, grazing, and a reduction of cool-season grasses by use of a selective herbicide. With a combination of inputs of non-selective herbicide and inter-seeding, the semi-native pasture will transition to a non-native pasture. Continual management is required to prevent

invasion of shrubs. Shrubs invade if the site is overgrazed and seeding and herbicide are discontinued.

**STATE 4 – EARLY SUCCESIONAL/WOODY INVADED FOREST STATE**

Abandonment of the shrub-invaded pasture for 20 or more years will result in a woody invaded forest consisting of larger diameter breast height honey locust and red cedar. At this state, a significant amount of input and resources would be required to reverse the invasion of woody species (Woodland Health, 2004).

**STATE 5 – RECONSTRUCTED PRAIRIE STATE**

Prairie reconstruction is accomplished through site preparation, use of herbicide, brush management, seeding, and tillage. Careful management and the planting, seeding, or natural propagation of forbs will further develop this site from an early successional ruderal prairie to a late successional prairie. Unsuccessful attempts to restore forbs due to poor seeding or drought will cause a shift back to the ruderal prairie state.

## Supporting Information

**Associated Ecological Sites:**

| Ecol. Site Name | Site ID | Narrative |
|---|---|---|
| Wet Upland Prairie | R108DY864IA | Fine textured soils, including Sperry, Winterset, Clearfield, Clarinda and Rinda. |
| Wet Upland Drainageway Prairie | R108DY824IA | Fine and fine-silty soils, including Ackmore, Colo, Vesser and Zook. |
| Till Upland Prairie | R108DY863IA | Fine and fine-loamy soils, including Adair, Armstrong, Bucknell, Gara, Lamoni and Shelby. |

**Similar Ecological Sites:**

| Ecol. Site Name | Site ID | Narrative |
|---|---|---|
| Sandy Upland Prairie | R108DY862IA | Sandy and coarse-loamy soils, including Dickinson and Dickman. |
| Loess Upland Woodland | F108DY850IA | Fine and fine-silty soils, including Clinton. |

**Ecological Site Correlation Issues and Questions:**

- Plant composition within reference state and alternative states is not yet well documented.
- Some soils in the MLRA 108D portion of Nodaway County, Missouri are currently assigned to a MLRA 109 ESD. This issue will need to be resolved in the future.

## References:

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological subregions: Sections and subsections of the conterminous United States. USDA Forest Service, General Technical Report WO-76.

Landfire. 2009. Biophysical setting 4314210 Central Tallgrass Prairie. In: Landfire National Vegetation Dynamics Models. USDA Forest Service and U.S. Department of the Interior.

Mutel, Cornelia F. 2008. The Emerald Horizon: The History of Nature in Iowa. University of Iowa Press.

NatureServe. 2013. Associations and alliances of Iowa. St. Paul, Minnesota.

Prior, Jean Cutler. 1991. Landforms of Iowa. University of Iowa Press, Iowa City, Iowa.

Rosburg, T. 2014 July 26. Medora Prairie. Unpublished raw data. Ecological Site Contract.

Soil Survey Staff. 2014. Keys to soil taxonomy, 12th ed. USDA Natural Resources Conservation Service.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. USDA Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. Hydrologic Soil Group. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054223#39 accessed August 29, 2016.

United States Department of Agriculture, Natural Resources Conservation Service. Land Capability Classification. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054226#02 accessed August 29, 2016.

Woodland Health: Stewardship Options for Iowa Woodland Owners. 2004. Iowa Natural Heritage Foundation. Des Moines, Iowa.