Ecological site R108XB019IL
Mucky Sedge Meadow

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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): 108X–Illinois and Iowa Deep Loess and Drift

The Illinois and Iowa Deep Loess and Drift, East-Central Part (MLRA 108B) includes the Rock River Hill Country, Grand Prairie, and Western Forest-Prairie physiographic divisions (Schewman et al. 1973). It falls entirely in one state (Illinois), encompassing approximately 7,450 square miles (Figure 1). The elevation ranges from approximately 985 feet above sea level (ASL) in the northern and western parts to 660 feet ASL in south and west. Local relief is mainly 3 to 10 feet on the broad, upland flats and about 160 feet along the major streams and dissected drainageways. Wisconsin-aged loess forms a moderately thin to thick layer across the entire area with Illinoisan glacial drift below. Bedrock lies beneath the glacial material with Pennsylvania shales, siltstones, and limestones in the south and west and Ordovician and Silurian limestone in the extreme north. This bedrock can be exposed on bluffs along the major rivers (USDA-NRCS 2006).

The vegetation in the MLRA 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. Moisture continued to increase in the southernmost region 5,000 years ago, resulting in an increase of forested systems (Taft et al. 2009). Fire, droughts, and grazing by native mammals helped to maintain the prairies and savannas until the arrival of European settlers, and the forests were maintained by droughts, wind, lightning, and occasional fire (Taft et al. 2009; NatureServe 2018).

Classification relationships

USFS Subregions: Southwestern Great Lakes Morainal (222K), Central Till Plains-Oak Hickory Section (223G), Central Dissected Till Plains (251C), and Central Till Plains and Grand Prairies (251D) Sections; Rock River Old Drift Country (222Kh), Effingham Plain (222Ga), Mississippi River and Illinois Alluvial Plains (251 Cf), East Mississippi River Hills (251Ci), Galesburg Dissected Till Plain (251Cj), Carlinville Dissected Till Plain (251Ck), Green River Lowland (251Da), Western Grand Prairie (251Db), Northern Grand Prairie (251Dc), Southern Grand Prairie (251De), and Springfield Plains (251Df) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Illinois/Indiana Prairies (54a), Sand Area (54d), Rock River Hills (54g), and Western Dissected Illinoian Till Plain (72i) (USEPA 2013)

National Vegetation Classification – Ecological Systems: Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687) (NatureServe 2018)

National Vegetation Classification – Plant Associations: Carex lacustris Wet Meadow (CEGL002256) (Nature Serve 2018)

Biophysical Settings: Eastern Great Plains Wet Meadow-Marsh-Prairie System (BpS 4214880) (LANDFIRE 2009)

Illinois Natural Areas Inventory: Marsh (White and Madany 1978)

Ecological site concept

Mucky Sedge Meadows are located within the blue areas on the map (Figure 1). They occur on lake plains and river valleys. The soils are Histosols that are very poorly-drained and deep, formed in organic parent materials. The site experiences seasonal flooding and ponding for a significant portion of the growing season.

The historic pre-European settlement vegetation on this ecological site was dominated by emergent herbaceous vegetation adapted to flooded and saturated conditions. Hairy sedge (Carex lacustris L.) and broadleaf arrowhead (Sagittaria latifolia Willd.) are the dominant and characteristic species for the site, respectively. River bulrush (Bolboschoenus fluviatilis (Torr.) Soják), softstem bulrush (Schoenoplectus tabernaemontani (C.C. Gmel.) Palla), and broadleaf cattail (Typha latifolia L.) are other common emergent associates. An herbaceous species typical of an undisturbed plant community associated with this ecological site is swamp loosestrife (Decodon verticillatus (L.) Elliott) (White and Madany 1978; Taft et al. 1997). Depth and duration of flooding are the primary disturbance factors that maintain this ecological site, while native mammal herbivory is a secondary factor (LANDFIRE 2009).

Associated sites

F108XB020IL	**Loamy Floodplain Forest** Alluvial parent material that is not shallow to a water table including Radford soils
F108XB021IL	**Wet Loamy Floodplain Forest** Alluvial parent material that has a water table 12 inches or less from the surface including Calco, Cohoctah, Fella, Normandy, and Sawmill soils

Similar sites

R108XB009IL	**Ponded Loess Sedge Meadow** Ponded Loess Sedge Meadows occur on uplands and are a MINERAL SOIL FLATS wetland.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex lacustris* (2) *Sagittaria latifolia*

Physiographic features

Mucky Sedge Meadows occur on lake plains and river valleys. They are situated on elevations ranging from approximately 341 to 1401 feet ASL. The site can experience periodic flooding and ponding (Table 1).

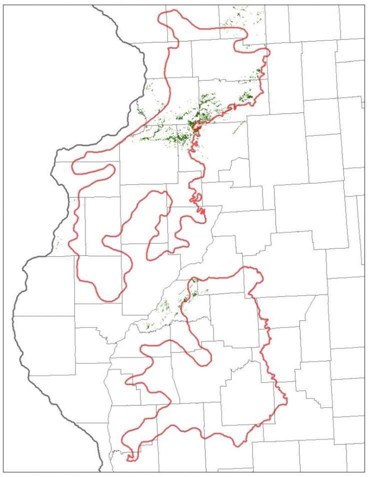


Figure 1. Figure 1. Location of Mucky Sedge Meadow ecological site within MLRA 108B.

Table 2. Representative physiographic features

Slope shape across	(1) Linear (2) Concave
Slope shape up-down	(1) Linear (2) Concave
Landforms	(1) Lake plain (2) River valley
Runoff class	Negligible
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding duration	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	341–1,401 ft
Slope	0–2%
Ponding depth	0–12 in
Water table depth	3–6 in
Aspect	Aspect is not a significant factor

Climatic features

The Illinois and Iowa Deep Loess and Drift, East-Central Part falls into the hot-summer humid continental climate (Dfa) and the humid subtropical continental climate (Cfa) 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 MLRA 108B 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 178 days, while the frost-free period is about 141 days (Table 2). The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is approximately 36 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 40 and 60°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from three National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site (Table 4).

Table 3. Representative climatic features

Frost-free period (characteristic range)	133-151 days
Freeze-free period (characteristic range)	173-183 days
Precipitation total (characteristic range)	35-37 in
Frost-free period (actual range)	126-152 days
Freeze-free period (actual range)	169-185 days
Precipitation total (actual range)	35-38 in
Frost-free period (average)	141 days
Freeze-free period (average)	178 days
Precipitation total (average)	36 in

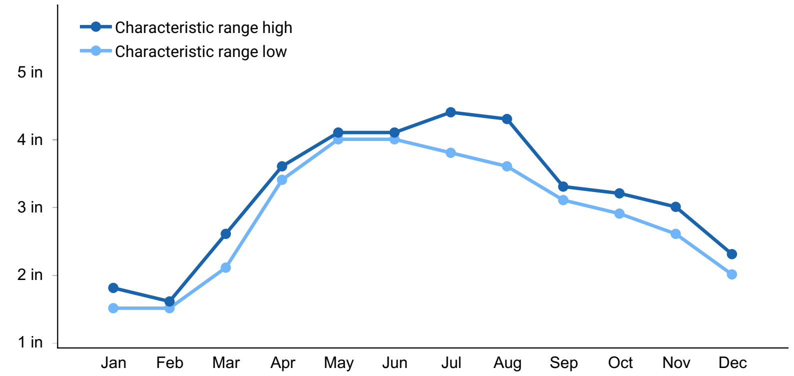


Figure 2. Monthly precipitation range

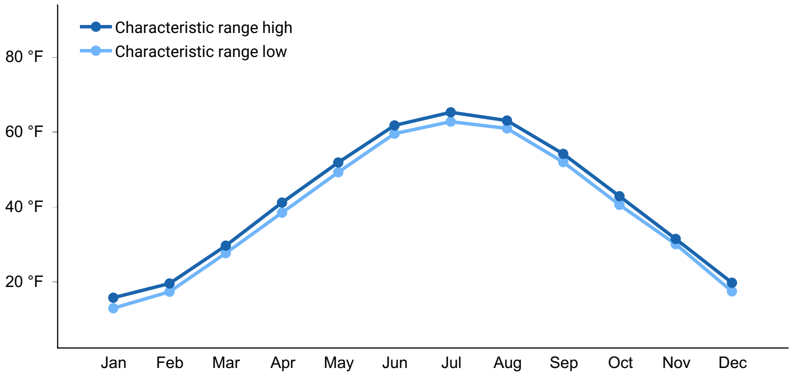


Figure 3. Monthly minimum temperature range

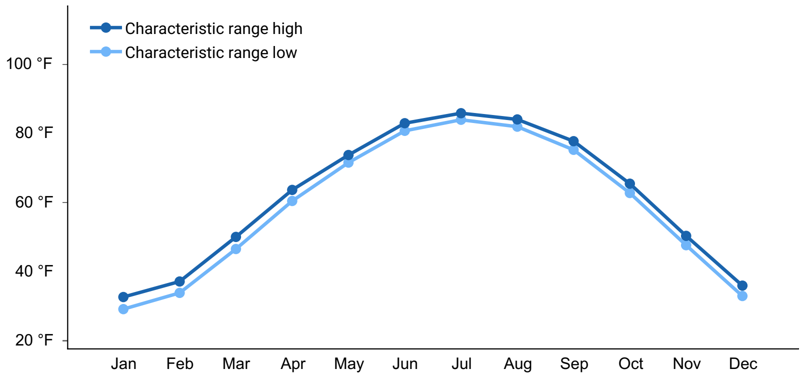


Figure 4. Monthly maximum temperature range

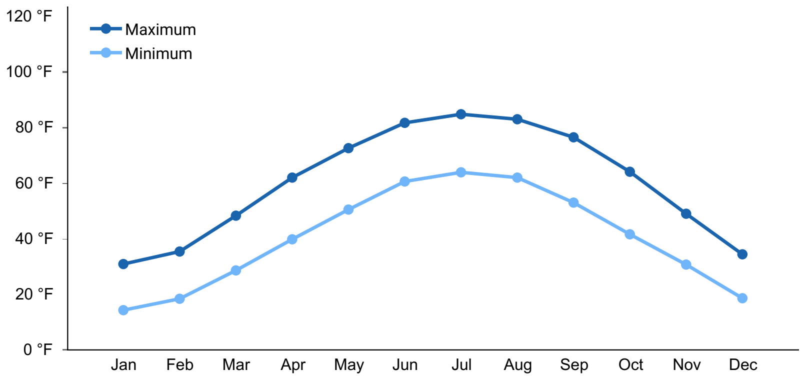


Figure 5. Monthly average minimum and maximum temperature

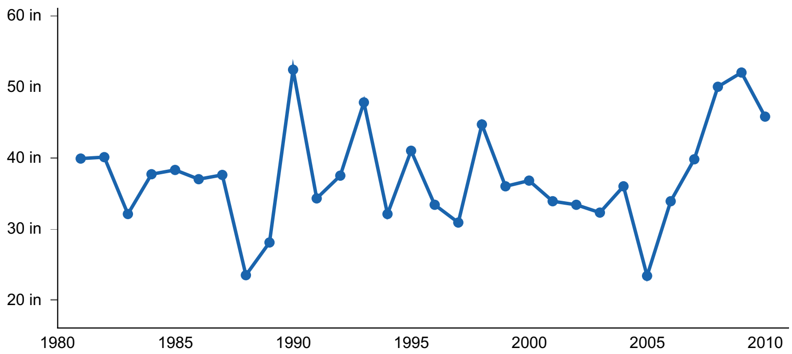


Figure 6. Annual precipitation pattern

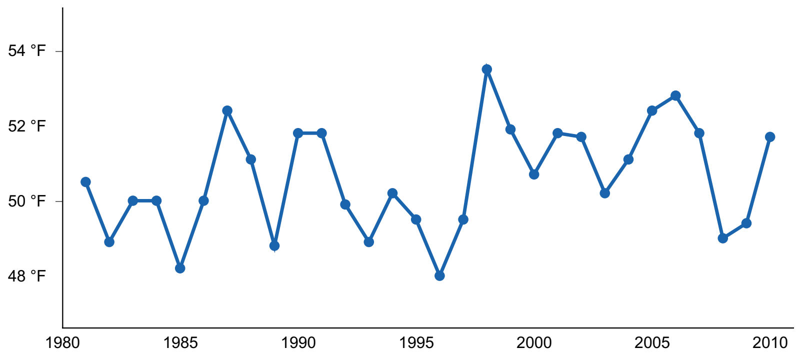


Figure 7. Annual average temperature pattern

Climate stations used

- (1) GENESEO [USC00113384], Geneseo, IL
- (2) ROCHELLE [USC00117354], Rochelle, IL
- (3) MASON CITY 2N [USC00115413], Mason City, IL

Influencing water features

Mucky Sedge Meadows are classified as a RIVERINE: flooded, ponded, herbaceous wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Persistent, Emergent, Seasonally Flooded-Saturated wetland under the National Wetlands Inventory (FGDC 2013). Overbank flow and subsurface hydraulic connections are the main sources of water for this ecological site, but other sources may be from surface runoff from adjacent uplands and precipitation (Smith et al. 1995). Infiltration is very slow (Hydrologic Group D) for undrained soils, and surface runoff is negligible (Figure 4).

Primary wetland hydrology indicators for an intact Mucky Sedge Meadows may include: A1 Surface water, A2 High water table, A3 Saturation, and B14 True aquatic plants. Secondary wetland hydrology indicators may include: B10: Drainage patterns, C2 Dry-season water table, D2 Geomorphic position, and D5 FAC-neutral test (USACE 2010).

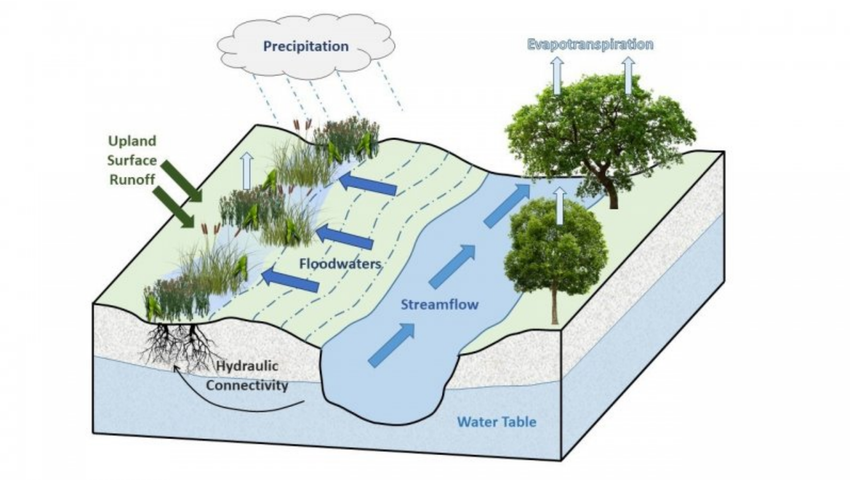


Figure 8. Figure 4. Hydrologic cycling in Mucky Sedge Meadow ecological site.

Soil features

Soils of Mucky Sedge Meadows are in the Histosols order, further classified as Limnic Haplosaprists and Terric Haplosaprists with very slow infiltration and negligible runoff potential. The soil series associated with this site includes Adrian, Muskego, and Palms. The parent material is herbaceous organic material, and the soils are very poorly-drained and deep with seasonal high-water tables. Soil pH classes are strongly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site (Table 5).

Some soil map units in this ecological site, if not drained, may meet the definition of hydric soils and are listed as meeting criteria 1 of the hydric soils list (77 FR 12234).

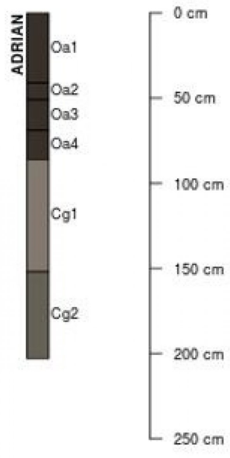


Figure 9. Figure 5. Profile sketch of soil series associated with Mucky Sedge Meadow.

Table 4. Representative soil features

Parent material	(1) Herbaceous organic material
Drainage class	Very poorly drained
Permeability class	Very slow to slow
Depth to restrictive layer	80 in
Soil depth	80 in

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.

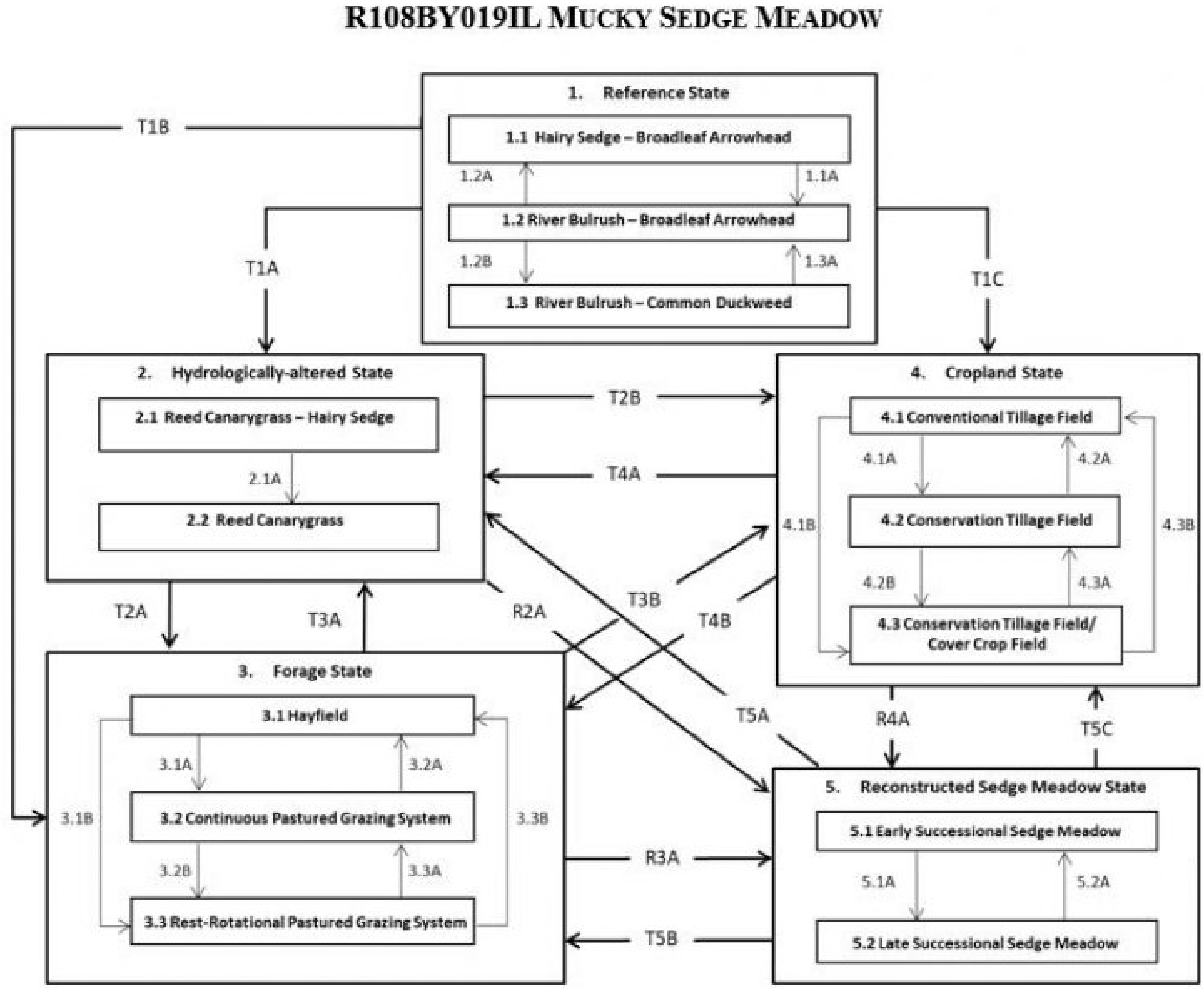
The MLRA lies within the tallgrass prairie ecosystem of the Midwest. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in support prairies, savannas, and forests. Mucky Sedge Meadows form an aspect of this vegetative continuum. This ecological site occurs on lake plains and river valleys on very poorly-drained soils. Species characteristic of this ecological site consist of hydrophytic vegetation.

Flooding is the dominant disturbance factor in Mucky Sedge Meadows (LANDFIRE 2009). Seasonal flooding likely occurred annually from spring snow melt and heavy rains. The depth and duration of ponded water affects species diversity, composition, and productivity. Little to no ponded water allows more of a sedge meadow community to dominate, while deep water depths create a shallow to deep marsh community populated with emergent and aquatic vegetation.

Animal herbivory also played a role in shaping this ecological site. Foraging muskrats can alter the extent of emergent vegetation, creating larger patches of open water. Left unchecked, muskrats can remove all the emergent vegetation, which won’t re-establish until the next drought or drawdown event (White and Madany 1978).

Today, Mucky Sedge Meadows have been greatly reduced as the land has mostly been converted for agricultural production. Remnants that do exist show evidence of indirect anthropogenic influences from hydrological alterations as non-native species have replaced the natural vegetation. A return to the historic plant community may not be possible due to significant hydrologic and water quality changes in the watershed, but long-term conservation agriculture or habitat reconstruction efforts can help to restore some natural 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



Code	Process
1.1A, 1.3A	Ponded water depths 12-24 inches
1.2A	Ponded water depths <12 inches
1.2B	Ponded water depths >24 inches
T1A, T3A, T4A, T5A	Changes to natural hydroperiod and/or land abandonment
2.1A	Increasing changes to hydrology and increasing sedimentation
T1B, T2A, T4B, T5B	Cultural treatments are implemented to increase forage quality and yield
3.1A	Mechanical harvesting is replaced with domestic livestock and continuous grazing
3.1B	Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing
3.2A, 3.3B	Tillage, forage crop planting, and mechanical harvesting replace grazing
3.2B	Implementation of rest-rotational grazing
3.3A	Implementation of continuous grazing
T1C, T2B, T3B, T5C	Agricultural conversion via drainage, tillage, seeding, and non-selective herbicide
4.1A	Less tillage, residue management
4.1B	Less tillage, residue management, and implementation of cover cropping
4.2B	Implementation of cover cropping
4.2A, 4.3B	Intensive tillage, remove residue, and reinitiate monoculture row cropping
4.3A	Remove cover cropping
R2A, R3A, R4A	Site preparation, non-native species control, hydroperiod repair, and native seeding
5.1A	Invasive species control and implementation of disturbance regimes
5.2A	Drought or improper timing/use of management actions

State 1
Reference State

The reference plant community is categorized as a marsh community, dominated by hydrophytic vegetation. The three community phases within the reference state are dependent on seasonal flooding and subsequent ponding. The depth and duration of ponding alters species composition, cover, and extent. Animal herbivory has more localized impacts in the reference phases, but does contribute to overall species composition, diversity, cover, and productivity.

Dominant plant species

- hairy sedge (*Carex lacustris*), other herbaceous
- broadleaf arrowhead (*Sagittaria latifolia*), other herbaceous
- river bulrush (*Bolboschoenus fluviatilis*), other herbaceous
- common duckweed (*Lemna minor*), other herbaceous

Community 1.1
Hairy Sedge-Broadleaf Arrowhead

Hairy Sedge – Broadleaf Arrowhead – This reference community phase can occur when the frequency and depth of ponding are reduced to less than 1 foot. Hairy sedge is the dominant monocot, but bulrushes can also be present. Broadleaf arrowhead is still the dominant forb, but forb diversity is greatest in this phase with species such as marsh skullcap (*Scutellaria galericulata* L.), longroot smartweed (*Polygonum amphibium* L. var. emersum Michx.), spotted joe pye weed (*Eutrochium maculatum* (L.) E.E. Lamont), and jewelweed (*Impatiens capensis* Meerb.) (White and Madany 1978; NatureServe 2018). Shallow ponded water depths (less than 1 foot) will maintain this phase, but an increase in water depths can shift the community to phase 1.2.

Dominant plant species

- hairy sedge (*Carex lacustris*), other herbaceous
- broadleaf arrowhead (*Sagittaria latifolia*), other herbaceous

Community 1.2
River Bulrush-Broadleaf Arrowhead

River Bulrush – Broadleaf Arrowhead – Sites in this reference community phase are dominated by hydrophytic herbaceous vegetation. River bulrush and broadleaf arrowhead are the dominant species. Some sites may be dominated by other bulrushes, such as softstem bulrush. Characteristic forbs can include broadfruit bur-reed (*Sparganium eurycarpum* Engelm.) and American water plantain (*Alisma subcordatum* Raf.) (NatureServe 2018). Water depths between 1 and 2 feet will maintain this phase, but a reduced water level (below 1 foot) will shift the community to phase 1.1 while an increase in water level (above 2 feet) will shift the community to phase 1.3.

Dominant plant species

- river bulrush (*Bolboschoenus fluviatilis*), other herbaceous
- broadleaf arrowhead (*Sagittaria latifolia*), other herbaceous

Community 1.3
River Bulrush - Common Duckweed

River Bulrush – Common Duckweed – This reference community phase can occur when the frequency and depth of ponding are greater than 2 feet. Bulrushes and cattails are the dominant monocots. Aquatic vegetation becomes important characteristic species during this phase and can include species such as common duckweed (*Lemna minor* L.), common duckmeat (*Spirodela polyrrhiza* (L.) Schleid), and American white waterlily (*Nymphaea odorata* Aiton ssp. tuberosa (Paine) Wiersma & Hellquist) (NatureServe 2018). Deep ponded water depths (greater than 2 feet) will maintain this phase, but a decrease in water depths can shift the community back to phase 1.1.

Dominant plant species

- river bulrush (*Bolboschoenus fluviatilis*), other herbaceous
- common duckweed (*Lemna minor*), other herbaceous

Pathway 1.1A

Community 1.1 to 1.2

Ponded water depths 12-24 inches

Pathway 1.2A
Community 1.2 to 1.1

Ponded water depths <12 inches

Pathway 1.2B
Community 1.2 to 1.3

Ponded water depths >24 inches

Pathway 1.3A
Community 1.3 to 1.2

Ponded water depths 12 to 24 inches

State 2
Hydrologically Altered State

Hydrology is the most important determinant of wetlands and wetland processes. Hydrology modifies and determines the physiochemical environment (i.e., sediments, soil chemistry, water chemistry) which in turn directly affects the vegetation, animals, and microbes (Mitsch and Gosselink 2007). Human activities on landscape hydrology have greatly altered Mucky Sedge Meadows. Alterations such as agricultural tile draining and conversion to cropland on adjacent lands in addition to stream channelization and damming have changed the natural hydroperiod, increased the rate of sedimentation, and intensified nutrient pollution (Werner and Zedler 2003; Mitsch and Gosselink 2007).

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), other herbaceous
- hairy sedge (*Carex lacustris*), other herbaceous

Community 2.1
Reed Canarygrass - Hairy Sedge

Reed Canarygrass – Hairy Sedge – This community phase represents the early changes to the natural wetland hydroperiod, increasing sedimentation, and unabated nutrient runoff. Native monocots, such as river bulrush, softstem bulrush, and cattails, continue to form a component of the herbaceous layer, but the highly invasive reed canarygrass (*Phalaris arundinacea* L.) co-dominates (Waggy 2010). As reed canarygrass invades, it can not only alter species composition, but vegetation structure as well (Annen et al. 2008). Common reed (*Phragmites australis* (Cav.) Trin. Ex Steud.) may be a non-native invader in conjunction with or in place of reed canarygrass.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), other herbaceous
- hairy sedge (*Carex lacustris*), other herbaceous

Community 2.2
Reed Canarygrass

Reed Canarygrass – Sites falling into this community phase have experienced significant sedimentation and nutrient enrichment and are dominated by a monoculture of reed canarygrass. Reed canarygrass stands can significantly alter the physiochemical environment as well as the biotic communities, making the site only suitable to reed canarygrass. These monotypic stands create a positive feedback loop that perpetuates increasing sedimentation, altered hydrology, and dominance by this non-native species, especially in sites affected by nutrient enrichment from agricultural runoff (Vitousek 1995; Bernard and Lauve 1995; Kercher et al. 2007; Waggy 2010). As in community phase 2.1, common reed may be present, dominant, or monotypic on the site.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Increasing changes to hydrology and increasing sedimentation

State 3
Forage State

The forage 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), hydrologic alterations 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.) and Kentucky bluegrass (*Poa pratensis* L.), to help extend the grazing season. 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.

Community 3.1
Hayfield

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).

Community 3.2
Continuous Pastured Grazing System

Continuous Pastured Grazing System – This community phase is characterized by continuous grazing where domestic livestock graze a pasture for the entire season. Depending on stocking density, this can result in lower forage quality and productivity, weed invasions, and uneven pasture use. Continuous grazing can also increase the amount of bare ground and erosion and reduce soil organic matter, cation exchange capacity, water-holding capacity, and nutrient availability and retention (Bharati et al. 2002; Leake et al. 2004; Teague et al. 2011). Smooth brome, Kentucky bluegrass, and white clover (*Trifolium repens* L.) are common pasture species used in this phase. Their tolerance to continuous grazing has allowed these species to dominate, sometimes completely excluding the native vegetation.

Community 3.3
Rest-Rotation Pastured Grazing System

Rest-Rotation Pastured Grazing System – This community phase is characterized by rotational grazing where the pasture has been subdivided into several smaller paddocks. Through the development of a grazing plan, livestock utilize one or a few paddocks, while the remaining area is rested allowing plants to restore vigor and energy reserves, deepen root systems, develop seeds, as well as allow seedling establishment (Undersander et al. 2002; USDA-NRCS 2003). Rest-rotation pastured grazing systems include deferred rotation, rest rotation, high intensity – low frequency, and short duration methods. Vegetation is generally more diverse and can include orchardgrass (*Dactylis glomerata* L.), timothy (Phleum pretense L.), red clover (*Trifolium pratense* L.), and alfalfa (*Medicago sativa* L.). The addition of native prairie species can further bolster plant diversity and, in turn, soil function. This community phase promotes numerous ecosystem benefits including increasing biodiversity, preventing soil erosion, maintaining and enhancing soil quality, sequestering atmospheric carbon, and improving water yield and quality (USDA-NRCS 2003).

Pathway 3.1A
Community 3.1 to 3.2

Mechanical harvesting is replaced with domestic livestock and continuous grazing

Pathway 3.1B
Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing

Pathway 3.2A
Community 3.2 to 3.1

Tillage, forage crop planting, and mechanical harvesting replace grazing

Pathway 3.2B
Community 3.2 to 3.3

Implementation of rest-rotational grazing

Pathway 3.3B
Community 3.3 to 3.1

Tillage, forage crop planting and mechanical harvesting replace grazing

Pathway 3.3A
Community 3.3 to 3.2

Implementation of continuous grazing

State 4
Cropland State

The continuous use of tillage, row-crop planting, and chemicals (i.e., herbicides, fertilizers, etc.) and hydrologic alterations have 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.

Community 4.1
Conventional Tillage Field

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).

Community 4.2
Conservation Tillage Field

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.

Community 4.3
Conservation Tillage Field/Alternative Crop Field

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.

Pathway 4.1A
Community 4.1 to 4.2

Less tillage, residue management

Pathway 4.1B
Community 4.1 to 4.3

Less tillage, residue management and implementation of cover cropping

Pathway 4.2A
Community 4.2 to 4.1

Intensive tillage, remove residue and reinitialize monoculture row cropping

Pathway 4.2B
Community 4.2 to 4.3

Implementation of cover cropping

Pathway 4.3B
Community 4.3 to 4.1

Intensive tillage, residue management and reinitialize monoculture row cropping

Pathway 4.3A
Community 4.3 to 4.2

Remove cover cropping

State 5
Reconstructed Sedge Meadow State

Sedge meadow habitats provide multiple ecosystem services including flood abatement, water quality improvement, and biodiversity support. However, many sedge meadow communities have been stressed from watershed-scale changes in hydrology or eliminated as a result of type conversions to agricultural production, thereby significantly reducing these services (Zedler 2003). The extensive alterations of lands adjacent to Mucky Sedge Meadows may not allow for restoration back to the historic reference condition. However, ecological reconstruction can aim to aid the recovery of degraded, damaged or destroyed functions. A successful reconstruction 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; Mitsch and Jørgensen 2004).

Community 5.1
Early Successional Sedge Meadow

Early Successional Sedge Meadow – This community phase represents the early community assembly from sedge meadow reconstruction and is highly dependent on seed viability, hydroperiod, soil organic matter content, and site preparation. Successful establishment of sedges can be maximized by using seed collected during the same growing season, utilizing genotypes adapted to the environmental location, ensuring soil moisture is saturated at the time of seeding, and improving the water holding capacity and fertility of the soil (Budelsky and Galatowitsch 1999; van der Valk et al. 1999; Mitsch and Gosselink 2007; Hall and Zedler 2010). In addition, suppression and removal of non-native species is essential for reducing competition (Perry and Galatowitsch 2003).

Community 5.2
Late Successional Sedge Meadow

Late Successional Sedge Meadow – Appropriately timed disturbance regimes (e.g., hydroperiod, prescribed fire) and nutrient management applied to the early successional community phase can help increase the species richness, pushing the site into a late successional community phase over time (Mitsch and Gosselink 2007).

Pathway 5.1A
Community 5.1 to 5.2

Invasive species control and implementation of disturbance regimes

Pathway 5.2A
Community 5.2 to 5.1

Drought or improper timing/use of management actions

Transition T1A
State 1 to 2

Changes to natural hydroperiod and/or land abandonment

Transition T1B
State 1 to 3

Cultural treatments are implemented to increase forage quality and yield

Transition T1C
State 1 to 4

Agricultural conversion via drainage, tillage, seeding and non-selective herbicide

Transition T2A
State 2 to 3

Cultural treatments are implemented to increase forage quality and yield

Transition T2B

State 2 to 4

Agricultural conversion via drainage, tillage, seeding and non-selective herbicide

Transition R2A
State 2 to 5

Site preparation, non-native species control, hydroperiod repair and native seeding

Restoration pathway T3A
State 3 to 2

Changes to natural hydroperiod and/or land abandonment

Transition T3B
State 3 to 4

Agricultural conversion via drainage, tillage, seeding and non-selective herbicide

Transition R3A
State 3 to 5

Site preparation, non-native species control, hydroperiod repair and native seeding

Restoration pathway T4A
State 4 to 2

Changes to natural hyroperiod and/or land abandonment

Restoration pathway T4B
State 4 to 3

Cultural treatments are implemented to increase forage quality and yield

Transition R4A
State 4 to 5

Site preparation, non-native species control, hydroperiod repair and native seeding

Restoration pathway T5A
State 5 to 2

Changes to natural hydroperiod and/or land abandonment

Restoration pathway T5B
State 5 to 3

Cultural treatments are implemented to increase forage quality and yield

Restoration pathway T5C
State 5 to 4

Agricultural conversion via drainage, tillage, seeding and non-selective herbicides

Additional community tables

Inventory data references

No field plots have been developed 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.

Contributors

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Approval

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This site was originally approved by Chris Tecklenburg, 5/27/2020.

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	07/02/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**