USDA Natural Resources Conservation Service

Ecological site R104XY003IA
Wet Bedrock 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.

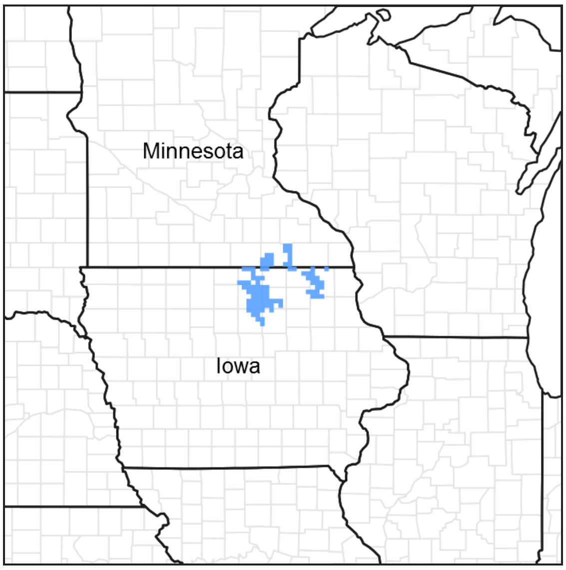


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 104X–Eastern Iowa and Minnesota Till Prairies

The Eastern Iowa and Minnesota Till Prairies (MLRA 104) includes the Iowan Surface, Oak Savanna, and Western Coulee and Ridges landforms (Prior 1991; MDNR 2005; WDNR 2015). It spans three states (Iowa, 74 percent; Minnesota, 22 percent; Wisconsin, 4 percent), encompassing approximately 9,660 square miles (Figure 1). The elevation ranges from approximately 1,310 feet above sea level (ASL) on the highest ridges to about 985 feet ASL in the lowest valleys. Local relief is mainly 10 to 20 feet. Glacial till and outwash deposits cover the uplands of the MLRA with recent alluvium located in the major river valleys. Paleozoic bedrock sediments, comprised primarily of shale and limestone, lies beneath the glacial material. The depth to limestone is shallow, resulting in karst topography across much of the area (USDA-NRCS 2006).

The vegetation in the MLRA has undergone drastic changes over time. Spruce forests dominated the landscape 30,000 to 21,500 years ago. As the last glacial maximum peaked 21,500 to 16,000 years ago, they were replaced with open tundras and parklands. The end of the Pleistocene Epoch saw a warming climate that initially prompted the return of spruce forests, but as the warming continued, spruce trees were replaced by deciduous trees (Baker et al. 1990). Not until approximately 9,000 years ago did the vegetation transition to prairies as climatic conditions continued to warm and subsequently dry. Between 4,000 and 3,000 years ago, oak savannas began intermingling within the prairie landscape, while the more wooded and forested areas maintained a foothold in sheltered areas. This prairie-forest transition ecosystem formed the dominant landscapes until the arrival of European settlers (Baker et al. 1992).

Classification relationships

USFS Subregions: North Central U.S. Driftless and Escarpment (222L), Minnesota and Northeast Iowa Morainal-Oak Savannah (222M), Central Dissected Till Plains (251C) Sections; Menominee Eroded Pre-Wisconsin Till (222La), Oak Savannah Till and Loess Plains (222Me), Southeast Iowa Rolling Loess Hills (251Ch) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Eastern Iowa and Minnesota Drift Plains (47c), Rolling Loess Prairies (47f), Lower St. Croix and Vermillion Valleys (47g), Rochester/Paleozoic Plateau Upland (52c) (USEPA 2013)

Biophysical Settings: Central Tallgrass Prairie (BpS 4214210) (LANDFIRE 2009)

Minnesota Department of Natural Resources: WPs54 Southern Wet Prairie (MDNR 2005)

U.S. Army Corps of Engineers: Fresh (Wet) Meadows (Eggers and Reed 2015)

Ecological site concept

Wet Bedrock Prairies are located within the green areas on the map (Figure 1). They occur on uplands and the soils are Mollisols that are poorly-drained, formed in loamy sediments over bedrock. Low hydraulic gradients create a shallow depth to the water table during the growing season.

The historic pre-European settlement vegetation on this ecological site was dominated by hydrophytic herbaceous vegetation. Spiked muhly (Muhlenbergia glomerata (Willd.) Trin.) and Riddell's goldenrod (Oligoneuron riddellii (Frank ex Riddell) Rydb.) are dominant and characteristic species of the site, respectively. Other monocots present can include bluejoint (Calamagrostis canadensis (Michx.) P. Beauv) and flatstem spikerush (Eleocharis compressa Sull.) (MDNR 2005). Forbs commonly present on this ecological site include cup plant (Silphium perfoliatum L.), giant goldenrod (Solidago gigantea Aiton), and sawtooth sunflower (Helianthus grosseserratus M. Martens) (Eggers and Reed 2015). Shrubs, when present, are widely scattered and may include red-osier dogwood (Cornus sericea L. ssp. sericea) and pussy willow (Salix discolor Muhl.) (MDNR 2005). Fire is the primary disturbance factor that maintains this site, while herbivory and drought are secondary factors (LANDFIRE 2009).

Associated sites

R104XY002IA	**Bedrock Prairie** Loamy sediments that are shallow to bedrock including Aureola, Bertram, Channahon, Copaston, Dodgeville, Emeline, Etter, Jacwin, Jacwin variant, Kensett, Limecreek, Marlean, Mottland, Ripon, Rockton, Rossfield, Rossfield variant, Wagen Prairie, and Wangs

Similar sites

R104XY006IA	**Wet Loamy Upland Prairie** Wet Loamy Upland Prairies are in a similar landscape position, but soils are deep to bedrock

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Muhlenbergia glomerata* (2) *Oligoneuron riddellii*

Physiographic features

Wet Bedrock Prairies occur on uplands (Figure 2). They are situated on elevations ranging from approximately 699 to 1401 feet ASL. The site does not experience flooding, but does contribute some runoff to adjacent, downslope ecological sites (Table 1).

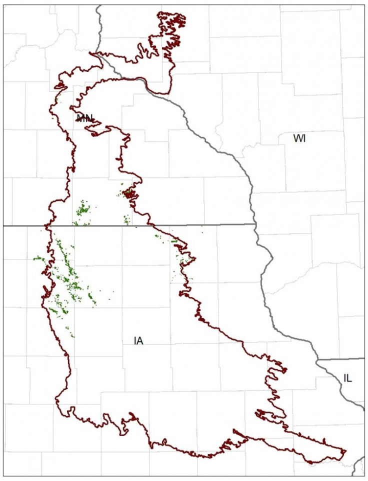


Figure 2. Figure 1. Location of Wet Bedrock Prairie within MLRA 104.

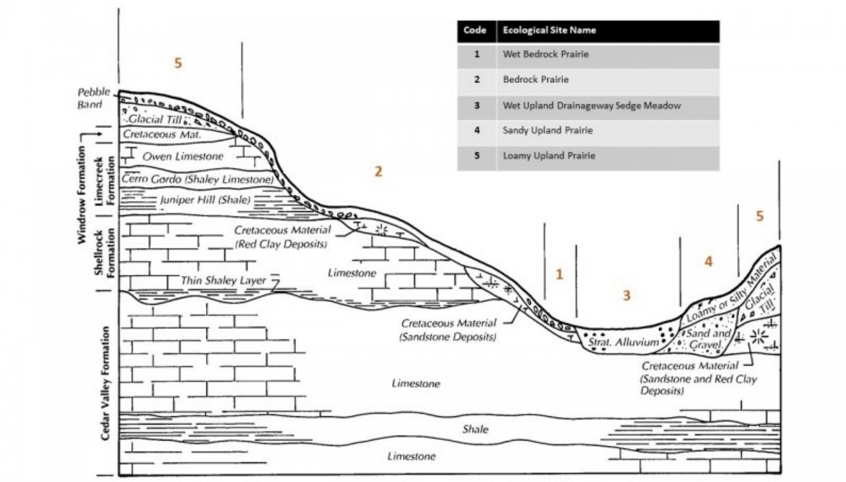


Figure 3. Figure 2. Representative block diagram of Wet Bedrock Prairie and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Linear (2) Concave
Slope shape up-down	(1) Linear (2) Concave
Landforms	(1) Upland
Runoff class	Low
Elevation	213–427 m
Slope	0–3%
Water table depth	0–15 cm
Aspect	Aspect is not a significant factor

Climatic features

The Eastern Iowa and Minnesota Till Prairies falls into the hot-summer humid continental climate (Dfa) and warm-summer humid continental climate (Dfb) Köppen-Geiger climate classifications (Peel et al. 2007). In winter, dry, cold air masses periodically shift south from Canada. As these air masses collide with humid air, snowfall and rainfall result. In summer, moist, warm air masses from the Gulf of Mexico migrate north, producing significant frontal or convective rains. Occasionally, hot, dry winds originating from the Desert Southwest will stagnate over the region, creating extended droughty periods in the summer from unusually high temperatures. Air masses from the Pacific Ocean can also spread into the region and dominate producing mild, dry weather in the autumn known as

Indian Summers (NCDC 2006).

The soil temperature regime of MLRA 104 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 148 days, while the frost-free period is about 127 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 35 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 35 and 55°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from four 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)	126-128 days
Freeze-free period (characteristic range)	145-151 days
Precipitation total (characteristic range)	864-889 mm
Frost-free period (actual range)	124-129 days
Freeze-free period (actual range)	142-152 days
Precipitation total (actual range)	864-914 mm
Frost-free period (average)	127 days
Freeze-free period (average)	148 days
Precipitation total (average)	889 mm

Climate stations used

- (1) CHARLES CITY [USC00131402], Charles City, IA
- (2) AUSTIN WWT FAC [USC00210355], Austin, MN
- (3) NORTHWOOD [USC00136103], Northwood, IA
- (4) CRESCO 1 NE [USC00131954], Cresco, IA

Influencing water features

Wet Bedrock Prairies are classified as a MINERAL SOIL FLATS: saturated, recharge, herbaceous wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Persistent Emergent, Seasonally Saturated wetland under the National Wetlands Inventory (FGDC 2013). Precipitation the main sources of water for this ecological site (Smith et al. 1995). Infiltration is very slow (Hydrologic Group D) for undrained soils, and surface runoff is low (Figure 5).

Primary wetland hydrology indicators for an intact Wet Bedrock Prairie may include: A2 High water table and A3 Saturation. Secondary wetland hydrology indicators may include: C2 Dry-season water table and D5 FAC-neutral test (USACE 2010).

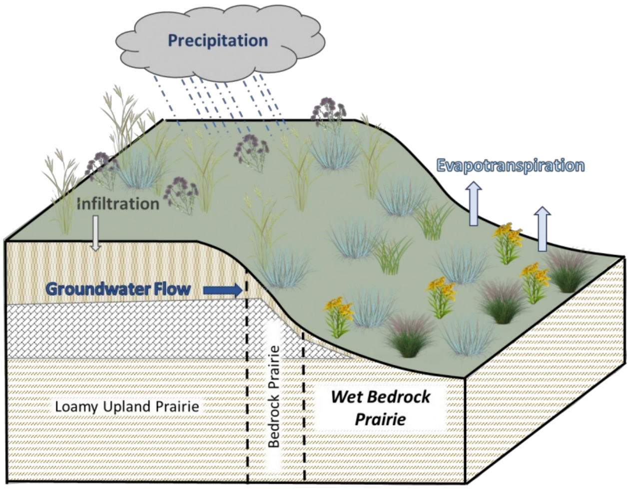


Figure 10. Figure 5. Hydrologic cycling in Wet Bedrock Prairie ecological site.

Soil features

Soils of Wet Bedrock Prairies are in the Mollisols order, further classified as Typic Argiaquolls and Typic Endoaquolls with very slow infiltration and low runoff potential. The soil series associated with this site includes Calamine, Faxon, and Rocksan. The parent material is loamy sediments over bedrock and the soils are poorly-drained and with seasonal high-water tables. Soil pH classes are slightly acid to strongly alkaline. A shallow depth to bedrock is noted as a rooting restriction 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 2 of the hydric soils list (77 FR 12234).

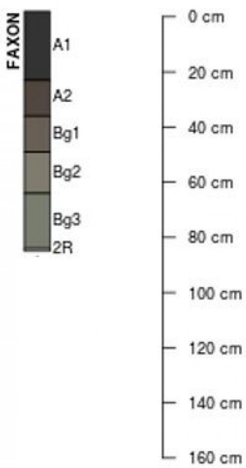


Figure 11. Figure 6. Profile sketches of soil series associated with Wet Bedrock Prairie.

Table 4. Representative soil features

Family particle size	(1) Fine-loamy
Drainage class	Poorly drained
Permeability class	Moderately slow
Depth to restrictive layer	76–127 cm
Soil depth	76–127 cm

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 transition zone between the eastern deciduous forests and the tallgrass prairies. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn support prairies, savannas, woodlands, and forests. Wet Bedrock Prairies form an aspect of this vegetative continuum. This ecological site occurs on uplands on shallow, poorly-drained soils. Species characteristic of this ecological site consist of hydrophytic herbaceous vegetation.

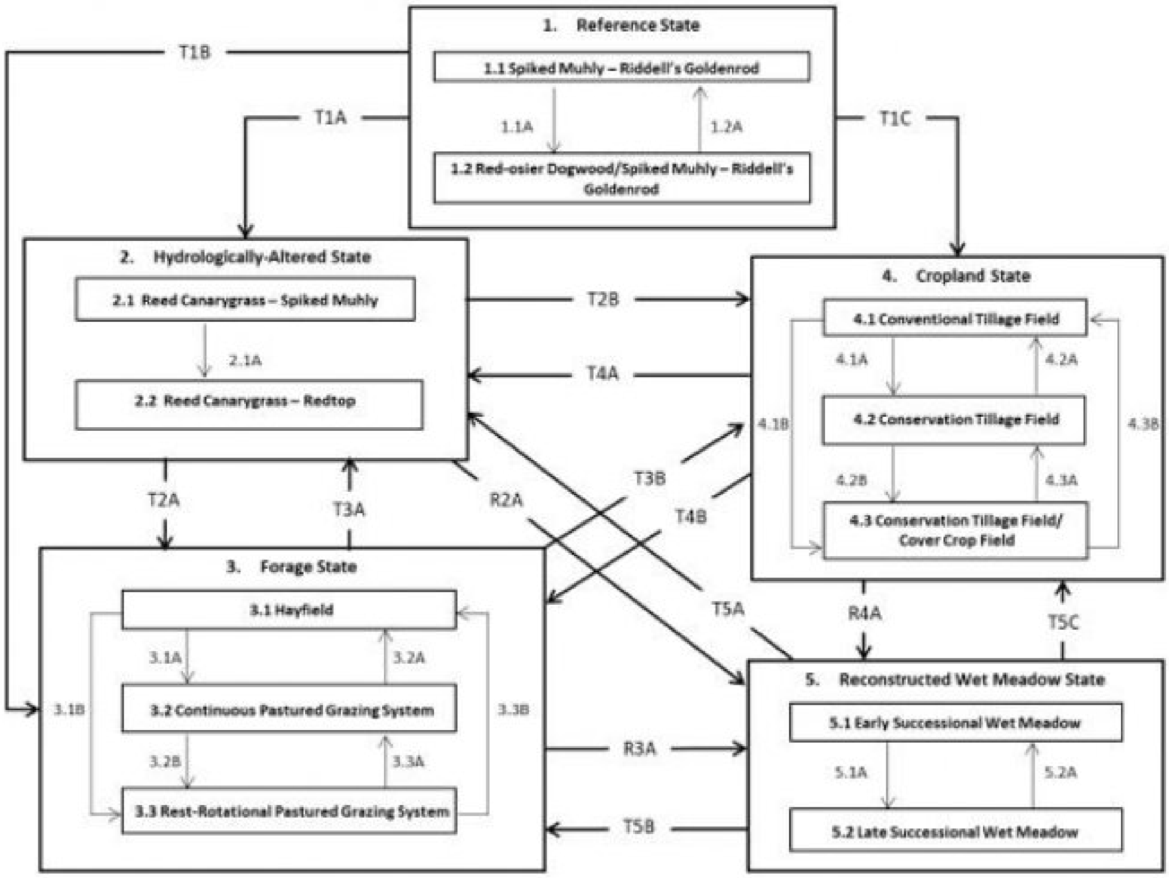
Fire is a critical disturbance factor that maintains Wet Bedrock Prairies. Fire intensity typically consisted of periodic, low-intensity surface fires occurring every 1 to 3 years (LANDFIRE 2009). Ignition sources included summertime lightning strikes from convective storms and bimodal, human ignitions 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).

Drought and herbivory by native ungulates have also played a role in shaping this ecological site. The periodic episodes of reduced soil moisture in conjunction with the poorly-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. Bison (Bos bison) grazing, while present, served a more limited role in community composition and structure than lands further west. Prairie elk (Cervus elaphus) and white-tailed deer (Odocoileus virginianus) likely contributed to woody species reduction but are also considered to be of a lesser impact compared to the west (LANDFIRE 2009). When coupled with fire, periods of drought and herbivory can further delay the establishment of woody vegetation (Pyne et al. 1996).

Today, Wet Bedrock Prairies have been greatly reduced as most areas have been converted to agricultural production. Corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merr.) are the dominant crops grown, but small patches of forage land may be present. Remnants that do exist show evidence of indirect anthropogenic influences from fire suppression, subsurface drainage, and non-native species invasion. 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

R104XY003IA WET BEDROCK PRAIRIE



Code	Process
T1A, T3A, T4A, T5A	Changes to natural hydroperiod and/or land abandonment
T1B, T2A, T4B, T5B	Cultural treatments are implemented to increase forage quality and yield
T1C, T2B, T3B, T5C	Agricultural conversion via tillage, seeding, and non-selective herbicide
1.1A	Increased fire return interval
1.2A	Reduced fire return interval
2.1A	Increasing changes to hydrology and increasing sedimentation
R2A, R3A, R4A	Site preparation, non-native species control, and native seeding
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
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
5.1A	Maintenance of proper hydrology, fire, and nutrient balances
5.2A	Drought or improper timing/use of management actions

State 1
Reference State

The reference plant community is categorized as a wet meadow community, dominated by hydrophytic vegetation. The two community phases within the reference state are dependent on periodic fires. The intensity and frequency alter species composition, cover, and extent, while regular fire intervals keep woody species from encroaching. Drought and herbivory have more localized impacts in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

Community 1.1
Spiked Muhly – Riddell's Goldenrod

Sites in this reference community phase are dominated by grasses and forbs adapted to saturated conditions. Mature plants range between 1.5 and 3 feet tall, and ground cover is continuous. Spiked muhly and Riddell's goldenrod are dominant and characteristic species, respectively. Bluejoint and flatstem spikerush are other monocots that can occur, while cup plant, giant goldenrod, sawtooth sunflower, and cutleaf coneflower (*Rudbeckia laciniata* L.) are common forbs (Eggers and Reed 2015). Cool, low-intensity fires will maintain this phase, but an increased fire interval will allow scattered woody species to develop, shifting the community to phase 1.2.

Community 1.2
Red-osier Dogwood/Spiked Muhly – Riddell's Goldenrod

This community phase represents natural succession as a result of an extended fire return interval. Vegetative cover is still continuous, but the prolonged absence of fire allows sparse shrubs to inhabit the site, such as red-osier dogwood and pussy willow. Cool, low-intensity fires will maintain this phase, but a higher intensity fire and a reduced fire return interval will shift the community back to phase 1.1 (LANDFIRE 2009).

Pathway 1.1A
Community 1.1 to 1.2

Natural succession following an increased fire return interval.

Pathway 1.2A
Community 1.2 to 1.1

Reduced fire return interval

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 Wet Bedrock Prairies. Alterations such as agricultural tile draining and conversion to cropland on adjacent lands have changed the natural hydroperiod and rate of sedimentation as well as increased nutrient pollution (Werner and Zedler 2003; Mitsch and Gosselink 2007; Eggers and Reed 2015).

Community 2.1
Reed Canarygrass – Spiked Muhly

This community phase represents the early changes to the natural wetland hydroperiod, sedimentation, and nutrient runoff. Sedimentation results in a reduction of soil organic matter and high dry bulk density. It also leads to a homogenization of the local microtopography, reducing the surface area and associated species diversity (Green and Galatowitsch 2002; Werner and Zedler 2002). Spiked muhly, bluejoint, and Riddell's goldenrod continue to form a component of the herbaceous layer, but the highly-invasive reed canarygrass (*Phalaris arundinacea* L.) co-dominates.

Community 2.2
Reed Canarygrass – Redtop

Sites falling into this community phase have experienced significant sedimentation and nutrient enrichment and are dominated by a monoculture of reed canarygrass (Eggers and Reed 2015). 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; Eggers and Reed 2015). Other invasive species, such as redtop (*Agrostis gigantea* Roth.) and Canada thistle (*Cirsium arvense* (L.) Scop.), can become established as well (Eggers and Reed 2015).

Pathway 2.1A
Community 2.1 to 2.2

Continuing alterations to the natural hydrology and increasing sedimentation

State 3
Forage State

The forage state occurs when the reference state is converted to a farming operation 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.) 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.

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).

Community 3.2
Continuous Pastured Grazing

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
Periodic-rest Pastured Grazing

This community phase is characterized by periodic-rest grazing where the pasture has been subdivided into several smaller paddocks. Subdividing the pasture in this way allows livestock to 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). Periodic-rest pastured grazing include deferred periods, rest periods, and periods of 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 utilizing continuous grazing.

Pathway 3.1B
Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock utilizing periodic-rest grazing.

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

Periodic-rest grazing replaces continuous grazing.

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

Continuous grazing replaces periodic-rest grazing.

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.

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 alternating periods of corn and soybean crops. 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

This community phase is characterized by periodically alternating crops and utilizing 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 operations. 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 operations 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 operations, 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

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 row crop operation.

Pathway 4.1A
Community 4.1 to 4.2

Tillage operations are greatly reduced, alternating crops 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, alternating crops 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 on a more-or-less continuous basis.

Pathway 4.3A
Community 4.3 to 4.2

Cover crop practices are abandoned.

State 5
Reconstructed Wet Meadow State

Wet meadow habitats provide multiple ecosystem services including flood abatement, water quality improvement, and biodiversity support. However, many wet 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 Wet Bedrock Prairies 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 Wet Meadow

This community phase represents the early community assembly from wet meadow reconstruction and is highly dependent on seed viability, hydroperiod, soil organic matter content, and site preparation. Successful establishment of native vegetation can be maximized by 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 (Mitsch and Gosselink 2007). In addition, suppression and removal of non-native species is essential for reducing competition (Perry and Galatowitsch 2003).

Community 5.2
Late Successional Wet 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

Maintenance of proper hydrology and nutrient balances in line with a developed wetland management plan.

Pathway 5.2A
Community 5.2 to 5.1

Reconstruction experiences a setback from extreme weather event or improper timing of management actions.

Transition T1A
State 1 to 2

Direct and indirect alterations to the landscape hydrology from human-induced land development transition the site to the hydrologically-altered state (2).

Transition T1B
State 1 to 3

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

Transition T1C
State 1 to 4

Installation of drain tiles, tillage, seeding of agricultural crops, and non-selective herbicide transition the site to the cropland state (4).

Transition T2A
State 2 to 3

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

Transition T2B
State 2 to 4

Installation of drain tiles, tillage, seeding of agricultural crops, and non-selective herbicide transition the site to the cropland state (4).

Restoration pathway R2A
State 2 to 5

Hydroperiod restoration, site preparation, non-native species control, and seeding native species transition the site to the reconstructed wet meadow state (5).

Transition T3A
State 3 to 2

Land abandonment and natural succession by opportunistic species transition the site to the hydrologically-altered state (2).

Transition 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 wet meadow state (5).

Transition T4A
State 4 to 2

Land abandonment and natural succession by opportunistic species transition the site to the hydrologically-altered state (2).

Transition T4B
State 4 to 3

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

Restoration pathway R4A
State 4 to 5

Site preparation, tree planting, invasive species control, and seeding native species transition this site to the reconstructed sedge meadow state (5).

Transition T5A
State 5 to 2

Land is abandoned and left fallow; natural succession by opportunistic species transition this site the hydrologically-altered state (2).

Transition T5B
State 5 to 3

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

Transition T5C
State 5 to 4

Installation of drain tiles, seeding of agricultural crops, and non-selective herbicide transition the 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 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	05/21/2024
Approved by	Chris Tecklenburg
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

bare ground):

---

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

---

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

---

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

---

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

---

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

---

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

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

---

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:**