Ecological site F108XA017IL
Terrace Woodland

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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, Eastern Part (MLRA 108A) encompasses the Grand Prairie physiographic division (Schewman et al. 1973). It spans two states – Illinois (97 percent) and Indiana (3 percent) – comprising about 11,145 square miles (Figure 1). The elevation ranges from 985 feet above sea level (ASL) in the northern part to 660 feet above sea level in the southern part. Local relief varies from 3 to 10 feet on most of the area which is on broad flat uplands. The maximum relief is about 160 feet along major streams. The northern part of this area is underlain by Ordovician and Silurian limestone and the southern part is underlain by Pennsylvanian shale, siltstone, and limestone. Except for some areas along streams where bedrock is exposed, glacial drift covers all the MLRA. The glacial drift consists of till and stratified outwash and is of Wisconsinan age. A moderately thin to thick layer of loess covers the entire area (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: Central Till Plains and Grand Prairies (251D) and Central Till Plains-Beech-Maple Sections; Northern Grand Prairie (251Dc), Eastern Grand Prairie (251Dd), Southern Grand Prairie (251De), and Entrenched Valleys (222Hf) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Illinois/Indiana Prairies (54a) and Glaciated Wabash Lowlands (72b) (USEPA 2013)

National Vegetation Classification – Ecological Systems: North-Central Interior Floodplain (CES202.694) (NatureServe 2018)

National Vegetation Classification – Plant Associations: Acer saccharum – Carya cordiformis/Asimina trilobal Floodplain Forest (CEGL005035) (Nature Serve 2018)

Biophysical Settings: Central Interior and Appalachian Floodplain (BpS 4914710) (LANDFIRE 2009)

Illinois Natural Areas Inventory: Mesic Floodplain Forest (White and Madany 1978)

Ecological site concept

Terrace Woodlands are located within the blue areas on the map (Figure 1). They occur on rarely-flooded stream terraces. The soils are Alfisols that are somewhat poorly to well-drained and very deep, formed in loess over outwash or alluvium.

The historic pre-European settlement vegetation on this ecological site was dominated by a canopy of deciduous upland lowland trees and shade- and flood-tolerant herbaceous plants. Sugar maple (Acer saccharum L.) and bur oak (Quercus macrocarpa Michx.) are the dominant species on the site. Other commonly encountered trees include American elm (Ulmus americana L.), hackberry (Celtis occidentalis L.), green ash (Fraxinus pennsylvanica Marshall), white oak (Quercus alba L.), and northern red oak (Quercus rubra L.). Pawpaw (Asimina trilobal (L.) Dunal) is a common shrub, and Canadian wildginger (Asarum canadense L.) and cutleaf toothwort (Cardamine concatenata (Michx.) Sw.) are dominant herbs (White and Madany 1978; INHS 2012; NatureServe 2018). Rare flooding is the primary disturbance factor that maintains this site, while damage from storms and periodic pest outbreaks are secondary disturbances (LANDFIRE 2009).

Associated sites

F108XA015IL	**Outwash Forest** Shallow loess over outwash on outwash plains including Camden, Campton, Kendall, Martinsville, Psamments, Rush, Somonauk, St. Charles, and Starks
F108XA019IL	**Silty Floodplain Forest** Silty alluvial material on floodplains including Aetna, Armiesburg, Armiesburg variant, Dozaville, Jules, Lawson, Radford, and Tice
F108XA011IL	**Loess Upland Forest** Deep loess parent material including Appleriver, Birkbeck, Chatsworth, Hennepin, Kernan, Loran, Mayville, Russell, Sabina, Senachwine, Strawn and Xenia soils

Similar sites

F108XA019IL	**Silty Floodplain Forest** Silty Floodplain Forests are lower on the landscape and experience occasional to frequent flooding

Table 1. Dominant plant species

Tree	(1) *Quercus macrocarpa* (2) *Ulmus americana*
Shrub	(1) *Asimina triloba*
Herbaceous	(1) *Asarum canadense* (2) *Cardamine concatenata*

Physiographic features

Terrace Woodlands occur on stream terraces and flood-plain steps. They are situated on elevations ranging from approximately 340 to 1020 feet. The site can experience rare flooding that can last up to two days (Table 1).

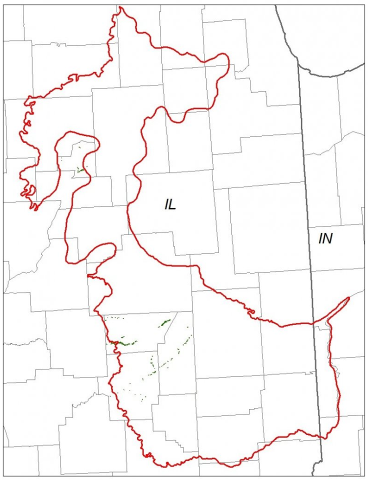


Figure 1. Figure 1. Location of Terrace Woodland ecological site within MLRA 108A.

Table 2. Representative physiographic features

Slope shape across	(1) Convex (2) Linear
Slope shape up-down	(1) Convex (2) Linear
Landforms	(1) River valley > Stream terrace (2) Flood-plain step
Runoff class	Low
Flooding frequency	None to rare
Ponding frequency	None
Elevation	104–311 m
Slope	0–10%
Water table depth	38–203 cm
Aspect	Aspect is not a significant factor

Climatic features

The Illinois and Iowa Deep Loess and Drift, Eastern 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 108A 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 170 days, while the frost-free period is about 140 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 40 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 42 and 63°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from two 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)	142 days
Freeze-free period (characteristic range)	170 days
Precipitation total (characteristic range)	991-1,016 mm
Frost-free period (actual range)	142 days
Freeze-free period (actual range)	170 days
Precipitation total (actual range)	991-1,016 mm
Frost-free period (average)	142 days
Freeze-free period (average)	170 days
Precipitation total (average)	991 mm

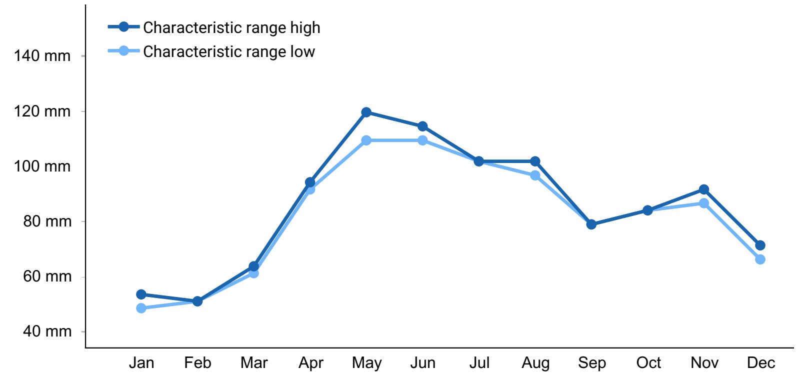


Figure 2. Monthly precipitation range

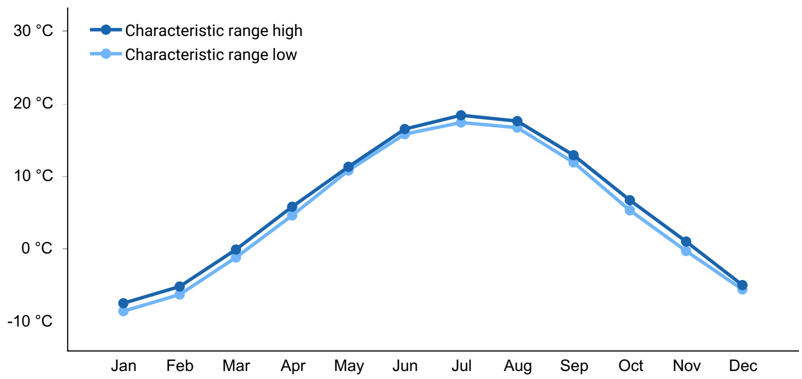


Figure 3. Monthly minimum temperature range

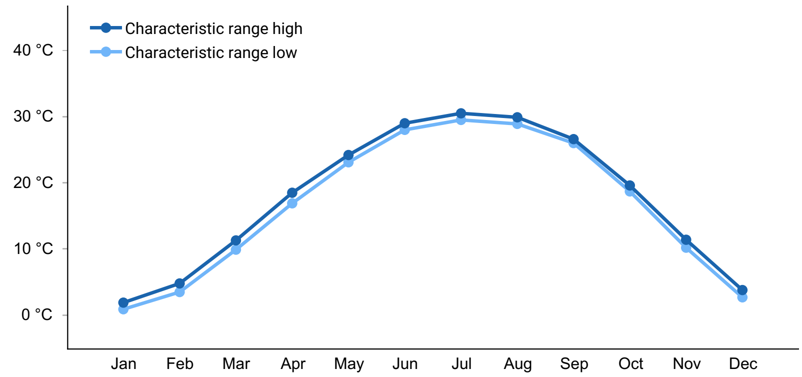


Figure 4. Monthly maximum temperature range

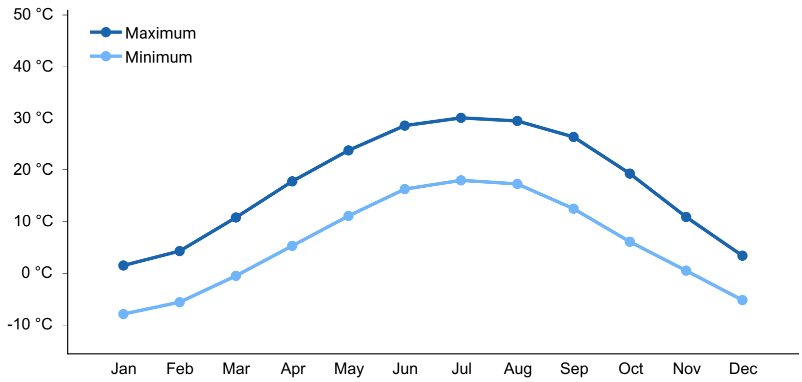


Figure 5. Monthly average minimum and maximum temperature

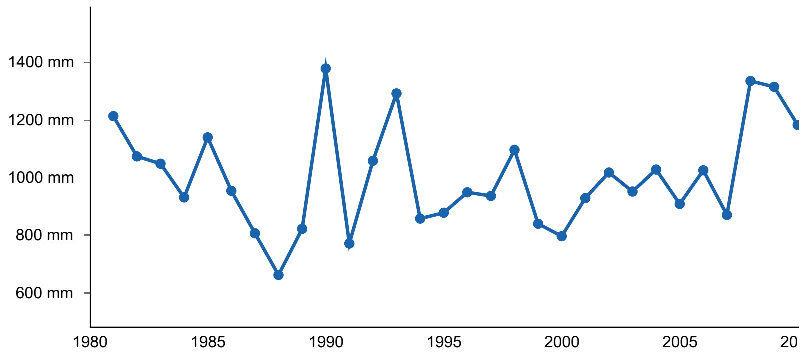


Figure 6. Annual precipitation pattern

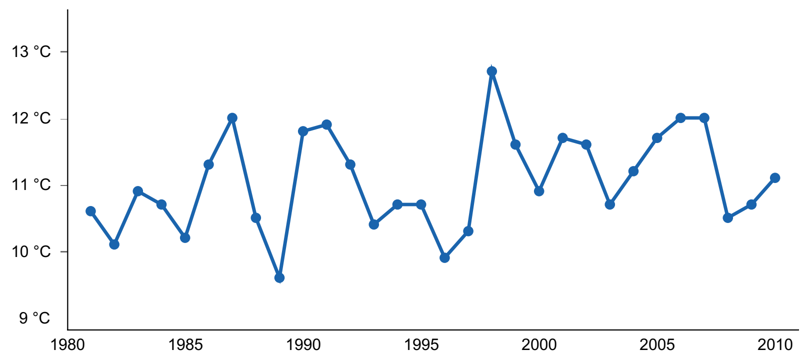


Figure 7. Annual average temperature pattern

Climate stations used

- (1) DECATUR WTP [USC00112193], Decatur, IL
- (2) FARMER CITY 3W [USC00112993], Farmer City, IL

Influencing water features

Terrace Woodlands are classified as a RIVERINE: Occasionally Flooded; forested wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Forested, Broad-leaved Deciduous, Temporarily Flooded wetland under the National Wetlands Inventory (FGDC 2013). Overbank flow from the channel and subsurface hydraulic connections are the main sources of water for this ecological site (Smith et al. 1995). Infiltration is moderate (Hydrologic Groups B) for undrained soils, and surface runoff is low to medium (Figure 4).

Wetland hydrology indicators may be present on undrained Terrace Woodlands (e.g., B2 Sediment deposits) but are not indicative of wetland hydrology due to the flooding frequency being less than 50 percent (USACE 2010).

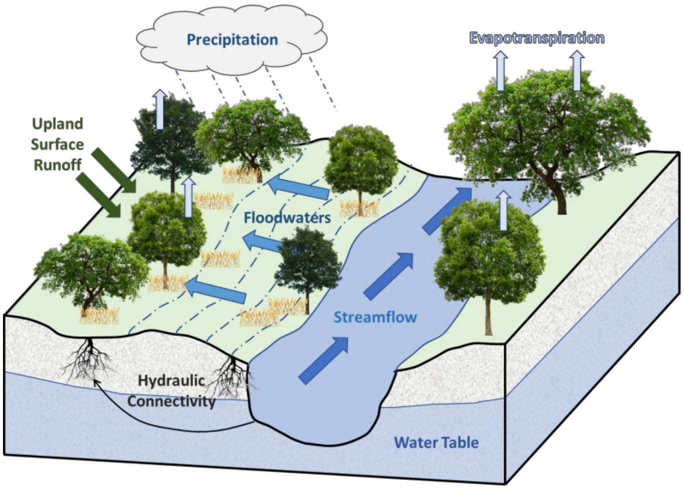


Figure 8. Figure 4. Hydrologic cycling in Terrace Woodland ecological site.

Soil features

Soils of Terrace Woodlands are in the Alfisols order, further classified as Aeric Endoaqualfs and Typic Hapludalfs with moderate infiltration and low to medium runoff potential. The soil series associated with this site includes Camden, Kendall, Martinsville, and St. Charles (Figure 5). The parent material is loess over outwash or alluvium and the soils are somewhat poorly to well-drained and very deep. Soil pH classes are very strongly acid to moderately alkaline. No rooting restrictions are noted for the soils of this ecological site (Table 5).

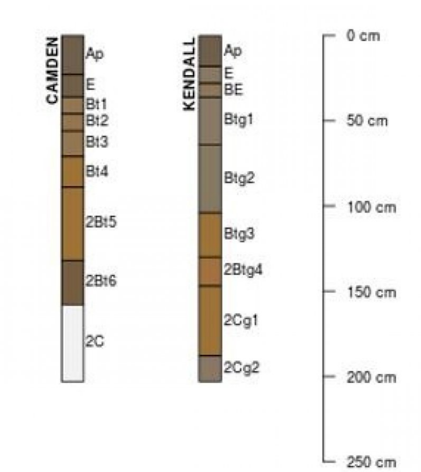


Figure 9. Figure 5. Profile sketches of soil series associated with Terrace Woodland.

Table 4. Representative soil features

Parent material	(1) Loess
Surface texture	(1) Silt loam
Family particle size	(1) Fine-silty (2) Fine
Drainage class	Somewhat poorly drained to well drained
Permeability class	Moderately slow
Soil depth	203 cm
Surface fragment cover <=3"	0–3%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	13.97–21.59 cm

Soil reaction (1:1 water) (Depth not specified)	5.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

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

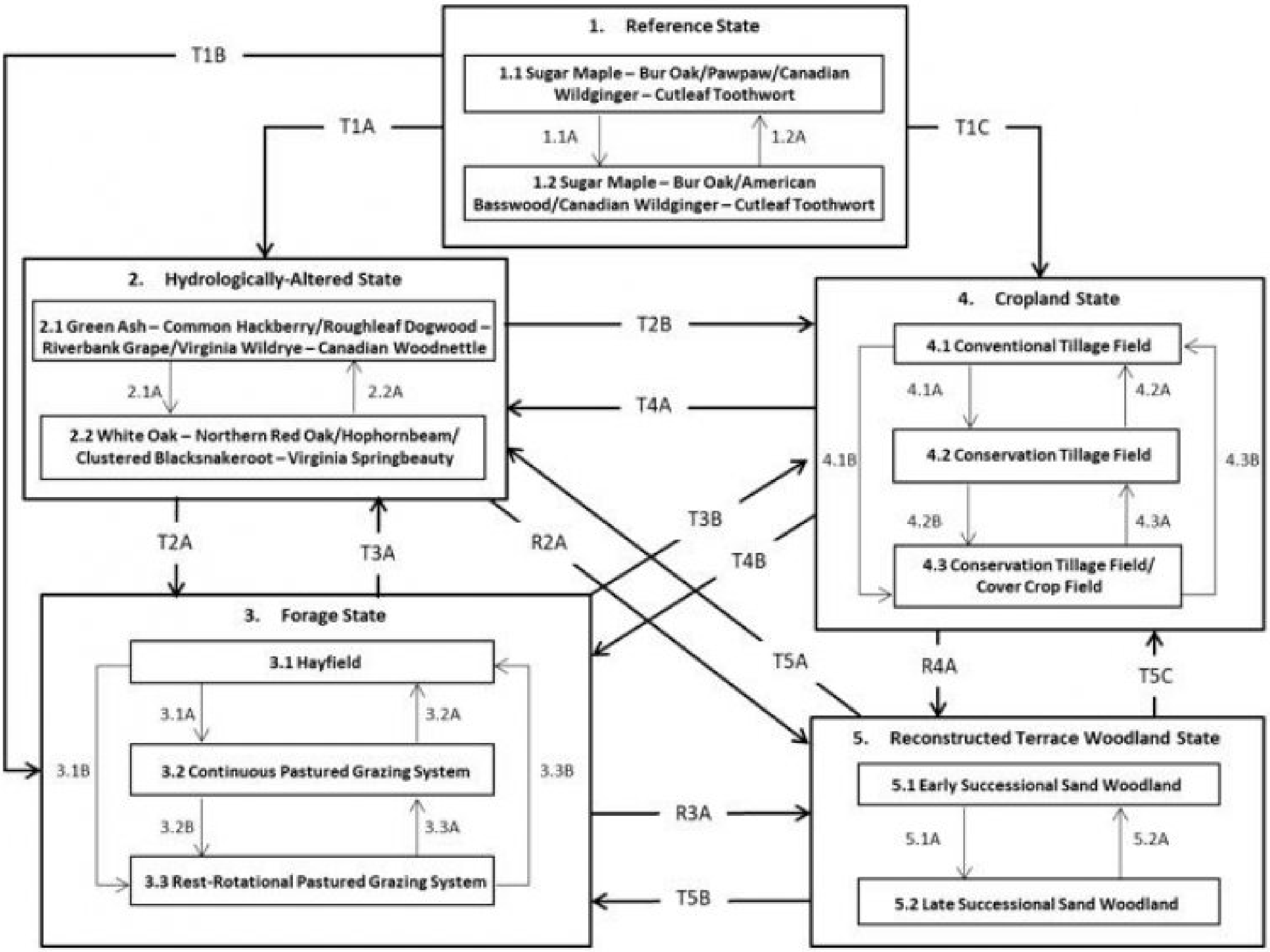
The MLRA lies within the tallgrass prairie ecosystem of the Midwest. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn support prairies, savannas, and forests. Terrace Woodlands form an aspect of this vegetative continuum. This ecological site occurs on rarely-flooded stream terraces on somewhat poorly to well-drained soils. Species characteristic of this ecological site consist of highly intermixed upland and lowland woody and herbaceous vegetation.

Flooding is the dominant disturbance factor in Terrace Woodlands, and storm damage and pests are secondary disturbances. Seasonal flooding occurs approximately every 20 to 100 years, and flooding can persist for up to two days at a time. Damage to trees from wind storms can vary from minor, patchy effects of individual trees to stand effects that temporarily affect community structure and species richness and diversity (Irland 2000; Peterson 2000). Trees are susceptible to a variety of pests (e.g., insects, fungi, cankers, wilts), therefore periodic insect and disease outbreaks play an important role in local canopy structure.

Today, many Terrace Woodlands have been reduced as a result of conversion to pasture. A few sites have been cleared and drained for agricultural production. Remnant sites have been degraded due to significant changes to the natural hydrologic regime and diminished water quality in the watershed. 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

F108AY017IL TERRACE WOODLAND



Code	Process
1.1A	Natural succession as a result of no disturbances
1.2A	Major flood event
T1A, T3A, T4A, T5A	Changes to natural hydroperiod and/or land abandonment
2.1A	Decreased flooding from entrenchment, channelization, dam and levee development
2.2A	Increased flooding from drainage activities and loss of water storage in the watershed
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 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, tree planting, repair hydrology, non-native species control
5.1A	Timber stand improvement practices implemented
5.2A	Setback from extreme weather event or improper timing of management actions

State 1
Reference State

The reference plant community is categorized as a floodplain woodland community, dominated by both upland and lowland woody and herbaceous vegetation. The two community phases within the reference state are dependent on rare flooding. The amount and duration of flooding alters species composition, cover, and extent. Periodic pest outbreaks and wind storms have more localized impacts in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

Community 1.1
Sugar Maple - Bur Oak/Pawpaw/Canadian Wildginger - Cutleaf Toothwort

Sites in this reference community phase are a closed canopy woodland (60 to 80 percent cover), defined by a mixture of hardwood trees. Sugar maple, bur oak, and American elm are common trees on the site, but other species present include hackberry, green ash, white oak, northern red oak, and black walnut(*Juglans nigra* L.). Trees are very large (>33-inch DBH) and range in height from 30 to over 80 feet tall (LANDFIRE 2009). Pawpaw is a dominant shrub in the plant community, and Canadian wildginger and cutleaf toothwort are common herbaceous species. Other ground layer species can include ramp (*Allium tricoccum* Aiton), bloody butcher (*Trillium recurvatum* Beck), Virginia waterleaf (Hydrophyllum virginanum L.), and Virginia bluebells (*Mertensia virginica* (L.) Pers. Ex Link) (INHS 2012). Rare flooding will maintain this phase, but a prolonged period of no disturbances will transition the site to community phase 1.2.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- bur oak (*Quercus macrocarpa*), tree
- pawpaw (*Asimina triloba*), shrub
- Canadian wildginger (*Asarum canadense*), other herbaceous
- cutleaf toothwort (*Cardamine concatenata*), other herbaceous

Community 1.2
Sugar Maple - Bur Oak/American Basswood/Canadian Wildginger - Cutleaf Toothwort

This reference community phase represents a late-sere plant community. Tree species diversity is still high, but the overstory cover shifts to a closed canopy forest (80 to 100 percent cover). As the community moves into an old-growth phase, the subcanopy overtops the shrub layer. Continued lack of disturbances will maintain this phase, but a major flood event will shift the site back to community phase 1.1.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- bur oak (*Quercus macrocarpa*), tree
- American basswood (*Tilia americana*), shrub
- Canadian wildginger (*Asarum canadense*), other herbaceous
- cutleaf toothwort (*Cardamine concatenata*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Natural succession as a result of no disturbances.

Pathway 1.2A
Community 1.2 to 1.1

Major flood event.

State 2
Hydrologically-Altered State

Agricultural tile drainage, stream channelization, habitat fragmentation, agricultural land development, and levee construction in hydrologically-connected waters have drastically changed the natural hydrologic regime of Terrace Woodlands (INHS 2012). In addition, increased amounts of precipitation and intensity have amplified flooding events (Pryor et al. 2014). This has resulted in a type conversion from the species-rich forest to either a wetter or drier plant community. In addition, exotic species have encroached and continuously spread, reducing native diversity and ecosystem stability.

Community 2.1
Green Ash - Common Hackberry/Roughleaf Dogwood - Riverbank Grape/Virginia Wildrye - Canadian Woodnettle

This community represents a transition in plant community composition as a result of an increased flooding regime. Upland drainage activities and loss of water storage across the watershed are some types of anthropogenic alterations that can increase flooding of this site. As a result, the community develops into more of a Silty Floodplain Forest (F108AY019IL) ecological site dominated by wet and wet-mesic woody and herbaceous plants.

Dominant plant species

- green ash (*Fraxinus pennsylvanica*), tree
- common hackberry (*Celtis occidentalis*), tree
- roughleaf dogwood (*Cornus drummondii*), shrub
- riverbank grape (*Vitis riparia*), shrub
- Virginia wildrye (*Elymus virginicus*), grass
- Canadian woodnettle (*Laportea canadensis*), other herbaceous

Community 2.2
White Oak - Northern Red Oak/Hophornbeam/Clustered Blacksnakeroot - Virginia Springbeauty

This community phase represents significant decreases in the flooding regime from activities such as stream entrenchment, channelization, levee formation, and dam development. The resulting plant community develops into an upland forest type, such as the Loess Upland Forest (F108AY011IL) or Outwash Forest (F108AY015IL) ecological site. Non-native invasive species are likely to be encountered, including honeysuckle (Lonicera L.), multiflora rose (*Rosa multiflora* L.), and garlic mustard (*Alliaria petiolata*(M. Bieb.) Cavara & Grande).

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- clustered blacksnakeroot (*Sanicula odorata*), other herbaceous
- Virginia springbeauty (*Claytonia virginica*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.2

Decreased flooding from entrenchment, channelization, dam and levee development.

Pathway 2.2A
Community 2.2 to 2.1

Increased flooding from stream entrenchment, channelization, and/or levee and dam development.

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. Selective tree removal, 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. 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 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

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 utilizing continuous grazing.

Pathway 3.1B
Community 3.1 to 3.3

Mechanical harvesting is replaced with domestic livestock utilizing rotational 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

Rotational 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 rotational 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 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

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

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

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

Pathway 4.1B
Community 4.1 to 4.3

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

Pathway 4.2A
Community 4.2 to 4.1

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

Pathway 4.2B
Community 4.2 to 4.3

Cover crops are implemented to minimize soil erosion.

Pathway 4.3B
Community 4.3 to 4.1

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

Pathway 4.3A
Community 4.3 to 4.2

Cover crop practices are abandoned.

State 5
Reconstructed Terrace Woodland State

The combination of natural and anthropogenic disturbances occurring today has resulted in numerous ecosystem health issues, and restoration back to the historic reference state may not be possible. Many natural woodland communities are being stressed by non-native diseases and pests, habitat fragmentation, permanent changes in hydrologic regimes, and overabundant deer populations on top of naturally-occurring disturbances (severe weather and native pests) (IFDC 2018). However, these habitats provide multiple ecosystem services including carbon sequestration; clean air and water; soil conservation; biodiversity support; wildlife habitat; as well as a variety of cultural activities (e.g., hiking, hunting) (Millennium Ecosystem Assessment 2005; IFDC 2018). Therefore, conservation of these communities should still be pursued. Habitat reconstructions are an important tool for repairing natural ecological functioning and providing habitat protection for numerous species of Terrace Woodlands. Therefore, ecological restoration should aim to aid the recovery of degraded, damaged, or destroyed ecosystems. A successful restoration will have the ability to structurally and functionally sustain itself, demonstrate resilience to the ranges of stress and disturbance, and create and maintain positive biotic and abiotic interactions (SER 2002). The reconstructed terrace woodlands state is the result of a long-term commitment involving a multi-step, adaptive management process.

Community 5.1
Early Successional Reconstructed Woodland

This community phase represents the early community assembly from woodland reconstruction. It is highly dependent on the current condition of the site based on past and current land management actions, invasive species, and proximity to land populated with non-native pests and diseases. Therefore, no two sites will have the same early successional composition. Technical forestry assistance should be sought to develop suitable conservation management plans.

Community 5.2
Late Successional Reconstructed Woodland

Appropriately timed management practices (e.g., forest stand improvement, continuing integrated pest management) applied to the early successional community phase can help increase the stand maturity, pushing the site into a late successional community phase over time. A late successional reconstructed forest will have an uneven-aged, closed canopy and a well-developed understory.

Pathway 5.1A
Community 5.1 to 5.2

Application of stand improvement practices in line with a developed 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

Altered hydrology throughout the watershed transitions the site to the hydrologically-altered state (2).

Transition T1B
State 1 to 3

Woody species removal and cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Transition T1C
State 1 to 4

Woody species removal, tillage, seeding of agricultural crops, and non-selective herbicide transition the site to the cropland state (4).

Transition T2A
State 2 to 3

Woody species removal and cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Transition T2B
State 2 to 4

Woody species removal, tillage, seeding of agricultural crops, and non-selective herbicide transition the site to the cropland state (4).

Restoration pathway R2A
State 2 to 5

Site preparation, tree planting, timer stand improvement, non-native species control, and water control structures installed to improve and regulate hydrology transition this site to the reconstructed terrace woodland state (5).

Transition T3A
State 3 to 2

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

Transition T3B
State 3 to 4

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

Restoration pathway R3A
State 3 to 5

Site preparation, tree planting, timber stand improvement, non-native species control, and water control structures installed to improve and regulate hydrology transition this site to the reconstructed terrace woodland state (5).

Transition T4A
State 4 to 2

Land abandonment transitions the site to the hydrologically-altered state (2).

Transition T4B
State 4 to 3

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

Restoration pathway R4A
State 4 to 5

Site preparation, tree planting, timber stand improvement, non-native species control, and water control structures installed to improve and regulate hydrology transition this site to the reconstructed terrace woodland state (5).

Transition T5A
State 5 to 2

Removal of water control structures and unmanaged invasive species populations transition this site to the hydrologically-altered state (2).

Transition T5B
State 5 to 3

Tree removal and cultural treatments to enhance forage quality and yield transition the site to the forage state (3).

Transition T5C
State 5 to 4

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

Additional community tables

Inventory data references

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

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	01/30/2023
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:**