USDA Natural Resources Conservation Service

Ecological site F134XY011AL
Northern Ponded Loess Terrace - PROVISIONAL

Last updated: 3/20/2025
Accessed: 05/11/2025

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): 134X–Southern Mississippi Valley Loess

The Southern Mississippi Valley Loess (MLRA 134) extends some 500 miles from the southern tip of Illinois to southern Louisiana. This MLRA occurs in Mississippi (39 percent), Tennessee (23 percent), Louisiana (15 percent), Arkansas (11 percent), Kentucky (9 percent), Missouri (2 percent), and Illinois (1 percent). It makes up about 26,520 square miles. Landscapes consist of highly dissected uplands, level to undulating plains, and broad terraces that are covered with a mantle of loess. The soils, mainly Alfisols, formed in the loess mantle. Stream systems of the MLRA typically originate as low-gradient drainageways in the upper reaches that broaden rapidly downstream to wide, level floodplains with highly meandering channels. Alluvial soils are predominantly silty where loess thickness of the uplands are deepest but grade to loamy textures in watersheds covered by thin loess. Underlying the loess mantle are Tertiary deposits of unconsolidated sand, silt, clay, gravel, and lignite. Crowley’s Ridge, Macon Ridge, and Lafayette Loess Plains are discontinuous, erosional remnants that run north to south in southeastern Missouri - eastern Arkansas, northeastern Louisiana, and south-central Louisiana, respectively. Elevations range from around 100 feet on terraces in southern Louisiana to over 600 feet on uplands in western Kentucky. The steep, dissected uplands are mainly in hardwood forests while less sloping areas are used for crop, pasture, and forage production (USDA, 2006).

The full distribution of this site is not known as it often occurs as local inclusions within the Northern Wet Loess Terrace site. However, it is highly probable that the site occurs throughout the Loess Plains (EPA Level IV Ecoregion: 74b) from western Kentucky south to the Southern Rolling Plains (EPA Level IV Ecoregion: 74c) in southwestern Mississippi. The reason this site is shown in only two counties is due to the recognition of a ponded phase for an associated soil for this site.

Classification relationships

All or portions of the geographic range of this site falls within a number of ecological/land classifications including:
-NRCS Major Land Resource Area (MLRA) 134 – Southern Mississippi Valley Loess
-Environmental Protection Agency’s Level IV Ecoregion: Loess Plains, 74b (Griffith et al., 1998; Woods et al., 2002; Chapman et al., 2004)
-231H - Coastal Plains-Loess section of the USDA Forest Service Ecological Subregion (McNab et al., 2005)
-LANDFIRE Biophysical Setting 4713260 and NatureServe Ecological System CES203.479 South – Central Interior / Upper Coastal Plain Flatwoods (LANDFIRE, 2008; NatureServe, 2009)
-LANDFIRE Biophysical Setting 4713270 and NatureServe Ecological System CES203.479 South – Central Interior / Upper Coastal Plain Wet Flatwoods (LANDFIRE, 2008; NatureServe, 2009)
-Xerohydric Flatwoods – Kentucky State Nature Preserves Commission (Evans et al., 2009)
-Western Mesophytic Forest Region - Mississippi Embayment Section (Braun, 1950)

Ecological site concept

The Northern Ponded Loess Terrace is characterized by deep, poorly drained soils that formed in loess or silty

materials. Locations within the Ohio River drainage, the extreme northern extent of the site, were likely formed in clayey lacustrine sediments. This site occurs as depressions on broad, level terraces with ponding typically occurring from winter to mid-spring in most years. These seasonally ponded depressions often occur as inclusions within a much larger ecological site, typically the hydroxeric flatwoods community of the Northern Wet Loess Terrace. Depressional areas differ from the latter in that a much higher proportion of species associated with wetland habitats are generally represented. Species composition appears to be associated with ponding duration. Depressions ponded for longer periods (e.g., winter through late spring or early summer) generally support a greater concentration of wetland obligates such as bald cypress, buttonbush, and arrowleaf. However, ponding duration for most sites is much shorter (3 to 4 months, maximum), with a composition often consisting of pin oak, cherrybark oak, Shumard's oak, swamp chestnut oak, and overcup oak. Swamp white oak is an additional component in portions of the site's northern extent.

Associated sites

F134XY010AL	**Northern Wet Loess Terrace - PROVISIONAL** This is the "matrix community" referenced and discussed in this report.

Similar sites

F134XY202AL	**Western Wet Loess Terrace - PROVISIONAL** This site is mapped broadly across the valley train terraces of the Western Lowlands ecoregion and is the western counterpart of the current ecological site.
F134XY103MS	**Southern Rolling Plains Loess Wet Terrace - PROVISIONAL** This site may possibly be the southern counterpart to the Northern Ponded Loess Terrace.
F134XY005AL	**Northern Wet Loess Interfluve** This is the upland counterpart of the current ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Northern Ponded Loess Terrace site represents shallow depressions that pond seasonally on old fluvial terraces. The site is thought to be broadly distributed across the largest physiographic subsection or ecoregion of the MLRA, the Loess Plains. West to east, this ecological site extends from the heart of the plains into portions of the Southeastern Plains (EPA Level III Ecoregion: 65). North to south, the site extends from the plains in western Kentucky to the border of the Southern Rolling Plains in southwestern Mississippi. The latter forms the southern-most boundary of the site due to warmer average annual air temperatures, greater annual rainfall, and a transition to slightly warmer soils (Chapman et al., 2004).

Characteristics of this region generally include undulating uplands, gently rolling hills, and irregular plains. Topographic relief of the Loess Plains is generally low, averaging about 30 to 70 feet. Upland slopes typically range from 0 to 20 percent with 1 to 8 percent being dominant. Elevations in the range of 300 to 400 feet are commonplace to the south but increase to nearly 600 feet in the north. In portions of western Kentucky and Tennessee, the undulating pattern of the plains is interrupted by dissected landscapes. Such areas tend to be hillier with steeper slopes and greater relief and appear to be concentrated along the borders of broader valleys and floodplains. As the plains continue eastward, starkness of the terrain becomes even more pronounced, which signals the transition of the Loess Plains to the thin loess-capped ridges, hills, and plateaus along the western edge of the Southeastern Plains. To the south, through much of Mississippi, the Loess Plains consists of a very thin east – west belt, compressed between the dissected Loess Hills and Mississippi Alluvial Plain to the west and the Coastal Plain to the east. The convergence of such contrasting ecoregions contribute to a very complex pattern of soils, landforms, and vegetation communities.

The full and accurate distribution of the Northern Ponded Loess Terrace cannot be illustrated due to an artifact of

soil mapping. This site represents a very common feature of the soils with which the site is inextricably associated. The presence of shallow depressions is an assumed and consistent feature of every soil series correlated to this site. Only two soil survey areas, Haywood and Henry counties in Tennessee, recognized a ponding phase large enough to map (at least based on their respective mapping scales). This is the reason for the abbreviated, and somewhat misleading, distribution of this site (see map). Therefore, the presence or occurrence of the Northern Ponded Loess Terrace is an anticipated feature for every soil series correlated to this site. Where such depressions are large enough to be mapped, future soil survey projects should at least distinguish these features as a phase inclusion. The importance of this site from an ecological and conservation perspective cannot be overstated. Exemplary examples of these sites on old fluvial terraces support wetland obligates, contributes to biodiversity of the terrace landscape, and function as critical habitat for amphibians and invertebrate communities.

All aspects are well represented and included in this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Terrace
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	Occasional to frequent
Elevation	200–400 ft
Slope	0–2%
Ponding depth	0–30 in
Water table depth	0–6 in
Aspect	Aspect is not a significant factor

Climatic features

Although this site is only mapped in two counties within MLRA 134, the actual distribution of the site ranges throughout the northern sections of the Loess Plains. This site occurs as inclusions anywhere Henry, Routon, Calhoun, and Adaton soils are mapped on old fluvial terraces within MLRA 134. This ecological site represents the shallow depressions of the preceding soils on loess-capped terraces.

This site falls under the Humid Subtropical Climate Classification (Koppen System). The average annual precipitation for this site from 1980 through 2010 is 56 and ranges from 53 in the north to 58 inches in the south. Maximum precipitation occurs in winter and spring and precipitation decreases gradually throughout the summer, except for a moderate increase in midsummer. Rainfall often occurs as high-intensity, convective thunderstorms during warmer periods but moderate-intensity frontal systems can produce large amounts of rainfall during winter, especially in the southern part of the area. Snowfall generally occurs in the north during most years. However, accumulations are generally less than 12 inches and typically melt within 3 to 5 days. South of Memphis, winter precipitation sometimes occurs as freezing rain and sleet. The average annual temperature is 60 degrees F and ranges from 58 in the north to 64 degrees F in the south. The freeze-free period averages 222 days and ranges from 206 days in the north to 252 days in the south. The frost free period averages 197 days and ranges from 191 in the north to 224 days in the south.

The broad geographic distribution of this site north to south naturally includes much climatic variability with areas farther south having a longer growing season and increased precipitation. These climatic factors likely lead to important differences in overall plant productivity and key vegetation components between the southern and northern portions of this site. As future work proceeds, the current distribution of this site will likely be revised with a “central” site interjected between the northern and southern extremes of this MLRA.

Table 3. Representative climatic features

Frost-free period (average)	197 days

Freeze-free period (average)	222 days
Precipitation total (average)	56 in

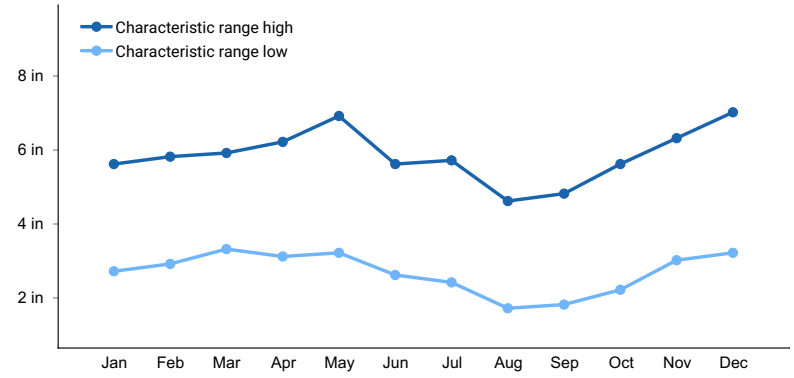

Figure 1. Monthly precipitation range

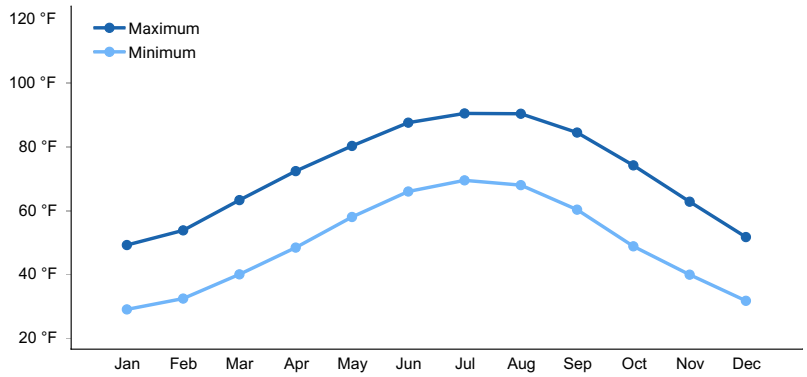

Figure 2. Monthly average minimum and maximum temperature

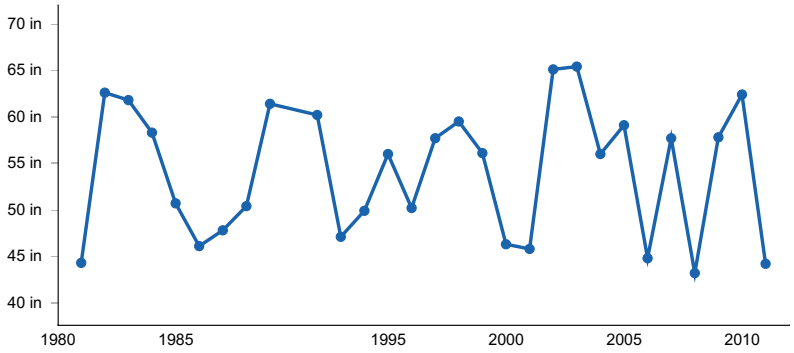

Figure 3. Annual precipitation pattern

Climate stations used

- (1) LOVELACEVILLE [USC00154967], Paducah, KY
- (2) OAKLEY EXP STN [USC00226476], Raymond, MS
- (3) COLLIERVILLE [USC00401950], Collierville, TN
- (4) COVINGTON 3 SW [USC00402108], Covington, TN
- (5) BARDWELL 2 E [USC00150402], Bardwell, KY
- (6) BATESVILLE 2 SW [USC00220488], Batesville, MS
- (7) CANTON 4N [USC00221389], Canton, MS
- (8) GRENADA [USC00223645], Grenada, MS
- (9) SENATOBIA [USC00227921], Coldwater, MS
- (10) VICKSBURG MILITARY PK [USC00229216], Vicksburg, MS
- (11) BOLIVAR WTR WKS [USC00400876], Bolivar, TN
- (12) UNION CITY [USC00409219], Union City, TN

- (13) PADUCAH [USW00003816], West Paducah, KY
- (14) JACKSON INTL AP [USW00003940], Pearl, MS
- (15) MURRAY [USC00155694], Murray, KY
- (16) HOLLY SPRINGS 4 N [USC00224173], Holly Springs, MS
- (17) LEXINGTON [USC00225062], Lexington, MS
- (18) DRESDEN [USC00402600], Dresden, TN
- (19) MILAN EXP STN [USC00406012], Milan, TN
- (20) BROOKPORT DAM 52 [USC00110993], Paducah, IL
- (21) YAZOO CITY 5 NNE [USC00229860], Yazoo City, MS
- (22) NEWBERN [USC00406471], Newbern, TN
- (23) GILBERTSVILLE KY DAM [USC00153223], Gilbertsville, KY

Influencing water features

This site is seasonally ponded in most years. Ponding is typically a result of precipitation since the principal location of this site is on old fluvial terraces above active floodplains (or the 100-year flood zone). However, there are instances where this site is flooded from adjoining streams during periods of very high rainfall. Those instances are anticipated to be localized and certainly not pervasive across the distribution of this site. Additionally, areas that occur near streams may be heavily influenced by groundwater during wetter periods of the year.

Soil features

Please note that the soils listed in this section of the description may not be all inclusive. There may be additional soils that fit the site's concepts. Additionally, the soils that provisionally form the concepts of this site may occur elsewhere, either within or outside of the MLRA and may or "may not" have the same geomorphic characteristics or support similar vegetation. Some soil map units and soil series included in this "provisional" ecological site were used as a "best fit" for a particular soil – landform catena during a specific era of soil mapping, regardless of the origin of parent material or the location of MLRA boundaries. Therefore, the listed soils may not be typical for MLRA 134 or a specific location, and the associated soil map units may warrant further investigation in a joint ecological site inventory – soil survey project. When utilizing this provisional description, the user is encouraged to verify that the area of interest meets the appropriate ecological site concepts by reviewing the soils, landform, vegetation, and physical location. If the site concepts do not match the attributes of the area of interest, please review the Similar or Associated Sites listed in the Supporting Information section of this description to determine if another site may be a better fit for your area of interest.

The soils of this site are very deep, poorly drained, and have a perched water table at or near the surface during wet periods of the year, generally winter into spring. They formed in a mantle of loess, or "water reworked" loess, on broad, level to nearly level terraces where they occur on extensive flats and interspersed, shallow depressions. Dominant slope gradient is between 0 and 1 percent but may range to a high of 2 percent. Permeability is slow and runoff is slow to very slow with some areas receiving overland flow from adjacent sites. The key characteristic of this site is the associated soils' propensity to occur on or develop distinct concavities or depressions, which frequently pond from winter to spring. Ponding depths vary but based on observations, depths may range from as little as 3 inches to 42 inches and potentially deeper.

The soils of this site are very deep, poorly drained, and have a perched water table at or near the surface during wet periods of the year, generally winter into spring. They formed in a mantle of loess, or "water reworked" loess, on broad, nearly level upland interfluves where they occur as depressions, headslopes, and flats. Dominant slope gradient is between 0 and 2 percent but may range to a high of 3 percent. Permeability is slow and runoff is negligible to slow with some areas receiving overland flow from adjacent sites.

Principal soils of this site are essentially the same as that for the Northern Wet Loess Terrace. This site represents a ponded phase of those soils. Associated soils of this site include Routon (Fine-silty, mixed, active, thermic Typic Epiaqualfs), Adaton (Fine-silty, mixed, active, thermic Typic Endoaqualfs), Henry (Coarse-silty, mixed, active, thermic Typic Fragiaqualfs), and Calhoun (Fine-silty, mixed, active, thermic Typic Glossaqualfs) soil series. Routon soils are characteristically episaturated; saturation occurs in the layers above 54 inches. Adaton soils are recognized as being endosaturated, but a seasonally high water table may be influenced by an argillic horizon consisting of 20 to 35 percent clay in the upper 20 inches. Henry soils have a slowly permeable fragipan in the subsoil. Depth to the fragipan ranges from 20 to 36 inches (USDA, 2016). Calhoun soils have very slow internal

drainage. Clay content of the Btg horizon ranges from 22 to 35 percent. The glossic horizon extends deeply into the B horizon. In at least one subhorizon within a depth of 30 inches, exchangeable aluminum makes up 20 to 70 percent of the effective cation-exchange capacity.

In northern-most extent of this site near Paducah, Kentucky, a local group of soils have been mapped that support similar perching properties and vegetation communities as the aforementioned loessal soils. This suite of soils apparently were formed from a lacustrine environment during the Late Pleistocene (Olive, 1966). They have a relatively higher clay content in subsoil horizons and have been mapped as the Natalbany (Fine, smectitic, thermic Vertic Epiaqualfs), Ginat (Fine-silty, mixed, active, mesic Typic Endoaqualfs), and Okaw (Fine, smectitic, mesic Chromic Vertic Albaqualfs) series. These soils have not been technically or officially correlated with this site given their regionally-assigned affiliation, but their presence and close association with loessal soils of this site (particularly Routon) warrant recognition.

Table 4. Representative soil features

Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Poorly drained
Permeability class	Slow to moderate
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	8.2 in
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5–5.6
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Northern Ponded Loess Terrace is characterized by shallow depressions on old fluvial terraces. The site typically occurs as inclusions within the larger hydroxeric flatwoods community (the latter defined here as the matrix community; also described as the Northern Wet Loess Terrace ecological site). These features typically pond during the wetter times of the year, which generally occurs from winter into spring. Hydrologically, these depressions may be classed as open or “flow-through” systems or closed, meaning no outlet. Most are thought to represent the latter, but based on topographic examinations of these features, a few are indicated as having “blue line” streams running through or beginning within their location.

Most ecological descriptions of flatwoods systems make mention of shallow depressions and their influence on vegetation (e.g., NatureServe, 2009; Bryant, 1999), but they are rarely defined or distinguished as a separate community. Terrace depressions are recognized here as a distinct ecological site given their conservation significance as essential breeding habitat for amphibian and invertebrate communities and for their overall contribution to species and site diversity. Plant communities occurring within terrace depressions generally support a greater concentration of wetland species than the surrounding matrix flatwoods community.

Dimensions or aerial extent of individual depressions vary widely with some encompassing an area less than 0.5 acre to others spanning 50 acres (USDA-NRCS, 1995). Depths within and among these features vary widely as

well. Some sites are shallow and remain ponded only during the wettest periods of the year, whereas others attain depths over three feet and remain ponded for longer durations, often through the spring and sometimes into early summer. These variations in size and depth have tremendous influences on associated vegetation. Shallower sites or zones within a depression may support species generally associated with better drainage such as Shumard's oak and cherrybark oak. Deeper areas often consists of species often associated with wetter conditions such as willow oak, pin oak, and overcup oak. Although rare, the deepest sites may consists mainly of wetland obligates such as bald cypress, overcup oak, buttonbush, and swamp cottonwood.

An additional contributor to the range of variability for this site is its geographic extent. The distribution of this site from western Kentucky to the Southern Rolling Plains in southwest Mississippi contributes to species differences north to south. For example, in western Kentucky swamp white oak occurs locally and to the south, loblolly pine may occur in some shallow depressions.

Since settlement of the region, this site has incurred a number of alterations and impacts. Most impacts probably resulted from a rippling effect as the surrounding matrix (flatwoods) community was being converted to agriculture, pastureland, and/or timberland. Seasonally wet depressions were often recognized as low spots and were simply avoided. As demands for more intensive production increased, these sites were sometimes targeted for drainage and conversion to cropland. Today, many local occurrences of this site are recognizable from a distance because they generally consist of a circle of trees situated in the middle of large agriculture fields.

This ecological site is as rare today as the matrix community within which it is inextricably associated. Impacts that are incurred to the surrounding flatwoods system are filtered into this site. Accordingly, reference conditions of this ecological site are entirely dependent upon the conditions of its matrix system, the Northern Wet Loess Terrace.

A single community phase is identified to represent the range of natural variability of this site and is entirely contingent upon the existence and functionality of the surrounding flatwoods community. Reference conditions of this site are not found in isolated patches of trees that are situated in open fields.

This ecological site has limitations of varying severity for all production purposes (i.e., cropland, pastureland, and timberland), mainly due to seasonal wetness. Two major altered states are recognized for this site: 1) the altered matrix community with depressions undrained; and 2) altered hydrology whereby some form of drainage system has been constructed to limit seasonal ponding. This approach is somewhat unconventional and should be regarded as "provisional". Future inventories and project development may lead to complete readjustments of the currently defined reference state and associated altered states.

Following this narrative, a "provisional" state and transition model is provided that includes the "perceived" reference state and several alternative (or altered) vegetation states that have been observed and/or projected for the Northern Ponded Loess Terrace ecological site. This model is based on limited reconnaissance, literature, expert knowledge, and interpretations. Plant communities will differ across MLRA 134 due to natural variability in climate, soils, and physiography. Some of the presented alternate states may warrant removal as additional information is learned and/or becomes available. Depending on objectives, the reference plant community may not necessarily be the management goal.

The environmental and biological characteristics of this site are complex and dynamic. As such, the following diagram suggests pathways that the vegetation on this site might take, given that the modal concepts of climate and soils are met within an area of interest. Specific locations with unique soils and disturbance histories may have alternate pathways that are not represented in the model. This information is intended to show the possibilities within a given set of circumstances and represents the initial steps toward developing a defensible description and model. The model and associated information are subject to change as knowledge increases and new information is garnered. This is an iterative process. Most importantly, local and/or state professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

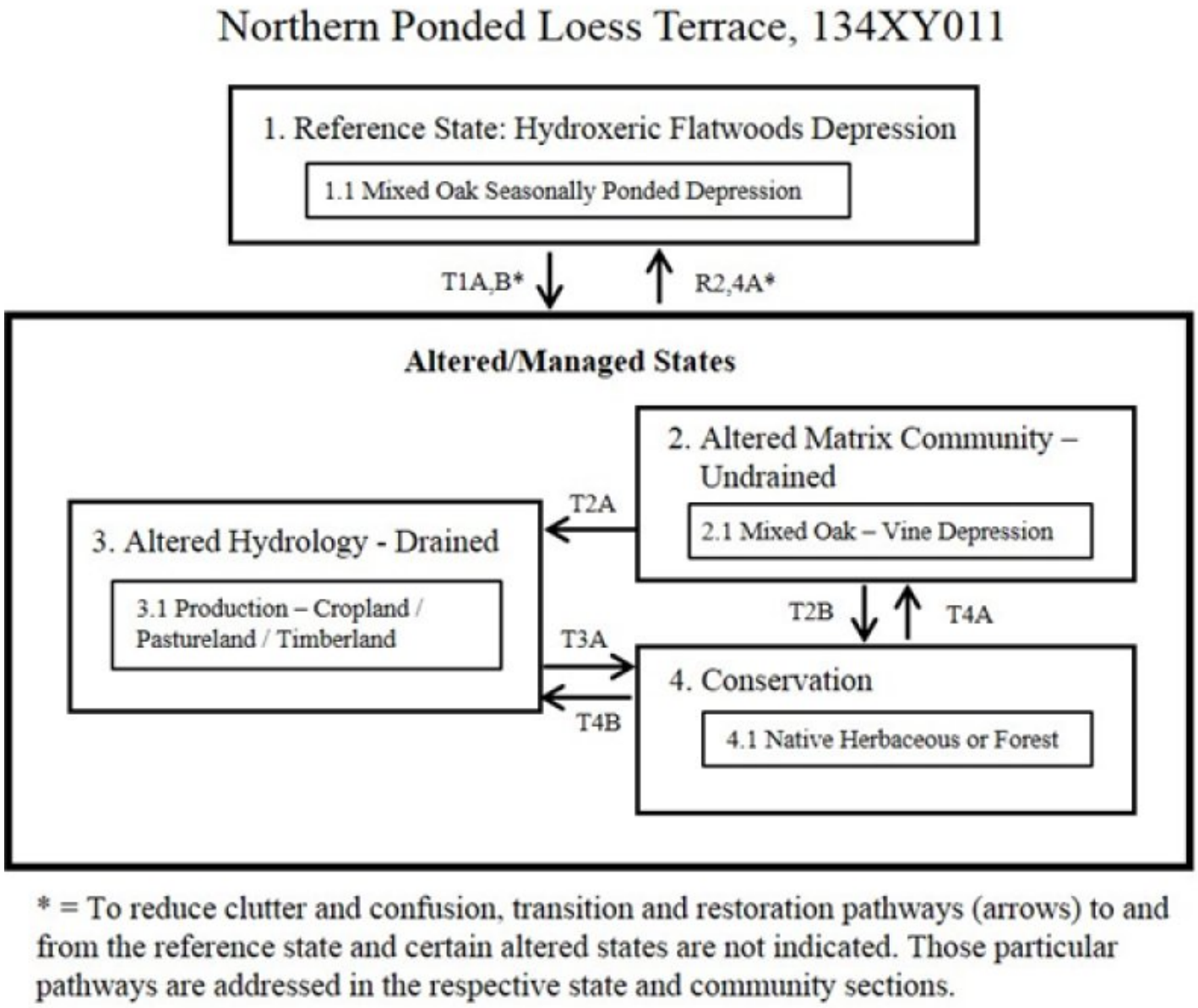

Figure 5. STM - Northern Ponded Loess Terrace

Pathway	Practice
T1A, T4A	conversion of surrounding flatwoods to other uses (cropland, pastureland, timberland) but leaving depressions mostly intact (undrained; State 2)
T1B, T2A, T4B	draining or altering hydrologic function of depressions and surrounding community matrix; placing into production (State 3)
R2A, R4A	natural succession; return of maintenance or disturbance (e.g., fire?); any former alteration to soil drainage MUST be restored before returning to true reference conditions (State 1)
T2B, T3A	discontinuing cultivation/pastureland/timberland and establishing native grasses/forbs or managing for native woodland; includes "guided" natural succession and maintenance, periodic fire, select herbicide treatment; restored hydrology if previously altered (State 4)

Figure 6. Legend - Northern Ponded Loess Terrace

State 1
Hydroxeric Flatwoods Depressions

The Northern Ponded Loess Terrace is inextricably linked to the larger matrix community within which it belongs, the Northern Wet Loess Terrace or hydroxeric flatwoods. Any severe alteration that changes composition or functionality of the matrix system affects this site. Therefore, reference conditions of these seasonally ponded flatwood depressions are defined by and occur within reference sites of the matrix community. Classifying this system with a single plant association name is extremely difficult, if not impossible, due to the variability of species dominance from one depression to another. Composition of this site appears to be directly related to aerial extant

and more importantly, depth of individual depressions. Collectively, size and depth of these surface concavities ultimately determine ponding duration – that and the amount of precipitation that has fallen within the wet season. Sites that are relatively shallow and ponded from winter into mid-spring typically support a mixed-oak stand that often consist of species found in drier habitats. Deeper sites that remain ponded for longer periods (some into early summer, precipitation depending) may support a greater number of wetland obligate species. From a conservation and biodiversity perspective, seasonally ponded (closed) depressions or vernal pools are recognized for the critically important functions and values they provide. This site contributes to the biodiversity of the overall flatwoods system by supporting a number of additional wetland components that may not occur otherwise. These features may also support rare and vanishing plant species and serve as vital habitat for an entire zoological system. Of concern, portions of this site have incurred tremendous alteration due to drainage. Any attempt to reestablish perceived reference conditions of a stand or a local site must first restore the natural hydrology of that location, which may entail removing drainage structures. If not, management may improve stand structure and even composition to a degree, but the site, overall, will remain in an altered state relative to reference conditions.

Community 1.1
Mixed Oak Seasonally Ponded Depression

This community phase represents the compositional, hydrological, and structural complexity of stands supporting perceived reference conditions. With no intact example of a pre-settlement community remaining, this phase is arbitrarily chosen to represent the range of conditions that exist. Composition of this community is quite variable and highly dependent upon ponding depth and duration. Canopy components of shallow sites (includes the wetted margin of deeper depressions) may consist of Shumard’s oak, cherrybark oak, willow oak, water oak, pin oak, swamp chestnut oak, sweetgum, green ash, red maple, and American elm with overcup oak occurring in deeper spots. Locales in the northern extent of this site may include swamp white oak and occasionally, northern red oak. Understory vegetation may include black willow, possumhaw, American snowbell, sawtooth blackberry, smallspike false nettle, catchfly grass, woolgrass, blunt broomsedge, hairy sedge, along with many additional sedges, rushes, and mosses. Although more rare, deeper sites (greater than 2 feet deep) have been observed to support stands of bald cypress, buttonbush, and small patches of swamp cottonwood; overcup oak is generally present in most all deeper depressions. Loblolly pine may be an additional component of this site to the south in Mississippi. Ground cover is highly dependent on ponding duration. Sites that are ponded for longer periods (e.g., winter into early summer) generally have a ground cover mainly comprised of leaf litter and detritus.

State 2
Altered Matrix Community – Undrained

This ecological site is inextricably associated to the matrix community within which it occurs. Impacts to the surrounding flatwoods system are filtered into this site. Therefore, this state represents many of the early impacts to the flatwoods system during and after settlement. This state is believed to represent the prevailing condition of this site, today. A key criterion of this state is that the geomorphological characteristics of the depressions are not destroyed and that these surface concavities still pond seasonally. The surrounding matrix community may sustain varying levels of impacts from land use actions that include forestry practices, pasturage, and cropland. It is acknowledged that each of the preceding land uses will exert varying levels of impacts on isolated depressions, and each land practice may transition this site to completely different altered states. However, adequate information to describe those potential differences (or altered states) are unknown at this time. Future inventories may lead to readjustments of this state. It is worth noting that all areas currently supporting perceived reference conditions were once in this particular altered state. There are no known examples of a pre-settlement reference site. Conceivably, if formerly impacted sites (from timber, grazing, and cropland) can support perceived reference conditions, today, then surely areas currently under varying land uses have that same potential, provided that soil properties, drainage patterns, and geomorphic characteristics have not been destroyed or severely altered.

Community 2.1
Mixed Oak – Vine Depression

This community phase represents the composition and condition of many isolated depressions that occur within timberland, pastureland, and/or cropland. Obviously, composition may vary under the different land uses, especially if particular tree species within the depressions are harvested. The community phase will also change if trees are removed and the area kept in herbaceous cover. However, there are a number of examples where trees have been

retained in these isolated depressions. Examples of forested depressions in open fields often consist of species found in reference sites, except there are usually some select species harvesting. Species occurring in these sites may consist of pin oak, willow oak, water oak, overcup oak, red maple, black cherry, winged elm, American elm, and green ash. The most notable difference in these sites surrounded by open areas is the profuse entanglement of greenbrier. Greenbrier is often the dominant vine in these sites, providing as much as 90 percent ground cover locally.

State 3
Altered Hydrology - Drained

This state is representative of areas that have had drainage structures installed to meet production objectives. Many of the drained depressions have been cleared of vegetation and included within the greater production system, which was either cropland or pastureland. In pastureland settings, some of these depressions were not drained but retained as stock or cattle ponds. Draining these seasonal ponds also assisted with forest or timberland production. Areas that have been simply ditched may have restorative capacity. However, those areas that have been drained and had the micro-topographic features of the depression removed (bulldozing, leveling, filling, etc.), are lost. Such former sites have been essentially erased.

Community 3.1
Production – Cropland / Pastureland / Timberland

This phase is representative of the varying land uses associated with depressions that have been drained. Although the intensity of each land use differs, impacts to the site are similar: draining these depressions removes their ecological functions and values. Sites that have not been filled or physically leveled may be reparable. For those that have, this state and phase serves as an endpoint.

State 4
Conservation

This alternative state is included to represent the range or breadth of conservation actions that may be implemented and established should other land uses be discontinued within a given location. Several actions may be chosen including the restoration of the site’s natural hydrology (removal of drainage structures) and establishing native warm season grasses, suitable forbs for pollinators, and/or native trees and managing for forest or woodland conditions. If at all possible, the herbaceous species established should be derived from the “wild types” (genetic stock) from the Loess Plains or from adjoining ecoregions. This action would help preserve the unique genetic material from the area and would help to reintroduce the native herbaceous varieties back into a portion of their former range.

Community 4.1
Native Herbaceous or Woodland

Maintaining this site’s capacity for seasonal ponding is key to any conservation action associated with this particular site. Beyond that, this community phase represents the establishment of select native plants to meet conservation objectives into the larger matrix flatwoods community (Northern Wet Loess Terrace). As alluded to above, the best case scenario is the establishment of native species selected from the genetic stock of the Loess Plains or neighboring ecoregions. Herbaceous species suitable for establishing on the larger flatwoods community include Indian grass, little bluestem, gama-grass, threeawn, wild oat grasses, panic grass, blazing star, evening-primrose, asters, sunflowers, goldenrod, tickseed, coneflowers, rattlesnake master, mountain mints, agave, milkweeds, sedges, among many others. Additional study is needed on this site before a complete set of plants can be generated. Key to the perpetuation and maintenance of an herbaceous community is frequent fire, generally on a 1 to 3 year return interval (judgement based on early accounts of frequent burning; e.g., Loughridge, 1888).

Transition T1A
State 1 to 2

This pathway represents what generally occurred historically where well-defined flatwoods depressions were left mostly intact. Some timber harvests to remove desirable species was certainly conducted, but the ponding

capabilities of the depressions were not altered (i.e., drained). However, the surrounding matrix community, the hydroxeric flatwoods, incurred alteration from heavy cutting, grazing, and then a final conversion to open cropland and/or pastureland.

Transition T1B
State 1 to 3

This pathway represents dramatic alteration to the function and characteristics of this site by ditching and draining depressions in addition to alteration of the matrix community.

Restoration pathway R2A
State 2 to 1

This pathway signifies a return to perceived reference conditions where the hydrologic characteristics of the flatwoods community and associated depressions were never severely altered. Natural succession is the principal process leading back to the perceived reference state. This pathway is representative of most “protected” flatwoods in existence, today.

Transition T2A
State 2 to 3

This pathway represents an attempt to drain these depressions for wider coverage of and increase in production (includes timberland, pastureland, and cropland).

Transition T2B
State 2 to 4

This pathway represents the decision to discontinue production of the surrounding matrix community and to establish native grasses/forbs or trees on this site. This action also includes management activities to “guide” natural succession and conservation maintenance. Actions may include prescribed fire for maintaining and enhancing herbaceous establishment of the matrix community and herbicide treatments for controlling exotic species invasions and to ensure select tree establishment.

Transition T3A
State 3 to 4

This pathway represents the decision to discontinue production of the surrounding matrix community and to establish native grasses/forbs or trees on this site. This action also includes management activities to “guide” natural succession and conservation maintenance. Actions may include prescribed fire for maintaining and enhancing herbaceous establishment of the matrix community and herbicide treatments for controlling exotic species invasions and to ensure select tree establishment. This action may also include the removal of drainage ditches, tiles, or other water control structures.

Restoration pathway R4A
State 4 to 1

This pathway signifies a return to perceived reference conditions where the hydrologic characteristics of the flatwoods community and associated depressions were never severely altered. Natural succession is the principal process leading back to the perceived reference state. This pathway is representative of most “protected” flatwoods in existence, today.

Transition T4A
State 4 to 2

This pathway represents the discontinuation of conservation practices and a return to production with isolated depressions remaining intact.

Transition T4B
State 4 to 3

This pathway represents the discontinuation of conservation practices and a return to production with isolated depressions being altered by draining and/or mechanically erased.

Additional community tables

Other references

Braun, E.L. 1950. Deciduous Forests of Eastern North America. Hafner Press, New York. 596 p.

Bryant, William S. 1999. Flatwoods of the Jackson Purchase Region, western Kentucky: Structure and Composition. In: Hamilton, Steven W., Edward W. Chester, David S. White and Mack T. Finley (eds.). Proceedings of the Eighth Symposium on the Natural History of the Lower Tennessee and Cumberland River Valleys. The Center for Field Biology, Austin Peay State University, Clarksville, TN.

Chapman, S.S, G.E. Griffith, J.M. Omernik, J.A. Comstock, M.C. Beiser, and D. Johnson. 2004. Ecoregions of Mississippi (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

Evans, M., M. Hines, and B. Yahn. 2009. Natural communities of Kentucky 2009. Kentucky State Nature Preserves Commission, Frankfurt, KY.

Griffith, G.E., J.M. Omernik, S. Azevedo. 1998. Ecoregions of Tennessee (color poster with map, descriptive text, summary tables, and photographs): Reston, VA., U.S. Geological Survey (map scale 1:1,000,000).

LANDFIRE. 2009. LANDFIRE Biophysical Setting Models. Biophysical Setting 46-47. (2009, February and March – last update). Homepage of the LANDFIRE Project, U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, [Online]. Available: http://www.landfire.gov/index.php (Accessed: 1 July 2014).

Loughridge, R.N. 1888. Report on the Geological and Economic Features of the Jackson Purchase Region, Embracing the Counties of Ballard, Calloway, Fulton, Graves, Hickman, McCracken, and Marshall. Geologic Survey of Kentucky. Frankfort, KY.

McNab, W.H.; Cleland, D.T.; Freeouf, J.A.; Keys, Jr., J.E.; Nowacki, G.J.; Carpenter, C.A., comps. 2005. Description of ecological subregions: sections of the conterminous United States [CD-ROM]. Washington, DC: U.S. Department of Agriculture, Forest Service. 80 p.

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 06 February 2009.

Olive, W.W. 1966. Lake Paducah, of Late Pleistocene Age, in western Kentucky and southern Illinois. U.S. Geological Survey Professional Paper 550-D. p 87-88.

[USDA-NRCS] United States Department of Agriculture, Natural Resources Conservation Service. 1995. Soil Survey of Haywood County, Tennessee. 129 p. Available online: http://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=TN. (Accessed: 30 November 2013).

[USDA-NRCS] United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

[USDA-NRCS] United States Department of Agriculture, Natural Resources Conservation Service. 2016. Official Soil Series Descriptions. Available online: https://soilseries.sc.egov.usda.gov/osdname.asp. (Accessed: 17 May 2016).

Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor.

2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): Reston, VA., U.S. Geological Survey (map scale 1:1,000,000).

Contributors

Barry Hart

Approval

Matthew Duvall, 3/20/2025

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	05/11/2025
Approved by	Matthew Duvall
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:**
