USDA Natural Resources Conservation Service

Ecological site F134XY008AL
Northern Moderately Wet Loess Terrace - PROVISIONAL

Accessed: 12/08/2023

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).

This 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.

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, 2009; NatureServe, 2009)
-LANDFIRE Biophysical Setting 4713270 and NatureServe Ecological System CES203.479 South – Central Interior / Upper Coastal Plain Wet Flatwoods (LANDFIRE, 2009; 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 Moderately Wet Loess Terrace is characterized by very deep, somewhat poorly drained soils that formed in loess or water reworked loess. This site primarily occurs on old fluvial terraces (generally above the 100-year flood zone) and secondarily on broad, nearly level toeslopes and valley bottoms of the Loess Plains. Dominant slope gradients are between 0 and 3 percent but may range to a high of 6 percent. Soils have a seasonally high water table from winter to mid-spring in most years that can become quite droughty by late summer. The site

sometimes occurs in complex or association with seasonally ponded depressions and poorly drained flatwoods. Natural vegetation of this site consists chiefly of mixed hardwoods that may include drought-tolerant oaks and hickory in addition to species found in moist environments such as sweetgum, green ash, willow oak, and maple. In the southern part of the range, shortleaf and loblolly pines may be additional components in addition to oak and other hardwoods.

Associated sites

F134XY010AL	**Northern Wet Loess Terrace - PROVISIONAL**

Similar sites

F134XY103MS	**Southern Rolling Plains Loess Wet Terrace - PROVISIONAL** This is the southern counterpart to the Northern Moderately Wet Loess Terrace.
F134XY209AL	**Western Moderately Wet Terrace - PROVISIONAL** This site occurs on the Valley Train Terraces of the Western Lowlands (eastern Arkansas) and is the western counterpart to the Northern Moderately Wet Loess Terrace.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Northern Moderately Wet Loess Terrace is 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.

This ecological site primarily occurs on broad, level to nearly level pre-Holocene age terraces that border the active floodplains of meandering rivers and large streams. Secondarily, soils of this site have been mapped on broad, nearly level toeslopes and valley basins of the Loess Plains. Embedded within this site are occasional, shallow depressions that pond during the wetter times of the year. Oftentimes, this site forms a soil – vegetation community transition from slightly higher and drier positions to lower and wetter areas of the terrace flatwoods.

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

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Depression
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	150–550 ft
Slope	0–5%
Ponding depth	0 in
Water table depth	8–24 in
Aspect	Aspect is not a significant factor

Climatic features

This site falls under the Humid Subtropical Climate Classification (Koppen System). The average annual precipitation for this site from 1980 through 2010 is 56 inches 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 the Northern Loess Interfluve 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

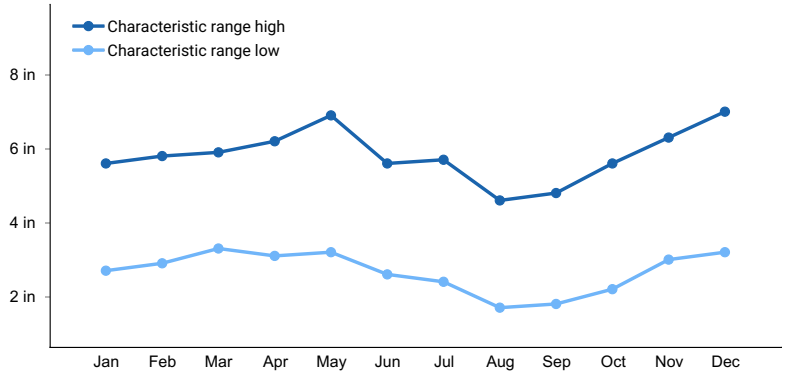

Figure 1. Monthly precipitation range

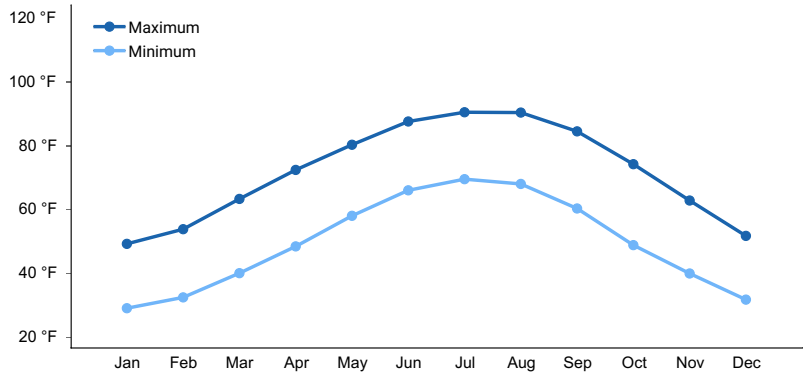

Figure 2. Monthly average minimum and maximum temperature

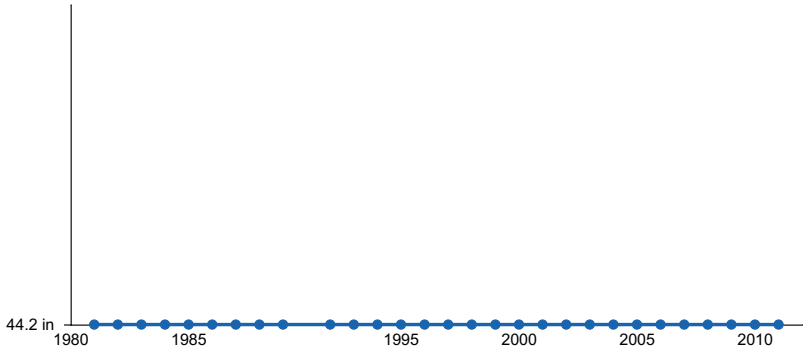

Figure 3. Annual precipitation pattern

Climate stations used

- (1) GILBERTSVILLE KY DAM [USC00153223], Gilbertsville, KY
- (2) BATESVILLE 2 SW [USC00220488], Batesville, MS
- (3) GRENADA [USC00223645], Grenada, MS
- (4) LEXINGTON [USC00225062], Lexington, MS
- (5) VICKSBURG MILITARY PK [USC00229216], Vicksburg, MS
- (6) COLLIERVILLE [USC00401950], Collierville, TN
- (7) MILAN EXP STN [USC00406012], Milan, TN
- (8) JACKSON INTL AP [USW00003940], Pearl, MS
- (9) LOVELACEVILLE [USC00154967], Paducah, KY
- (10) HOLLY SPRINGS 4 N [USC00224173], Holly Springs, MS
- (11) DRESDEN [USC00402600], Dresden, TN
- (12) BROOKPORT DAM 52 [USC00110993], Paducah, IL
- (13) OAKLEY EXP STN [USC00226476], Raymond, MS
- (14) YAZOO CITY 5 NNE [USC00229860], Yazoo City, MS
- (15) BOLIVAR WTR WKS [USC00400876], Bolivar, TN
- (16) COVINGTON 3 SW [USC00402108], Covington, TN
- (17) PADUCAH [USW00003816], West Paducah, KY
- (18) BARDWELL 2 E [USC00150402], Bardwell, KY
- (19) MURRAY [USC00155694], Murray, KY
- (20) CANTON 4N [USC00221389], Canton, MS
- (21) SENATOBIA [USC00227921], Coldwater, MS
- (22) NEWBERN [USC00406471], Newbern, TN
- (23) UNION CITY [USC00409219], Union City, TN

Influencing water features

Soils of this site are noted for supporting a high water table (perched) during periods of high rainfall and low evapotranspiration, typically winter to spring. The site is sometimes associated with or may occur in complex with upland depressions that are seasonally ponded; headslopes that form the origins of intermittent or perennial streams; and small, drainageways on terraces.

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, somewhat poorly drained, and have a perched water table 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 to gently sloping upland interfluves and terraces. Dominant slope gradient is between 0 and 3 percent but may range to a high of 6 percent. Permeability is moderate to moderately slow above the perching layer and slow in that layer.

The principal soils of this site formed in thick loess (i.e., > 48 inches.) or in silty alluvium over loess and include the Calloway (Fine-silty, mixed, active, thermic Aquic Fraglossudalfs) and Kurk (Fine-silty, mixed, active, thermic Aeric Epiaqualfs) soil series. Collectively for both soils, depth to a seasonally high water table is approximately 1.0 to 1.7 feet (USDA, 2004). Of the two, only Calloway has a true fragipan; depth to the fragipan ranges from 14 to 38 inches. For Calloway, reaction is very strongly acid through moderately acid in the upper part of the solum and strongly acid through slightly alkaline in the lower part. For Kurk, reaction ranges from strongly acid to neutral in the surface and subsurface, and very strongly acid to neutral in the subsoil, and strongly acid to slightly alkaline below the discontinuity (USDA, 2016).

Two additional soil series are "provisionally" included in this site until the results from field observations more accurately determine their influence on plant community dynamics. These "tentative" soils include the Bude (Fine-silty, mixed, active, thermic Aquic Fragiudalfs) and Hatchie (Fine-silty, siliceous, active, thermic Aquic Fraglossudalfs) soil series. Both soils are formed in a mantle of thin loess (i.e., 2 to 4 ft.) over loamy material and have fragipans. Collectively, depth to the fragipan ranges from approximately 18 to 40 inches. Reactions range from very strongly acid to moderately acid throughout the profile (USDA, 2016).

Table 4. Representative soil features

Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained
Permeability class	Slow to moderate
Soil depth	9–34 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6–8.2 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm

Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.9–6.6
Subsurface fragment volume <=3" (Depth not specified)	0–2%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This ecological site is distributed across broad expanses of level to nearly level flats on old fluvial terraces and secondarily, on valley floors (nearly level toeslopes) of the Loess Plains. A key characteristic of this site is the propensity of these somewhat poorly drained soils to perch water during wetter times of the year. Low surface runoff and slow permeability through a dense fragipan contribute to saturated conditions from winter through spring in most years. This extreme wet condition through the first part of the year is reversed by mid- to late summer when evapotranspiration essentially removes moisture above the soils' perching layer. This leads to droughty conditions during summer and fall. The alternating wet – dry pattern of this site characteristically occurs in other "flatwoods" communities in the eastern United States (see Taft et al., 1995; Fralish et al., 1999). This moisture regime is often referred to as "hydroxeric".

It's important to note that this site generally occurs above the modern floodplain of larger streams and rivers and receives very little, if any, overland flow. Interspersed across the broad flats of this site are surface irregularities that include occasional, subtle mounds or microhighs and distinct, shallow depressions. These microreliefs contribute to species and site diversity, overall.

Because of the moisture regime and surface complexities, plant communities of this site are highly variable. Species characteristic of uplands and lowlands are often seen co-occurring within a small area. Areas that remain wetter for longer periods, such as shallow depressions, may support a greater abundance of willow oak and water oak. Conversely, areas that tend to dry more quickly support a preponderance of post oak, southern red oak, hickory, and other upland species. To the south, loblolly and shortleaf pine are important components of the community, particularly on the thin loess fragipan soils of Bude.

An important characteristic of this site is that it often occurs in complex or close association with lower, more poorly drained flatwoods, the Northern Wet Loess Terrace ecological site. The slightly better drained soils and higher position of this site support conditions conducive for a "drier association" of plants. Although many of the same species occur on both the poorly drained flats (wet phase) and this site (i.e., better drained flats or "dry phase"), there may be a greater concentration of upland species on this particular site (dry phase). However, clear distinction of the vegetation communities between this site and the wetter site may not always be apparent. Bryant (1999) associated a key soil of this site, Calloway, with the poorly drained soils of the wet loess terrace, Henry and Routon. More work is needed to accurately determine if vegetation differences are expressed between the wetter and drier soils of the terrace flatwoods system.

Historically, fire may have been an important influence on this site. Low-intensity fires would have occurred when adjacent systems burned. Additional disturbance factors include severe ice-storm damage and windthrow from tornados and strong, straight-line winds (LANDFIRE, 2009).

The predominant land use activity on this site today is agriculture production with principal crops being soybean, corn, and cotton (USDA-NRCS, 2016). A minor use on this site is reportedly pastureland or hayland with principal forage of bermudagrass, bahiagrass, and tall fescue. An additional use of this site is forest production. All uses on this site likely experience some limitations due to seasonal wetness, however forest production may have additional challenges due to seasonal dryness, particularly with respect to planted seedlings.

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 Moderately Wet 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

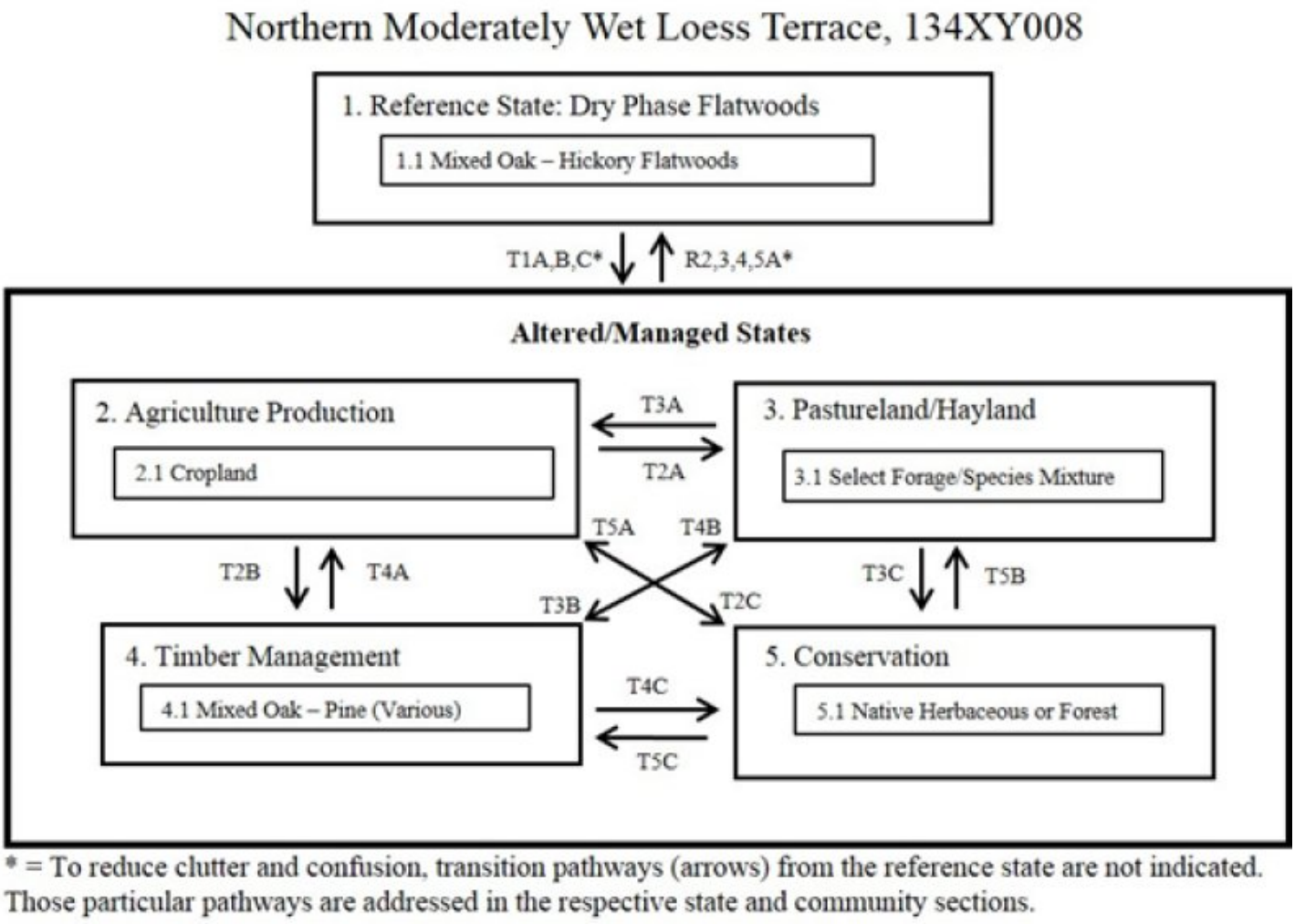

Figure 5. STM - Northern Moderately Wet Loess Terrace

Pathway	Practice
T1A, T3A, T4A, T5A	mechanical removal of vegetation; establish cultivation (State 2)
T1B, T2A, T4B, T5B	mechanical removal of vegetation; herbicide application; seedbed preparation; planting desired species at appropriate rate (State 3)
T1C, T2B, T3B, T5C	various approaches; includes uneven-age and even-age; goal of mixed oak or pine management; may consist of timber stand improvements; group selection; single tree harvest (State 4)
T2C, T3C, T4C	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 (State 5)
R2A, R3A, R4A, R5A	natural succession over time; may require exotic plant control and reestablishment of missing species; NOTE: any former alteration to soil drainage MUST be restored before returning to true reference conditions (State 1)

Figure 6. Legend - Northern Moderately Wet Loess Terrace

State 1
Dry Phase Flatwoods

The somewhat poorly and poorly drained soils occurring on level to nearly level terraces and valleys of the Loess Plains are situated in such close association that it is difficult to distinguish their respective influences on natural vegetation. This is especially confounding today due to nearly two centuries of continual manipulation and alteration of these systems. It is hypothesized that the somewhat poorly drained soils of this site support a slightly drier association of plants due to the soils' slightly higher position and slope gradient relative to the lower poorly drained soils. However, this perceived vegetation difference has not been substantiated or definitively determined in the field. In the Western Lowlands of eastern Arkansas, a very similar pattern occurs, and it has been hypothesized that Calloway soils (also correlated to this provisional site) of that region produce an association consisting mainly of upland hardwoods (interpretation and adoption from Klimas et al., 2012). LANDFIRE (2009) and NatureServe (2009) also recognize a wet and drier versions of flatwoods for the Loess Plains, which is construed to correspond with the Northern Wet Loess Terrace and Northern Moderately Wet Loess Terrace ecological sites, respectively. Adoption of their system suggests that the dominant components of this site consist of a drier association of oaks with hickory as important associates (LANDFIRE, 2009). A single community phase is recognized for representing the range of species occurring on this site. As additional information becomes available, revisions to this site may warrant significant changes. At a minimum, a new site will be developed for areas to the south in Mississippi where loblolly and shortleaf pine enters the community as components. Of concern, this site has incurred tremendous alteration due to seasonal wetness issues. Any attempt to reestablish perceived reference conditions of a stand or a local site must first restore the natural hydrology of that site, if ditching or drainage structures had been constructed. If local hydrology is not restored, 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. Retaining drainage structures will directly influence the types of vegetation that colonize the site, which may be entirely different than reference conditions.

Community 1.1
Mixed Oak – Hickory Flatwoods

This community phase represents the successional stage, compositional, and structural complexity of stands supporting perceived reference conditions for a late development community. Stands may be dominated by post oak in addition to white oak, black oak, shagbark hickory, and pignut hickory. Some areas may have southern red oak as a prominent associate and other stands supporting cherrybark oak. In the north, shingle oak may be a component of this system and areas to the south, loblolly and/or shortleaf pine may be present. Understories are generally open to moderately open with components consisting of possumhaw, winged elm, and hawthorn. The herbaceous layer may range from sparse to moderate with representatives consisting of little bluestem, Indian grass, broomsedge, poverty oatgrass, woodoats, agave, Indian physic, evening primrose, mountain mint, among many additional species.

State 2
Agriculture Production

Agriculture production is the dominant land use activity on this site, today, although production is somewhat limited due to seasonal wetness. Many areas in production have some form of drainage structures established due to seasonal saturation of the soil surface.

Community 2.1
Cropland

Principal crops generally include soybean, corn, and cotton.

State 3
Pastureland / Hayland

This state is representative of sites that have been converted to and maintained in pasture and forage cropland,

typically a grass – legume mixture. For pastureland, planning or prescribing the intensity, frequency, timing, and duration of grazing can help maintain desirable forage mixtures at sufficient density and vigor (USDA-NRCS, 2010; Green et al., 2006). Overgrazed pastures can lead to soil compaction and numerous bare spots, which may then become focal points of colonization by undesirable plants or weeds. Soils exhibiting the core concepts of this site have a pronounced period of wetness followed by droughty conditions. Limitations may pertain mainly to periods of extreme wetness. Planning or prescribing the intensity, frequency, timing, and duration of grazing can help maintain desirable forage mixtures at sufficient density and vigor (USDA-NRCS, 2010; Green et al., 2006). Because of the limitations of this site, grazing may be limited to small intervals within the appropriate season(s). It is strongly advised that consultation with State Grazing Land Specialists and District Conservationists at local NRCS Service Centers be sought when assistance is needed in developing management recommendations or prescribed grazing practices on this site.

Community 3.1
Select Forage/Species Mixture

This community phase represents commonly planted forage species on pasturelands and haylands. The suite of plants established on any given site may vary considerably depending upon purpose, management goals, usage, and soils. The limitations of this site may preclude some of the commonly planted mixtures. However, there is some indication that tall fescue, common bermudagrass, bahiagrass, and white clover may be adapted to this site (USDA-SCS, 1960). Should active management (and grazing) of the pastureland be halted, this phase will transition to “old field” conditions, which is the transitional period between a predominantly open, herbaceous field and the brushy stage of a newly initiated stand of trees.

State 4
Timber Management

This state represents a broad range of management objectives, options, and stand conditions including woodlots allowed to grow or revert naturally; repeated single-tree harvests (often high-graded); carefully prescribed treatments; and conversion to a monoculture or single-species stand. Various management or silvicultural methods can lead to very different structural and compositional results. For prescribed management options, methods are diverse, which include even-aged (e.g., clearcut and shelterwood) and uneven-aged (single tree, diameter-limit, basal area, group selection, etc.) approaches. Included within these approaches is an option to use disturbance mechanisms (e.g., fire, TSI, etc.) to reduce competition and achieve maximum growth potential of the desired species. Inherently, these various approaches result in different community or “management phases” and possibly alternate states. The decision to represent these varying approaches and management results into a single state and phase at this time hinges on the need for additional information in order to formulate definitive pathways, management actions, and community responses. Forthcoming inventories of this site will provide more detail on this state and associated management phases. Of warning, there are some timber management limitations due to alternating seasonal wetness and dryness; the latter often rendering the soil hard and compact and droughty. These collective impacts could lead to high seedling mortality and/or low productivity of individual trees.

Community 4.1
Mixed Oak – Pine (Various)

Some of the most desirable timber on this site consists of a few species of oak. However, productivity is likely low, and there are severe limitations. Depending on the desired end product, management activities will differ. Management for oak dominant stands may be achieved by shelterwood and/or seed tree approaches. Managing for other hardwoods, and pine to the south, may only require timber stand improvement methods or artificial regeneration where other hardwoods predominate. Pine management should be relegated to southern portions of this site. Of caution, properties of these soils may limit the types of oaks, and other species, that will survive and produce any returns. Finding the appropriate approach for a given stand and environment necessitates close consultation with trained, experienced, and knowledgeable forestry professionals. It is strongly urged and advised that professional guidance be secured and a well-designed silvicultural plan developed in advance of any work conducted.

State 5
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 standard of establishing: native warm season grasses; suitable forbs for pollinators; select native trees to manage 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 taxa back into a portion of their former range.

Community 5.1
Native Herbaceous or Woodland

This community phase represents the establishment of select native plants to meet conservation objectives on this site. 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 this site 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 this system 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

Actions include mechanical removal of vegetation and stumps; preparation for and establishment of crops (State 2).

Transition T1B
State 1 to 3

This pathway represents an attempt to convert the woodland community to pasture or forage production. Actions include clearing, stump removal, seedbed preparation, and the establishment of desired plants (State 3).

Transition T1C
State 1 to 4

This pathway consists of prescribed silvicultural activities specifically designed to meet stand compositional and production objectives (State 4).

Restoration pathway R2A
State 2 to 1

This pathway represents natural succession back to perceived reference conditions. The period required for this transition to take place likely varies by location and is dependent upon local site conditions. In some cases, a return to the reference state may not be possible without considerable management effort. That effort may involve exotic species control, restoration of the natural hydrologic regime of a given locality, and the reestablishment of components considered characteristic of the reference state.

Transition T2A
State 2 to 3

Seedbed preparation and establishment of desired forage/grassland mixture.

Transition T2B
State 2 to 4

This pathway represents prescribed management strategies for transitioning former cropland and/or cutover woodland to one that meets timber stand composition and production objectives. However, there are significant timber management limitations due to seasonal wetness and dryness; the latter often rendering the soil very hard

and compact. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Depending on species, seedling mortality could be high on this site. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter should be limited to southern portions of this site.

Transition T2C
State 2 to 5

This pathway represents the decision to discontinue cultivation/production and 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 and herbicide treatments for controlling exotic species invasions and to ensure select tree establishment.

Restoration pathway R3A
State 3 to 1

This pathway represents natural succession back to perceived reference conditions. The period required for this transition to take place likely varies by location and is dependent upon local site conditions. In some cases, a return to the reference state may not be possible without considerable management effort. That effort may involve exotic species control, restoration of the natural hydrologic regime of a given locality, and the reestablishment of components considered characteristic of the reference state.

Transition T3A
State 3 to 2

Actions include removal of vegetation; herbicide treatment of residual plants; and preparation for crop establishment.

Transition T3B
State 3 to 4

This pathway represents natural succession of former pasture to non-managed “woods” or implementing prescribed management strategies for meeting timber stand composition and production objectives. However, there are significant timber management limitations due to seasonal wetness and dryness; the latter often rendering the soil very hard and compact. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Depending on species, seedling mortality could be high on this site. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter should be limited to southern portions of this site.

Transition T3C
State 3 to 5

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

Restoration pathway R4A
State 4 to 1

Natural succession over a period of time may transition a former timber-managed stand to one supporting reference conditions. Based on observations of some reference stands, a period greater than 50 years may be required, unless it was a former pine monoculture. Some question remains whether a return to reference conditions will occur in every situation, especially since some components may have been selectively culled from the stand. Management activities to aide recovery may include exotic species control and silvicultural treatment (State 1).

Transition T4A
State 4 to 2

Actions include removal of vegetation; herbicide treatment of residual plants; and preparation for crop establishment (State 2).

Transition T4B
State 4 to 3

Seedbed preparation and establishment of desired forage/grassland mixture (State 3).

Transition T4C
State 4 to 5

This pathway represents the decision to discontinue timber management or forest cover and establish native grasses/forbs or woodland/savanna on this site. This decision also includes the implementation of management activities to “guide” natural succession and conservation end goals. Actions may include prescribed fire for maintaining and enhancing herbaceous establishment and herbicide treatments for controlling exotic species invasions (State 5).

Restoration pathway R5A
State 5 to 1

This pathway represents natural succession back to perceived reference conditions. The period required for this transition to take place likely varies by location and is dependent upon local site conditions. In some cases, a return to the reference state may not be possible without considerable management effort. That effort may involve exotic species control, restoration of the natural hydrologic regime of a given locality, and the reestablishment of components considered characteristic of the reference state.

Transition T5A
State 5 to 2

This pathway represents the discontinuation of conservation practices and a return to crop production.

Transition T5B
State 5 to 3

This pathway represents the discontinuation of conservation practices and a return to pasture and/or hayland management entailing removal of vegetation, seedbed preparation, and establishment of desired forage/grassland mixture.

Transition T5C
State 5 to 4

This pathway represents natural succession of former pasture to non-managed “woods” or implementing prescribed management strategies for meeting timber stand composition and production objectives. However, there are significant timber management limitations due to seasonal wetness and dryness; the latter often rendering the soil very hard and compact. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Depending on species, seedling mortality could be high on this site. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter should be limited to southern portions of this site.

Additional community tables

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Contributors

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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	
Approved by	
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):**

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

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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):**

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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:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
