Ecological site F134XY010AL
Northern Wet Loess Terrace - PROVISIONAL

Accessed: 05/19/2024

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, 2006a).

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 Wet Loess Terrace is characterized by deep, poorly drained soils that primarily 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 on broad, nearly level terraces with slopes typically ranging from 0 to 2 percent. Soils have a seasonal high water table from winter to mid-spring, but by late summer, they often become very droughty. This extreme alternation between saturated and droughty conditions is attributed to an impermeable

or slowly permeable subsoil layer that is either a fragipan or a dense accumulation of clay. Natural vegetation of these broad flats often resemble or possess characteristics that are suggestive of “hydroxeric” flatwoods; that is, they have a relatively open understory and support droughty woodland species such as post, southern red, and black oaks in a lowland environment. However, considerable variation in the plant community may occur among and between occurrences. Where some local flats are dominated by post oak, others may be dominated by willow oak, and still others may consist of a strange combination of species found in wetlands (e.g., overcup and pin oak) growing beside drought-tolerant trees (e.g., post oak). Shortleaf pine may become an additional community component farther south.

Associated sites

F134XY008AL	**Northern Moderately Wet Loess Terrace - PROVISIONAL** This site often occurs in complex or close association with the Northern Wet Loess Terrace. This site may also represent a "drier phase" of the hydroxeric flatwoods community. More work is needed on both systems.
F134XY011AL	**Northern Ponded Loess Terrace - PROVISIONAL** This site occurs in very close association with the Northern Wet Loess Terrace. In fact, the soils are the same; only a ponded phase distinguishes the two sites.

Similar sites

F134XY103MS	**Southern Rolling Plains Loess Wet Terrace - PROVISIONAL** This site is the southern counterpart to the Northern Wet Loess Terrace.
F134XY202AL	**Western Wet Loess Terrace - PROVISIONAL** This site is the western counterpart to the Northern Wet Loess Terrace, which occurs on the broad, Valley Train Terraces of the Western Lowlands.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Northern 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. Embedded within this site are occasional, shallow depressions

that pond during the wetter times of the year, generally late winter to spring (typically referred to as vernal pools). It's important to note that this site occurs to the west of the EPA Level IV Ecoregion, Flatwoods / Black Land Prairie Margins (65b) and should not be construed as part of that ecoregion. There is at least one overlap of a soil series among these ecoregions, and there are many similarities concerning vegetation.

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

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Flat
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	30–143 m
Slope	0–2%
Ponding depth	0–76 cm
Water table depth	0–53 cm
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 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)	1,422 mm

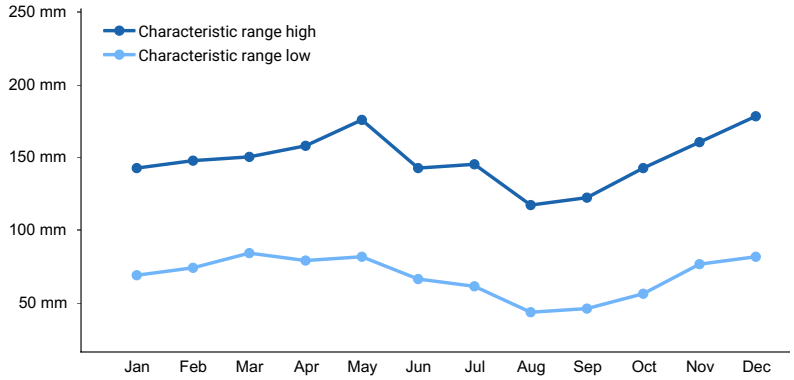

Figure 1. Monthly precipitation range

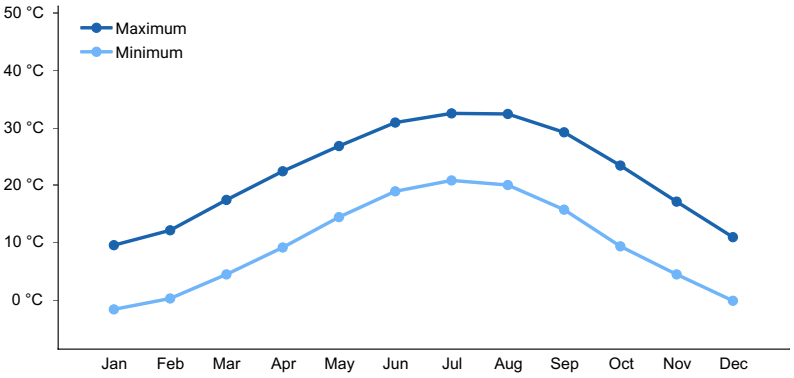

Figure 2. Monthly average minimum and maximum temperature

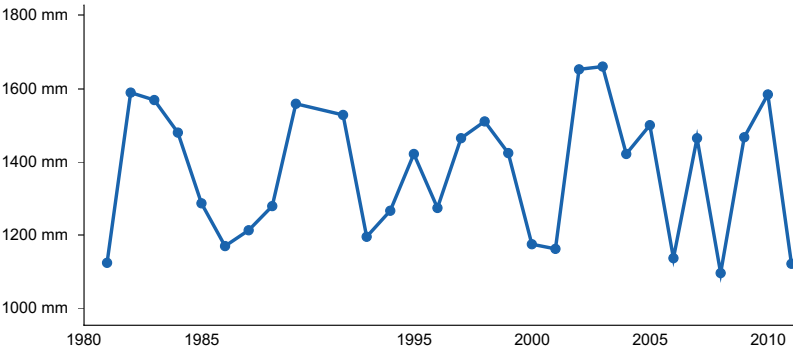

Figure 3. Annual precipitation pattern

Climate stations used

- (1) GRENADA [USC00223645], Grenada, MS
- (2) COLLIERVILLE [USC00401950], Collierville, TN
- (3) COVINGTON 3 SW [USC00402108], Covington, TN
- (4) LOVELACEVILLE [USC00154967], Paducah, KY
- (5) MURRAY [USC00155694], Murray, KY
- (6) HOLLY SPRINGS 4 N [USC00224173], Holly Springs, MS
- (7) LEXINGTON [USC00225062], Lexington, MS
- (8) DRESDEN [USC00402600], Dresden, TN
- (9) MILAN EXP STN [USC00406012], Milan, TN
- (10) BARDWELL 2 E [USC00150402], Bardwell, KY
- (11) GILBERTSVILLE KY DAM [USC00153223], Gilbertsville, KY
- (12) BATESVILLE 2 SW [USC00220488], Batesville, MS
- (13) CANTON 4N [USC00221389], Canton, MS
- (14) OAKLEY EXP STN [USC00226476], Raymond, MS
- (15) VICKSBURG MILITARY PK [USC00229216], Vicksburg, MS
- (16) YAZOO CITY 5 NNE [USC00229860], Yazoo City, MS

- (17) BOLIVAR WTR WKS [USC00400876], Bolivar, TN
- (18) PADUCAH [USW00003816], West Paducah, KY
- (19) JACKSON INTL AP [USW00003940], Pearl, MS
- (20) BROOKPORT DAM 52 [USC00110993], Paducah, IL
- (21) SENATOBIA [USC00227921], Coldwater, MS
- (22) NEWBERN [USC00406471], Newbern, TN
- (23) UNION CITY [USC00409219], Union City, TN

Influencing water features

The poorly drained soils of this site are noted for supporting a high water table (perched) during periods of high rainfall and low evapotranspiration, typically from winter to spring. With the exception of some headslopes and streams traversing across terrace landscapes, wetness of this site is primarily influenced by precipitation. Highly localized surfacing of groundwater may influence the site along a very narrow corridor of some drainheads and streams, but such occurrences generally do not have a demonstrable influence on the overall vegetation of this site. Instances where water has the greatest influence are within closed and open (or flow-through) depressions that seasonally pond and in areas where the site is positioned adjacent to small drainageways. Wetland or hydrophytic vegetation occurs mainly within depressions. Vegetation of the drier areas consists predominantly of upland species, although some facultative wetland species may occur.

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.

Principal 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. That suite of soils apparently was formed from a lacustrine environment during the Late Pleistocene (Olive, 1966). Those soils 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. Of note, these soils support exemplary examples of the hydroxeric flatwood communities associated with this site.

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	20–71 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	17.78–21.84 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.6–5.7
Subsurface fragment volume <=3" (Depth not specified)	1%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The concepts of the Northern Wet Loess Terrace were developed from flatwoods communities within the Loess Plains of MLRA 134. The distribution of this site occurs to the west of the EPA Level IV Ecoregion, Flatwoods / Black Land Prairie Margins (65b) and should not be construed as representative of that ecoregion. Although, there is at least one overlap of a soil series, Adaton that occurs in both the Loess Plains and the Flatwoods ecoregions.

This ecological site is distributed across broad, level to nearly level flats on old fluvial terraces. A key characteristic of this site is the propensity of these poorly drained soils to perch water during wetter times of the year. Poor surface runoff and slow permeability contributes 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, which leads to very 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" (or xero-hydric, depending on preference). It's important to note that this site is generally above the modern floodplains of larger streams and rivers and receives very little overland flow. Exceptions occur where this site borders small streams and/or rivers and backflow moves over land.

Interspersed across the broad flats of this site are surface irregularities that include occasional, subtle mounds or micro-highs and distinct, shallow depressions. These microreliefs contribute to species and site diversity, overall. Depressional areas are designated as a separate ecological site, the Northern Ponded Loess Terrace, and is closely associated with the overall complexity of these poorly drained, terrace systems.

Because of the moisture regime and surface complexities, plant communities of this site are highly variable with some areas consisting predominantly of willow oak and others post oak. Species characteristic of both uplands and lowlands often co-occur within a small area (e.g., post oak, an upland species beside overcup oak, typically a wetland species). Areas that remain wetter for longer periods, such as shallow depressions, may support a greater

abundance of pin oak, willow oak, and overcup oak. Conversely, areas that tend to dry more quickly may support a preponderance of post oak, hickory, and other upland species.

Some ecologists have typed or classified flatwoods based on the dominant and co-dominant plant species observed. Systems supporting a greater number of species having wet affinities (e.g., willow oak) have been classified as “wet flatwoods”, and those dominated by post oak and other drought-tolerant species are typed as “dry flatwoods” (NatureServe, 2009; M. Hines, personal communication). This provisional site represents both wet and dry versions because it is not clear which soils contribute to the observed “wet – dry vegetation gradient.” Very little work has been conducted in these dynamic and odd systems. As new information becomes available, one or more soil series provisionally associated with this site may warrant removal or new ones added.

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). Some areas are in pasture or hayland with principal forage of bermudagrass, bahiagrass, and tall fescue. An additional use of this site is forest production. Overall, all uses on this site likely experience some limitations due to seasonal wetness, however forest production may have additional limitations 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 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

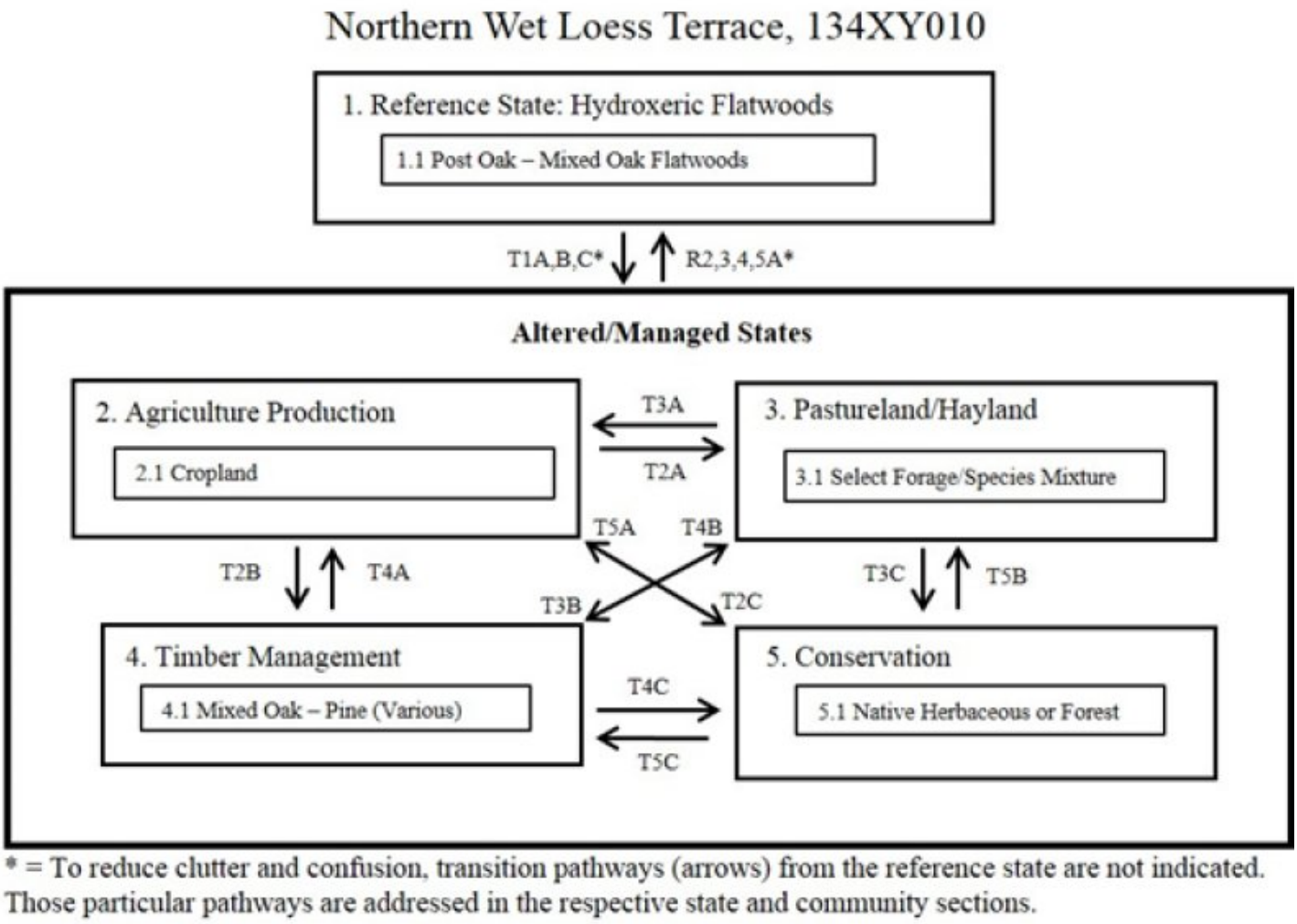

Figure 5. STM - Northern Wet Loess Terrace

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 Wet Loess Terrace

State 1
Hydroxeric Flatwoods

Exemplary examples of the full range of plant communities and ecological processes that were once commonplace on this ecological site no longer exist. Vestiges of this once vast system are primarily relegated to abandoned woodlots that have undergone numerous impacts since settlement. Still, there appears to be a close correlation between the species reported in earlier state reports (e.g., Loughridge, 1888; Lowe, 1921) and more recent accounts of extant woodlots (Bryant, 1999). One major difference between the historic community and present stands is the absence of fire, which is thought to have been an important disturbance factor (NatureServe, 2009). Classifying this system with a single plant association name is extremely difficult, if not impossible, due to the variability of species dominance from stand to stand. One characteristic that appears to be similar throughout is the structural profile of a relatively open to moderately open understory, although this may vary due to local gap-scale

dynamics. Some areas in West Tennessee are dominated by willow oak (on Adaton soils) while others support a mixed association of species that include post oak, willow oak, white oak, black oak, and hickory (on Routon soils). Some sites in western Kentucky have been observed to support a characteristic post oak flatwood with adjacent stands consisting of a mixture of post oak, black oak, cherrybark oak, hickory, with interspersed stems of overcup oak. Lowe (1921) reported the entrance of loblolly and shortleaf pine within flatwoods systems to the south in Mississippi. Such odd associations and combinations may be due to different inclusions of soil, interspersed micro-highs and depressions, former land use impacts (Bryant, 1999), latitude, or a combination of any or all of these factors. 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 are components. Of concern, portions of this site have incurred tremendous alteration 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. Retaining drainage structures will directly influence the types of vegetation that colonize the site, which may be entirely different than what would occur, naturally.

Community 1.1
Post Oak – Mixed Oak Flatwoods

This community phase represents the compositional 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 ranging from post oak dominated flatwoods to a near monoculture of willow oak to a complex mixture of lowland and upland species. Where vegetation differs the most are within shallow depressions that are scattered throughout this site. (Note that the depressions represent a separate ecological site, the Northern Ponded Loess Terrace.) Species considered typical of this site include post oak, black oak, cherrybark oak, willow oak, water oak, shagbark hickory, mockernut hickory, pignut hickory, winged elm, along with occasional occurrences of white oak, southern red oak, overcup oak, pin oak, black cherry, and persimmon. To the south, loblolly and shortleaf pine are components and Lowe (1921) also reported blackjack oak as a component. Again, the combinations of one or more of the preceding species varies greatly from site to site. In general, species more typical of wet environments (e.g., overcup oak and pin oak) may be more associated with the interspersed, shallow depressions. The understory is quite open with components consisting of red maple, winged elm, farkleberry, possumhaw, green hawthorn, and a herbaceous cover of little bluestem, Indian grass, broomsedge, woodoats, poverty oatgrass, agave, Indian physic, Willdenow's croton, narrowleaf mountain mint, and a number of sedges and rushes.

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

Crops may include soybean, corn, milo, 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-NRCS, 2006b). 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 methods 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 methods and management strategies 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 significant timber management limitations due to alternating seasonal wetness and dryness; the latter often rendering the soil very hard and compact. These collective impacts could lead to high seedling mortality and/or low productivity of individual trees. Implementing this state or management option on this site should be carefully reviewed and considered.

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 may be low, and there are moderate to severe limitations. Depending on the desired end product, management actions may 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 hardwoods that will survive and/or produce returns on the time and effort invested. 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 cultivation (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 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

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.

Fralish, J.S., S.B. Franklin, and D.D. Close. 1999. Open woodland communities of southern Illinois, western Kentucky, and Middle Tennessee. In: Anderson, R.C., J.S. Fralish, and J.M. Baskin (eds.). Savannas, Barrens, and Rock Outcrop Plant Communities of North America. Cambridge University Press, New York. 470 p.

Green, Jonathan D., W.W. Witt, and J.R. Martin. 2006. Weed management in grass pastures, hayfields, and other farmstead sites. University of Kentucky Cooperative Extension Service, Publication AGR-172.

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).

Hines, M. personal communication. Ecologist, Natural Heritage Program Manager, Kentucky State Nature Preserves Commission, Frankfurt, KY.

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.

Lowe, E.N. 1921. Plants of Mississippi. A list of flowering plants and ferns. Mississippi State Geological Survey. Bulletin No. 17. 259 p.

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.

Rhodes, G.N., Jr., G.K. Breeden, G. Bates, and S. McElroy. 2005. Hay crop and pasture weed management. University of Tennessee, UT Extension, Publication PB 1521-10M-6/05 (Rev). Available: https://extension.tennessee.edu/washington/Documents/hay_crop.pdf.

Taft, J.B., M.W. Schwartz, and L.R. Philippe. 1995. Vegetation ecology of flatwoods on the Illinoian till plain. Journal of Vegetation Science 6:647-666.

[USDA-NRCS] United States Department of Agriculture, Natural Resources Conservation Service. 2006a. 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. 2006b. Soil Survey of Greene County, Arkansas. 231 p. Available online: http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/arkansas/AR055/0/Greene%20County_Arkansas.pdf.

(Accessed: 30 November 2015).

[USDA-NRCS] United States Department of Agriculture, Natural Resources Conservation Service. 2010. Conservation Practice Standard: Prescribed Grazing. Practice Code 528. Updated: September 2010. Field Office Technical Guide, Notice 619, Section IV. [Online] Available: efotg.sc.egov.usda.gov/references/public/ne/ne528.pdf.

[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

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):**

---

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:**
