USDA Natural Resources
Conservation Service

Ecological site F134XY004AL
Northern Moderately Wet Loess Interfluve

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 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 4714270 and NatureServe Ecological System CES203.353 East Gulf Coastal Plain Jackson Plain Prairie and Barrens (LANDFIRE, 2009; NatureServe, 2009)
-LANDFIRE Biophysical Setting 4713060 and NatureServe Ecological System CES203.482 East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (LANDFIRE, 2009; NatureServe, 2009)
-LANDFIRE Biophysical Setting 4713720 and NatureServe Ecological System CES203.506 East Gulf Coastal Plain Interior Shortleaf Pine – Oak Forest (LANDFIRE, 2009; NatureServe, 2009)
-LANDFIRE Biophysical Setting 4713260 and NatureServe Ecological System CES203.479 South – Central Interior / Upper Coastal Plain Flatwoods (LANDFIRE, 2009; NatureServe, 2009)
-Western Mesophytic Forest Region - Mississippi Embayment Section (Braun, 1950)

Ecological site concept

The Northern Moderately Wet Loess Interfluve is characterized by very deep, somewhat poorly drained soils that formed in loess or water reworked loess. This site primarily occurs on broad, nearly level upland interfluves and headslopes (or drainheads) 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 or perched water table from winter to mid-spring in most years and can become quite droughty by late summer. In many areas, this site is closely associated with wet or poorly drained headslopes, depressions, and upland flatwoods. The principal vegetation type consists of upland hardwoods that often include white oak, post oak, southern red oak, black oak, and hickories. However, composition of local stands may vary widely and is often dependent on former land uses and landscape position. Historically, natural vegetation of this site may have consisted of a complex mosaic of community types that ranged from fire-maintained prairies (locally and historically called "barrens"), fire-influenced oak-dominated flatwoods, and a mixture of species associated with both dry and moist conditions. In the southern part of the range, shortleaf and loblolly pines may have been important historic components in addition to oak.

Associated sites

F134XY005AL	**Northern Wet Loess Interfluve**
F134XY012AL	**Northern Loess Fragipan Upland - PROVISIONAL**

Similar sites

F134XY209AL	**Western Moderately Wet Terrace - PROVISIONAL** This is the western counterpart to the current site, which occurred on the broad, valley train terraces of the Western Lowland ecoregion.
F134XY008AL	**Northern Moderately Wet Loess Terrace - PROVISIONAL** This is the terrace counterpart to the current, upland interfluve or divide site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Northern Moderately Wet Loess Interfluve 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 border of the Loess Hills (EPA Level IV Ecoregion: 74a), across the Loess Plains, and 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 interfluves or divides where it may occur in complex with upland depressions that are seasonally ponded; headslopes that form the origins of intermittent or perennial streams; and small, upland drainageways. Several local examples in western Kentucky and Tennessee occur in areas that are, physiographically, plateau-like; the area historically identified as Flatwoods (Loughridge, 1888).

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

Table 2. Representative physiographic features

Landforms	(1) Interfluve (2) Plain (3) Divide
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to very rare
Ponding frequency	None
Elevation	61–198 m
Slope	0–5%
Ponding depth	0 cm
Water table depth	20–61 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 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)	1,422 mm

Climate stations used

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

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, upland drainageways. However, wetland plant communities are generally not supported on these soils.

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. 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	23–86 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–20.83 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)	4.9–6.5
Subsurface fragment volume <=3" (Depth not specified)	2%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This ecological site is the upland counterpart to the Northern Moderately Wet Loess Terrace. The soils that define this site have been mapped on broad, nearly level upland flats or divides and on headslopes or heads of drains. 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 generally leads to droughty conditions during summer and fall. Unlike the terrace counterpart, slopes may range a little higher in some local areas, increasing to a maximum 6 percent.

Determining the natural vegetation of this site is extremely difficult. There are few examples of any natural vegetation remaining and where they do occur, the locations are often heavily overgrown and recovering from a long series of former impacts. Historically, this site likely supported various vegetation and/or community types that were directly influenced by surrounding ecological systems and especially, natural and/or human-induced actions such as frequent burning. This broad generalization is drawn from an overlay of the current distribution of this site and broadly defined and mapped vegetation types (or land cover types) from the 1880s.

In the Jackson Purchase area of western Kentucky, the soils of this upland site span across at least three major land cover types that were identified and illustrated by Loughridge (1886): Brown Loam 'Timbered Lands'; Brown Loam 'Barrens' (originally Prairie); Flatwoods. (The punctuations and nomenclature of each cover type are reproduced from Loughridge's 1886 map.) The greatest proportion of the site's distribution occurs within the Brown Loam Timbered Lands, which he describes as Oak and Hickory Uplands (Loughridge, 1888). Loughridge mentions that this cover type "...is well timbered with red, black, Spanish and post oaks and hickory, and an undergrowth of dogwood and sassafras."

The distribution of this site in portions of the 'barrens' or prairies of the Jackson Purchase covers a relatively minor extent of site's range across the north, but it illustrates the diversity of community types the site historically supported. DeSelm (1989) visited a remnant of this former system in Henry County, Tennessee and specifically commented on one of the soils that was associated with the site, the Calloway series. That soil series is a principal soil of this provisional ecological site.

Calloway soils sometimes occur in close associated with the poorly drained soils that characterize the Northern Wet Loess Interfluve ecological site (and its terrace counterpart). Where these somewhat poorly and poorly drained fragipans occur in close association (and complex), flatwoods community characteristics appear to occur. This is particularly notable in a portion of western Kentucky that Loughridge (1886) delineated and typed as Flatwoods. Within that circumscribed area, the soils comprising the Northern Wet Loess Interfluve and this site occur in very close association, just as they do on terraces.

Given these broad characterizations, associating a singular vegetation type to this provisional site may be impossible. This is an example where specific management actions of a much larger landscape may have as much if not a greater influence on natural vegetation of the ecological site as soil properties and landform characteristics.

A more appropriate approach may entail close examination of this site's position on the landscape and its association with surrounding ecological sites. Where this site occurs on headslopes and in association with better drained sites, an upland oak – hickory association may best characterize the site. In the southern extent, shortleaf pine and possibly loblolly pine would represent important community associates (see NatureServe, 2009 – East Gulf Coastal Plain Interior Shortleaf Pine – Oak Forest) under this scenario. Where the site occurs in association with flat, poorly drained soils, post oak flatwoods may best characterize the site. The presence of prairie or savanna conditions is entirely management driven with periodic fire the key management tool.

Reference conditions of this site have been arbitrarily chosen to reflect two major physiognomic characteristics that reportedly occurred. The prevailing or dominant community phase is oak – hickory woodland. Both the structure and components of that phase would include many of the species associated with upland flatwoods and the oak – hickory cover type on headslopes and gently sloping areas associated with better drained sites. A southern modifier to this phase may appropriately be typed as shortleaf pine – oak – hickory woodland.

The second reference community phase represents a system that occurred in portions of this site, prairie and/or savanna. The distribution of prairie farther south through Tennessee and Mississippi within the Loess Plains are not as well documented. But, wherever local indigenous communities existed and fire was an important management tool, patches of open, herbaceous vegetation most certainly persisted. Conceivably, such openings would have graded to the surrounding woodland matrix by transitioning from treeless prairie to savanna and on to woodland conditions.

The predominant land use of this site, today, is agriculture production. Those areas that are not in cropland, consist of pastureland with a few acres in timberland, mostly pine monoculture. An additional use is recognized and represented for this site: conservation. This use or “state” is provided to represent the range of conservation related actions and management that either “reconstructs” the perceived historic conditions (both composition and ecological processes) or enhances a degraded and highly altered location by planting species native to this site.

Of particular note and concern, the soils that are “provisionally” associated with this site warrant further investigation and review. Further confounding these influences, climate differences also occur north to south. The breadth of environmental variability of this site, as it is currently mapped, necessitates future investigations to ascertain the collective influences of both climate and soils on local vegetation communities. Future work may culminate in the determination of a latitudinal division or break of this site (if it is justified) and a much more accurate and defensible soil – vegetation community correlation. Succinctly put, one or more ecological sites are likely to be defined based on soil differences and climatic influences. This provisional site is essentially a foundation from which to begin future soil – site surveys and ecological site inventories.

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 Interfluve ecological site. This model is based on limited inventories, literature, expert knowledge, and interpretations. Plant communities will differ across MLRA 134 due to natural variability in climate, soils, and physiography. 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

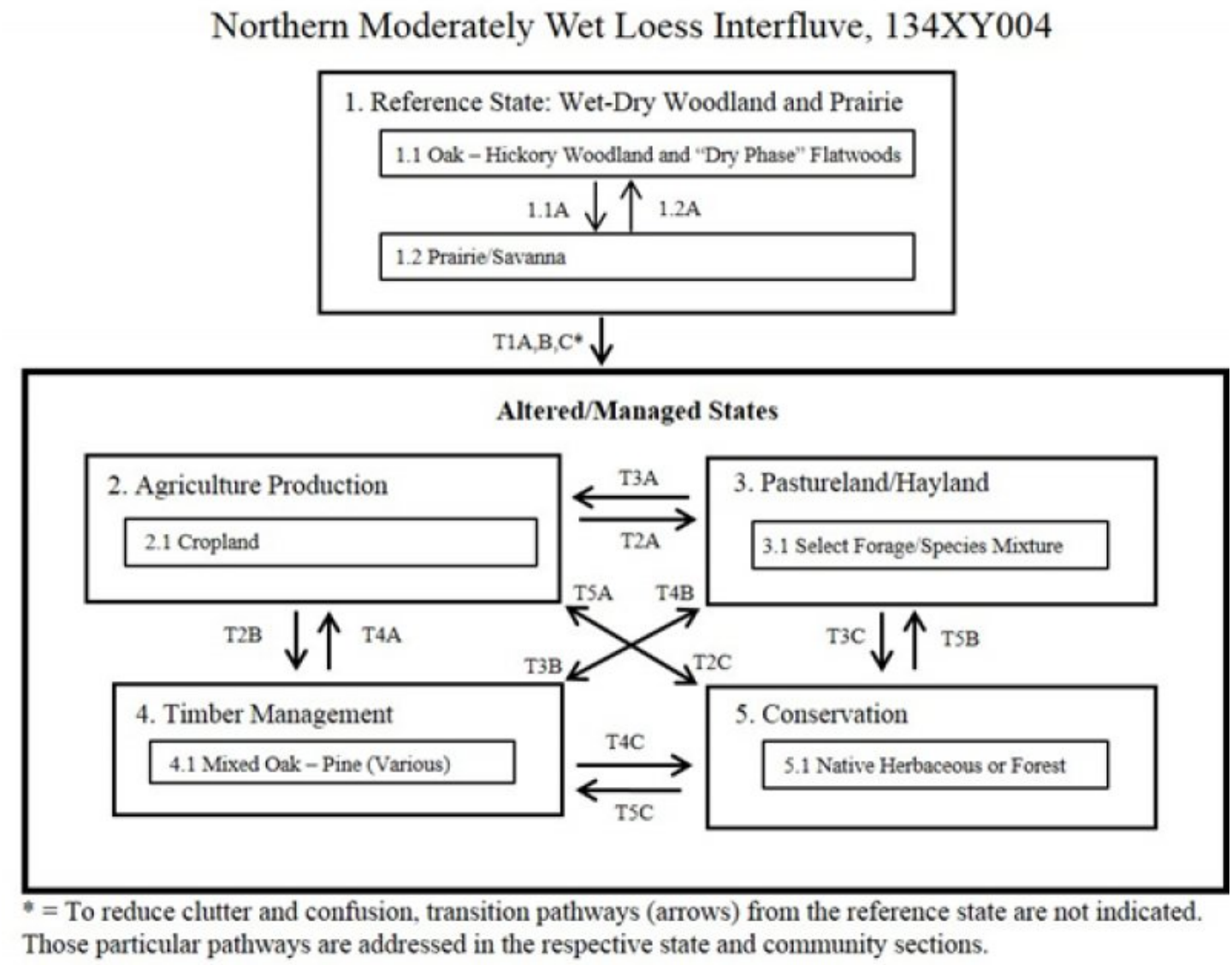

Figure 6. STM - Northern Moderately Wet Loess Interfluve

Pathway	Practice
1.1A	major stand-scale disturbance (extensive, prolonged drought, wind, catastrophic ice, replacement fire) followed by periodic surface fire on a frequent return interval
1.2A	natural succession; infrequent fire (long return interval); small, gap-scale disturbance (wind, ice, mixed-severity fire); to maintain woodland, return of periodic surface fires
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)

Figure 7. Legend - Northern Moderately Wet Loess Interfluve

State 1
Wet-Dry Woodland and Prairie

The reference state of this ecological site was chosen to represent the breadth of community types that historically occurred across the loess capped uplands of MLRA 134. Exemplary examples of the full range of plant communities and ecological processes that were once commonplace on this ecological site no longer exist. Where trees occur today, they typically form a closed canopy forest comprised of exotic species and an understory entangled by native and non-native vines. Vestiges of this once vast system are primarily relegated to cutover forest

blocks, narrow roadway and powerline corridors, and corners of old fields and pastures that now hold the only remaining examples of native prairie vegetation (Estes et al., 2016). Therefore, a complete and exhaustive description and treatment of this system cannot be provided. However, some native plant species that comprised the woodlands, flatwoods, and prairies of long ago still exist. It is from these instances coupled with historical accounts that we project reference conditions of the site. The name of the reference state, “woodland and prairie,” implies the existence of systems maintained and directly influenced by fire. The accounts provided by Loughridge (1888), Gardner (1876), and many others are testament of the historic importance of fire on the Loess Plains, some natural but most were first induced by Native Americans and second, by early settlers striving to maintain and enhance pasturage. The “wet-dry” descriptor pertains to the soils’ capacity to perch water during wetter times of the year followed by droughty conditions during the drier period, such as late summer and fall. This site is anticipated to differ from its associated sites, Northern Loess Fragipan Upland and Northern Wet Loess Interfluve, due to its intermediate wetness capacity. This site is anticipated to support wetter species, especially certain herbaceous taxa, than the former and is better drained and has slightly more slope than the latter. With respect to upland flatwoods, this site would potentially support drier conditions and associated species. It must be emphasized that this site is in provisional status at this time and much more investigative work is needed before a clear description can be provided. It is due to this lack of information that restoration pathways are not provided for this site. In order to reconstruct or establish simulated reference conditions, a Conservation state has been added to the state and transition model.

Community 1.1
Oak – Hickory Woodland and “Dry Phase” Flatwoods

This community phase represents what is perceived to be the predominant condition or vegetation type associated with this site. The structural descriptor of “woodland” in the community name represents what likely occurred in areas where fire from adjoining systems (e.g., prairies and savannas) moved into and across areas that supported trees. The “Dry Phase” Flatwoods descriptor represents areas where this site occurs in close association with the Northern Wet Loess Interfluve. The latter forms the core concept of upland “hydroxeric” flatwoods, and this site represents the drier end of the wet – dry gradient within the overall flatwoods system. Canopy components dominating headslopes and areas where this site was associated with better drained systems likely included southern red oak, black oak, white oak, cherrybark oak, post oak, shagbark hickory, pignut hickory, mockernut hickory, black gum, and winged elm, with wetter areas supporting Shumard oak, water oak, black cherry, sweetgum, white ash, and slippery elm. Where this site occurred in complex or association with flatwoods systems, post oak may have been dominant with associates of southern red oak, black oak, hickory, and possibly blackjack oak on the driest spots. Understory was anticipated to have been quite open with associates of hophornbeam, flowering dogwood, and a shrub layer dominated by ericaceous shrubs. Although not included in the reference community name, shortleaf pine was very likely an important component of the system farther south in Mississippi (Lowe, 1921).

Community 1.2
Prairie/Savanna

In relation to the full distribution of this ecological site, this community phase is representative of a relatively small area, which is primarily restricted to the site’s northern extent in western Kentucky and northwest Tennessee. However, it is possible that the system existed in small, local patches farther south. The presence of humans coupled with the ease with which fire moved across the landscape (e.g., areas of little relief) likely played a more significant role than loess depth alone. Fire was a critical and frequent factor for maintaining this community phase, and most fires were deliberately set (Gardner, 1876; Loughridge, 1888). Gardner (1876) provided general characterizations of the plains and mentioned “barren grass” growing three to four feet high, and being able to see a horseman miles away. Referring to the nearly treeless plains, he specifically mentioned woody vegetation occurring as “…small clumps of scrubby blackjack oak, post oak, and hickory bushes a few feet high, interspersed with patches of sumac and hazel.” Examples of this open, herbaceous system likely consisted of a dense herbaceous layer that was dominated by tall grasses such as big bluestem, little bluestem, and Indian grass (DeSelm, 1989; NatureServe, 2009). Select associates of the tall grasses likely included switchgrass, splitbeard bluestem, threeawns, panic-grass, wild indigo, blazing star, evening-primrose, New England aster, compass plant, goldenrod, lanceleaf tickseed, tall tickseed, rattlesnake master, ashy sunflower, flowering spurge, Virginia strawberry, purple milkwort, slender milkwort, Sampson’s snakeroot, agave, New Jersey tea, goat’s-rue, various milkweeds, sedges, and many additional species (Heineke, 1987; also selected from an exhaustive list provided D. Estes). The wetter conditions of this site in the winter and spring likely influenced composition of the early flowering species, thus

contributing to a slightly “wetter” list of associates of the Jackson Purchase prairie. This broad, open system transitioned to a dense, oak – hickory forest within 30 years of settlement and cessation of frequent fires (DeFriese, 1880; Loughridge, 1888).

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a major stand-scale disturbance that effectively removed the overstory such as extensive, prolonged drought, wind, catastrophic ice, tree girdling/removal by humans, and/or stand replacement fire. Such catastrophic events would then be followed by low-intensity surface fires on a frequent return interval, which would support transition to prairie and/or savanna conditions.

Pathway 1.2A
Community 1.2 to 1.1

This pathway represents a return to an open woodland or forest structural characteristic. Processes leading to woodland conditions is a relaxation of fire or fire occurring on a much longer return interval. Disturbance occurs or returns at the gap-scale, often single tree (i.e., less than 1 acre).

State 2
Agriculture Production

Agriculture production is the dominant land use activity on this site, today. Most cropland is relegated to the Loess Plains and in other areas of little topographic relief (generally long, gradual slopes).

Community 2.1
Cropland

Crops may include soybean, corn, and cotton with tobacco grown locally in the north.

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 accelerated erosion and colonization sites of undesirable plants or weeds. Establishing an effective pasture management program can help minimize the rate of weed establishment and assist in maintaining vigorous growth of desired forage. An effective pasture management program includes: selecting well-adapted grass and/or legume species that will grow and establish rapidly; maintaining proper soil pH and fertility levels; using controlled grazing practices; mowing at proper timing and stage of maturity; allowing new seedings to become well established before use; and renovating pastures when needed (Rhodes et al., 2005; Green et al., 2006). 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.

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. Most systems include a mixture of grasses and legumes that provide forage throughout the growing season. Cool season forage may include tall fescue (*Schedonorus arundinaceus*), orchardgrass (*Dactylis glomerata*), white clover (*Trifolium repens*), and red clover (*T. pratense*), and warm season forage often consists of bermudagrass (*Cynodon dactylon*), bahiagrass (*Paspalum notatum*), and annual lespedeza (Kummerowia spp.). Several additional plants and/or species combinations may be desired depending on the objectives and

management approaches and especially, local soils. 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, depending on one’s perspective. 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. It should be noted that there are some limitations to timber management on this site due to seasonal wetness. To avoid and/or limit rutting, compaction, and erosion of soils, harvests should be relegated to drier periods of the year. An additional limitation to this site may be due to the presence of a fragipan (or root restriction layer) and seasonal dryness. Broadfoot (1976) provided site indices for a list of hardwoods occurring on one of the soils associated with this site, the Calloway series. Most site indices of hardwoods on this site were 20 percent less than the indices of the same species occurring on well drained loessal soils such as Memphis. In general, hardwood productivity of this site is lower relative to production on better drained soils.

Community 4.1
Mixed Oak – Pine (Various)

Some of the most desirable timber on this site consists of oak. 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 may be called for where other hardwoods predominate. Fire can be a management tool on this site given its location on drier interfluves. Low intensity ground fires on a frequent return interval can be effective for reducing competition and potentially enhancing production of individual trees. The establishment of pine monoculture is the dominant timberland action on this site to the south. 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; establishing a suite of suitable forbs for pollinators; establishing select native trees and managing for open woodland/savanna conditions. Of the options available, the one that best mimics the perceived reference conditions of this site would provide the best case conservation scenario. This action requires a concerted effort to reestablish herbaceous species most common to the prairies (“barrens”) of western Kentucky, West Tennessee and Mississippi with the possible addition of widely spaced hardwoods (e.g., upland oaks from the reference state) mimicking savanna to open 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 prairie system back into a portion of its 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 big bluestem, Indian grass, little bluestem, threeawn, wild oat grasses, panic grass, wild indigo, blazing stars, evening-primrose, asters, black-eyed susans, compass plant, coneflowers, goldenrod, lanceleaf tickseed, tall tickseed, rattlesnake master, sunflowers, flowering spurge, Virginia strawberry, purple milkwort, slender milkwort, Sampson's snakeroot, mountain mints, agave, New Jersey tea, goat's-rue, various milkweeds, sedges, among many others (partially derived from Heineke, 1987 and D. Estes). 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). Although, LANDFIRE (2009) models suggest replacement or surface fire every 10 years maintains the early development characteristics of this system. Managing for native open woodlands on this site entails establishment and maintenance of the most commonly reported tree species, which generally includes southern red oak, blackjack oak, post oak, white oak, black oak, pignut hickory, mockernut hickory, and shrub/small tree stratum of hophornbeam, dogwood, deerberry, and hazelnut among others. Canopy closure will range from 20 to 60 percent and coverage of the herbaceous layer may exceed that of the trees. Shrubs are widely scattered and limited in abundance and coverage. Trees are widely spaced or dispersed and open-grown. Mixed-severity fire every 20 years or low intensity surface fire within every 10 years is modeled to maintain the open woodland condition (LANDFIRE, 2009).

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 initially consisted of fire suppression (for areas formerly in prairie or woodland conditions) followed by a series of selective cuttings for firewood, construction, staves, and income. Many stands have been high-graded due to repeated, unscrupulous harvest methods (State 4).

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 to one that meets timber stand composition and production objectives. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Managing for mixed hardwood production may require exotic species control and general timber stand improvement practices. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter may be most successful on thin loess soils, such as Providence, and/or in the southern portions of the site. Note that there are some limitations to the timberland management due to seasonal wetness.

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. 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.

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 forest or implementing prescribed management strategies for meeting timber stand composition and production objectives. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Managing for mixed hardwood production may require exotic species control and general timber stand improvement practices. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter may be most successful on thin loess soils and/or in the southern portions of the site. Note that there are some limitations to management due to seasonal wetness.

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.

Transition T4A
State 4 to 2

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

Transition T4B
State 4 to 3

Seedbed preparation and establishment of desired forage/grassland mixture.

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.

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 the discontinuation of conservation practices and establishing prescribed management strategies for timber stand composition and production objectives. For enhanced oak production, actions may include artificial regeneration and reduction of oak competition. Managing for mixed hardwood production may require exotic species control and general timber stand improvement practices. The final option of this pathway is the establishment of a pine monoculture or plantation. Establishment of the latter may be most successful on thin loess soils and/or in the southern portions of the site.

Additional community tables

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Contributors

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Approval

Matthew Duvall, 3/20/2025

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community

cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/12/2025
Approved by	Matthew Duvall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**