USDA Natural Resources Conservation Service

Ecological site F134XY205AL
Western Moderately Wet Alluvial Flat - 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. Underlying the loess are Tertiary deposits of unconsolidated sand, silt, clay, gravel, and lignite. 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, mostly Entisols and Inceptisols, are predominantly silty where loess thickness of the uplands are deepest but grade to loamy textures in watersheds covered by thin loess. 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-NRCS, 2006).

This site primarily occurs on floodplains of larger stream systems that drain upland areas of Crowley's Ridge from about Helena, Arkansas northward through Stoddard County and into Scott County, Missouri.

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 (USDA-NRCS, 2006)
-Environmental Protection Agency's Level IV Ecoregion: Bluff Hills, 74a (Chapman et al., 2002; Woods et al., 2004)
-231H - Coastal Plains-Loess section of the USDA Forest Service Ecological Subregion (McNab et al., 2005)
-LANDFIRE Biophysical Setting 4514730, Gulf and Atlantic Coastal Plain Floodplain Systems (LANDFIRE, 2008)
- East Gulf Coastal Plain Small Stream and River Floodplain Forest CES203.559 (NatureServe, 2012)
-Wet-Mesic Bottomland Forest (Nelson, 2005)
-Western Mesophytic Forest Region - Mississippi Embayment Section - Loess Hills (Braun, 1950)

Ecological site concept

The Western Moderately Wet Alluvial Flat is characterized by very deep, somewhat poorly drained soils that formed in silty or loamy alluvium. Soil reactions range from very strongly acid to moderately acid. This site occurs on level to nearly level alluvial flats and within localized, shallow depressions that are often pocked throughout the better drained areas of narrow to broad floodplains. The site is also a transitional zone between landforms and positions with better drainage, such as natural levees, and the wet, low-lying flats and backswamps. On narrower floodplains, this site is positioned at slightly lower elevations landward of the stream bank. Slopes are commonly less than 1 percent but range from 0 to 3 percent. Flooding ranges from rare to frequent during winter and spring, and duration is brief to very long depending on stream and drainage basin size and flood magnitude. Outside of overbank flooding, a seasonal high water table generally occurs within 1 to 2 feet of the soil surface. Vegetation associated with the site exhibit signs of increasing soil wetness compared to better drained areas. Species requiring drier conditions begin dropping out and are replaced by plants more tolerant of anaerobic conditions. Overstory components generally include swamp chestnut oak, water oak, willow oak, overcup oak, Nuttall oak, pin oak, American sycamore, sweetgum, red maple, hickory, green ash, American elm, and ironwood. Understory density is typically lower than better drained sites and ground cover is often a mixture of facultative wetland and wetland obligate species.

Associated sites

F134XY204AL	**Western Alluvial Flat - PROVISIONAL** This site occurs in close association with the Western Moderately Wet Alluvial Flat where it occupies drier positions (e.g., natural levees, rises, etc.) within the floodplain environment.

Similar sites

F134XY019AL	**Northern Moderately Wet Alluvial Flat - PROVISIONAL** This site is the eastern counterpart to the Western Moderately Wet Alluvial Flat.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The distribution of the Western Moderately Wet Alluvial Flat is primarily associated with streams that drain upland areas of a distinct physiographic subsection of the Southern Mississippi Valley Loess (MLRA 134): Crowley’s Ridge. However, there are a few instances where the soils of this site have been mapped on the adjoining Western Lowlands (EPA Level IV Ecoregion: 73g; Woods et al., 2004) and along the eastern edge of Crowley’s Ridge and the Southern Mississippi River Alluvium (MLRA 131A).

Physiographic features of the site include alluvial flats along narrow stream drainageways and moderately broad to broad floodplain flats of larger stream systems. This ecological site generally borders the better drained natural levees and alluvial flats and is often transitional to the wettest position(s) of the floodplain environment: the wet alluvial flat and/or backswamps. Interestingly, this site often occurs as inclusions within the better drained alluvial flats in the form of shallow depressions and linear, relict scour and overwash channels and sloughs. These lower, subtle surface irregularities often hold water for slightly longer periods than the surrounding, better drained flats.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Alluvial flat (3) Depression
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Elevation	46–119 m
Slope	0–3%
Ponding depth	0 cm
Water table depth	30–46 cm
Aspect	Aspect is not a significant factor

Climatic features

This site falls under the Humid Subtropical Climate Classification (Koppen System). The mean annual precipitation for this site from 1980 through 2010 was approximately 51 inches with a range from 37 to roughly 65 inches. Maximum precipitation occurs in spring (April and May) and late fall (November and December) and typically decreases throughout the summer. Rainfall often occurs as high-intensity, convective thunderstorms during warmer periods but moderate-intensity frontal systems can produce large amounts of rainfall during winter. Snowfall generally occurs in most years, and the average annual snowfall in the northern portions of this site in Stoddard County, Missouri is 11 inches (USDA-NRCS, 2006). The average annual maximum and minimum air temperature is 71 (range 46 to 91) and 49 (range 28 to 70) degrees F, respectively. The average frost free and freeze free periods are 200 and 226 days, respectively.

Table 3. Representative climatic features

Frost-free period (average)	200 days
Freeze-free period (average)	226 days
Precipitation total (average)	1,295 mm

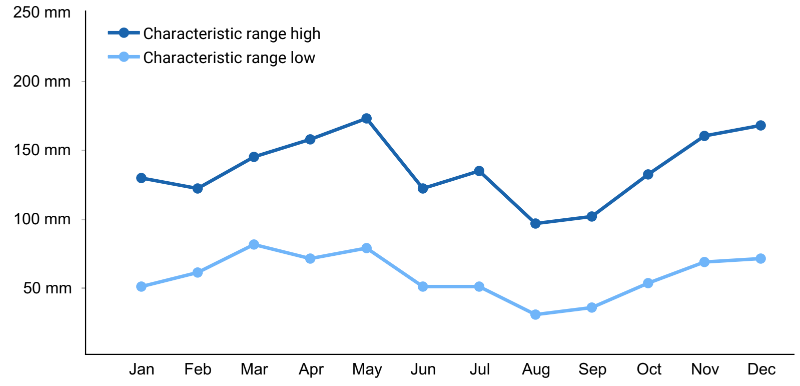

Figure 1. Monthly precipitation range

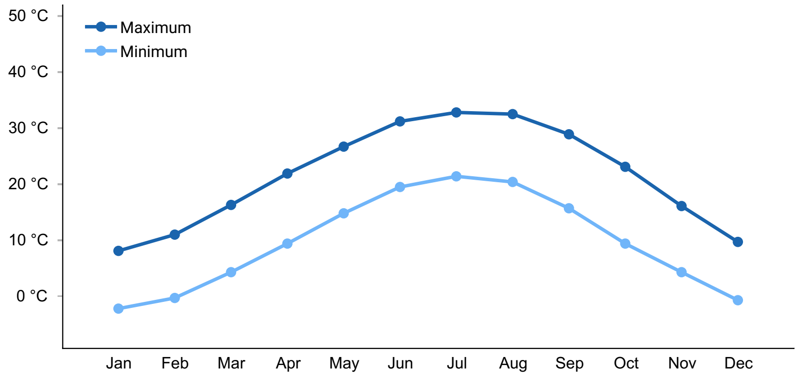

Figure 2. Monthly average minimum and maximum temperature

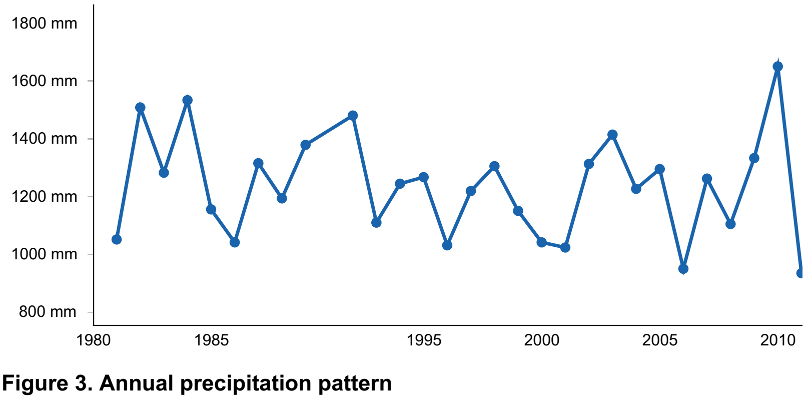

Figure 3. Annual precipitation pattern

Climate stations used

- (1) MADISON 1 NW [USC00034528], Forrest City, AR
- (2) WYNNE [USC00038052], Wynne, AR
- (3) MALDEN MUNI AP [USC00235207], Malden, MO
- (4) CLARENDON [USC00031442], Clarendon, AR
- (5) HELENA [USC00033242], Helena, AR
- (6) JONESBORO 2 NE [USC00033734], Jonesboro, AR
- (7) SAINT CHARLES [USC00036376], Clarendon, AR
- (8) MARIANNA 2 S [USC00034638], Marianna, AR
- (9) CAPE GIRARDEAU MUNI AP [USW00003935], Chaffee, MO
- (10) PARAGOULD 1S [USC00035563], Paragould, AR
- (11) ADVANCE 1 S [USW00093825], Advance, MO

Influencing water features

This site occurs within floodplains of small to large stream systems. Overland flooding occurs over a large percentage of the site's distribution. Flood duration is highly variable and directly dependent upon stream size and watershed position. Narrow floodplains of small streams are typically "flashy" and may flood occasionally to frequently but flood duration is generally brief. Sites associated with larger streams and large drainage basins may flood frequently with much longer flood duration. Soils of this site are somewhat poorly drained and the wettest soil associated with this site, Arkabutla, often supports hydrophytic vegetation (both obligate wetland and facultative wetland species). However, not every soil correlated with this site classifies as hydric. Particularly problematic situations pertain to channelized and leveed stream systems, which deleteriously affects connectivity with associated soils and vegetation.

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.

This site is characterized by very deep, somewhat poorly drained soils that formed in silty and/or loamy alluvium. These level to nearly level soils are generally associated with wide floodplains but also occur on wetter and lower positions of narrow, stream floodplains. The site is subject to flooding during winter to early spring. Flood duration ranges from brief to very long depending on stream and drainage basin size and flood magnitude. The seasonal high water table ranges from 1 to 2 feet of the surface during periods of high rainfall. Soil reactions generally range from strongly acid to very strongly acid.

Principal soils associated with this site include Falaya (Coarse-silty, mixed, active, acid, thermic Aeric Fluvaquents) and Arkabutla (Fine-silty, mixed, active, acid, thermic Fluventic Endoaquepts). Secondary soils of this site consist of Mantachie (Fine-loamy, siliceous, active, acid, thermic Fluventic Endoaquepts) and Waverly (Coarse-silty, mixed, active, acid, thermic Fluvaquentic Endoaquepts). The latter two soil series are represented by a single map unit, each. Waverly is the only poorly drained soil of this site.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Silty clay loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained
Permeability class	Moderate
Soil depth	142 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	17.27–21.59 cm
Electrical conductivity (0-101.6cm)	0–1 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.8–6.3
Subsurface fragment volume <=3" (Depth not specified)	2–3%
Subsurface fragment volume >3" (Depth not specified)	2%

Ecological dynamics

This site occurs on level to nearly level alluvial flats and within localized, shallow depressions that are often pocked throughout the better drained areas of narrow to broad floodplains. The site may also be viewed as a transitional zone between landforms and positions with better drainage (e.g., natural levees) and the hydric, low-lying flats and backswamps. Within narrower floodplains, this site is positioned at slightly lower elevations landward of the stream bank.

A key characteristic of this site pertains to a distinct gradation of soil wetness. When viewed from the perspective of a soil catena, this site lies in the middle of the classic floodplain moisture gradient. This gradient is also reflected in the plant community. Species requiring drier conditions begin dropping out and are replaced by plants more tolerant of anaerobic conditions. Overstory components generally include swamp chestnut oak, water oak, willow oak, overcup oak, pin oak, American sycamore, sweetgum, red maple, hickory, green ash, American elm, and ironwood. Understory density is typically lower than the adjoining better drained sites and ground cover may consist of a mixture of facultative wetland and wetland obligate species, depending on local conditions.

The dominant ecological processes associated with this site include periodic flooding, stand disturbances at varying scales, and natural, stream migration. Given the site's landform position, periodic flooding is a common and important process of the system. Flooding can enhance fertility of the soil environment via deposition of new alluvium but can also impact the site by scouring and/or depositing excessive materials. Flood duration is highly variable and directly dependent upon stream size and magnitude of the flood event. Flood durations of small streams are typically brief and "flashy", while those of larger systems may range from brief to very long depending on drainage basin size and flood magnitude. The collective effects of the hydrodynamics within this system naturally lead to migration or movement of the stream across its connected landscape, the floodplain. Low-gradient streams generally meander and frequently change course leading to the erosion of a portion of the floodplain with the concomitant deposition and creation of new point bars, levees, and alluvial flats (LANDFIRE, 2008).

Forest stand disturbances vary in both size and type. Disturbances range from gap-scale (single tree to small group) to stand-initiating events that are greater than one acre (per Johnson et al., 2009). Smaller gaps or forest openings may result in the release of suppressed understory components, but the greatest response is often ingrowth or expansion of the surrounding canopy (Oliver and Larson, 1990). Understories of long-term, non-disturbed portions of the stand (i.e., complete canopy closure) are typically comprised of shade-tolerant woody and herbaceous species. Larger gaps often consist of heavy, downed woody debris and a dense concentration of shrubs, forbs, vines, and released saplings and young trees. Types of disturbances may include wind, severe ice storms, and beaver. The influence of the latter is perhaps the most dynamic as local hydrologic regimes are dramatically altered leading to wetter soils, different vegetation communities, and a different suite of ecological processes.

An additional disturbance factor that rarely occurs on this site today but is thought to have been an important historical influence is fire. This supposition is drawn from the presence of a single species: cane. Cane grows readily on this site and historically, extended across many floodplains of the Southeast (Gagnon, 2009). The sheer presence of this species in the historic community suggests disturbance beyond flooding alone. Fire may have been an important disturbance factor in the pre-settlement bottomland community (see Gagnon and Platt, 2008; Gagnon, 2009), which suggests that the structure of this site may have been more open where dense canebrakes existed. However, any vestige of that system is long past. Those areas that have been allowed to revert naturally are now best characterized as closed-canopied, bottomland hardwoods.

The principal land use, today, is agriculture production with some areas in pasture and/or forage production. The fertile soils of the broader floodplains are almost exclusively cropland. Timber production is mostly restricted to the narrower drainageways. Perhaps the largest and most significant alteration to this site has been channelization and levee (or spoil bank) construction. Such hydrologic alterations are probably more commonplace on streams that extend onto the Western Lowlands than those occurring within Crowley's Ridge physiographic area. Still, this action results in a disconnection between the stream - floodplain environment, which interrupts and alters the ecological processes and functions of the system as a whole.

There are a few areas that have been set aside in the public and/or private interest (e.g., parks, refuges, natural areas, and forest preserves), and those areas are now heavily forested. With no example of the pre-settlement plant community remaining intact, reference conditions of this site have been arbitrarily chosen to reflect the native plant species that most frequently occur and that influence the overall structure and characteristics of maturing stands. Locations that offer an opportunity to examine these "surrogate" reference conditions are relegated to those public and private land holdings.

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 this 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

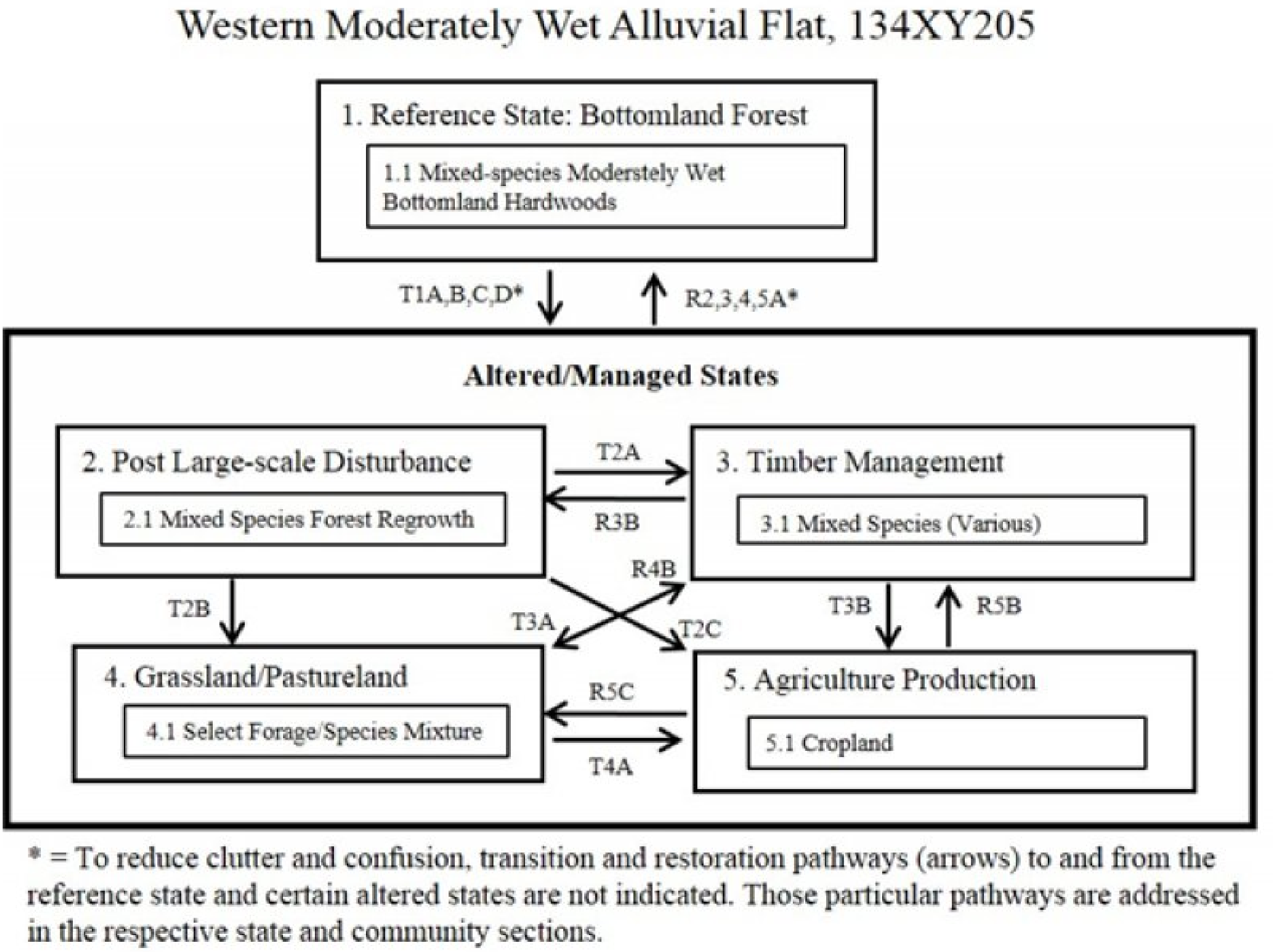

Figure 5. STM - Western Moderately Wet Alluvial Flat

Pathway	Practice
T1A, R3B,	large-scale stand initiating disturbance (wind, ice, clearcut; State 2)
T1B	beginning point uneven-aged stand; goal of timber management; timber stand improvements; group selection; single tree harvest (State 3)
T1C, T2B, T3A, R5C	mechanical removal of vegetation; herbicide application; seedbed preparation; planting desired species at appropriate rate (State 4)
T1D, T2C, T3B, T4A	removal of vegetation (mechanical/chemical); preparation for cultivation (State 5)
T2A, R4B, R5B	beginning point even-aged stand; potential planting; competitor control – herbicide/mechanical; TSI (State 3)
R2A, R3A, R4A, R5A	natural succession over time; may require exotic plant control and reestablishment of missing species (State 1)

Figure 6. Legend - Western Moderately Wet Alluvial Flat

State 1
Moderately Wet Bottomland Forest

The pre-settlement plant community of this ecological site was largely removed more than 150 years ago, and there are no extant examples of that community. Following decades of land-use impacts, the plant community that returned in areas initially set aside for protection include several species of broad-leaved trees commonly referred to as bottomland hardwoods. Vegetation associated with this site exhibits signs of increasing soil wetness compared to the better drained areas of the floodplain. Species that may occur on the drier flats (e.g., American beech, white oak, tuliptree) generally begin to drop out or their abundance decreased. A shift toward species more tolerant of wet conditions (or increased anaerobic conditions) typically occurs.

Community 1.1
Mixed Species Moderately Wet Bottomland Hardwoods

This community phase represents the successional stage, composition, and structural complexity of stands supporting perceived reference conditions. Today, this community is representative of maturing stands (late development) often found on public lands and private preserves. Overstory composition of this site may vary due to local conditions. Where soils are a little drier and conditions more conducive, tree species may consist of swamp chestnut oak, water oak, willow oak, cherrybark oak, Shumard's oak, sweetgum, American sycamore, hickory, sugarberry, green ash, American elm, red maple, and an understory component of American hornbeam and cane. This pattern may shift where water remains on a local area for longer periods. Species occurring within wetter areas may include overcup oak, water hickory, water tupelo, bald cypress, and water elm. The latter suite of species are more indicative of "wet" alluvial flats, which occur as inclusions on broader floodplains of this site.

State 2
Post Large-scale Disturbance Forest

This state is characterized by the regeneration or regrowth of a pre-existing forest stand following a major, stand-replacing disturbance. Scale of the disturbance is at the stand level, which is greater than one acre (per Johnson et al., 2009). Potential types of disturbances include catastrophic windstorms, wildfire, silvicultural clearcuts, and particularly destructive ice storms. The resulting, even-aged stand (or single-cohort) is set on a new course of development, which is highly dependent upon several critical factors including: the composition and structure of the stand prior to the disturbance; the degree or intensity of the disturbance; size and configuration of the disturbed area; and distance to seed sources. Composition and condition of the forest stand prior to a major disturbance may dictate, in large part, future composition of the regenerating stand. Although colonization by new species is expected soon after the disturbance, many of the pre-existing overstory components are anticipated to occupy position in the new, developing stand – their presence arising mainly from stump or root sprouts, advance regeneration, and germination from the seed bank (Oliver and Larson, 1990).

Community 2.1
Mixed Species Forest Regrowth

Large blowdowns such as straight-line winds and tornadoes may have a major influence on composition and successional patterns of hardwood stands (Hodges, 1998). Soon after overstory removal, numerous species may colonize large openings and influence the dynamics of the site. Initial colonizers are often forbs, graminoids, and vines that may have existed in the seed bank, were forest floor components prior to disturbance, or transported into the site via flood waters, wind, and/or animals. Overstory species anticipated to occur during the stand-initiation stage include sweetgum, American sycamore, eastern cottonwood, ash, oaks, hickory, elm, sugarberry, boxelder, along with the residual shade-tolerant species of red maple and American hornbeam. For stands that were highly altered prior to the disturbance (e.g., high-graded), intensive management may be necessary in order to establish a desired composition. Management actions may include controlling undesirable species mechanically and chemically and planting the desired species.

State 3
Timber Management

This state represents the breadth of forest management activities on this site. Various management or silvicultural methods can lead to very different structural and compositional results within a managed stand. The range of methods are diverse and 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., timber stand improvement, etc.) to reduce competition and achieve maximum growth potential of the desired species. Inherently, these various approaches result in different community or "management phases" and possibly alternate states. The decision to represent these varying approaches and management results into a single state and phase at this time hinges on the need for additional information in order to formulate definitive pathways, management actions, and community responses. Forthcoming inventories and description iterations of this site will provide more detail on this state and associated management phases.

Community 3.1

Mixed Species (Various)

This phase represents the prevailing compositional diversity of hardwood species occurring on this site. Components of the system that are often in greatest demand are the oaks. Oaks that respond well on the drier portions of this site include cherrybark, Shumard's, swamp chestnut, willow, and water. However, managing for oaks alone on this site may be time, labor, and cost prohibitive. Managing for a mixed diversity of hardwoods (including oaks) is the option representative of this management phase. In addition to oaks, species responding well on this site include sweetgum, ash, elm, sycamore, and cottonwood. There are a variety of silvicultural methods for achieving this management state including both uneven-aged approaches (e.g., group selection) and even-aged actions (e.g., clearcut). Finding the appropriate approach for a given stand and environment necessitates close consultation with trained, experienced, and knowledgeable forestry professionals. If there is a desire to proceed with this state, it is strongly urged and advised that professional guidance be secured and a well-designed silvicultural plan developed in advance of any work conducted. As an additional precaution, this site has seasonal limitations to timber management due to flooding and wetness issues. It is strongly advised to refrain from management activities when the soils are saturated.

State 4
Grassland/Pastureland

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 4.1
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. However, wetness is a limitation of this site, which may affect the type of forage established and management activities during wet seasons and after heavy rain events (Capability Class 2w). Cool season forage may include tall fescue, orchardgrass, white clover, and red clover, and warm season forage often consists of bermudagrass, bahiagrass, and annual lespedeza. Several additional plants and/or species combinations may be desired depending on the objectives and management approaches. As a precaution, the location of this site and the seasonal wetness of the soil creates exceptional conditions (habitat) for a number of native sedges, rushes, and grasses, which will seed quickly and form thick cover (thatch) in wetter spots of pastures and hayfields. If active management (and grazing) of the pastureland is stopped, 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 5
Crop Production

Upon settlement, the fertility of the soils led to rapid land clearing and crop production. Today, crops that are often established include cotton, corn, soybean, and small grains.

Community 5.1

Cropland

Soybean, small grains, and grain sorghum are a few of the crops grown on this site. This site does have some seasonal wetness limitations, which may restrict the types of crops grown in addition to management activities.

Transition T1A
State 1 to 2

This pathway represents a large-scale, stand replacing disturbance, which may be caused by a catastrophic windstorm (e.g., straight-line winds, tornado), ice storm, severe fire, or a silvicultural clearcut. For this stressor to occur, most or all of the overstory must be removed or destroyed. A few residual trees may persist, but overall, the disturbance must be intensive enough, at least one acre or larger (Johnson et al., 2009), that a new, even-aged stand is created.

Transition T1B
State 1 to 3

This pathway consists of prescribed silvicultural activities specifically designed to meet stand compositional and production objectives. Activities may include release cuttings through a combination of low and high thinning, mechanical and chemical control of competition, and artificial regeneration (i.e., planting) of sites with low oak presence. A variety of silvicultural methods may be employed including group selection, single tree selection harvests (all classes/condition; avoid “high-grading”), or even-age management (clearcut).

Transition T1C
State 1 to 4

Actions required to convert forests to grassland or forage production include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T1D
State 1 to 5

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for planting.

Restoration pathway R2A
State 2 to 1

This pathway represents a return to reference conditions through natural succession, if the disturbance occurred within a reference community. Depending upon objectives and stand condition, management activities to aide recovery may include exotic species control and silvicultural treatment that benefits oak regeneration and establishment (e.g., TSI practices such as crop tree release, low thinning, and cull removal). This pathway will occur only under the natural hydrologic regime (i.e., natural channel and no levees).

Transition T2A
State 2 to 3

This pathway represents the development of an even-aged stand that is prescribed to meet compositional and production objectives.

Transition T2B
State 2 to 4

Actions required to convert forests to pasture or forage production include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T2C

State 2 to 5

Actions include mechanical removal of vegetation and stumps, herbicide treatment of residual plants, and preparation for planting.

Restoration pathway R3A
State 3 to 1

Natural succession over a period of time may transition a former timber-managed stand to one supporting reference conditions. 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. Floodplains where streams have been channelized and leveed must have the natural hydrology restored BEFORE reference conditions are achieved.

Restoration pathway R3B
State 3 to 2

This pathway represents a large-scale, stand-initiating disturbance, which effectively removes most or all of the pre-existing overstory. Disturbances may include a catastrophic windstorm, severe wildfire, and silvicultural management (even-aged).

Transition T3A
State 3 to 4

Actions required to convert forests to pasture or forage production include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T3B
State 3 to 5

Actions include mechanical removal of vegetation and stumps, herbicide treatment of residual plants, and preparation for planting.

Restoration pathway R4A
State 4 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. LANDFIRE models (2008) suggest that over 80 years is required for a return to a late development community and this pathway is highly dependent upon species present in the developing stand in addition to the appropriate level and type of disturbance (e.g., periodic flood regime, presence/absence of catastrophic wind events, etc.). Significant efforts may be required before a return to reference conditions is achieved (e.g., exotic species control, appropriate connectivity between stream and floodplain, potential artificial regeneration of community components, etc.). Floodplains where streams have been channelized and leveed must have the natural hydrology restored BEFORE reference conditions are achieved.

Restoration pathway R4B
State 4 to 3

This pathway represents prescribed management strategies for transitioning abandoned pastureland to managed woodland. Activities may include artificial regeneration of and management for desired species and exotic species control.

Transition T4A
State 4 to 5

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for planting.

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. LANDFIRE models (2008) suggest that over 80 years is required for a return to a late development community and this pathway is highly dependent upon species present in the developing stand in addition to the appropriate level and type of disturbance (e.g., periodic flood regime, presence/absence of catastrophic wind events, etc.). Significant efforts may be required before a return to reference conditions is achieved and may never fully reach perceived reference conditions (e.g., exotic species control, appropriate connectivity between stream and floodplain, potential artificial regeneration of community components, etc.). Floodplains where streams have been channelized and leveed must have the natural hydrology restored BEFORE reference conditions are achieved.

Restoration pathway R5B
State 5 to 3

This pathway represents prescribed management strategies for transitioning abandoned cropland to managed woodland. Activities may include artificial regeneration of and management for desired species and exotic species control.

Restoration pathway R5C
State 5 to 4

Seedbed preparation and establishment of desired forage/grassland mixture.

Additional community tables

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Contributors

Barry Hart

Acknowledgments

Tom Foti (Ecologist, Arkansas Natural Heritage Commission) and Henry Langston (Arkansas Highway Department) provided invaluable discussion, knowledge, and experience with regards to the soils and vegetation associated with this site.

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:

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

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

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

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

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17. **Perennial plant reproductive capability:**
