USDA Natural Resources Conservation Service

Ecological site F134XY207AL
Western Fragipan Uplands - PROVISIONAL

Accessed: 05/12/2025

General information

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

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. 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 is restricted to the uplands of Crowley's Ridge from Helena, Arkansas north through Stoddard County, Missouri. [Note that the distribution of this site as shown extending west of Crowley's Ridge (the Loess Hills in pink) onto the Western Lowland terraces (yellow) is an artifact of soil mapping and does not reflect the actual distribution of this ecological site.]

Classification relationships

All or portions of the geographic range of this site falls within a number of ecological/land classifications including:
-NRCS Major Land Resource Area (MLRA) 134 – Southern Mississippi Valley Loess
-Environmental Protection Agency's Level IV Ecoregion: Bluff Hills, 74a (Griffith et al., 1998; Woods et al., 2002; Chapman et al., 2002; Chapman et al., 2004; Woods et al., 2004; Daigle et al., 2006)
-231H - Coastal Plains-Loess section of the USDA Forest Service Ecological Subregion (McNab et al., 2005)
-NatureServe Ecological System CES203.071: Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest (NatureServe 2011)
-Mixed Oak – Hickory Forest Type (Clark et al., 1974)
-Dry-Mesic Loess Forest; Dry-Mesic Loess Woodland (Nelson, 2005)
-Western Mesophytic Forest Region - Mississippi Embayment Section - Loess Hills (Braun, 1950)

Ecological site concept

The Western Fragipan Upland is characterized by deep, moderately well drained soils that formed in a mantle of loess. Soils often perch water during wet seasons and/or high rainfall events due to moderately slow to slow permeability in a dense subsoil layer, typically a fragipan. This site occurs on narrow to broad, upland interfluves to strongly sloping sideslopes. Slopes range from 0 to 20 percent, but dominant gradients are 2 to 12 percent. The natural vegetation prior to settlement likely consisted of a dry-mesic oak – hickory association throughout much of Crowley's Ridge. However, local inclusions of drier vegetation components such as shortleaf pine and black hickory likely occurred in areas where the soils of this site are in close proximity to and in association with thin loess soils and exposed fluviomarine deposits (gravel and sand). Fire may have been an important influence on both community structure and composition in the northern portions of Crowley's Ridge but potentially less so toward the southern end.

Associated sites

F134XY001TN	**Northern Deep Loess Backslope Mesophytic Forest** This site joins the Western Fragipan Upland in portions of the southern and northern end of Crowley's Ridge.
F134XY002TN	**Northern Deep Loess Summit** This site joins the Western Fragipan Upland where thick loess soils (no fragipan) occur.
F134XY208AL	**Western Dry Loess Backslope - PROVISIONAL**
F134XY210AL	**Western Dry Loess Summit - PROVISIONAL**

Similar sites

F134XY105MS	**Southern Rolling Plains Loess Fragipan Upland - PROVISIONAL** This site is the southeastern counterpart to the Western Fragipan Upland.
F134XY012AL	**Northern Loess Fragipan Upland - PROVISIONAL** This site is the northeastern counterpart to the Western Fragipan Upland.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Western Fragipan Upland ecological site occurs entirely within a distinct physiographic subsection of the Southern Mississippi Valley Loess (MLRA 134): Crowley's Ridge. This prominent physiographic feature is a western counterpart to the Loess Hills east of the Mississippi River (Braun, 1950). Crowley's Ridge is a narrow belt of low, dissected hills that extends roughly 200 miles north to south from southeastern Missouri into eastern Arkansas. Shared characteristics with the bluffs to the east include a loess-cap (but with varying depths) that is underlain by Tertiary deposits of silt, sand, clay, and gravel. One notable distinction of its geographic location is that the entire length of Crowley's Ridge is surrounded by the Southern Mississippi River Alluvium (i.e., MLRA 131A; USDA, 2006) and is separated from the Loess Hills to the east by 23 to 50 miles of the vast Mississippi River delta region. Elevation crests over 500 feet above sea level with local topographic relief rising 200 feet above the adjoining alluvial plain (Clark et al., 1974). EPA combines Crowley's Ridge and the bluffs to the east within a single Level IV Ecoregion: the Bluff Hills, 74a (Woods et al., 2004).

This site is restricted to the uplands of Crowley's Ridge with slopes ranging from 0 to 20 percent. The site reaches maximum development on upland interfluves, divides, and ridges where slopes are dominantly 2 to 12 percent.

Table 2. Representative physiographic features

Landforms	(1) Interfluve (2) Ridge (3) Divide
Flooding frequency	None
Ponding frequency	None
Elevation	300–580 ft
Slope	0–20%
Ponding depth	0 in
Water table depth	18–26 in
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 50 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 70 (range 46 to 91) and 49 (range 28 to 70) degrees F, respectively. The average frost free and freeze free periods are 199 and 227 days, respectively.

Table 3. Representative climatic features

Frost-free period (average)	199 days
Freeze-free period (average)	227 days
Precipitation total (average)	50 in

Climate stations used

- (1) MADISON 1 NW [USC00034528], Forrest City, AR
- (2) MALDEN MUNI AP [USC00235207], Malden, MO
- (3) HELENA [USC00033242], Helena, AR
- (4) JONESBORO 2 NE [USC00033734], Jonesboro, AR
- (5) MARIANNA 2 S [USC00034638], Marianna, AR
- (6) PARAGOULD 1S [USC00035563], Paragould, AR
- (7) WYNNE [USC00038052], Wynne, AR
- (8) ADVANCE 1 S [USW00093825], Advance, MO

Influencing water features

This site is not influence by a hydrologic regime.

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 deep, moderately well drained and formed in loess on level to moderately steep uplands. A distinguishing feature of the soils is the presence of a fragipan that generally perches water during wet seasons. Depth to the fragipan varies but generally ranges from 14 to 35 inches. Due to the relatively shallow depths to a pan, soils can become somewhat droughty during drier periods, especially late summer to early autumn. Permeability is moderate above the fragipan and moderately slow to slow in the fragipan.

The principal or dominant soil of this site is Loring (Fine-silty, mixed, active, thermic Oxyaquic Fragiudalfs) and a minor or secondary soil is Grenada (Fine-silty, mixed, active, thermic Oxyaquic Fraglossudalfs). Both soils formed in loess greater than 48 inches, and sand content throughout the solum is usually less than 10 percent but may range up to 15 percent for Loring. The distribution of Loring on Crowley's Ridge extends from the southern end near Helena, Arkansas northward through Stoddard County. Grenada, however, has only been mapped in three Arkansas counties: Craighead, Lee, and Poinsett.

A distinguishing feature of Crowley's Ridge is the progressive thinning of the loess cap as one proceeds northward from the deep loess region of Helena toward and over into the Missouri Bootheel. There is a distinct probability that a thin loess fragipan occurs in proximity to other thin loess soils such as the broadly mapped Brandon soils. Recent investigations located and confirmed the presence of the thin loess fragipan soil, Providence (Fine-silty, mixed, active, thermic Oxyaquic Fragiudalfs) in northern sections of Crowley's Ridge in Arkansas (personal observations). The Providence series consists of moderately well drained soils with a fragipan. These soils formed in a thin loess mantle of about 2 feet thick and the underlying sandy and loamy sediments (USDA-NRCS, 2016). Depth to a fragipan is comparable to that of Loring and Grenada. These observations suggest that a joint ecological site inventory – soil survey project for the distribution of this site is warranted.

Of particular caution, the distribution of this site is shown as extending west of Crowley's Ridge onto the Pleistocene terraces of the Western Lowlands (red delineations on site distribution map). Those occurrences west of the Ridge proper constitute a separate and distinctly different ecological site. The reason for the dual mapping of multiple sites is due to the establishment of identical soils and soil map unit phases for both the uplands of Crowley's Ridge and the Western Lowland terraces during the original county soil surveys.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained
Permeability class	Very slow to moderate
Soil depth	19–32 in

Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6.1–7.5 in
Electrical conductivity (0-40in)	0–1 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.9–6
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This ecological site occurs exclusively on the uplands of Crowley's Ridge. The distribution of this site encompasses various geomorphic situations that range from narrow ridges within dissected landscapes to broad, undulating plains or plateau-like areas where the intervening sideslopes are short and not as steep. In addition to physiographic differences, there are perceived vegetation differences between the deeper loess areas to the south and thinner loess northern sections.

In the "deep loess country" of the southern portion of Crowley's Ridge, this site occurs on narrow ridges and broader summits or divides with moderate to steep slopes. Vegetation is predominantly a mixed oak – hickory association with common components consisting of white oak, southern red oak, black oak, post oak, mockernut hickory, black gum, elm, and cherrybark oak on the moister sites. Proceeding northward, shortleaf pine may become an additional component in addition to black hickory and understory components of aromatic sumac and farkleberry – a plant association exhibiting drier characteristics.

The pre-settlement vegetation of Crowley's Ridge was projected by Clark et al. (1974), which was drawn from the journals of early naturalists and published state geologic reports (e.g., Call, 1891). Clark et al. (1974) associated the dominant forest type occurring on the Loring – Grenada soil association as Mixed Oak – Hickory. A similar soil – vegetation relationship was observed during reconnaissance of this site.

There were a few instances where shortleaf pine, black hickory, aromatic sumac, and farkleberry were observed on the mapped soils of this site, which appear to be out of place for these deep loess soils (irrespective of fragic properties). That association appears to be more closely aligned with the droughty, gravelly soils of Brandon and Saffell than the deep loess soils of Loring and Grenada. Plausible explanations for the occasional presence of the shortleaf pine – black hickory association may be due to local, site-specific factors such as severe erosion, former land use impacts, and/or local inclusions of a thin loess soil that has gone undetected. In general, the natural vegetation of this site may be best characterized as a mixed oak – hickory land cover type.

Much of the oak – hickory forest on this site today supports a closed canopy. Historically, the structure of the overstory may have been open to moderately open, especially in the northern sections of Crowley's Ridge where shortleaf pine – mixed oak woodlands were in juxtaposition with this site. Under this scenario, fire would certainly have extended through this site on a recurring interval.

Once settlement commenced, various land use activities and habitat alterations were extensive. Any location that could grow crops was farmed. Much of the area was converted to pastureland, row crops, orchards, and/or remained in timber and consistently logged. With the advent of fire suppression, regrowth of formerly cutover land was often overcrowded with forest productivity suppressed. Today, the major land uses continue to be pastureland, limited agriculture, orchard production, and forestry. Additionally, a few areas have been converted to a loblolly pine monoculture.

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 Western Fragipan Upland ecological site. This model is based on limited inventories, literature, expert knowledge, and interpretations. The plant community of this site differs across Crowley’s Ridge due to natural variability in 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

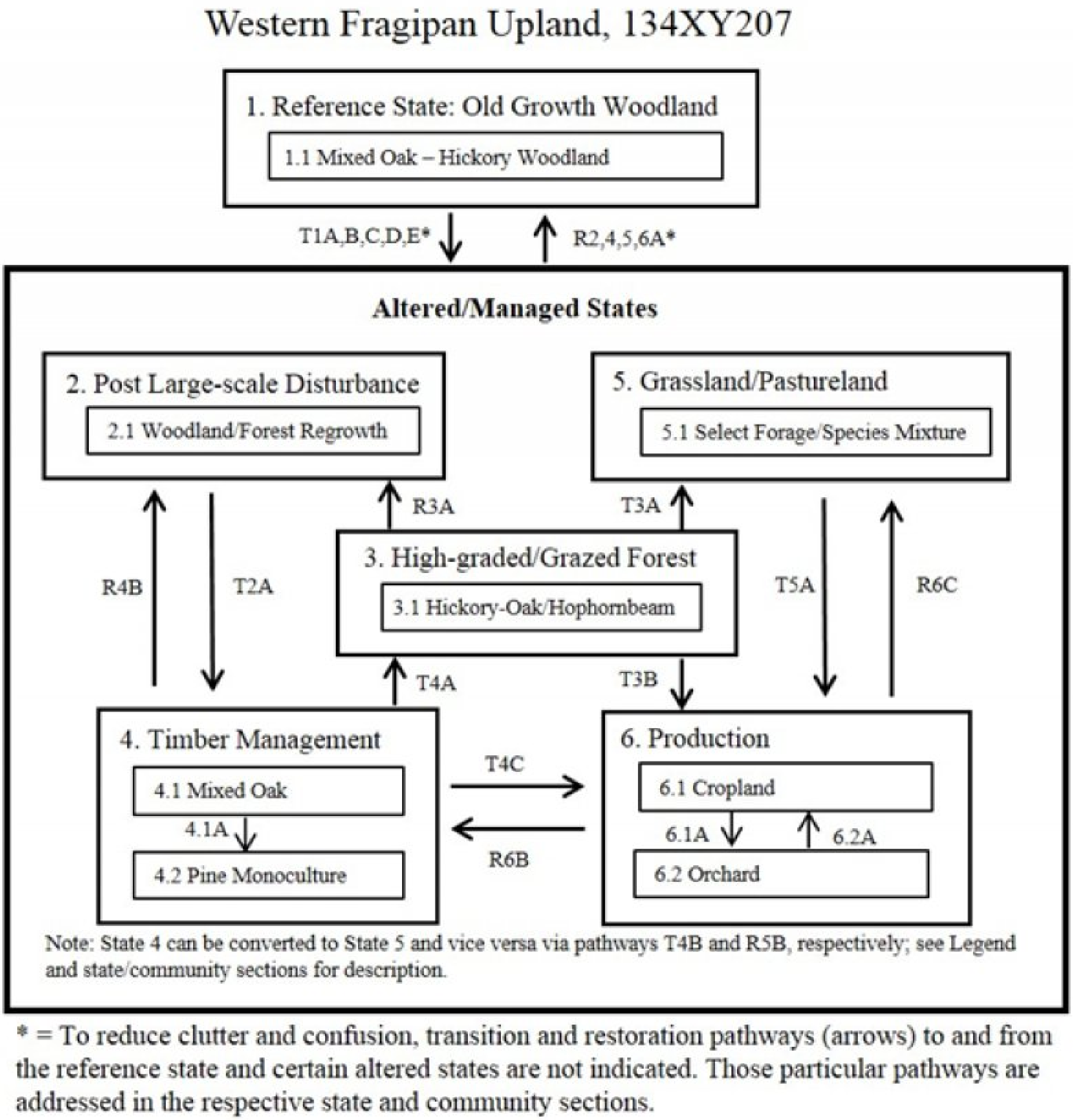

Figure 6. STM - Western Fragipan Upland

Pathway	Practice
T1A, R3A, R4B	large-scale stand initiating disturbance (wind, ice, replacement fire, clearcut; State 2)
T1B, T4A	repeated select harvest (high-grading) and/or livestock grazing - uncontrolled access (State 3)
T1C	beginning point uneven-aged stand; goal of mixed oak management; timber stand improvements; group selection; single tree harvest; or pine monoculture (State 4)
T1D, T3A, T4B, R6C	mechanical removal of vegetation; herbicide application; seedbed preparation; planting desired species at appropriate rate (State 5)
T1E, T3B, T4C, T5A	mechanical removal of vegetation; preparation for cultivation or orchard establishment (State 6)
T2A, R5B, R6B	beginning point even-aged stand; potential planting; competitor control – herbicide/mechanical; TSI; or pine monoculture (State 4)
R2A, R4A, R5A, R6A	natural succession over time; may require exotic plant control and reestablishment of missing species (State 1)
4.1A	conversion to pine monoculture
6.1A	planting and establishment of orchard(s)
6.2A	mechanical removal of vegetation and establishment of cropland

Figure 7. Legend - Western Fragipan Upland

State 1
Old Growth Woodland

The pre-settlement plant community of this ecological site was largely removed more than 150 years ago, and there are no extant examples remaining. However, inferences over the structure and dynamics of that system are drawn based on landscape position, soils, and existing community components. Clark et al. (1974) classed the community of this site as a Mixed Oak – Hickory forest. Based on the site's distribution, varying structural and compositional characteristics likely occurred. A richer community comprised of several species of oak likely dominated the site on the southern end of Crowley's Ridge where the loess mantle is thickest. A drier oak – hickory community with local inclusions of shortleaf pine and black hickory may have occurred toward the northern end of the Ridge where thinner loess deposits predominate. This range of compositional differences may have also been reflected in community structure with the southern end of the site exhibiting moderately open woodland to forest conditions and the northern end having an open woodland profile. The occurrence of fire and fire frequency may have also varied between the southern and northern extent of this site. The southern end of the deep loess country may have been more "fire sheltered" due to the dissection of the landscape as evidenced by numerous ravines. Either the absence of fire or a long fire return interval would have contributed to more closed canopy conditions. Conversely, the drier conditions of the northern end of the ridge likely led to higher fire frequencies, which would have fostered woodland conditions and created opportunities for fire adapted species such as shortleaf pine to filter into the community as occasional components.

Community 1.1
Mixed Oak – Hickory – Woodland

This community phase represents the perceived reference state of this ecological site. The range of variability is fairly broad in that the site encompasses some vegetation differences between the southern and northern end of the site. Dominant canopy components to the south include white oak, cherrybark oak, northern red oak, black oak, and secondarily southern red oak and post oak. Additional associates include shagbark hickory, mockernut hickory, pignut hickory, black gum, elm, white ash, hophornbeam, and flowering dogwood. Farther north, a change in species dominance can occur locally with cherrybark and northern red becoming less common with a concomitant increase in post oak, southern red oak, and occasional entrances of shortleaf pine and black hickory. Overall, structural characteristics of the reference community is perceived to range from open to moderately open woodland, although richer areas to the south may border on closed canopy forest conditions. Local site factors such as the type and frequency of disturbance, soil moisture, and soil type will likely be the influences that determine stand structure.

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 and is greater than one acre in size (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 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). If the intensity of the disturbance only removed the overstory and damage to the understory strata was light, then understory components of advance regeneration may proliferate in the new opening. This may be a desired condition if managing for an oak shelterwood harvest and subsequent oak recruitment. However, this scenario is particularly problematic in high-graded stands.

Community 2.1
Woodland/Forest Regrowth

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 wind and/or animals. Early successional or pioneer species may include winged elm, sumac, greenbrier, grapevine, blackberry, and various graminoids. Overstory species anticipated to occur during the stand-initiation stage include post oak, southern red oak, black oak, white oak, and various hickories. Composition of the young stand will vary dramatically if the disturbance is a well-designed and implemented shelterwood harvest that favors the advancement of an established oak understory. 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 components.

State 3
High-graded/Grazed Forest

Forests in this state have undergone repeated select harvests over time. Actions leading to this condition consist of removing the biggest and best trees of the most desirable species and leaving low-quality trees (damaged and deformed) and undesirable species. This action, conducted repeatedly, can cause tremendous shifts in species composition and can decrease the vigor and health of the residual stand. Without implementing carefully prescribed management actions, species composition of extreme high-graded stands may remain in a highly altered condition for many decades, even after large, stand-replacing disturbances resets “successional opportunity.” Today, this vegetation state probably represents the conditions of many forest stands throughout the distribution of this site. Local stands in which desirable species such as high quality white, cherrybark, and northern red oaks were repeatedly targeted often results in sites with proportionally more hickory, undesirable oaks (e.g., post oak), and a midstory of hophornbeam. Because “overgrazed woods” often consists of components very similar to high-graded stands, uncontrolled livestock access to forests is also included in this state. This does not take into account carefully prescribed and/or managed forms of forest grazing (e.g., agroforestry or silvopasture), which generally has a mutual goal of providing quality forage and productive forest management. The conditions considered and represented here are the extreme cases of long-term forest grazing; this form of uncontrolled access has been referred to as “turning livestock into the woods” (Brantly, 2014). A single community phase is selected to represent the breadth of conditions that may be anticipated in stands having been high-graded and with uncontrolled livestock access.

Community 3.1
Hickory-Oak/Hophornbeam

High-graded stands generally consist of a paucity of oaks. Species typically left or avoided during harvests often include hickory and practically the entire understory. This has resulted in canopies largely comprised of the preceding species along with a dense understory of hophornbeam and “scrub oak” or undesirable species such as post oak and blackjack oak. Noticeable characteristics of this condition are a conspicuous reduction of more merchantable oaks and other valuable hardwoods. The most palatable forage of a forest stand is typically the herbaceous understory, which is targeted first. The combined effects of trampling, browsing woody plants, and foraging on the herbaceous layer often results in a high percentage of bare soil, exposed roots, and an open understory. Furthermore, overstory trees occurring in stands with high livestock traffic grow more slowly over time (Johnson, 1952).

State 4
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., fire, TSI, etc.) to reduce competition and achieve maximum growth potential of the desired species. Inherently, these various approaches result in different community or “management phases” and possibly alternate states. The decision to represent these varying approaches and management results into a single state at this time hinges on the need for additional information in order to formulate definitive pathways, management actions, and community responses. Forthcoming inventories and descriptions of this site will provide more detail on this state and associated management phases. Currently, this state is represented by two distinctly different management options: oak management and conversion to pine monoculture.

Community 4.1
Mixed Oak

Some of the most desirable timber on this site consists of oak. Depending on the desired product, management activities will differ. Management for oak dominant stands may be achieved by shelterwood and/or seed tree approaches. Managing for mixed hardwoods may only require timber stand improvement methods, or artificial regeneration may be needed if the desired species are absent. The location of this site on drier summit and shoulder slope positions should carry fire, well, and low intensity ground fires on a frequent return interval may be an effective tool for reducing competition on this site, with the potential effect of benefitting some oaks. 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.

Community 4.2
Pine Monoculture

This community phase represents site conversion to a pine monoculture. Several examples of this management option exists on this site with loblolly pine as the species typically planted.

Pathway 4.1A
Community 4.1 to 4.2

This pathway represents the conversion of the former oak dominated forest to a pine monoculture or plantation (Phase 4.2). This action requires mechanical removal of all hardwoods, site preparation, herbicide treatment of root sprouts, and planting in pine.

State 5
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 5.1
Select Forage/Species Mixture

This community phase represents commonly planted forage species on pasturelands, haylands, and open grasslands. 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 6
Production

Agriculture production is generally a minor state or land use on this site due to the narrowness of some of the ridgetops and the dissected landscape. Most production is limited to broader interfluves and divides. Adapted crops on this site include soybeans, grain sorghum, and winter small grains. There are a few orchards that have been established on some of the broader interfluves of this site. Of the active orchards that have been observed, peach production may be among the most important.

Community 6.1
Cropland

Various crops are suited for this site but soybeans are among the most frequently planted and harvested.

Community 6.2
Orchard

The principal orchard observed on this site is peach.

Pathway 6.1A
Community 6.1 to 6.2

This pathway represents discontinuation of cropland and conversion to orchard.

Pathway 6.2A
Community 6.2 to 6.1

Mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for crop establishment.

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

Repeated selective harvests or high-grading of stands over time can cause shifts in species composition, structure, and overall health of affected stands. High-grading occurs when the most desirable trees of select species are repeatedly removed leaving behind inferior, low quality stems and undesirable species. This transition also includes uncontrolled access by livestock and impacts from sustained, selective grazing and browsing.

Transition T1C
State 1 to 4

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

Transition T1D
State 1 to 5

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 T1E
State 1 to 6

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation or orchard establishment.

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 (State 1).

Transition T2A
State 2 to 4

This pathway represents the development of an even-aged stand that is prescribed to meet compositional and production objectives (State 4).

Restoration pathway R3A
State 3 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, landslide, or a silvicultural clearcut (State 2).

Transition T3A
State 3 to 5

Actions include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants (State 5).

Transition T3B
State 3 to 6

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation or orchard establishment.

Restoration pathway R4A
State 4 to 1

Natural succession over a period of time coupled with disturbance such as low intensity (and possibly mixed severity fire) 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 (State 1).

Restoration pathway R4B
State 4 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 T4A
State 4 to 3

Repeated selective harvesting or high-grading of stands over time can cause shifts in species composition, structure, and overall health of affected stands. This transition also includes uncontrolled access by livestock and impacts from sustained, selective grazing and browsing (State 3).

Transition T4B
State 4 to 5

Actions include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants (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. This pathway is highly dependent upon species present in the developing stand in addition to the appropriate level and type of disturbance (e.g., fire return interval). Significant efforts and many decades of continual management may be required before a return to reference conditions is achieved (e.g., exotic species control, appropriate intensity and return interval of fire, potential artificial regeneration of community components, etc.).

Restoration pathway R5B
State 5 to 4

This pathway represents prescribed management strategies for transitioning abandoned pastureland to managed woodland. Activities may include artificial regeneration of desired species; exotic species control; appropriate intensity and return interval of fire (State 4).

Transition T5A
State 5 to 6

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation or orchard establishment (State 6).

Restoration pathway R6A
State 6 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. This pathway is highly dependent upon species present in the developing stand in addition to the appropriate level and type of disturbance (e.g., fire return interval). Significant efforts and many decades of continual management may be required before a return to reference conditions is achieved (e.g., exotic species control, appropriate intensity and return interval of fire, potential artificial regeneration of community components, etc.).

Restoration pathway R6B
State 6 to 4

This pathway represents prescribed management strategies for transitioning abandoned cropland/orchard to managed woodland. Activities may include artificial regeneration of desired species; exotic species control; appropriate intensity and return interval of fire (State 4).

Restoration pathway R6C
State 6 to 5

Seedbed preparation and establishment of desired forage/grassland mixture.

Additional community tables

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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

Indicators

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

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

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

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

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

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

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

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

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):

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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:**
