USDA Natural Resources Conservation Service

Ecological site F115XB005MO
Loamy Upland Woodland

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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): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

LRU notes

The Central Mississippi Valley Wooded Slopes, Western Part consists of deeply dissected, loess-covered hills bordering the Missouri and Mississippi Rivers as well as floodplains and terraces of these rivers. The Northern boundary runs along the South Fabius River valley separating it from the broad rounded interfluves of the northern till plain. A major physiographic feature within the LRU (Land Resource Unit) includes the Lincoln Hills region. The Lincoln Hills extend along the Mississippi River in Missouri, starting about 40 miles (64 kilometers) northwest of St. Louis and extending north to Hannibal. The Lincoln Hills partially escaped the most recent glaciation in the region during the Pleistocene. In geology and biology, they resemble the rugged and forested hills of the Ozark Highlands (MLRA 116A) more than the rolling plains of northern Missouri. The underlying limestone bedrock has formed bluffs, glades, caves, springs, and sinkholes. Elevation ranges from about 420 feet (128 meters) along the Mississippi River near Cape Girardeau, Missouri to about 830 feet (253 meters) near Clarksville along the Mississippi River upstream from St. Louis. High ridges near Hillsboro, Missouri can reach over 1,000 feet (305 meters). Underlying bedrock is mainly Ordovician-aged dolomite and sandstone, with Mississippian-aged limestone north of the Missouri River. Loess caps both stream and glacial outwash terraces along the major rivers along with Pre-Illinoisan till near the edges of the area.

Classification relationships

Major Land Resource Area (MLRA) (USDA-NRCS, 2022):
115X–Central Mississippi Valley Wooded Slopes

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Dry-Mesic Chert Woodland.

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this ecological site is most similar to a Mixed Oak Woodland.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium Woodland (CEGL002150).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs primarily in Land Type Associations of the following Subsections:
Inner Ozark Border
Outer Ozark Border
Mississippi River Hills

Ecological site concept

Loamy Upland Woodlands occur throughout the uplands but not adjacent to the Missouri or Mississippi River floodplains. Soils are very deep, and typically have coarse fragments with depth. The reference plant community is woodland with an overstory dominated by white oak, black oak, and hickory species, and a ground flora of native

grasses and forbs.

Associated sites

F115XB006MO	**Loamy Protected Backslope Forest** Loamy Protected Backslope Forests formed in loess over limestone or dolomite residuum are typically downslope on north and east facing slopes.
F115XB044MO	**Loamy Exposed Backslope Woodland** Loamy Exposed Backslope Woodlands formed in loess over limestone or dolomite residuum are typically downslope on south and west facing slopes.

Similar sites

F115XB004MO	**Loess Upland Woodland** Loess Upland Woodlands are on similar upland landscape positions but are generally more productive.

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus velutina*
Shrub	(1) *Rhus aromatica*
Herbaceous	(1) *Elymus virginicus* (2) *Solidago ulmifolia*

Physiographic features

This site is on upland summit crests, shoulders and upper backslopes, with slopes of 1 to 15 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Held, 1978) shows a typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the uplands. The site is within the area labeled “4”. These sites include different soils formed in both sandstone and limestone. Loess Upland Woodland sites are typically upslope on hillslope crests, with or without the intervening band of Chert Upland sites shown in the figure. Loess Upland sites north of the Missouri River are commonly underlain by a thin layer of till, as shown in the figure.

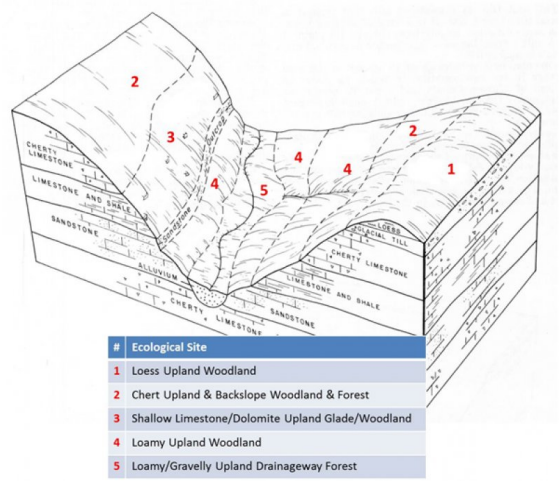


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Interfluve (3) Hill
Flooding frequency	None

Ponding frequency	None
Elevation	350–1,020 ft
Slope	1–15%
Water table depth	27–60 in
Aspect	Aspect is not a significant factor

Climatic features

The Central Mississippi Valley Wooded Slopes, Western Part has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Central Mississippi Valley Wooded Slopes, Western Part experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line diagonally crossing the MLRA from northwest to southeast. Both mean annual temperature and precipitation exhibit gradients along this line.

The average annual precipitation in most of this area is 38 to 48 inches. The average annual temperature is 53 to 57 degrees F. Mean January minimum temperature follows the northwest-to-southeast gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along the same gradient as temperature. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer. Snowfall is common in winter.

During years when precipitation is normal, moisture is stored in the soil profile during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces create characteristic glade and cliff ecological sites. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

Source:
University of Missouri Climate Center - http://climate.missouri.edu/climate.php;

Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States Department of Agriculture Handbook 296 - http://soils.usda.gov/survey/geography/mlra/

Table 3. Representative climatic features

Frost-free period (characteristic range)	156-165 days

Freeze-free period (characteristic range)	187-201 days
Precipitation total (characteristic range)	44-46 in
Frost-free period (actual range)	152-166 days
Freeze-free period (actual range)	182-202 days
Precipitation total (actual range)	43-49 in
Frost-free period (average)	160 days
Freeze-free period (average)	193 days
Precipitation total (average)	45 in

Climate stations used

- (1) PERRYVILLE WTP [USC00236641], Perryville, MO
- (2) BOONVILLE [USC00230817], Boonville, MO
- (3) UNION [USC00238515], Union, MO
- (4) JACKSON [USC00234226], Jackson, MO
- (5) JEFFERSON CITY WTP [USC00234271], Jefferson City, MO

Influencing water features

The water features of this upland ecological site include evapotranspiration, surface runoff, and drainage. Each water balance component fluctuates to varying extents from year-to-year. Evapotranspiration remains the most constant. Precipitation and drainage are highly variable between years. Seasonal variability differs for each water component. Precipitation generally occurs as single day events. Evapotranspiration is lowest in the winter and peaks in the summer. Water stored as ice and snow decreases drainage and surface runoff rates throughout the winter and increases these fluxes in the spring. The surface runoff pulse is greatly influenced by extreme events. Conversion to cropland or other high intensities land uses tends to increase runoff, but also decreases evapotranspiration. Depending on the situation, this might increase groundwater discharge, and decrease baseflow in receiving streams (Vano 2005).

Soil features

These soils have no major rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is loess over slope alluvium and residuum weathered from limestone and dolomite, or from sandstone. The soils have silt loam surface horizons. Subsoils are silty clay loam in the upper part, and are gravelly to very gravelly and cobbly silty clay loam, clay loam to clay in the underlying slope alluvium and residuum. Soils with sandstone residuum have more sand in the subsoil. Some soils are slightly affected by seasonal wetness. A few soils have a bedrock contact below 40 inches. Soil series associated with this site include Bluelick, Bucklick, Cotton, Crider, Holstein, Lamotte, Minnith, Useful, Weingarten, and Wrengart.

The accompanying picture of the Bluelick series shows loess over reddish brown clayey residuum, underlain by very cobbly clay. Roots can be seen in the picture throughout the soil profile. Picture from Baker (1998).

Figure 9. Bluelick series

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Soil depth	40–72 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6–7 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	10–46%
Subsurface fragment volume >3" (Depth not specified)	0–40%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

The reference plant community is well developed woodland dominated by an overstory of white oak, along with black oak and hickory species. The canopy is moderately tall (65 to 80 feet) but less dense (65 to 85 percent

closure) and less structurally diverse than nearby protected slopes. Increased light from the open canopy causes a diversity of woodland ground flora species to flourish. Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving ground flora species. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees, and tree height growth.

Despite being somewhat distant from prairies, fire played a significant role in the maintenance of these systems. It is likely that these ecological sites burned at least once every 10 to 15 years. These periodic fires kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs. During fire free intervals, woody understory species increased and the herbaceous understory diminished. The return of fire would open the woodlands up again and stimulate the abundant ground flora.

Loamy Upland Woodlands were also subjected to occasional disturbances from wind and ice, as well as grazing by large native herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Grazing by native herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction and woodland ground flora species.

Today, these ecological sites have been cleared and converted to pasture or have undergone repeated timber harvests and domestic grazing. Most existing wooded ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices. In the long term absence of fire, woody species, especially hickory, encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration means.

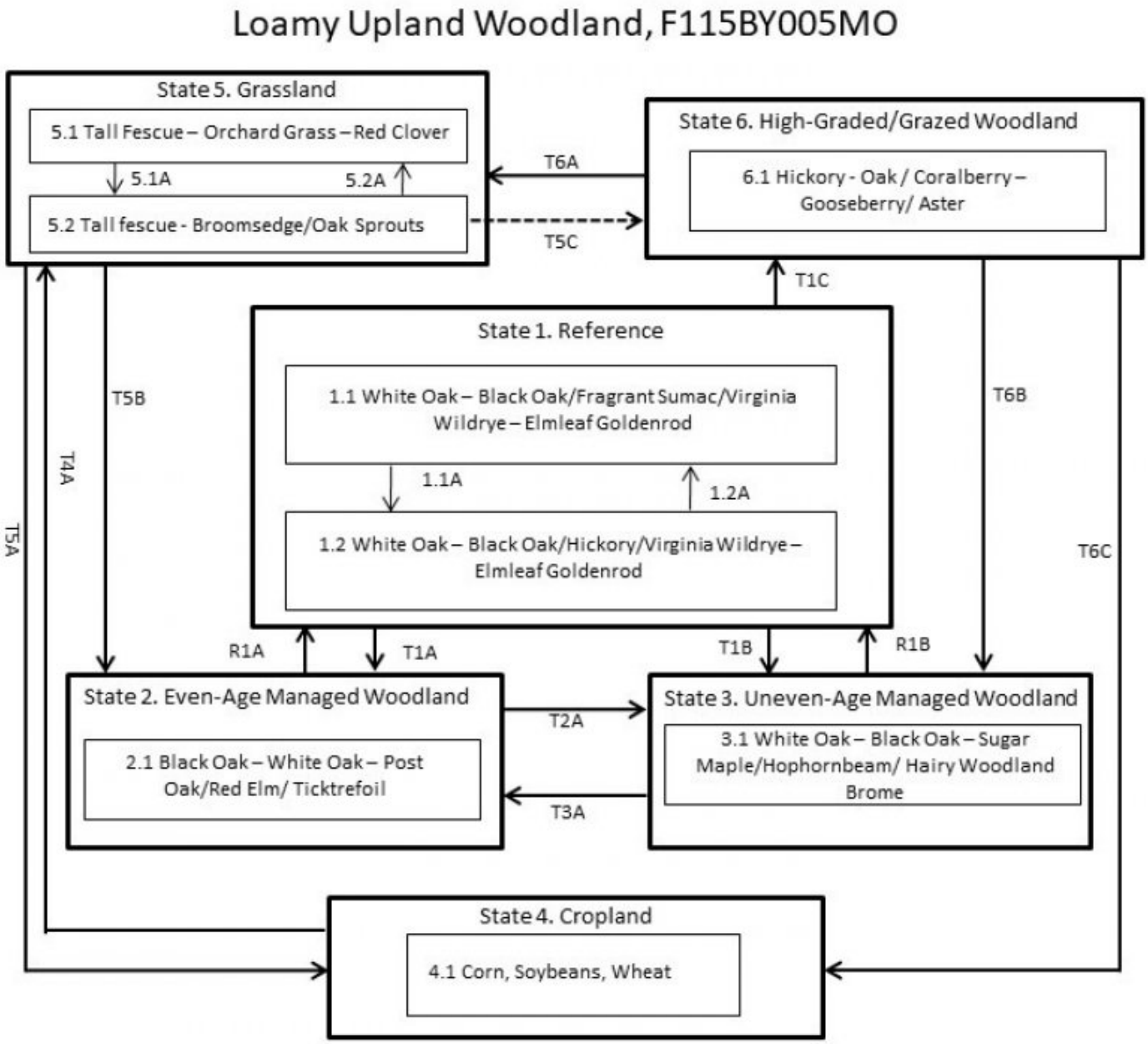
Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as coralberry, gooseberry, and Virginia creeper. Grazed sites also have a more open understory. In addition, soil compaction and soil erosion from grazing can be a problem and lower productivity.

These ecological sites are moderately productive. Oak regeneration can be problematic. Sugar maple, red elm, and hickories are often dominant competitors in the understory after fire suppression. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects. Single tree selection timber harvests are common in this region and often results in removal of the most productive trees (high grading) in the stand leading to poorer quality timber and a shift in species composition away from more valuable oak species. Better planned single tree selection or the creation of small group openings can help regenerate and maintain more desirable oak species and increase vigor on the residual trees.

Clearcutting also occurs and results in dense, even-aged stands dominated by oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands and the application of prescribed fire, the ground flora diversity can be shaded out and diversity of the stand may suffer.

A State and Transition Diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

State and transition model



Code	Activity/Process
T1A	Fire suppression; even-aged management
T1B	Fire suppression; uneven-age management
T1C	Poorly planned harvest; uncontrolled grazing
T2A	Uneven-age management; extended rotations
T3A	Even-age management; thinning
T4A	Pasture planting; prescribed grazing
T5A	Tillage; crop rotation
T5B	No grazing; idle - no disturbance >30 years
T5C	Light intermittent grazing; woody growth
T6A	Clearing; pasture planting; prescribed grazing
T6B	Uneven-age management; tree planting
T6C	Clearing; tillage; crop rotation
R1A, R1B	Prescribed fire; extended rotations

Code	Activity/Process
1.1A	No disturbance >10 years
1.2A	Disturbance (fire, wind, ice) < 10 years
5.1A	Over grazing; no fertilization
5.2A	Brush management; prescribed grazing

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The historical reference state for this ecological site was old growth oak woodland. The woodland was dominated by white oak and black oak. Maximum tree age was likely 150 to 300 years. Periodic disturbances from fire, wind or ice as well as grazing by native large herbivores maintained the woodland structure and diverse ground flora species. Long disturbance-free periods allowed an increase in both the density of trees and the abundance of shade tolerant species. Two community phases are recognized in the Reference State, with shifts between phases based on disturbance frequency. Reference states are very rare today. Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Most Reference States are currently altered because of timber harvesting, domestic grazing or clearing and conversion to grassland or cropland.

Dominant plant species

- white oak (*Quercus alba*), tree
- black oak (*Quercus velutina*), tree
- black hickory (*Carya texana*), tree
- shagbark hickory (*Carya ovata*), tree
- pignut hickory (*Carya glabra*), tree
- fragrant sumac (*Rhus aromatica*), shrub
- Virginia wildrye (*Elymus virginicus*), grass
- elmleaf goldenrod (*Solidago ulmifolia*), other herbaceous

Community 1.1
White Oak – Black Oak/Fragrant Sumac/Virginia Wildrye – Elmleaf Goldenrod

This phase has an overstory that is dominated by white oak and black oak with hickory and post oak also present. This woodland community has a two-tiered structure with an open understory and a dense, diverse herbaceous ground flora. Periodic disturbances including fire, ice and wind create canopy gaps, allowing white oak and black oak to successfully reproduce and remain in the canopy. It is likely that this phase burned at least once every 10 to 15 years.

Forest overstory. The Overstory Species list is based on field surveys (species with cover percentages) and commonly occurring species listed in Nelson (2010).

Forest understory. The Understory Species list is based on field surveys (species with cover percentages) and commonly occurring species listed in Nelson (2010).

Community 1.2
White Oak – Black Oak/Hickory/Virginia Wildrye – Elmleaf Goldenrod

This phase is similar to community phase 1.1 but oak and hickory understory densities are increasing due to longer periods of fire suppression. Displacement of some grasses and forbs may be occurring due to shading and competition from the increased densities of oak and hickory saplings in the understory.

Pathway P1.1A
Community 1.1 to 1.2

This pathway is the result of fire-free interval 10 to 20 years.

Pathway P
Community 1.2 to 1.1

State 2
Even-Age Managed Woodland

An even-age managed forest can resemble the reference state. The primary difference is tree age, most being only 50 to 90 years old. Composition is also likely altered from the reference state depending on tree selection during harvests and disturbance activities. Without a regular 15 to 20 year harvest re-entry into these stands, they will

slowly increase in more shade tolerant species such as sugar maple and white oak will become less dominant. This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire.

Dominant plant species

- black oak (*Quercus velutina*), shrub
- white oak (*Quercus alba*), shrub
- post oak (*Quercus stellata*), shrub
- pointedleaf ticktrefoil (*Desmodium glutinosum*), other herbaceous
- panicledleaf ticktrefoil (*Desmodium paniculatum*), other herbaceous

Community 2.1
Black Oak – White Oak – Post Oak/Red Elm/ Ticktrefoil

This is an even-aged forest management phase. Logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in red oak. Large group, shelterwood or clearcut harvests create a more uniform age class structure throughout the canopy layer while also opening up the understory and allowing more sunlight to reach the forest floor.

State 3
Uneven-Age Managed Woodland

Due to selective single tree harvesting canopy densities have increased. Composition is likely altered from the Reference State depending on tree selection during harvest. This state will slowly increase in more shade tolerant species and white oak will become less dominant and is also dense because of fire suppression. Without periodic canopy disturbance, stem density and fire intolerant species, like hickory and maple will increase in abundance. This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire.

Dominant plant species

- white oak (*Quercus alba*), tree
- black oak (*Quercus velutina*), tree
- sugar maple (*Acer saccharum*), tree
- hophornbeam (*Ostrya*), tree
- hairy woodland brome (*Bromus pubescens*), grass

Community 3.1
White Oak – Black Oak – Sugar Maple/Hophornbeam/ Hairy Woodland Brome

This is an uneven-aged forest management phase. Selective logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase black oak and sugar maple. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4
Cropland

This is a state that exists currently with intensive cropping of corn, soybeans, and wheat occurring especially when commodity prices are high. Some conversion to cool season grassland occurs for a limited period of time before transitioning back to cropland. Limited acres are sometimes converted to native warm season grassland through government programs.

Dominant plant species

- corn (*Zea mays*), grass
- wheat (*Triticum*), grass
- soybean (*Glycine max*), other herbaceous

Community 4.1
Corn, Soybeans, Wheat

This phase exists currently with intensive cropping of corn, soybeans, and wheat occurring. Some conversion to cool season grassland occurs for a limited period of time before transitioning back to cropland.

State 5
Grassland

Conversion of other states to non-native cool season species such as tall fescue, orchard grass, and red clover has been common. Occasionally, these pastures will have scattered oaks. Long term uncontrolled grazing can cause significant soil erosion and compaction. A return to the reference state may be impossible, requiring a very long term series of management options. If oak sprouting is left unchecked and grazing is eliminated or reduced then over time this state will transition to an even-age managed woodland (livestock controlled and woodland management initiated) or to a high-graded/grazed woodland (continued grazing, high graded harvesting, and no woodland management).

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- orchardgrass (*Dactylis glomerata*), grass
- red clover (*Trifolium pratense*), other herbaceous

Community 5.1
Tall Fescue – Orchard Grass - Red Clover

This phase is well-managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring. The effects of long-term liming on soil pH, and calcium and magnesium content, is most evident in this phase. Studies show that these soils have higher pH and higher base status in soil horizons as much as two feet below the surface, relative to poorly managed grassland and to woodland communities (where liming is not practiced).

Community 5.2
Tall fescue - Broomsedge/Oak Sprouts

This phase is the result of over use, poor grassland and grazing management and lack of adequate nutrient application. Oak sprouts, oak saplings, and invasive species are increasing as a result of poor management.

Pathway P5.1A
Community 5.1 to 5.2

This pathway is the result of over grazing and lack of proper grassland management.

Pathway P5.2A
Community 5.2 to 5.1

This pathway is the result of over grazing and lack of proper grassland management.

State 6
High Graded/Grazed Woodland

States that were subjected to repeated, high-grading timber harvests and uncontrolled domestic grazing will transition to a High-Graded/Grazed Woodland State. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as buckbrush, gooseberry, poison ivy and Virginia creeper. The existing vegetation offers little nutritional value for cattle, and excessive cattle stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Two common transitions from this state are woody clearing and conversion to state 4, Cropland or removing livestock, limited harvesting, and allowing long term succession to occur to some other woodland state (state 2 or

3).

Dominant plant species

- black hickory (*Carya texana*), tree
- shagbark hickory (*Carya ovata*), tree
- pignut hickory (*Carya glabra*), tree
- white oak (*Quercus alba*), tree
- black oak (*Quercus velutina*), tree
- post oak (*Quercus stellata*), tree
- northern red oak (*Quercus rubra*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub
- manyray aster (*Symphyotrichum anomalum*), other herbaceous
- smooth violet prairie aster (*Symphyotrichum turbinellum*), other herbaceous
- eastern poison ivy (*Toxicodendron radicans*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Community 6.1
Hickory - Oak / Coralberry - Gooseberry/ Aster

This is the only phase associated with this state. Statements relating to this phase are covered in the discussions above.

Transition T1A
State 1 to 2

Transition T1B
State 1 to 3

This transition is the result of fire suppression and uneven-age management.

Restoration pathway R1A
State 2 to 1

This restoration pathway is the result of the systematic application of prescribed fire along with extended rotations. Mechanical thinning may also be used along with understory removal.

Transition T2A
State 2 to 3

This transition is the result of uneven-age management.

Restoration pathway R1B
State 3 to 1

This restoration pathway is the result of the systematic application of prescribed fire along with extended rotations. Mechanical thinning may also be used along with understory removal.

Transition T3A
State 3 to 2

This transition is the result of even-age management.

Transition T4A
State 4 to 5

This transition is the result of grassland planting, grassland management and prescribed grazing.

Transition T5B
State 5 to 2

This transition is the result of cessation of grazing; idle - no disturbance >30 years; and forest stand improvement.

Transition T5A
State 5 to 4

This transition is the result of tillage and conservation cropping system.

Transition T5C
State 5 to 6

This transition is the result of intermittent grazing and woody regrowth for an extended period of time.

Transition T6B
State 6 to 3

This transition is the result of uneven-age management, tree planting, and forest stand improvement.

Transition T6C
State 6 to 4

This transition is the result of clearing, tillage and conservation cropping system.

Transition T6A
State 6 to 5

This transition is the result of clearing, grassland planting, grassland management, and prescribed grazing.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
white oak	QUAL	*Quercus alba*	Native	–	2–75	–	–
black oak	QUVE	*Quercus velutina*	Native	–	2–50	–	–
post oak	QUST	*Quercus stellata*	Native	–	2–20	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	2–10	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	1–5	–	–
sassafras	SAAL5	*Sassafras albidum*	Native	–	2–5	–	–
black hickory	CATE9	*Carya texana*	Native	–	2–5	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	2–5	–	–
pignut hickory	CAGL8	*Carya glabra*	Native	–	2–5	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
rock muhly	MUSO	*Muhlenbergia sobolifera*	Native	–	0.1–10
poverty oatgrass	DASP2	*Danthonia spicata*	Native	–	0.1–10

poverty oatgrass	DASPI2	*Danthonia spicata*	Native		0.1–10
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	0.1–5
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	0.1–5
Bosc's panicgrass	DIBO2	*Dichanthelium boscii*	Native	–	0.1–2
Indiangrass	SONU2	*Sorghastrum nutans*	Native	–	0.1–1
James' sedge	CAJA2	*Carex jamesii*	Native	–	0.1–1
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	0.1–1
hirsute sedge	CACO9	*Carex complanata*	Native	–	0.1–1
black edge sedge	CANI3	*Carex nigromarginata*	Native	–	0.1–1
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	–
parasol sedge	CAUM4	*Carex umbellata*	Native	–	–
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
big bluestem	ANGE	*Andropogon gerardii*	Native	–	–
Forb/Herb					
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	0.1–10
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	0.1–10
trailing lespedeza	LEPR	*Lespedeza procumbens*	Native	–	2–10
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	0.1–10
white crownbeard	VEVI3	*Verbesina virginica*	Native	–	2–5
trailing lespedeza	LEPR	*Lespedeza procumbens*	Native	–	0.1–5
American ipecac	GIST5	*Gillenia stipulata*	Native	–	0.1–5
manyray aster	SYAN2	*Symphyotrichum anomalum*	Native	–	0.1–5
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	0.1–5
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	0.1–5
panicledleaf ticktrefoil	DEPA6	*Desmodium paniculatum*	Native	–	0.1–5
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	Native	–	1–2
wild quinine	PAIN3	*Parthenium integrifolium*	Native	–	0.1–1
smooth Solomon's seal	POBI2	*Polygonatum biflorum*	Native	–	0.1–1
late purple aster	SYPA11	*Symphyotrichum patens*	Native	–	0.1–1
smooth violet prairie aster	SYTU2	*Symphyotrichum turbinellum*	Native	–	0.1–1
fourleaf milkweed	ASQU	*Asclepias quadrifolia*	Native	–	0.1–1
Canadian blacksnakeroot	SACA15	*Sanicula canadensis*	Native	–	0.1–1
eastern purple coneflower	ECPU	*Echinacea purpurea*	Native	–	–
bluejacket	TROH	*Tradescantia ohiensis*	Native	–	–
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	0.1–75
coralberry	SYOR	*Symphoricarpos orbiculatus*	Native	–	2–5
blackhaw	VIPR	*Viburnum prunifolium*	Native	–	0.1–5
American hazelnut	COAM3	*Corylus americana*	Native	–	–
New Jersey tea	CEAM	*Ceanothus americanus*	Native	–	–
Tree					
flowering dogwood	COFL2	*Cornus florida*	Native	–	0.1–10

Animal community

Wildlife Species (MDC 2006):

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Oaks provide hard mast; scattered shrubs provide soft mast; native legumes provide high-quality wildlife food; sedges and native cool-season grasses provide green browse; patchy native warm-season grasses provide cover and nesting habitat; and a diversity of forbs provides a diversity and abundance of insects. Post-burn areas can provide temporary bare-ground – herbaceous cover habitat important for turkey poults and quail chicks.

Bird species associated with mature communities include Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Eastern Wood-Pewee, Broad-winged Hawk, Great-Crested Flycatcher, Summer Tanager, and Red-eyed Vireo.

Reptile and amphibian species associated with the Loess Upland Woodland include tiger salamander, small-mouthed salamander, ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, flat-headed snake, and rough earth snake.

Other information

Forestry (NRCS 2002, 2014):

Management: Field collected site index values average 55 for white oak and 60 for black oak. Timber management opportunities are fairly good. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality, may not be fitting, or should be used with caution on a particular site if timber management is the primary objective.

Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Potential Reference Sites for Loamy Upland Woodland

Plot BAWIUM01 - Bluelick soil
Located in Baskett Wildlife Area, UMC, Boone County, MO
Latitude: 38.738467
Longitude: -92.203667

Plot DABOCA04 - Hostein soil
Located in Daniel Boone CA, Warren County, MO
Latitude: 38.776283
Longitude: -91.38070

Plot DANVCA_JK03 - Wrengart soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.862386
Longitude: -91.499747

Plot DANVCA_JK08 - Bluelick soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.870004
Longitude: -91.508542

Plot DANVCA_JK21 - Bluelick soil

Located in Danville CA, Montgomery County, MO
Latitude: 38.879726
Longitude: -91.541275

Plot GRCASP10 - Bucklick soil
Located in Graham Cave SP, Montgomery County, MO
Latitude: 38.908222
Longitude: -91.572646

Plot THCRCA_JK01 – Wrengart soil
Located in Three Creeks CA, Boone County, MO
Latitude: 38.837507
Longitude: -92.29195

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Contributors

Fred Young
Doug Wallace

Approval

Suzanne Mayne-Kinney, 12/30/2024

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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	05/12/2025
Approved by	Suzanne Mayne-Kinney
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:**

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

---

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:

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17. **Perennial plant reproductive capability:**
