Ecological site F136XY200VA
Mesic Temperature Regime, Basic Upland Flats and Depressions, Expansive Clay, Seasonally Wet and Dry

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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.

MLRA notes

Major Land Resource Area (MLRA): 136X–Southern Piedmont

This MLRA is on a large piedmont underlain by metamorphic and igneous bedrock. It stretches from north-central Virginia to east-central Alabama, running parallel to the Appalachian highlands to the northwest and the Atlantic coast to the southeast. MLRA 136 has only subtle climatic differences with MLRA 148 (Northern Piedmont), with which it shares a common geologic origin. This adjacent MLRA sits to the north. Along the fall line, it shares a boundary with MLRA 133A (Southern Coastal Plain), MLRA 137 (Carolina and Georgia Sand Hills), and 133C (Gulf Coastal Plain). Here, unconsolidated Coastal Plain sediments intersect the much older Piedmont bedrock. Along it's northwestern boundary, it sits adjacent to MLRAs 130B (Southern Blue Ridge), 130A (Northern Blue Ridge), and 128 (Southern Appalachian Ridges and Valleys). These MLRAs are distinguished from the Southern Piedmont by topographic and elevational differences, as well as differences in the age, origin, and degree of metamorphism of the underlying bedrock. Five states are intersected by the MLRA, including North Carolina (29 percent), Georgia (27 percent), Virginia (20 percent), South Carolina (17 percent), and Alabama (7 percent). The MLRA extent makes up about 63,720 square miles (165,034 square kilometers). MLRA PHYSIOGRAPHY The landscape is generally rolling to hilly, with a well-defined drainage pattern. Streams have dissected the original Piedmont plateau, forming narrow ridgetops, somewhat broad interfluves, and short, steep side slopes adjacent to the streams and drainageways. With some exceptions, the valley floors are generally narrow and make up about 10 percent or less of the land area. The associated stream terraces are generally small and of minor extent. The landscape is moderately dissected overall, with isolated erosional remnants (monadnocks) and other areas of high topographic relief interspersed. Over most of the MLRA, elevation ranges from approximately 325 to 1,315 feet (100 to 400 meters), with elevations generally increasing toward the Appalachian Highlands, in the upper Piedmont, and decreasing toward the Coastal Plain, in the lower Piedmont. The major rivers that cross this area en route to the ocean include, from north to south, the James, Roanoke, Cape Fear, Savannah, Altamaha, Chattahoochee, and Alabama Rivers. These rivers typically originate within the Piedmont or in the Blue Ridge. They flow east and south across the Coastal Plain and empty into the Atlantic Ocean or the Gulf of America. MLRA GEOLOGY Precambrian and Paleozoic metamorphic and igneous rocks underlie almost all of this MLRA. The dominant metamorphic rock types include gneiss, schist, slate, argillite, and phyllite, among others. Dominant igneous rock types include granite and other related felsic crystalline rocks. Mafic intrusive rocks, including gabbro, diabase, amphibolite, and other dark colored rocks, underlie a minority of the upland landscape. These mafic intrusions crop out in the form of dikes and sills, and often weather to produce soils high in base cations. The Carolina Slate Belt runs lengthwise through the east-central part of the MLRA, in southern Virginia, North Carolina, South Carolina, and the eastern-most part of the Georgia Piedmont. This region is underlain by fine-grained metasedimentary and metavolcanic rock, which generally weathers to produce soils high in silt. From Virginia to North Carolina, and in a single county in South Carolina, fault-bounded Triassic Basins are scattered amongst the igneous and metamorphic uplands. These basins are underlain by Triassic and Jurassic siltstone, shale, sandstone, and mudstone, which were laid down in response to continental rifting and subsequent erosion during the Mesozoic era. MLRA SOILS The dominant soil orders of the MLRA are Ultisols, Inceptisols, and Alfisols. Ultisols and Alfisols are typically found on more stable landforms, such as interfluves, gentle hillslopes, broad ridgetops, and stream terraces, while Inceptisols are typically found on less stable landforms, including flood plains, steep hillslopes, and narrow ridgetops. Soils of the region predominantly have a thermic temperature regime, a udic moisture regime, and generally have kaolinitic or mixed mineralogy. In the upper Piedmont of Virginia and North Carolina however, soils have a mesic soil temperature regime, as depicted in figure 2. The mesic soil temperature regime portion of the MLRA is oriented from northeast to southwest and occupies approximately 18 percent of the MLRA extent, or 11,729 square miles (30,377 square kilometers). Broadly speaking, soils of the Southern Piedmont uplands are shallow to very deep, well drained, and loamy or clayey. Soils of the river valleys are generally very deep, well to poorly drained, and loamy. Soils tend to be finer-textured than in Coastal Plain regions. MLRA CLIMATE In general, precipitation is evenly distributed throughout the year in this MLRA, with occasional drought-like conditions extending from late summer into autumn. During the growing season, most of the rainfall comes from high-intensity, convective thunderstorms. Significant moisture also comes from the movement of warm and cold fronts across the MLRA from November to April. High amounts of rain can also occur during hurricanes, usually during the months of August through October. Over most of the MLRA, snowfall is typically light, though overall, the mesic soil temperature regime portion of the MLRA features colder temperatures, more snowfall, and a shorter growing season than in the thermic portion. The cooler climate in this region supports an increase in species with northern or Blue Ridge affinities. Both the mean annual temperature and the length of the freeze-free period increase from north to south and with decreasing elevation from the upper to the lower Piedmont. MLRA LAND USE AND RESOURCES Once largely cultivated, much of this region is now planted to loblolly pine or has reverted to successional pine and hardwood forests. The more productive lands support small to medium-size family farms that produce crops and livestock, while the less productive lands have been in forest for some time. Most of the open areas are used for grazing beef cattle, though in years past, dairy cattle were also important to the local economy. The principal crops of the region include corn, soybeans, and small grains. Burley tobacco remains a crop of local importance. Cotton is grown in the thermic soil temperature regime portion of the MLRA. Several major land cover transformations have occurred in the Southern Piedmont over the past several centuries; from open woodlands sculpted by fire, to farmland, to closed forests and planted pine, past land uses have played an outsized role in shaping present-day soils and vegetation patterns in the region. Land-use intensity peaked with the arrival of the industrial revolution, which gradually increased demand for textiles. Cotton became the dominant crop over much of the region. In spite of early successes, two centuries of poor management practices accelerated soil erosion, stripping away the fertility and moisture-supplying capacity of soils. In addition to soil losses in the uplands, legacy sediments derived from the eroded land rapidly accumulated in the river valleys below, often leading to changes in hydrology and flooding frequency. After being stripped of it's loamy topsoil, many areas of the Piedmont had been so badly eroded as to render the land unsuitable or economically impractical for agriculture. The effects of erosion were widespread, with cumulative soil loss estimates ranging from 5 to 10 inches on average. The steeper slopes, which had often been cleared and farmed at the height of the Cotton era, generally suffered greater losses. By the 1930's, crop production was in rapid decline in the Southern Piedmont. The loss of soil productivity due to erosion, losses to the cotton boll weevil, development of synthetic fibers, and the onset of the Great Depression all contributed to rapid abandonment of cropland. By 1960, cropland acres had decreased by more than 50 percent in nearly every county in the Southern Piedmont. While crop production is still important today on the more productive lands, those of lower productivity, or those that were subject to severe erosion, were often abandoned some time ago. Typically, they have either reverted to forest, or have been converted to other uses. Although the productivity of soils was greatly reduced through erosion, less intensive land uses such as grazing and forestry were still feasible. These land uses gained popularity as patterns of urban migration, low commodity prices, and other factors gradually made crop production less economical on the marginal lands. In recent years, large-scale adoption of soil conservation practices have led to better outcomes with respect to erosion in much of MLRA, increasing the economic viability and long-term sustainability of Piedmont farms. Despite some success, water erosion remains one of the most important soil resource concerns in the MLRA. Other major resource concerns include increasing conversion of prime farmland and farmland of statewide importance to urban uses. Throughout the MLRA, metropolitan areas are expanding into lands that have historically been used for timber or agriculture. This change in land use is occurring rapidly in the corridor called the Piedmont Crescent, which extends from Atlanta, Georgia, to Raleigh, North Carolina. HISTORIC VEGETATION COVER Over most of the Southern Piedmont uplands, the historic oak-hickory, or oak-hickory-pine forest, once covered large portions of the landscape. It was dominated by upland oaks, such as white oak (Quercus alba), northern red oak (Quercus rubra), and southern red oak (Quercus falcata), with a smaller contribution from hickories (Carya spp.) and pines. The principal pine species are shortleaf pine (Pinus echinata), loblolly pine (Pinus taeda), and to the north and west, Virginia pine (Pinus virginiana). In the southernmost and easternmost portions of the MLRA, the historic montane longleaf pine forest, dominated by longleaf pine (Pinus palustris), shortleaf pine (P. echinata), and dry-site oaks, was found on ridgetops and steep south or west-facing slopes. According to historic accounts, forests and woodlands of the past were generally more open and park-like, having been exposed to a more frequent fire regime. Piedmont prairies, likely maintained by Native Americans, were also reportedly common across the landscape, as were fire-maintained canebrakes along the streams (Trimble 1974; Daniels 1987; Griffith et al. 2002; Van Lear et al. 2004; Dearman and James 2019; Schomberg et al. 2020; USDA-NRCS 2022).

LRU notes

MLRA 136 is one of the largest MLRAs in the United States. It has a broad north-south and east-west extent and covers a wide range of elevations. The MLRA is partitioned by the mesic-thermic line, which divides the MLRA into mesic and thermic soil temperature regimes (figure 2.). The mesic soil temperature regime was delineated based on estimates of the native range of loblolly pine, which was historically absent in this part of the MLRA. In addition, this region is said to represent the northern and western limits of cotton production, an important crop to the south and east. ESDs developed for this MLRA were split geographically into mesic and thermic ecological site concepts. Climate variation across the MLRA extent warrants the development of Land Resource Unit (LRU) classifications, to further subdivide the MLRA and support more precise Ecological Site Descriptions.

Classification relationships

APPLICABLE USNVC ASSOCIATIONS CEGL007403 Quercus phellos / Carex (albolutescens, intumescens, joorii) / Climacium americanum; CEGL004037 Quercus phellos - Quercus (alba, stellata) - Carya carolinae-septentrionalis APPLICABLE EPA ECOREGIONS Level III: 45. Piedmont Level IV: 45e. Northern Inner Piedmont (EPA 2013). APPLICABLE USFS ECOLOGICAL UNITS Domain: Humid Temperate Division: Subtropical Ecological province: 231. Southeastern Mixed Forest Ecological sections: 231I.Central Appalachian Piedmont (Cleland et al. 2007). Based on the USGS physiographic classification system (Fenneman and Johnson 1946), most of MLRA 136 is in the Piedmont Upland section of the Piedmont province, in the Appalachian Highlands division.

Ecological site concept

This ecological site includes seasonally wet and seasonally dry circumneutral soils on upland flats, upland depressions, and at the heads of drainageways. It is geographically restricted to the mesic soil temperature regime portion of the Southern Piedmont, in the northwestern-most part of the MLRA. This ecological site is subject to wetting and drying cycles typical of "hydroxeric" conditions, due primarily to shrink-swell clay minerology and low relief. These sites are saturated or even ponded during the cooler months, but generally dry out by late spring or summer. Soils on this ecological site are weathered from mafic intrusive rock or strongly basic sedimentary rock of Triassic age. The material can be overlain by a thin mantle of slope alluvium washed from higher areas. Soils are typically moderately deep to deep, poorly drained Alfisols. The subsoil has a high clay content and the clay fraction is dominated by 2:1 clay minerals. Base saturation is greater than or equal to 35 percent in the subsoil. A transient water table is present within 12 inches of the soil surface during the cooler months. Nevertheless, these wet conditions are temporary and the vegetation generally has a drier character than would be expected. Seasonally drier examples still, in which the water table remains well below the surface, are covered by PX136X00X210, a similar and often associated ecological site. The reference state supports an open to partially open canopy woodland with a species-rich herbaceous understory. Important canopy species include willow oak (Quercus phellos), post oak (Quercus stellata), and American elm (Ulmus americana). Dominant land uses include pasture and hayland, cropland, wildlife habitat, and other land uses meant to conserve threatened plants and animals. Soils are poorly-suited to most building applications or septic system installations because of seasonal wetness and shrink-swell hazard. ES CHARACTERISTICS SUMMARY • Mesic soil temperature regime • Occurs on Piedmont uplands, on upland flats, upland depressions, and at the heads of drainageways • Parent materials: mafic intrusive rock or strongly basic Triassic sedimentary rock • Base saturation: ? 35 percent in the subsoil • Seasonal high water table: perched, 0 - 12 inches from the soil surface • Soils: moderately deep to deep, poorly drained Alfisols • The subsoil has a high clay content and a high shrink-swell potential

Associated sites

F136XY210VA	**Mesic Temperature Regime, Basic Upland Woodland, Expansive Clay, Seasonally Wet and Dry** Found in slightly higher and drier landscape positions. Soils have a comparable shrink-swell potential, but the seasonal high water table is deeper (12-40 inches from the soil surface), supporting a relative increase in dry-site species, of which blackjack oak (Quercus marilandica) is most notable.
F136XY220VA	**Mesic Temperature Regime, Basic Upland Forest, Moist** Found in higher landscape positions. The seasonal high water table is much deeper (? 40 inches from the soil surface, usually deeper). The clay fraction is not dominated by shrink-swell clay minerals, reducing fluctuations in plant available water and allowing moisture-loving plant species to increase in abundance, of which northern red oak (Quercus rubra) is most notable.

Similar sites

F136XY700NC	**Basic Upland Flats and Depressions, Expansive Clay, Seasonally Wet and Dry** The soil temperature regime is thermic, occurring within the native range of loblolly pine (Pinus taeda).
F136XY300VA	**Mesic Temperature Regime, Acidic Upland Depressions and Heads of Drains, Wet** The geomorphic setting is similar, but soils weathered from acidic igneous or metamorphic rock. The subsoil is not dominated by shrink-swell clay minerals and has a base saturation less than 35 percent. Seasonal extremes in plant available water are less pronounced, significantly reducing cover from dry-site species such as post oak (Quercus stellata). These stands are comparatively less diverse.
F136XY210VA	**Mesic Temperature Regime, Basic Upland Woodland, Expansive Clay, Seasonally Wet and Dry** Soil properties are similar, but the seasonal high water table is deeper (12-40 inches from the soil surface). Cover from dry-site species tends to increase, of which blackjack oak (Quercus marilandica) is most notable.

Figure 1. EPA level IV ecoregions of the Southern Piedmont (45).

Figure 2. Spatial illustration of soil temperature regimes of the Southern Piedmont.

Figure 3. Spatial extent of this ecological site representing the major areas where this site is important on the landscape.

Table 4. Dominant plant species

Tree	(1) *Quercus phellos* (2) *Quercus stellata*
Shrub	(1) *Viburnum* (2) *Ilex decidua*
Herbaceous	(1) *Dichanthelium* (2) *Carex*

Physiographic features

This ecological site is found on broad upland flats, smooth depressions, and at the heads of drainageways, in EPA ecoregion 45e (Northern Inner Piedmont). This ecoregion roughly coincides with the mesic soil temperature regime portion of the Southern Piedmont, the northwestern-most part of the MLRA. Representative locations are nearly level or gently sloping, with a representative slope of 4 percent or less and a maximum slope of 8 percent. The geologic substrate includes mafic intrusive rock, such as diabase, gabbro, and amphibolite, or strongly basic Triassic sedimentary rock.

Figure 1. Typical soil-landscape relationships in the Mafic Soil System of the Southern Piedmont. Elbert soils are associated with this ecological site, depicted here around the heads of drainageways.

Table 5. Representative physiographic features

Hillslope profile	(1) Summit (2) Toeslope
Landforms	(1) Piedmont > Depression (2) Piedmont > Drainageway (3) Piedmont > Flat
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	170 – 220 m
Slope	0 %
Water table depth	20 – 30 cm
Aspect	Aspect is not a significant factor

Table 6. Representative physiographic features (actual ranges)

Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None to rare
Elevation	110 – 250 m
Slope	0 – 10 %
Water table depth	0 – 30 cm

Climatic features

On this ecological site, the average mean annual precipitation is 45 inches. On average, the rainiest months occur from June through September, as well as in March. The driest months occur from October through February.

Table 7 Representative climatic features

Frost-free period (characteristic range)	150-170 days
Freeze-free period (characteristic range)	180-210 days
Precipitation total (characteristic range)	1,090-1,170 mm
Frost-free period (actual range)	140-180 days
Freeze-free period (actual range)	160-230 days
Precipitation total (actual range)	1,070-1,190 mm
Frost-free period (average)	160 days
Freeze-free period (average)	200 days
Precipitation total (average)	1,140 mm

- (1) LEXINGTON [USC00314970], Lexington, NC
- (2) MARTINSVILLE FLTR PLT [USC00445300], Martinsville, VA
- (3) SALISBURY [USC00317615], Salisbury, NC

- (4) SALISBURY 9 WNW [USC00317618], Salisbury, NC
- (5) BROOKNEAL [USC00441082], Brookneal, VA
- (6) YADKINVILLE 6 E [USC00319675], East Bend, NC
- (7) RURAL HALL [USC00317548], Rural Hall, NC
- (8) WINSTON SALEM RYNLDS AP [USW00093807], Winston Salem, NC
- (9) DANBURY [USC00312238], Danbury, NC
- (10) APPOMATTOX [USC00440243], Appomattox, VA
- (11) BREMO BLUFF [USC00440993], New Canton, VA
- (12) PALMYRA 3S [USC00446491], Palmyra, VA
- (13) LOUISA [USC00445050], Louisa, VA
- (14) PIEDMONT TRIAD INTL AP [USW00013723], Greensboro, NC
- (15) HIGH POINT [USC00314063], High Point, NC
- (16) HICKORY FAA AP [USW00003810], Hickory, NC
- (17) REIDSVILLE 2 NW [USC00317202], Reidsville, NC
- (18) DANVILLE [USC00442245], Danville, VA
- (19) DANVILLE RGNL AP [USW00013728], Danville, VA
- (20) CHATHAM [USC00441614], Chatham, VA
- (21) MOCKSVILLE 5SE [USC00315743], Mocksville, NC
- (22) STATESVILLE 2 NNE [USC00318292], Statesville, NC

Influencing water features

This ecological site is not influenced by surface water features. Unless artificial drainage is introduced, the seasonal high water table is present at depths between 0 to 12 inches, generally during the months of November to May.

Wetland description

This ecological site will not always support hydrophytic vegetation in proportions sufficient to meet wetland criteria. A field visit is usually necessary to make a determination. In the reference state, wetlands on this ecological site typically classify as follows according to the Cowardin system (Cowardin 1979).

System: Palustrine
Class: Forested
Subclass: Broad-leaved deciduous

Lower-level Modifiers
Water Regime: Saturated
Water Chemistry: Fresh, acid
Soil: Mineral

Soil features

Soils on this ecological site are typically moderately deep to deep, poorly drained Alfisols. Parent materials are residuum derived from mafic intrusive rock, which can be overlain by a thin mantle of slope alluvium washed from higher areas. The subsoil has a high clay content and the clay fraction is dominated by 2:1 clay minerals, namely montmorillonite or others in the smectite group. In representative pedons, subsoil layers have a very plastic, very sticky, and very firm consistence. Soils weathered from strongly basic Triassic sedimentary rock are also included in this ecological site concept. These soils behave similarly, support similar vegetation, and occur within the same climatic region.

Reaction in the subsoil is typically slightly acid to neutral (pH 6.1 to 7.3). In the surface layers, reaction varies with land use and management. Under low input or forested conditions, it generally falls somewhere between pH 5.1 and 7.3. Base saturation is greater than or equal to 35 percent in the subsoil. These soils are typically in a fine particle size family.

As a result of their clay minerology, soils on this ecological site are subject to distinct wetting and drying cycles, fluctuations in plant available water, and seasonal periods of soil saturation and anaerobic conditions. Soils dominated by 2:1 clay minerals can store large volumes of water at field capacity. Soil water content can remain high for extended periods, typically during the winter and early spring. However, these clay minerals also hold on to water more tightly when they do dry out, leaving little water available to plants during dry periods.

The result is a water availability dynamic that alternates between being saturated and anaerobic during the cooler months, to being thoroughly parched during warm-season dry spells. These soil properties interact with landscape position and local hydrology to produce a continuum of soil moisture conditions, from predominantly dry to predominantly wet. This ecological site generally covers the wetter of these site conditions, though locally conditions can vary over short distances with microtopography (Buol et al. 2011).

Soils on this ecological site have a seasonal high water table between 0 and 12 inches of the mineral soil surface. The perched water table persists for periods long enough to leave behind redoximorphic features indicative of anaerobic conditions (i.e., iron and manganese depletions).

Soils on this ecological site have a mesic soil temperature regime, which is characterized by a mean annual soil temperature is 8°C to 15°C and a winter to summer temperature differential of 6°C or more in the subsoil.

Modal soil taxa include: Typic Endoaqualfs, Typic Albaqualfs
Modal soil series include: Elbert, Leaksville
No other soils are currently attributed to this ecological site.

Figure 8. An illustration of a soil profile belonging to the Elbert series, a representative soil series associated with this ecological site.

Table 8. Representative soil features

Parent material	(1) Residuum – amphibolite (2) Residuum – diabase (3) Residuum – diorite (4) Residuum – gabbro (5) Residuum – hornblende gneiss (6) Residuum – sedimentary rock
Surface texture	(1) Silt loam (2) Loam
Family particle size	(1) Fine
Drainage class	Poorly drained
Permeability class	Very slow to slow
Depth to restrictive layer	70 – 160 cm
Soil depth	70 – 160 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-203.2cm)	10.16 – 22.86 cm

Soil reaction (1:1 water) (0-25.4cm)	5.1 – 7.3
Subsurface fragment volume <=3" (0-203.2cm)	0 – 10 %
Subsurface fragment volume >3" (0-203.2cm)	Not specified

Table 9. Representative soil features (actual values)

Drainage class	Poorly drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	50 – 2,540 cm
Soil depth	50 – 200 cm
Surface fragment cover <=3"	0 %
Surface fragment cover >3"	0 %
Available water capacity (0-203.2cm)	5.08 – 25.4 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5 – 7.8
Subsurface fragment volume <=3" (0-203.2cm)	0 – 10 %
Subsurface fragment volume >3" (0-203.2cm)	0 – 10 %

Ecological dynamics

U.S. National Vegetation Classification (USNVC) associations that are consistent with reference conditions on this ecological site include CEGL004037 Quercus phellos - Quercus (alba, stellata) - Carya carolinae-septentrionalis. Under slightly wetter site conditions, CEGL007403 Quercus phellos / Carex (albolutescens, intumescens, joorii) / Climacium americanum may be more representative. These concepts are closely related to the reference community, though likely broader than the scope of this ecological site, as they cover both acidic and basic (circumneutral) examples and have a broader geographic extent.

The reference community on this ecological site overlaps that of Schafale (2012a) 'Upland Depression Swamp Forest (Wet Mafic Variant),' 'Upland Depression Swamp Forest (Dry Mafic Variant),' and 'Mixed Moisture Hardpan Forest,' corresponding to a gradient from wetter to drier.

This ecological site is subject to wetting and drying cycles typical of "hydroxeric" conditions. These conditions include seasonal extremes in plant available water, caused primarily by shrink-swell clay minerology and low relief. The shrinking and swelling properties are responsible for fluctuating soil water potentials and cause shearing of the fine roots of woody plants. Layers of dense, plastic clays, which sit below the surface, can behave somewhat like rock, inhibiting root development, perching or ponding water during wet cycles, while simultaneously limiting the infiltration of water, contributing to dry cycles.

These edaphic factors produce a characteristically stunted canopy and create favorable conditions for recurring fires which would have historically helped maintain an open woodland structure. Forest patches associated with this ecological site are usually small and insular, being restricted to areas of mafic geology and unusual edaphic conditions.

Woodlands of this type are known locally by many names, including Piedmont flatwoods, Iredell flatwoods, montmorillonite forests, basic hardpan woodlands, gabbro upland depression forests, and vertic diabase woodlands. Regionally and locally, much variability exists between vegetation communities of this type, but all share a relatively open woodland structure, a fluctuating plant available water dynamic, and a predominance of base-loving plants in the understory. This ecological site includes seasonally wetter examples of these woodlands, which have a seasonal high water table within 12 inches of the soil surface.

MATURE FORESTS
The reference state has an open to partially open canopy structure. The canopy is dominated by bottomland oaks or an unusual mixture of bottomland oaks and dry-site oaks. Representative canopy species include willow oak (Quercus phellos), post oak (Quercus stellata), and American elm (Ulmus americana). Other notable species include winged elm (Ulmus alata), white oak (Quercus alba), as well as swamp white oak (Quercus bicolor), a species restricted to wet mafic sites in the northern part of the MLRA.

On the drier end of the range of variability, post oak (Q. stellata), and white oak (Q. alba) tend to be more abundant, while on the wetter end, willow oak (Q. phellos) tends to dominate strongly. In the wettest areas, overcup oak (Quercus lyrata) can occupy a portion of the canopy cover. The understory is characterized by a suite of basic indicator species, including a species-rich herb layer containing species that are seldom seen elsewhere in the Southern Piedmont.

Under reference conditions, the subcanopy and shrub layers are generally sparse and poorly-developed. Basic indicator species are well-represented, including white ash (Fraxinus americana), several species of elm (Ulmus spp.), and eastern redcedar (Juniperus virginiana). Subcanopy generalists include species such as red maple (Acer rubrum) and common persimmon (Diospyros virginiana). Sweetgum has the potential to be important in the subcanopy layer in the southern part of the extent, but becomes scarcer in the northern part. Sweetgum is generally more abundant in the understory of disturbed examples. Shrubs that may be present include several species of arrowwood (Viburnum spp.), possumhaw (Ilex decidua), and common winterberry (Ilex verticillata). Acid-loving flora, such as ericaceous (heath family) shrubs and subshrubs, are usually absent or scarce.

In the herb layer, common forbs include helmet flower (Scutellaria integrifolia), narrowleaf evening primrose (Oenothera fruticosa), ebony spleenwort (Asplenium platyneuron), obedient plant (Physostegia virginiana), and narrowleaf mountainmint (Pycnanthemum tenuifolium). Common graminoids include various rosette grasses (Dichanthelium spp.) and sedges (Carex spp.).

DYNAMICS OF NATURAL SUCCESSION AND FIRE ECOLOGY
Beginning in the early 20th century, a widespread fire suppression campaign resulted in a dramatic decrease in the frequency of fires across the Southeast. These changes gradually altered the vegetation structure and species composition of ecosystems that were dependent on fire for seedling recruitment, reproduction, and maintenance.

On this ecological site, the partially open canopy structure seen in some remnant examples is maintained, at least in part, by extremes in plant water availability. Few tree species are tolerant of alternating periods of soil saturation and the extremely dry soil conditions which develop during the growing season. Further, herbaceous plants are more tolerant of shrinking and swelling cycles that lead to shearing of the fine roots. Still, the natural fire regime would have produced a much more open canopy and understory than is seen in most examples presently, and promoted a dense herbaceous layer that could efficiently carry fire in future burns.

Because these communities are predominantly small-patch and spatially insular, fires would have spread primarily from the surrounding landscape. In all likelihood, the fire return interval would have largely matched that of the surrounding forests. However, because of extreme fluctuations in soil moisture, the effects of fire would have been greater, presumably maintaining a more open woodland structure than is seen presently. With a dense grassy herb layer, burning would have been more complete and fire more intense than in the current hardwood litter. Under a more regular fire regime, pyrophytic oaks, pines, and other fire-dependent plant species are more competitive. Under these conditions, tree replacement would presumably be less dependent on canopy gaps and more on fire than under fire-suppressed conditions, or compared to the more prevalent oak-hickory forests of the surrounding landscape.

A combination of prescribed burns and selective removals can open up the understory and constrain the growth of fire-intolerant opportunistic species, thereby restoring the health and vigor of forests that evolved under a more regular fire regime (Schafale and Weakley 1990; Oakley et al. 1995; Boul et al. 2011; Seymour et al. 2011; Schafale 2012a, 2012b; Vander Yacht et al. 2020; Flemming et al. 2021; Greenberg et al. 2021; Spooner et al. 2021).

SPECIES LIST
Canopy layer: Quercus phellos, Quercus stellata, Ulmus americana, Ulmus alata, Quercus alba, Quercus bicolor, Quercus lyrata, Quercus palustris, Fraxinus pennsylvanica,

Subcanopy layer: Fraxinus americana, Ulmus alata, Ulmus rubra, Acer rubrum, Diospyros virginiana, Juniperus virginiana, Carya tomentosa, Carya glabra, Carya ovata, Liquidambar styraciflua, Gleditsia triacanthos, Chionanthus virginicus, Cercis canadensis, Celtis sp.,

Vines/lianas: Smilax rotundifolia, Campsis radicans, Toxicodendron radicans, Parthenocissus quinquefolia, Smilax bona-nox, Smilax glauca, Smilax tamnoides, Vitis rotundifolia, Lonicera japonica (I)

Shrub layer: Ilex decidua, Ilex verticillata, Rosa carolina, Lindera benzoin, Symphoricarpos orbiculatus, Rhus aromatica, Berberis canadensis

Herb layer - forbs: Scutellaria integrifolia, Oenothera fruticosa, Asplenium platyneuron, Parthenium integrifolium, Physostegia virginiana, Pycnanthemum tenuifolium, Helianthus spp., Zizia aurea, Desmodium spp., Lespedeza spp., Marshallia obovata, Climacium americanum, Allium canadense, Leucobryum spp., Isoetes spp., Geum virginianum,

Herb layer - graminoids: Dichanthelium spp., Carex spp. (complanata, caroliniana, festucacea, normalis, caroliniana, intumescens, typhina), Danthonia spicata, Dichanthelium boscii, Panicum anceps, Tripsacum dactyloides, Cinna arundinacea, Sorghastrum nutans, Juncus coriaceus, Danthonia sericea, Panicum philadelphicum, Panicum capillare, Andropogon gerardii, Andropogon virginicus, Melica mutica,

(I) = introduced

State and transition model

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 13. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 14. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Inventory data references

Data collection and analysis of field data will be performed during the Verification Stage of ESD development.

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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	08/20/2026
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**