Ecological site F136XY660NC
High Terraces, Very Rare Inundation

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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 CEGL007006 Liquidambar styraciflua - Quercus (phellos, nigra, alba) / Carpinus caroliniana APPLICABLE EPA ECOREGIONS Level III: 45. Piedmont Level IV: 45a. Southern Inner Piedmont; 45b. Southern Outer Piedmont; 45c. Carolina Slate Belt; 45f. Northern Outer Piedmont; 45g. Triassic Basins; 45i. Kings Mountain; 45d. Talladega Upland; 45h. Pine Mountain Ridges (EPA 2013). APPLICABLE USFS ECOLOGICAL UNITS Domain: Humid Temperate Division: Subtropical Ecological province: 231. Southeastern Mixed Forest Ecological sections: 231I.Central Appalachian Piedmont; 231A. Southern 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 moist areas on high stream terraces, which usually sit several meters above the active flood plain and experience a low incidence of flooding. It is geographically restricted to the thermic soil temperature regime portion of the MLRA. Although it does experience periodic flooding of very brief to brief duration, it may go several years or more without flooding. In this setting, mesophytic upland species and bottomland species often intermingle, promoting the establishment of a diverse assemblage of mixed hardwoods and pines at maturity. Soils on this ecological site are typically very deep, well to moderately well drained Ultisols or Alfisols. They are generally better developed than those of adjacent flood plains, as the flooding frequency is not great enough to interfere with soil formation to any major extent. Being situated on more stable surfaces, soils on this ecological site usually have an argillic horizon in subsurface layers. Parent materials are typically loamy to clayey old alluvial sediments. The reference state supports a closed canopy forest dominated by a mixture of mesophytic upland species and bottomland hardwoods, including willow oak (Quercus phellos), water oak (Quercus nigra), sweetgum (Liquidambar styraciflua), white oak (Quercus alba), American beech (Fagus grandifolia), northern red oak (Quercus rubra), Shumard's oak (Quercus shumardii), American elm (Ulmus americana), and many others. Dominant land uses include cropland, pasture and hayland, wildlife habitat, and planted pine. ES CHARACTERISTICS SUMMARY • Thermic soil temperature regime • Occurs on stream terraces in river valleys • Seasonal high water table: > 18 inches from the soil surface • Soils: very deep, well to moderately well drained Ultisols or Alfisols

Associated sites

F136XY650NC	**Low Terraces and Drains, Rare Inundation** Typically found in lower landscape positions. The seasonal high water table is shallower (12-18 inches from the soil surface) and the flooding frequency is usually higher, supporting an increase in obligate or facultative wetland indicator species.
F136XY640VA	**Low Terraces and Drains, Occasional Inundation** Found in lower landscape positions. The seasonal high water table is much shallower (0-12 inches from the soil surface) and the flooding frequency is usually higher, supporting a greater proportion of obligate wetland indicator species.

Similar sites

F136XY160VA	**Mesic Temperature Regime, High Terraces, Very Rare Inundation** The soil temperature regime is mesic, occurring outside of the native range of loblolly pine (Pinus taeda).
F136XY620GA	**Flood Plain Forest, Moist** Found on active flood plains that are subject to regular overbank flooding and higher flooding-related tree mortality, supporting an increase in riparian species which invest in rapid growth and early reproduction (e.g., American sycamore (Platanus occidentalis), sugarberry (Celtis laevigata), etc.). Soil pH and natural fertility are usually higher on these younger surfaces.

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* (2) *Liquidambar styraciflua*
Shrub	(1) *Viburnum prunifolium* (2) *Euonymus americanus*

Herbaceous	(1) *Polystichum acrostichoides* (2) *Carex*

Physiographic features

This ecological site is found on high stream terraces, in the thermic soil temperature regime portion of the MLRA. It typically sits several meters above the active flood plain and some distance from the river channel, on alluvial landforms that are spared from most of the flooding experienced on lower surfaces. Although stream terraces are the most representative landform associated with this ecological site, the range of variability also includes transitional terraces known as flood-plain steps, which sit below the 100 year flood zone. Occasionally, this ecological site can be found along the lower segments of drainageways leading down to river valleys. In either case, overbank flooding is not the primary driver of pedogenesis or ecological dynamics.

This ecological site is more widespread than the wetter associated ecological site concepts PX136X00X640 and PX136X00X650, as these concepts are mostly restricted to relatively broad river valleys with broad, stepped surfaces. This ecological site on the other hand, is found in both broad and narrow river valleys, and along large and small river systems. Although it is of widespread extent across much of the MLRA, stream terraces do tend to be narrower and occupy less area along the smaller streams.

Stream terraces form in response to gradual downcutting of a stream channel and its immediately adjacent surfaces, usually initiated by events that shift erosional and depositional equilibrium. Over time, abandoned portions of the flood plain are left behind as remnant features. Representative locations are nearly level to gently sloping, with a representative slope of 0 to 6 percent and a maximum slope of 10 percent. The geologic substrate is generally loamy to clayey old alluvial sediments (Zinck 2016; Schoeneberger and Wysocki 2017).

Figure 1. Typical soil-landscape relationships in a broad river valley in the Southern Piedmont. State soils are associated with this ecological site, depicted here on high stream terraces above an active flood plain.

Figure 2. Typical soil-landscape relationships in a narrow river valley in the Southern Piedmont, featuring Altavista and rarely flooded Wickham soils. Note that the associated wetter ecological site concepts PX136X00X650/PX136X00X640 are absent in this setting.

Table 5. Representative physiographic features

Landforms	(1) River valley > Stream terrace (2) River valley > Flood-plain step (3) Piedmont > Drainageway
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	70 – 320 m
Slope	0 – 10 %
Water table depth	60 – 180 cm

Aspect	Aspect is not a significant factor

Table 6. Representative physiographic features (actual ranges)

Runoff class	Negligible to very high
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	50 – 560 m
Slope	0 – 10 %
Water table depth	50 – 2,540 cm

Climatic features

On this ecological site, the average mean annual precipitation is 47 inches. On average, the rainiest months occur in July and August, as well as in March. The driest months occur in April, May, and October.

Table 7 Representative climatic features

Frost-free period (characteristic range)	170-190 days
Freeze-free period (characteristic range)	200-230 days
Precipitation total (characteristic range)	1,140-1,270 mm
Frost-free period (actual range)	160-200 days
Freeze-free period (actual range)	190-240 days
Precipitation total (actual range)	1,090-1,370 mm
Frost-free period (average)	180 days
Freeze-free period (average)	210 days

Precipitation total (average)	1,190 mm

- (1) LAWRENCEVILLE 3 E [USC00444768], Freeman, VA
- (2) CHARLOTTE COURT HOUSE [USC00441585], Keysville, VA
- (3) AMELIA 8 NE [USC00440188], Amelia Court House, VA
- (4) ROXBORO 7 ESE [USC00317516], Roxboro, NC
- (5) ARCOLA [USC00310241], Macon, NC
- (6) HAW RIVER 1E [USC00313919], Graham, NC
- (7) MONROE AP [USW00053872], Monroe, NC
- (8) RALEIGH DURHAM INTL AP [USW00013722], Raleigh, NC
- (9) ROCK HILL YORK CO AP [USW00053871], Rock Hill, SC
- (10) CAMP HILL 2NW [USC00011324], Camp Hill, AL
- (11) SILOAM 3N [USC00098064], Greensboro, GA
- (12) MONTICELLO [USC00095988], Monticello, GA
- (13) LA GRANGE 1N [USC00094949], LaGrange, GA
- (14) TALBOTTON [USC00098535], Talbotton, GA
- (15) CHESTER 1 SE [USC00381633], Chester, SC
- (16) PARR [USC00386688], Jenkinsville, SC
- (17) GREENWOOD CO AP [USW00053874], Greenwood, SC
- (18) ROCKFORD 3 ESE [USC00017020], Rockford, AL
- (19) ALBEMARLE [USC00310090], Albemarle, NC
- (20) SALISBURY [USC00317615], Salisbury, NC
- (21) NEWBERRY [USC00386209], Newberry, SC
- (22) SIMMS WTP [USC00387885], Chesnee, SC
- (23) CROZIER [USC00442142], Maidens, VA
- (24) CARROLLTON [USC00091640], Carrollton, GA
- (25) COVINGTON [USC00092318], Covington, GA
- (26) WEST POINT [USC00099291], Lanett, GA
- (27) CHARLOTTE DOUGLAS AP [USW00013881], Charlotte, NC
- (28) COLUMBUS METRO AP [USW00093842], Columbus, GA
- (29) SILER CITY 2 N [USC00317924], Siler City, NC
- (30) CHASE CITY [USC00441606], Chase City, VA
- (31) HICKORY FAA AP [USW00003810], Hickory, NC
- (32) ASHLAND 3 ENE [USC00010369], Ashland, AL
- (33) DALLAS 7 NE [USC00092485], Dallas, GA
- (34) EXPERIMENT [USC00093271], Griffin, GA
- (35) GAINESVILLE [USC00093621], Gainesville, GA
- (36) MILLEDGEVILLE [USC00095874], Milledgeville, GA
- (37) ASHEBORO 2 W [USC00310286], Asheboro, NC
- (38) CHESNEE 7 WSW [USC00381625], Chesnee, SC
- (39) CLEMSON UNIV [USC00381770], Clemson, SC
- (40) GREENWOOD [USC00383754], Greenwood, SC
- (41) ATHENS BEN EPPS AP [USW00013873], Athens, GA

Influencing water features

This ecological site sits high enough above the active flood plain to avoid much of the flooding experienced on lower surfaces. Flooding occurs mainly after a period of unusually wet weather. The heavy rainfall generates saturation-excess runoff, filling rivers and streams, leading to flooding on the higher river valley surfaces. Though it is prone to flooding during wet periods, it may go several years or more without flooding. In most locations, the chance of flooding in any given year is no greater than 5 percent, or approximately once every 20 years, though some locations can experience greater flooding frequency. The seasonal high water table is apparent at depths of 18 inches or greater, generally during the months of December to April.

Soil features

Soils on this ecological site are typically very deep, well to moderately well drained Ultisols or Alfisols. They are better developed than soils of adjacent flood plains, as they are generally found on more stable surfaces that are more conducive to soil genesis. As such, soils on this ecological site usually have an argillic horizon in subsurface layers.

Unlike many of the nearby or adjacent upland soils, the subsoil on this ecological site is generally yellowish or brownish in color and of medium texture, as opposed to being reddish in color and high in clay. Together these attributes are usually indicative of long periods of weathering on a very stable geomorphic surface, and a higher, drier, and warmer weathering environment. As a general rule, these attributes are usually associated with the genesis of nearby upland soils, which in turn tend to support upland or upland-like vegetation. Soils on this ecological site can fall into either a fine-loamy or fine particle size family. The subsoil however, is almost always yellowish or brownish in color. Redoximorphic features (iron and/or manganese depletions) may be found at depths of 18 inches or greater. Parent materials are loamy to clayey old alluvial sediments.

Reaction in the subsoil is typically moderately acid to very strongly acid (pH 4.5 to 6.0), although it can be closer to neutral under unusually rich site conditions. In the surface layers, reaction varies with land use and management. Under low input or forested conditions, it generally falls somewhere between pH 4.5 and 6.5. These soils have a long history of cultivation in most parts of the MLRA. Soils generally have few limitations for most agricultural land uses.

Soils on this ecological site have a thermic soil temperature regime, which is characterized by a mean annual soil temperature of 15°C to 22°C and a winter to summer temperature differential of 6°C or more in the subsoil.

Modal taxa include: Typic Hapludults, Aquic Hapludults
Modal soil series include: Altavista, State
Other soils attributed to this ecological site include Peawick, Tillery, Bolling, Dorian, Dogue, Thomson, Whistlestop, McQueen, Pamunkey, Starr, Wickham (rarely flooded phases), Seneca, Mattaponi

Figure 9. An illustration of a soil profile belonging to the State series, a representative soil series associated with this ecological site.

Figure 10. A soil profile of the Altavista series.

Table 8. Representative soil features

Parent material	(1) Alluvium – igneous, metamorphic and sedimentary rock
Surface texture	(1) Fine sandy loam (2) Sandy loam (3) Silt loam (4) Loam
Family particle size	(1) Fine-loamy (2) Fine
Drainage class	Moderately well drained to well drained
Permeability class	Moderate to moderately rapid
Soil depth	200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified

Available water capacity (0-203.2cm)	17.78 – 33.02 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5 – 6.5
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	Moderately well drained to well drained
Permeability class	Moderate to moderately rapid
Soil depth	200 cm
Surface fragment cover <=3"	0 %
Surface fragment cover >3"	0 %
Available water capacity (0-203.2cm)	12.7 – 45.72 cm
Soil reaction (1:1 water) (0-25.4cm)	3.5 – 7.3
Subsurface fragment volume <=3" (0-203.2cm)	0 – 10 %
Subsurface fragment volume >3" (0-203.2cm)	0 %

Ecological dynamics

U.S. National Vegetation Classification (USNVC) associations that are consistent with reference conditions on this ecological site include CEGL007006 Liquidambar styraciflua - Quercus (phellos, nigra, alba) / Carpinus caroliniana. This concept is closely related to the reference community, although examples with a high cover of sweetgum (L. styraciflua) in the canopy may represent an intermediate stage of succession, preceding a more diverse steady-state mature forest community. Examples that contain a high cover of American beech (F. grandifolia), which can be abundant on high stream terraces, are included in this association. The reference community on this ecological site overlaps that of Schafale (2012), 'Piedmont Bottomland Forest (High Subtype)' (USNVC 2022).

MATURE FORESTS
The reference state supports a closed canopy forest dominated by a mixture of mesophytic upland species, bottomland hardwoods, and scattered pines. Characteristic species of the canopy layer include willow oak (Quercus phellos), water oak (Quercus nigra), sweetgum (Liquidambar styraciflua), white oak (Quercus alba), American beech (Fagus grandifolia), northern red oak (Quercus rubra), Shumard's oak (Quercus shumardii), American elm (Ulmus americana), loblolly pine (Pinus taeda), red maple (Acer rubrum), and various hickories (Carya spp.). Swamp chestnut oak (Quercus michauxii) may be present, but it is not usually as important as it is on lower surfaces.

Species typical of flood plains and natural levees, such as boxelder (Acer negundo), American sycamore (Platanus occidentalis), sugarberry (Celtis laevigata), green ash (Fraxinus pennsylvanica), and river birch (Betula nigra) may be present, but these species rarely make a sizable contribution to the canopy in mature stands. In general, this is a community of high canopy diversity.

The subcanopy layer is generally well-developed, featuring a diverse group of tree species. Common species include American holly (Ilex opaca), flowering dogwood (Cornus florida), American beech (Fagus grandifolia), American hornbeam (Carpinus caroliniana), winged elm (Ulmus alata), blackgum (Nyssa sylvatica), and common persimmon (Diospyros virginiana), among others.

Unless invaded by non-native understory species, vines, shrubs, and herbs are diverse. Characteristic shrubs include blackhaw (Viburnum prunifolium), bursting-heart (Euonymus americana), American holly (Ilex opaca), possumhaw (Ilex decidua), and southern arrowwood (Viburnum recognitum, V. dentatum).

Though the herb layer is often diverse, it is not usually dense. Species that occur with some frequency in plot data include forbs such as Christmas fern (Polystichum acrostichoides), white avens (Geum canadense), partridgeberry (Mitchella repens), littlebrownjug (Hexastylis arifolia), Canadian blacksnakeroot (Sanicula canadensis), smooth Solomon's seal (Polygonatum biflorum), helmet flower (Scutellaria integrifolia), and licorice bedstraw (Galium circaezans). Common graminoids include several species of Carex (C. debilis, radiata, amphibola, etc.), Indian woodoats (Chasmanthium latifolium), and several species of Dichanthelium (D. commutatum, boscii, dichotomum, etc.).

DYNAMICS OF NATURAL SUCCESSION
Successional dynamics on this ecological site are not well-documented. Tree replacement likely takes place in canopy gaps caused by windthrow, disease, and the like, much like on moist uplands of the Piedmont. Flooding presumably plays a relatively minor role. Though fire was historically a key driver of successional dynamics on Piedmont uplands, the influence of fire on this ecological site was probably of limited importance.

This ecological site is particularly vulnerable to invasion by Chinese privet (Ligustrum sinense), a non-native shrub or small tree which was introduced in the mid-nineteenth century. Many thousands of acres of bottomlands and flood plain forests now have a nearly continuous layer of Chinese privet, excluding most of the native flora beneath. Also problematic is Nepalese browntop (Microstegium vimineum), otherwise known as Japanese stiltgrass, which thrives in low-lying areas. This non-native bamboo-like grass can outcompete most native herbs under conditions of low light, often forming dense monospecific stands with few other species. These and other introduced species, such as multiflora rose (Rosa multiflora), usually require disturbance to gain a foothold, but once they do, they are remarkably persistent due to their reproductive capacity and tolerance for shade.

YOUNG SECONDARY FORESTS
Young secondary forests associated with this ecological site are usually even-aged, less diverse, and more likely to be invaded by non-native understory species. Typically, these forests are strongly dominated by only a handful of species, of which sweetgum (L. styraciflua) is probably most common overall. The dominance of sweetgum (L. styraciflua) and other early pioneers declines as the forest matures, though some of these species remain important in mature stands as well, albeit to a lesser extent. Other characteristic species of young secondary forests on this ecological site include American sycamore (Platanus occidentalis), loblolly pine (Pinus taeda), tuliptree (Liriodendron tulipifera), red maple (Acer rubrum), blackgum (Nyssa sylvatica), common persimmon (Diospyros virginiana), and winged elm (Ulmus alata).

At the start of European settlement, high stream terraces would have been particularly attractive for agriculture, given the inherent combination of fertile soils, nearly level ground, adequate drainage, and a low annual probability of flooding. During the colonial period onward, most of the acreage associated with this ecological site was cleared and converted to cropland. Before that, these areas may have been the primary focus of pre-settlement agriculture. Although a portion of the acreage was abandoned some time ago, the majority is still in crops or pasture, or alternatively under urban land uses. In those examples that have been allowed to regenerate, the majority are currently in a state of young secondary growth. These stands provide an opportunity to study site-specific successional trends and they may offer important clues as to what these forests will look like in the future (Nelson et al. 1957; Wharton 1978; Skeen et al. 1980; Schafale and Weakley 1990; Matthews et al. 2011; Schafale 2012a, 2012b; Edwards et al. 2013; Fleming et al. 2021).

SPECIES LIST
Canopy layer: Quercus phellos, Quercus nigra, Liquidambar styraciflua, Quercus alba, Fagus grandifolia, Quercus rubra, Quercus shumardii, Ulmus americana, Carya cordiformis, Carya ovata, Pinus taeda, Carya glabra, Carya tomentosa, Acer rubrum, Ulmus alata, Liriodendron tulipifera, Fraxinus pennsylvanica, Quercus pagoda, Quercus michauxii,

Subcanopy layer: Ilex opaca, Cornus florida, Fagus grandifolia, Carpinus caroliniana, Ulmus alata, Nyssa sylvatica, Diospyros virginiana, Acer rubrum, Prunus serotina, Acer floridanum, Ostrya virginiana, Magnolia tripetala, Amelanchier arborea,

Vines/lianas: Parthenocissus quinquefolia, Bignonia capreolata, Smilax rotundifolia, Smilax bona-nox, Smilax glauca, Smilax tamnoides, Toxicodendron radicans, Vitis rotundifolia, Passiflora lutea, Menispermum canadense, Vitis cinerea var. baileyana, Vitis vulpina, Vitis labrusca, Gelsemium sempervirens, Lonicera japonica (I)

Shrub layer: Viburnum prunifolium, Euonymus americanus, Ilex opaca, Ilex decidua, Viburnum recognitum, Viburnum dentatum, Aesculus sylvatica, Aesculus pavia, Crataegus spp. (flabellata, marshallii, iracunda, etc.), Staphylea trifolia, Ligustrum sinense (I), Rosa multiflora (I), Elaeagnus umbellata (I)

Herb layer - forbs: Polystichum acrostichoides, Geum canadense, Mitchella repens, Hexastylis arifolia, Sanicula canadensis, Polygonatum biflorum, Scutellaria integrifolia, Galium circaezans, Asarum canadense, Polygonum virginianum, Geranium maculatum, Solidago caesia, Ruellia caroliniensis, Collinsonia canadensis, Pluchea camphorata, Elephantopus carolinianus, Cryptotaenia canadensis, Erythronium umbilicatum, Tipularia discolor, Viola spp., Maianthemum racemosum, Dioscorea quaternata, Aristolochia serpentaria, Asplenium platyneuron, Goodyera pubescens, Sanguinaria canadensis, Sisyrinchium angustifolium, Athyrium filix-femina ssp. asplenioides, Smallanthus uvedalius, Phegopteris hexagonoptera, Podophyllum peltatum, Boehmeria cylindrica, Verbesina occidentalis, Verbesina alternifolia, Viola sororia, Botrychium dissectum, Botrychium biternatum, Botrychium virginianum, Phryma leptostachya, Arisaema dracontium, Claytonia virginica, Ageratina altissima, Solidago rugosa, Thelypteris noveboracensis, Symphyotrichum lateriflorum, Potentilla simplex, Uvularia perfoliata, Stellaria pubera, Trillium catesbaei, Amsonia tabernaemontana, Prenanthes altissima, Hepatica americana, Desmodium paniculatum,

Herb layer - graminoids: Carex spp. (debilis, radiata, amphibola, laxiflora, gracillima, laxiculmis, oxylepis, kraliana, jamesii, etc.), Chasmanthium latifolium, Dichanthelium spp. (commutatum, dichotomum, laxiflorum, boscii), Poa cuspidata, Poa autumnalis, Festuca subverticillata, Chasmanthium sessiliflorum, Melica mutica, Cinna arundinacea, Luzula spp., Microstegium vimineum (I)

(I) = introduced

State and transition model

Additional community tables

Table 10. Community 2.1 plant community composition

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

Table 11. Community 2.2 plant community composition

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

Table 12. Community 2.3 plant community composition

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

Table 13. Community 5.1 plant community composition

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

Table 14. Community 5.2 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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Contributors

Yogev Erez
Dee Pederson

Approval

Charles Stemmans, 5/02/2025

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	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):**

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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:**
