USDA Natural Resources
Conservation Service

Ecological site PX136X00X380
Mesic Temperature Regime, Acidic High Hills and Isolated Ridges, Depth Restriction, Dry

Last updated: 5/02/2025
Accessed: 05/21/2025

General information

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

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
CEGL006281 *Quercus montana* - *Quercus alba* / *Oxydendrum arboreum* / *Vitis rotundifolia*; CEGL004415 *Quercus montana* - *Quercus alba* / *Oxydendrum arboreum* / *Kalmia latifolia*; CEGL004148 *Quercus montana* - *Pinus echinata* / *Vaccinium pallidum*; CEGL004446 *Pinus echinata* - *Quercus marilandica* / *Kalmia latifolia* - *Symplocos tinctoria*; CEGL007493 *Pinus echinata* - Quercus (montana, falcata) / *Oxydendrum arboreum* / *Vaccinium pallidum*

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 dry, nutrient-poor, acidic uplands, found in highly dissected and higher elevation parts of the MLRA, or on isolated erosional remnants known as monadnocks. 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 typically found in upper landscape positions, on steep backslopes and along the shoulders of high hills, prominent ridges, or monadnocks. On narrow ridges, it can be found in summit positions.

This ecological site is exposed to the elements, including sun, wind, and historically fire. It generally occupies some of the driest topographic positions in the region, although part of the dry character is derived from the infertility of soils. The vegetation and relative moisture status vary with aspect, being driest on south or west-facing exposures and moister on those that face north. Overall, species-richness is low.

Soils on this ecological site are typically shallow to moderately deep, well drained to somewhat excessively drained Inceptisols. At the surface and throughout, these soils typically have an abundance of rock fragments. Parent materials are residuum derived from acidic, weathering-resistant igneous or metamorphic rocks.

The reference state typically has a somewhat open tree canopy dominated by dry-site oaks, or a mixture of dry-site oaks and pines. Typical species include chestnut oak (*Quercus montana*), scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), black oak (*Quercus velutina*), and pine (*Pinus virginiana*, *P. echinata*, *P. strobus*). Dominant land uses include wildlife habitat, pasture, and planted pine.

ES CHARACTERISTICS SUMMARY
• Mesic soil temperature regime
• Occurs on Piedmont uplands, typically in backslope and shoulder positions, on high hills, prominent ridges, and isolated monadnocks, in highly dissected and higher elevation parts of the MLRA
• Base saturation: < 35 percent in the subsoil
• Seasonal high water table: absent within 72 inches of the soil surface
• Depth to bedrock is < 40 inches, AND the available water storage capacity of the profile (from the soil surface to 80 inches, or to paralithic or lithic bedrock, whichever is shallower) is less than 4 inches
• Parent materials: residuum derived from felsic igneous or metamorphic rock
• Soils: shallow to moderately deep, well drained to somewhat excessively drained Inceptisols, or shallow Ultisols

Associated sites

PX136X00X340	**Mesic Temperature Regime, Acidic Upland Colluvial Forest** Found in lower landscape positions, in sheltered colluvial areas that receive water from upslope. Moisture-loving plant species, such as American beech (Fagus grandifolia), northern red oak (Quercus rubra), and tuliptree (Liriodendron tulipifera) are dominant in the canopy.

Similar sites

PX136X00X880	**Acidic High Hills and Isolated Ridges, Depth Restriction, Dry** The soil temperature regime is thermic, occurring within the native range of loblolly pine (Pinus taeda).
PX136X00X370	**Mesic Temperature Regime, Acidic Upland Woodland, Depth Restriction, Dry** Soil properties are similar but the landscape is generally less dissected and elevation is lower overall. Aspect plays a much smaller role in shaping environmental conditions at any given location. Species with Blue Ridge affinities, such as chestnut oak (Quercus montana), are often present, but they are not usually abundant in the canopy.

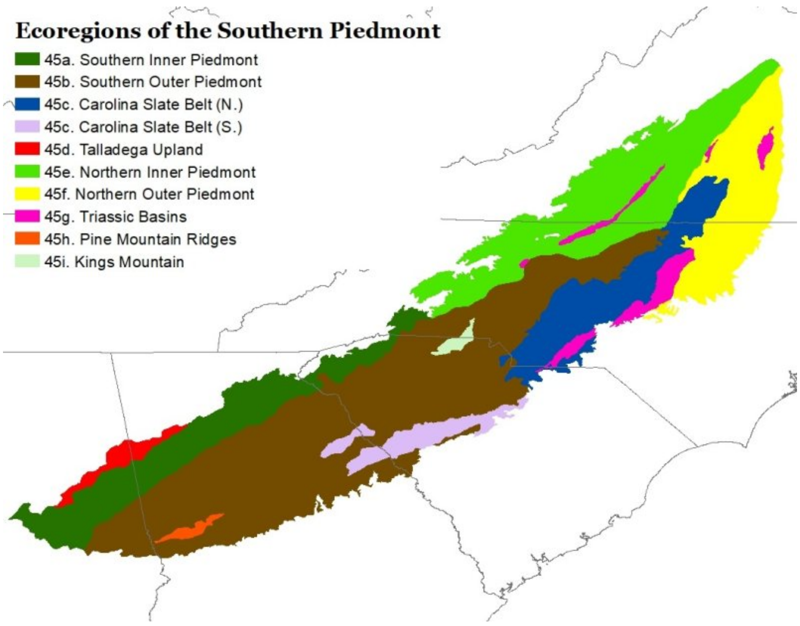

Figure 1. EPA level IV ecoregions of the Southern Piedmont (45).

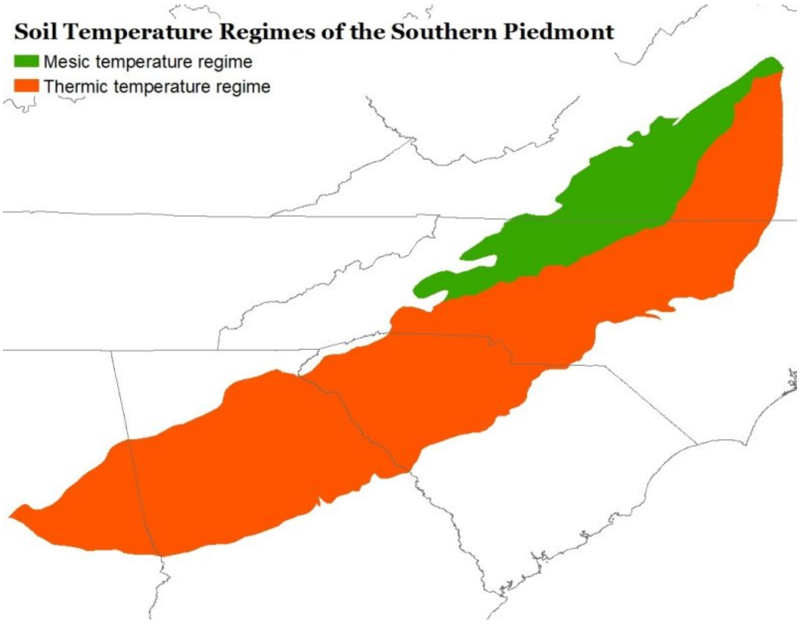

Figure 2. Spatial illustration of soil temperature regimes of the Southern Piedmont.

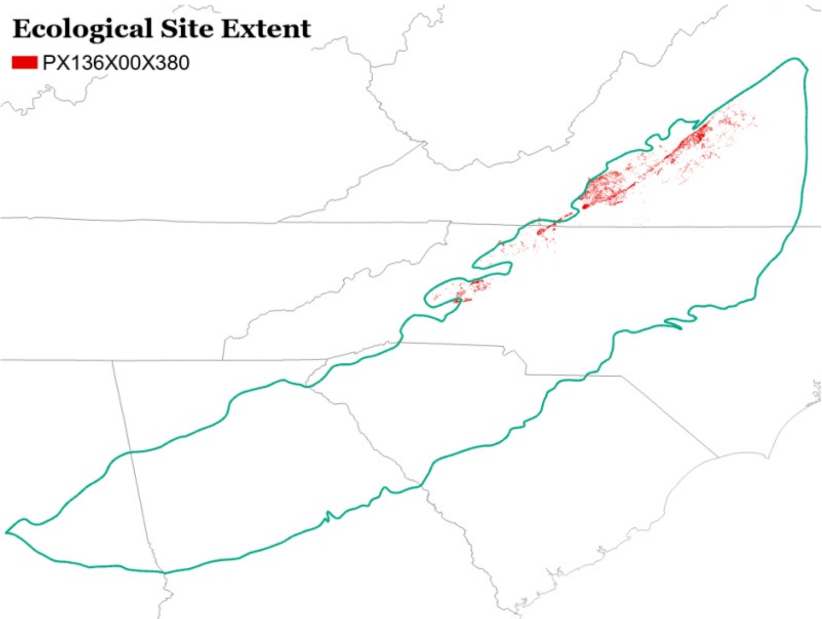

Figure 3. Spatial extent of this ecological site representing the major areas where this site is important on the landscape.

Table 1. Dominant plant species

Tree	(1) *Quercus montana* (2) *Quercus coccinea*
Shrub	(1) *Vaccinium pallidum* (2) *Vaccinium stamineum*
Herbaceous	(1) *Danthonia spicata* (2) *Schizachyrium scoparium*

Legacy ID

F136XY380VA

Physiographic features

This ecological site includes dry acidic uplands, which sit in upper landscape positions, in highly dissected and higher elevation parts of the MLRA, or on isolated erosional remnants known as monadnocks. It is found in the backslope and shoulder positions, on high hills, prominent ridges, or monadnocks. On narrow ridges, it can be found in summit positions. This ecological site is geographically restricted to the upper Piedmont of Virginia and North Carolina, in EPA ecoregion 45e (Northern Inner Piedmont). This ecoregion roughly coincides with the mesic soil temperature regime portion of the Southern Piedmont.

The landscape of the Northern Inner Piedmont consists of a low, hilly plain to the north and east, with areas of higher elevation and topographic relief becoming more common to the southwest. In general, elevations are highest towards the western boundary and south of the Roanoke river, where the land rises to a broad area of high hills. Areas of higher elevation and topographic relief are generally found west of the Brookneal shear zone (Woods et al. 1999; Griffith et al. 2002).

Representative locations are gently sloping on ridgetops, to steeply sloping on backslopes, with a representative slope of 25 to 60 percent and a maximum slope of 70 percent. The geologic substrate is typically low in ferromagnesian minerals and high in silica. Parent materials include fine-grained metasedimentary rock or felsic crystalline rock. Examples include gneiss, schist, phyllite, dacite, rhyolite, and other weathering-resistant rocks.

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Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Shoulder (3) Summit
Landforms	(1) Piedmont > Ridge (2) Piedmont > Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	640–1,740 ft
Slope	25–60%
Water table depth	72–999 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	550–2,190 ft
Slope	6–70%
Water table depth	72–999 in

Climatic features

On this ecological site, the average mean annual precipitation is 47 inches. On average, the rainiest months occur from May through September, as well as in March. The driest months occur from October through February.

Table 4. Representative climatic features

Frost-free period (characteristic range)	151-165 days
Freeze-free period (characteristic range)	184-196 days
Precipitation total (characteristic range)	45-49 in
Frost-free period (actual range)	144-171 days
Freeze-free period (actual range)	167-206 days
Precipitation total (actual range)	42-50 in
Frost-free period (average)	157 days
Freeze-free period (average)	190 days
Precipitation total (average)	47 in

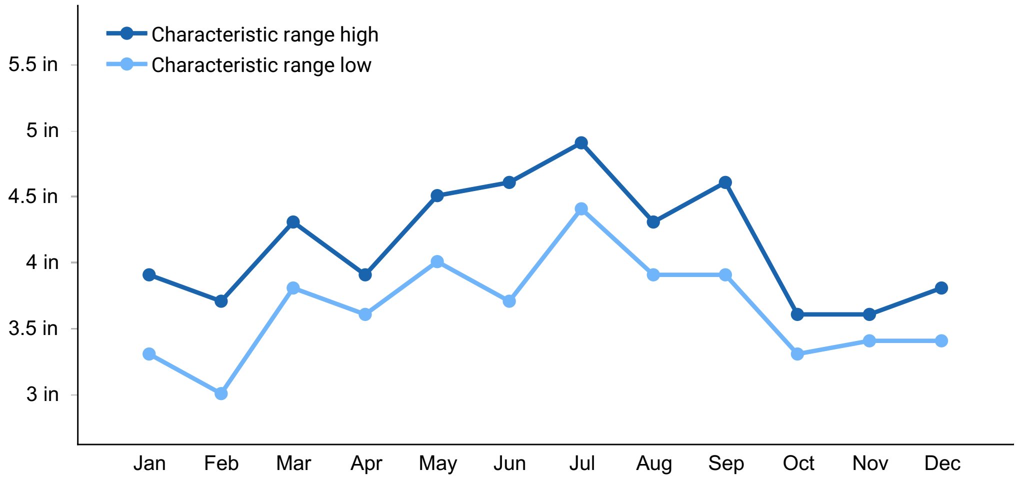


Figure 4. Monthly precipitation range

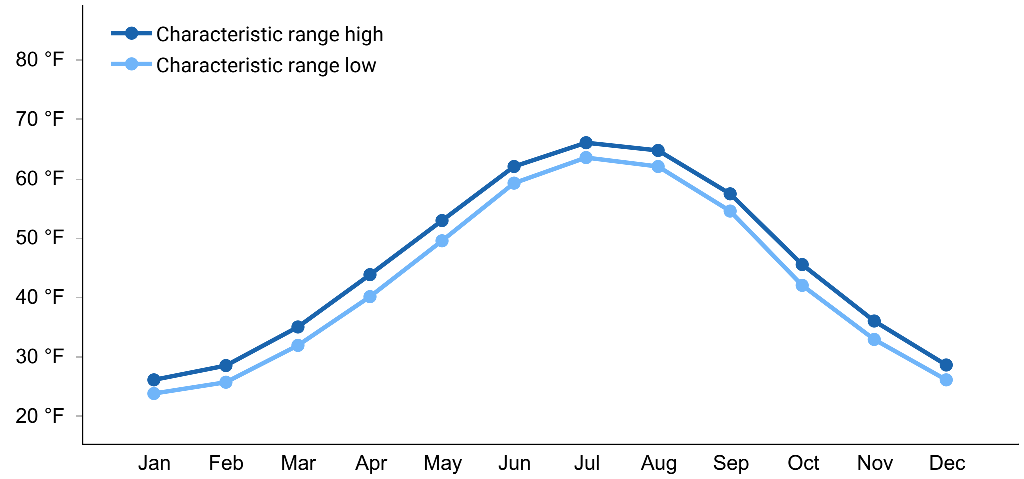


Figure 5. Monthly minimum temperature range

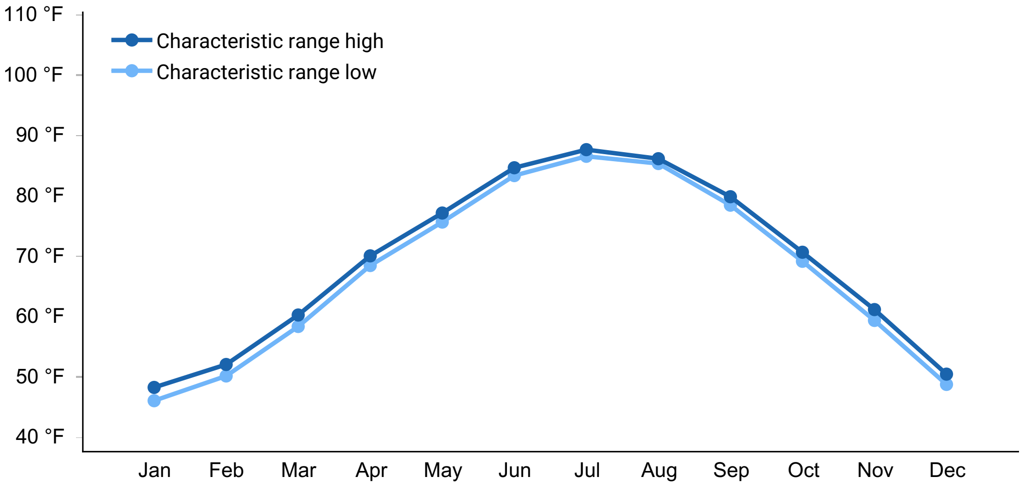


Figure 6. Monthly maximum temperature range

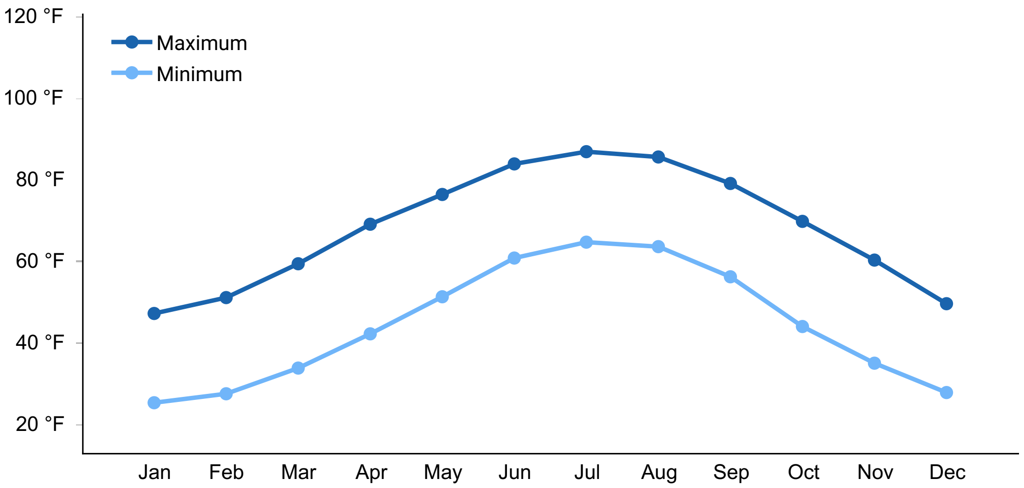


Figure 7. Monthly average minimum and maximum temperature

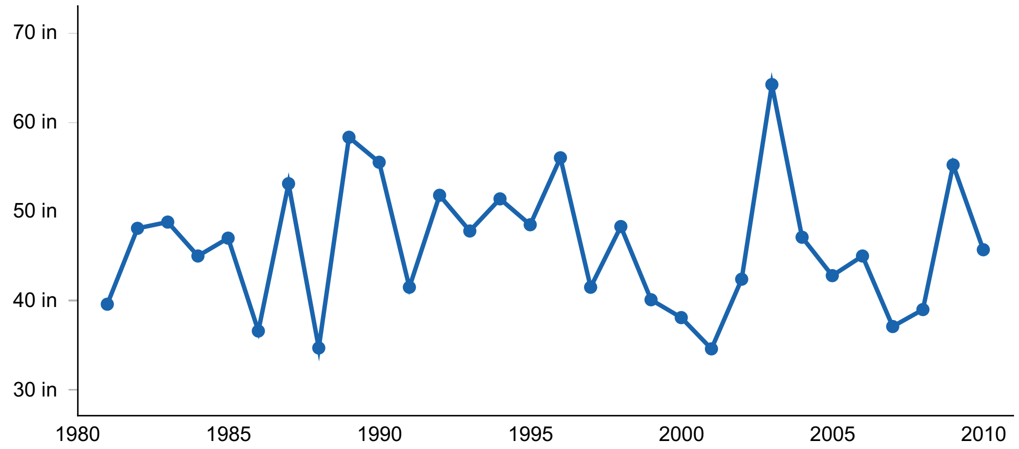


Figure 8. Annual precipitation pattern

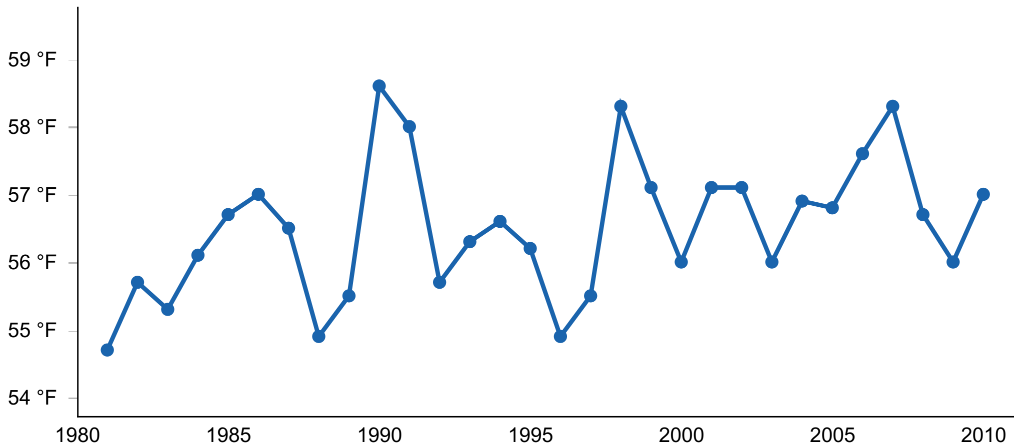


Figure 9. Annual average temperature pattern

Climate stations used

- (1) MORGANTON [USC00315838], Morganton, NC
- (2) HICKORY FAA AP [USW00003810], Hickory, NC
- (3) LENOIR [USC00314938], Lenoir, NC
- (4) TAYLORSVILLE [USC00318519], Taylorsville, NC
- (5) W KERR SCOTT RSVR [USC00319555], Wilkesboro, NC
- (6) NORTH WILKESBORO [USC00316256], Wilkesboro, NC
- (7) MT AIRY 2 W [USC00315890], Mount Airy, NC
- (8) BROOKNEAL [USC00441082], Brookneal, VA
- (9) CHATHAM [USC00441614], Chatham, VA
- (10) STUART [USC00448170], Stuart, VA
- (11) PHILPOTT DAM 2 [USC00446692], Henry, VA
- (12) MARTINSVILLE FLTR PLT [USC00445300], Martinsville, VA
- (13) ROCKY MT [USC00447338], Rocky Mount, VA
- (14) BEDFORD [USC00440551], Bedford, VA
- (15) LYNCHBURG RGNL AP [USW00013733], Lynchburg, VA
- (16) LYNCHBURG #2 [USC00445117], Lynchburg, VA

- (17) TYE RIVER 1 SE [USC00448600], Amherst, VA
- (18) APPOMATTOX [USC00440243], Appomattox, VA

Influencing water features

This ecological site is not influenced by surface or ground water features.

Soil features

Soils on this ecological site are typically shallow to moderately deep, well drained to somewhat excessively drained Inceptisols or shallow Ultisols. The depth to unweathered or partially weathered bedrock is less than 40 inches, with representative examples being much shallower to bedrock. Parent materials are residuum derived from weathering-resistant acidic igneous or metamorphic rock, such as phyllite, schist, gneiss, dacite, or rhyolite.

Soils on this ecological site are typically rocky or gravelly. Areas of exposed rock, or large boulders, may sit at the surface in places. Representative particle size families include loamy-skeletal and coarse-loamy families. The available water storage capacity of the profile is generally 4 inches or less.

Reaction in the subsoil is typically strongly acid to extremely acid (pH 3.5 to 5.5). In the surface layers, reaction varies with land use and management. Under low input or forested conditions, it generally falls somewhere between pH 3.5 and 6.0.. Base saturation is less than 35 percent in the subsoil.

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 taxa include: Typic Dystrudepts, Lithic Dystrudepts
Modal soil series include: Bugley
Other soils attributed to this ecological site include Bannertown, Bellspur, Devotion, Fairystone, Hibriten, Hickoryknob, Meadowfield, Perrowville, and Strawfield.

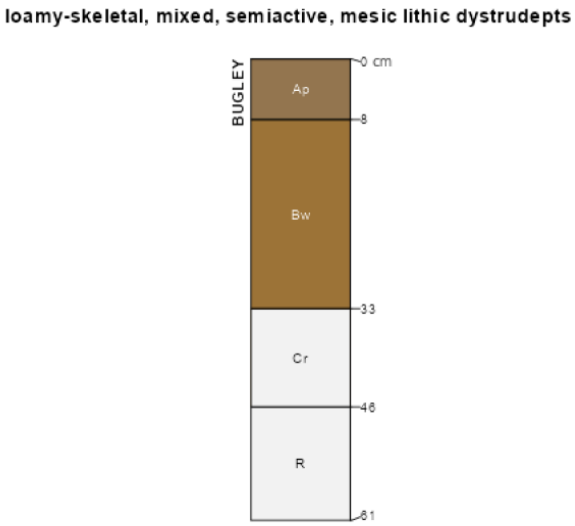


Figure 10. An illustration of a soil profile belonging to the Bugley series, a representative soil series associated with this ecological site.

Table 5. Representative soil features

Parent material	(1) Residuum–phyllite (2) Residuum–schist (3) Residuum–gneiss
Surface texture	(1) Very channery, channery silt loam (2) Channery, very gravelly loam (3) Gravelly coarse sandy loam (4) Very cobbly, cobbly sandy loam
Family particle size	(1) Loamy-skeletal (2) Coarse-loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	14–30 in
Soil depth	14–30 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-80in)	2–3.5 in
Soil reaction (1:1 water) (0-10in)	3.5–6
Subsurface fragment volume <=3" (0-80in)	4–11%

Subsurface fragment volume >3" (0-80in)	2–16%

Table 6. Representative soil features (actual values)

Drainage class	Well drained to excessively drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	11–38 in
Soil depth	11–38 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–3%
Available water capacity (0-80in)	1–4.5 in
Soil reaction (1:1 water) (0-10in)	3.5–6
Subsurface fragment volume <=3" (0-80in)	1–20%
Subsurface fragment volume >3" (0-80in)	0–85%

Ecological dynamics

U.S. National Vegetation Classification (USNVC) associations that are consistent with reference conditions on this ecological site include CEGL006281 *Quercus montana* - *Quercus alba* / *Oxydendrum arboreum* / *Vitis rotundifolia*, which is typical of ridgetops and east-facing slopes. North-facing slopes are often represented by the very similar CEGL004415 *Quercus montana* - *Quercus alba* / *Oxydendrum arboreum* / *Kalmia latifolia*. On west-facing or south-facing slopes, pines generally become more abundant. Here, CEGL004148 *Quercus montana* - *Pinus echinata* / *Vaccinium pallidum*, or CEGL004446 *Pinus echinata* - *Quercus marilandica* / *Kalmia latifolia* - *Symplocos tinctoria*, may apply. These and other similar associations, are part of the vegetation complex typical of high hills of the Southern Piedmont.

In the western foothills, along the Piedmont-Blue Ridge transition, or on some high monadnocks further east, CEGL007493 *Pinus echinata* - Quercus (montana, falcata) / *Oxydendrum arboreum* / *Vaccinium pallidum* will likely apply to some examples (USNVC 2022).

MATURE FORESTS
The reference state typically has a somewhat open tree canopy and is dominated by dry-site oaks, or a mixture of dry-site oaks and pines. Though the natural vegetation often includes species with Blue Ridge affinities, such as chestnut oak (*Quercus montana*),

these elements are very seldom as abundant as they are in the Blue Ridge proper.

On account of the shallow effective rootzone and nutrient-poor substrate, trees grow slowly and generally have a stunted appearance. Species diversity tends to be very low in the canopy layer. Typical species include chestnut oak (*Quercus montana*), scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), and black oak (*Quercus velutina*). Pines (*Pinus virginiana*, *P. echinata*, *P. strobus*) are consistent in the canopy but their importance varies depending on aspect.

On south-facing exposures, the canopy tends to be more open and trees conspicuously stunted. Here, blackjack oak (*Quercus marilandica*) or post oak (*Quercus stellata*) often become more important, along with pines (*P. virginiana*, *P. echinata*, *P. strobus*). On west-facing exposures, pines are typically even more numerous, and on some of the driest sites, they may be codominant in the canopy.

This ecological site is within the historic range of the American chestnut (*Castanea dentata*), which was reportedly present on prominent ridgetops of the upper Piedmont of Virginia and North Carolina, prior to the early 1900's. In the years that followed, blight infestation decimated American chestnut populations across the eastern United States. On these high ridgetops, American chestnut was among the dominant canopy species, along with chestnut oak, scarlet oak, and several pines. In its place, chestnut oak has come to fill the vacuum, presumably assuming a more dominant role than it had in the past. Occasionally, surviving sprouts of the American chestnut are still observed in these areas, although functionally, the species has been extirpated over the extent of the MLRA.

On the whole, the subcanopy layer tends to be poorly developed. It is dominated by acid-tolerant understory trees, including sourwood (*Oxydendrum arboreum*), flowering dogwood (*Cornus florida*), blackgum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), and red maple (*Acer rubrum*), several of which often take on a shrub-like appearance. Also consistent, though generally of low cover are hickories, including mockernut hickory (*Carya tomentosa*) and pignut hickory (*C. glabra*).

The shrub layer is of variable cover, depending largely on aspect. Typical shrubs include members of the heath family, notably Vaccinium spp., Gaylussacia spp., along with stunted subcanopy species. Blue Ridge blueberry (*Vaccinium pallidum*) and deerberry (*Vaccinium stamineum*) are most consistent in the shrub layer. On protected north-facing slopes, mountain laurel (*Kalmia latifolia*) often dominates in places and can form dense colonies.

As a result of decades of fire suppression, the herb layer is generally sparse and species-poor, with true herbaceous species usually being poorly represented in most contemporary stands. Typically, the herb layer is dominated by scattered ericaceous subshrubs (semi-woody members of the heath family). Representative species include striped prince's pine (*Chimaphila maculata*), trailing arbutus (*Epigaea repens*), and eastern teaberry (*Gaultheria procumbens*). Other species that appear frequently in plot data include western brackenfern (*Pteridium aquilinum*) and little heartleaf (*Hexastylis minor*). Muscadine (*Vitis rotundifolia*) may form a fairly dense ground cover in places, but unlike moister sites, it seldom climbs into trees.

Grasses common to this ecological site, especially where fire has been reintroduced, include species such as little bluestem (*Schizachyrium scoparium*), poverty oatgrass (*Danthonia spicata*), and blackseed speargrass (*Piptochaetium avenaceum*), among others. Forbs that are more abundant in fire-maintained examples include various species of ticktrefoil (Desmodium spp.), lespedeza (Lespedeza spp.), Virginia tephrosia (*Tephrosia virginiana*), anisescented goldenrod (*Solidago odora*), and various other composites (Asteraceae) and leguminous forbs.

DYNAMICS OF NATURAL SUCCESSION AND FIRE ECOLOGY
The exposure of prominent ridges and high hills to the elements makes them particularly susceptible to lightning and wind. They are also subject to the uphill spread of fire, which produces burns of increased speed and intensity.

Historically, oak and oak-pine forests of the Southeast were maintained through recurring fire, either naturally-occurring or introduced by humans. 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 Piedmont uplands, the historical influence of fire on successional dynamics was likely expressed on a continuum, from dry to moist, where moist or sheltered sites were shaped more by gap-driven dynamics and dry or exposed sites more by fire. On intermediate sites, their respective influence on successional dynamics probably fell somewhere in between.

In contemporary upland forests of the Southern Piedmont, an overall shift towards gap-driven successional dynamics (driven largely by windthrow, drought, disease, etc.) has had a homogenizing effect on the upland vegetation of the region, making moist, intermediate, and dry sites more similar to one another than they were in the past.

In most contemporary examples associated with this ecological site, a thick layer of leaf litter and duff has accumulated on the forest floor, suppressing the growth of understory grasses and forbs. Shrubs, vines, and small trees have often grown up in the understory, further constraining herb growth. Over years of fire exclusion, these characteristics have often progressed to such a degree that conditions are no longer conducive to the spread of fire, a phenomenon known as mesophication. In this scenario, when fire is removed for long periods of time, positive feedbacks result in succession toward forest systems that are less apt to burn.

In the past, the routine use of fire by Native Americans, coupled with periodic lightninginduced fires, constrained the growth of understory shrubs and fire-intolerant trees. These fires maintained a more open canopy and promoted a dense herbaceous layer that could efficiently carry fire in future burns. While the historic fire return interval is thought to be relatively similar across most of the Southern Piedmont uplands, drier sites were more prone to fire and hence burned more completely and at higher intensities than moister sites.

Vegetation structure was historically more open throughout the Southern Piedmont uplands, but particularly on drier or more exposed sites. Given the more frequent fire regime of the past, canopy cover was likely more open and more heterogeneous than it is presently, and herb cover higher overall, as per historical accounts and witness tree records.

The reduction in the frequency of fires over the past century has allowed shade-tolerant, fire-sensitive trees such as red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and American holly (*Ilex opaca*) to become more abundant in many upland forests in the Southeast, but they are particularly out of place on dry or exposed sites. Except for in sheltered areas, these thin-barked species would have been largely excluded from the understory of dry upland forests under a more frequent fire regime.

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 (Oosting 1942; Peet and Christensen 1980; Schafale and Weakley 1990; Cowell 1998; Schwartz et al. 2007; Spira 2011; Fleming 2012; Guyette et al. 2012; Schafale 2012a, 2012b; Vander Yacht 2020; Greenberg et al. 2021; Spooner et al. 2021).

SPECIES LIST
Canopy layer: *Quercus montana*, *Quercus coccinea*, *Quercus alba*, *Quercus velutina*, *Quercus marilandica*, *Quercus stellata*, *Pinus echinata*, *Pinus virginiana*, *Pinus strobus*

Subcanopy layer: *Oxydendrum arboreum*, *Cornus florida*, *Nyssa sylvatica*, *Sassafras albidum*, *Acer rubrum*, *Diospyros virginiana*, *Carya tomentosa*, *Carya glabra*, *Prunus serotina*, *Robinia hispida*, *Robinia pseudoacacia*, *Castanea pumila*

Vines/lianas: *Vitis rotundifolia*, *Smilax rotundifolia*, *Smilax glauca*

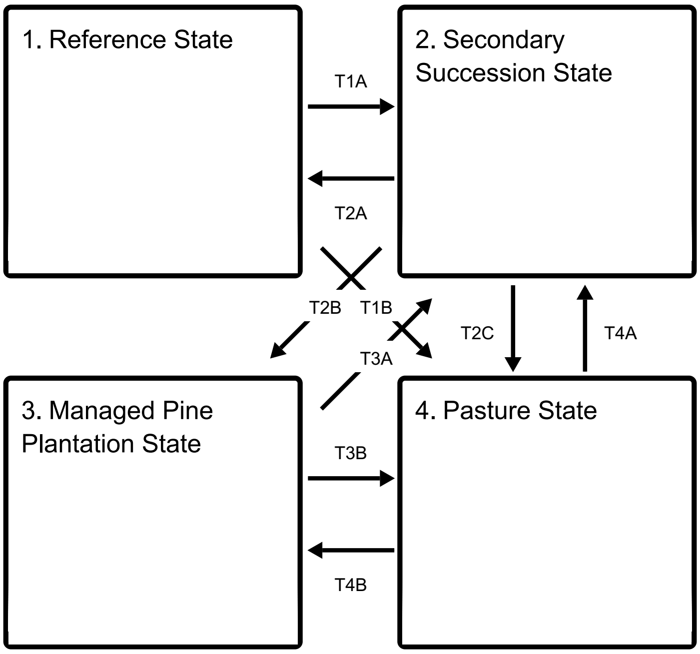
Shrub layer: *Vaccinium pallidum*, *Vaccinium stamineum*, *Gaylussacia baccata*, *Hypericum hypericoides* ssp. multicaule, *Kalmia latifolia*, *Viburnum acerifolium*, *Rhododendron periclymenoides*, *Vaccinium corymbosum*, *Pyrularia pubera*, *Castanea dentata* (stump sprouts), *Rhus glabra*, *Rhus copallinum*, *Rubus allegheniensis*

Herb layer - forbs: *Chimaphila maculata*, *Epigaea repens*, *Tephrosia virginiana*, *Pteridium aquilinum*, *Solidago odora*, *Hexastylis minor*, *Desmodium laevigatum*, Desmodium spp., *Lespedeza virginica*, *Lespedeza hirta*, *Clitoria mariana*, *Baptisia tinctoria*, *Coreopsis* *major*, *Pityopsis aspera*, *Gaultheria procumbens*, *Chrysopsis mariana*, *Cunila origanoides*, *Ageratina aromatica*, *Eupatorium album*, *Euphorbia corollata*, *Hieracium venosum*, *Hieracium gronovii*, *Goodyera pubescens*, *Antennaria plantaginifolia*, *Symphyotrichum undulatum*, *Uvularia puberula*, *Hypoxis hirsuta*, *Iris verna*, *Lilium michauxii*, *Aureolaria virginica*, *Asplenium montanum*, *Hieracium scabrum*, *Spiraea corymbosa*, *Hylotelephium telephioides*, *Comptonia peregrina*

Herb layer - graminoids: *Danthonia spicata*, *Schizachyrium scoparium*, *Piptochaetium avenaceum*, *Scleria oligantha*, *Dichanthelium commutatum*, *Dichanthelium depauperatum*, *Andropogon ternarius*, *Carex nigromarginata*,

State and transition model

Ecosystem states



T1A - Clearcut logging or other large-scale disturbances that cause canopy removal.

T1B - Mechanical tree/brush/stump/debris removal, seedbed preparation, and planting of perennial grasses and forbs.

T2A - Long-term natural succession.

T2B - Site preparation and tree planting.

T2C - Mechanical tree/brush/stump/debris removal, seedbed preparation, and planting of perennial grasses and forbs.

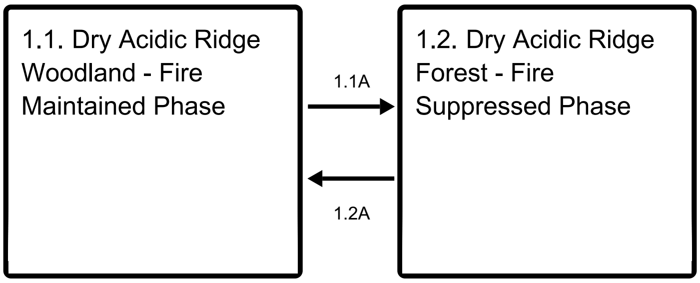
T3A - Abandonment of forestry practices.

T3B - Timber harvest, mechanical stump and debris removal, seedbed preparation, and planting of perennial grasses and forbs.

T4A - Long-term cessation of grazing.

T4B - Site preparation and tree planting.

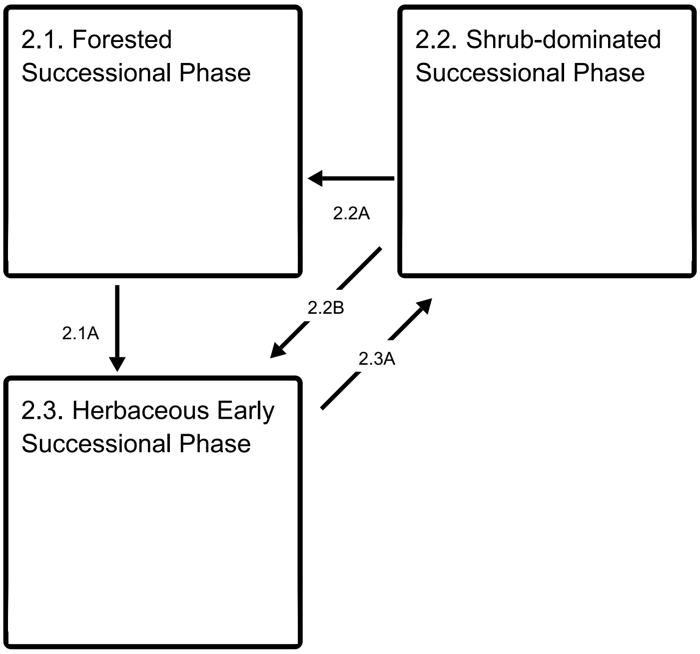
State 1 submodel, plant communities



1.1A - Long-term exclusion of fire.

1.2A - Prescribed burns and selective removals.

State 2 submodel, plant communities



2.1A - Clearcut logging.

2.2A - Natural succession.

2.2B - Brush management.

2.3A - Natural succession.

State 1
Reference State

This mature forest state is generally dominated by dry-site oaks, or a mixture of dry-site oaks and pines, with acid-tolerant flora in the understory.

Characteristics and indicators. Stands are uneven-aged with at least some old trees present.

Community 1.1

Dry Acidic Ridge Woodland - Fire Maintained Phase

This is an open canopy mature forest community/phase. Regular low-intensity fires have been reintroduced, keeping the understory somewhat open, increasing the cover and diversity of herbaceous species and limiting the importance of fire-intolerant woody species.

Resilience management. This community/phase is maintained through regular prescribed burns. The recruitment of fire-adapted oaks and pines benefits from regular low-intensity ground fires, as these forests evolved under a more regular fire regime. Tree ring data suggests that the mean fire return interval of the past in the Southern Piedmont is approximately 6 years, though the actual return interval varied from 3 to 16 years. To approximate the pre-colonial fire regime, prescribed burns should be carried out every 4 to 8 years.

Forest overstory. The overstory is dominated by dry-site oaks, or a mixture of dry-site oaks and pines. Species diversity is very low. Characteristic species include chestnut oak (Quercus montana), scarlet oak (Quercus coccinea), white oak (Quercus alba), black oak (Quercus velutina), Virginia pine (Pinus virginiana), and shortleaf pine (Pinus echinata). Canopy cover is lower than in the fire suppressed phase.

Forest understory. Generally, sourwood (Oxydendrum arboreum) is the most commonly seen understory tree species. Other characteristic species include flowering dogwood (Cornus florida), blackgum (Nyssa sylvatica), sassafras (Sassafras albidum), and common persimmon (Diospyros virginiana), several of which often take on a shrub-like appearance.

Representative understory shrub species include Blue Ridge blueberry (Vaccinium pallidum), deerberry (Vaccinium stamineum), and black huckleberry (Gaylussacia baccata). On protected north-facing slopes, mountain laurel (Kalmia latifolia) often dominates the shrub layer and can form dense colonies.

The herb layer is denser, grassier, and more diverse than in the fire suppressed phase.

Dominant plant species

- chestnut oak (*Quercus montana*), tree
- scarlet oak (*Quercus coccinea*), tree
- white oak (*Quercus alba*), tree
- black oak (*Quercus velutina*), tree
- shortleaf pine (*Pinus echinata*), tree
- sourwood (*Oxydendrum arboreum*), tree
- blackgum (*Nyssa sylvatica*), tree
- common persimmon (*Diospyros virginiana*), tree
- flowering dogwood (*Cornus florida*), shrub
- sassafras (*Sassafras albidum*), shrub
- Blue Ridge blueberry (*Vaccinium pallidum*), shrub

- deerberry (*Vaccinium stamineum*), shrub
- black huckleberry (*Gaylussacia baccata*), shrub
- St. Andrew's cross (*Hypericum hypericoides ssp. multicaule*), shrub
- muscadine (*Vitis rotundifolia*), shrub
- roundleaf greenbrier (*Smilax rotundifolia*), shrub
- blackberry (*Rubus*), shrub
- poverty oatgrass (*Danthonia spicata*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- blackseed speargrass (*Piptochaetium avenaceum*), grass
- littlehead nutrush (*Scleria oligantha*), grass
- variable panicgrass (*Dichanthelium commutatum*), grass
- starved panicgrass (*Dichanthelium depauperatum*), grass
- splitbeard bluestem (*Andropogon ternarius*), grass
- black edge sedge (*Carex nigromarginata*), grass
- Virginia tephrosia (*Tephrosia virginiana*), other herbaceous
- western brackenfern (*Pteridium aquilinum*), other herbaceous
- anisescented goldenrod (*Solidago odora*), other herbaceous
- ticktrefoil (*Desmodium*), other herbaceous
- lespedeza (*Lespedeza*), other herbaceous
- Atlantic pigeonwings (*Clitoria mariana*), other herbaceous
- horseflyweed (*Baptisia tinctoria*), other herbaceous
- greater tickseed (*Coreopsis major*), other herbaceous
- pineland silkgrass (*Pityopsis aspera*), other herbaceous
- Maryland goldenaster (*Chrysopsis mariana*), other herbaceous

Community 1.2
Dry Acidic Ridge Forest - Fire Suppressed Phase

This is a partially open to closed canopy mature forest community/phase. This phase accounts for the majority of contemporary examples. Canopy cover is higher than in stands in which fire has been reintroduced and the herb layer is typically sparser. The understory usually contains a greater proportion of fire-intolerant species.

Forest overstory. The overstory is dominated by dry-site oaks, or a mixture of dry-site oaks and pines. Species diversity is very low. Characteristic species include chestnut oak (Quercus montana), scarlet oak (Quercus coccinea), white oak (Quercus alba), Virginia pine (Pinus virginiana), and shortleaf pine (Pinus echinata). Canopy cover is higher than in the fire maintained phase.

Forest understory. Generally, sourwood (Oxydendrum arboreum) is the most commonly seen understory tree species. Other characteristic species include flowering dogwood (Cornus florida), blackgum (Nyssa sylvatica), sassafras (Sassafras albidum), and common persimmon (Diospyros virginiana), several of which often take on a shrub-like appearance. In the absence of fire, red maple (Acer rubrum) commonly invades the understory of stands associated with this ecological site.

Representative understory shrub species include Blue Ridge blueberry (Vaccinium pallidum), deerberry (Vaccinium stamineum), and black huckleberry (Gaylussacia baccata). On protected north-facing slopes, mountain laurel (Kalmia latifolia) often dominates the shrub layer and can form dense colonies.

The herb layer is sparser, less grassy, and less diverse than in the fire maintained phase.

Dominant plant species

- chestnut oak (*Quercus montana*), tree
- scarlet oak (*Quercus coccinea*), tree
- white oak (*Quercus alba*), tree
- black oak (*Quercus velutina*), tree
- Virginia pine (*Pinus virginiana*), tree
- shortleaf pine (*Pinus echinata*), tree
- sourwood (*Oxydendrum arboreum*), tree
- blackgum (*Nyssa sylvatica*), tree
- red maple (*Acer rubrum*), tree
- flowering dogwood (*Cornus florida*), shrub
- Blue Ridge blueberry (*Vaccinium pallidum*), shrub
- deerberry (*Vaccinium stamineum*), shrub
- black huckleberry (*Gaylussacia baccata*), shrub
- muscadine (*Vitis rotundifolia*), shrub
- mountain laurel (*Kalmia latifolia*), shrub
- rhododendron (*Rhododendron*), shrub
- roundleaf greenbrier (*Smilax rotundifolia*), shrub
- poverty oatgrass (*Danthonia spicata*), grass
- rosette grass (*Dichanthelium*), grass
- black edge sedge (*Carex nigromarginata*), grass
- striped prince's pine (*Chimaphila maculata*), other herbaceous
- trailing arbutus (*Epigaea repens*), other herbaceous
- western brackenfern (*Pteridium aquilinum*), other herbaceous
- little heartleaf (*Hexastylis minor*), other herbaceous
- eastern teaberry (*Gaultheria procumbens*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Long-term exclusion of fire causes an increase in fire-intolerant understory species and a deterioration of the abundance and diversity of herbaceous species.

Pathway 1.2A
Community 1.2 to 1.1

The fire suppressed phase can be managed towards the fire maintained phase through a combination of prescribed burns and selective removals. To approximate the pre-colonial fire regime, prescribed burns should be carried out every 4 to 8 years.

Context dependence. After decades of fire suppression, most upland forests of the Southeast have undergone mesophication, or succession toward forest systems that are less apt to burn. If prescribed fire is to be used as a management tool in fire suppressed ecosystems of the Piedmont, planning will be needed in some forest systems to overcome the effects of mesophication in the early stages of fire reintroduction.

State 2
Secondary Succession State

This successional phase develops in the wake of clearcut logging, storm-related catastrophic tree mortality, or other large-scale disturbances that have led to canopy removal in the recent past. Which species colonize a particular location in the wake of a disturbance does involve a considerable degree of chance. It also depends a great deal on the type, duration, and magnitude of the disturbance event.

Characteristics and indicators. Plant age distribution is even. Plants exhibit pioneering traits such as rapid growth, early reproduction, and shade-intolerance.

Community 2.1
Forested Successional Phase

This successional phase develops in the wake of recent, large-scale disturbances which have resulted in canopy removal. Stands are even-aged and species diversity is low. The canopy is usually dominated by pines, with hardwoods confined mostly to the understory. Species that exhibit pioneering traits are usually most abundant.

Forest overstory. The overstory is dominated by pines, including Virginia pine (Pinus virginiana), shortleaf pine (P. echinata), or eastern white pine (Pinus strobus).

Forest understory. Common understory tree species include sassafras (Sassafras albidum), blackgum (Nyssa sylvatica), red maple (Acer rubrum), and flowering dogwood (Cornus florida). Seedlings of dry-site oaks are usually present in the understory. These seedlings are released gradually as the forest matures and the pines begin to die off.

In the shrub layer, representative species include various blueberries (Vaccinium spp.), along with stunted subcanopy species, and several vines.

Dominant plant species

- Virginia pine (*Pinus virginiana*), tree
- shortleaf pine (*Pinus echinata*), tree

- sassafras (*Sassafras albidum*), tree
- blackgum (*Nyssa sylvatica*), tree
- red maple (*Acer rubrum*), tree
- sourwood (*Oxydendrum arboreum*), tree
- common persimmon (*Diospyros virginiana*), tree
- flowering dogwood (*Cornus florida*), tree
- eastern white pine (*Pinus strobus*), tree
- oak (*Quercus*), tree
- blueberry (*Vaccinium*), shrub
- muscadine (*Vitis rotundifolia*), shrub
- sassafras (*Sassafras albidum*), shrub
- greenbrier (*Smilax*), shrub
- poverty oatgrass (*Danthonia spicata*), grass
- rosette grass (*Dichanthelium*), grass
- striped prince's pine (*Chimaphila maculata*), other herbaceous
- trailing arbutus (*Epigaea repens*), other herbaceous

Community 2.2
Shrub-dominated Successional Phase

This successional phase is dominated by shrubs and vines, along with seedlings of opportunistic hardwoods and pines. It grades into the forested successional phase as tree seedlings become saplings and begin to occupy more of the canopy cover.

Forest overstory. Species composition varies considerably from location to location.

Dominant plant species

- Virginia pine (*Pinus virginiana*), tree
- blackgum (*Nyssa sylvatica*), tree
- black locust (*Robinia pseudoacacia*), tree
- common persimmon (*Diospyros virginiana*), tree
- sourwood (*Oxydendrum arboreum*), tree
- muscadine (*Vitis rotundifolia*), shrub
- greenbrier (*Smilax*), shrub
- blackberry (*Rubus*), shrub
- sassafras (*Sassafras albidum*), shrub
- winged sumac (*Rhus copallinum*), shrub
- St. Johnswort (*Hypericum*), shrub
- smooth sumac (*Rhus glabra*), shrub
- broomsedge bluestem (*Andropogon virginicus*), grass
- lespedeza (*Lespedeza*), other herbaceous
- thoroughwort (*Eupatorium*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- ticktrefoil (*Desmodium*), other herbaceous
- aster (*Symphyotrichum*), other herbaceous

Community 2.3
Herbaceous Early Successional Phase

This transient community is composed of the first herbaceous invaders in the aftermath of clearcut logging or other large-scale natural disturbances that lead to canopy removal.

Resilience management. If the user wishes to maintain this community/phase for wildlife or pollinator habitat, a prescribed burn, mowing, or prescribed grazing will be needed at least once annually to prevent community pathway 2.3A. To that end, as part of long-term maintenance, periodic overseeding of wildlife or pollinator seed mixtures can be helpful in ensuring the viability of certain desired species and maintaining the desired composition of species for user goals.

Dominant plant species

- grape (*Vitis*), shrub
- greenbrier (*Smilax*), shrub
- broomsedge bluestem (*Andropogon virginicus*), grass
- splitbeard bluestem (*Andropogon ternarius*), grass
- hairy crabgrass (*Digitaria sanguinalis*), grass
- smooth crabgrass (*Digitaria ischaemum*), grass
- southern crabgrass (*Digitaria ciliaris*), grass
- goldenrod (*Solidago*), other herbaceous
- thoroughwort (*Eupatorium*), other herbaceous
- lespedeza (*Lespedeza*), other herbaceous
- ticktrefoil (*Desmodium*), other herbaceous
- common mullein (*Verbascum thapsus*), other herbaceous
- Virginia dwarfdandelion (*Krigia virginica*), other herbaceous
- aster (*Symphyotrichum*), other herbaceous
- Canadian horseweed (*Conyza canadensis*), other herbaceous

Pathway 2.1A
Community 2.1 to 2.3

The forested successional phase can return to the herbaceous early successional phase through clearcut logging or other large-scale disturbances that cause canopy removal.

Context dependence. Note: if the user wishes to use this community pathway to create wildlife or pollinator habitat, please contact a local NRCS office for a species list specific to the area of interest and user needs.

Pathway 2.2A
Community 2.2 to 2.1

The shrub-dominated successional phase naturally moves towards the forested successional phase through natural succession.

Pathway 2.2B
Community 2.2 to 2.3

The shrub-dominated successional phase can return to the herbaceous early successional phase through brush management, including herbicide application, mechanical removal, prescribed grazing, or fire.

Context dependence. Note: if the user wishes to use this community pathway to create wildlife or pollinator habitat, please contact a local NRCS office for a species list specific to the area of interest and user needs. If the user wishes to maintain the shrub-dominated successional phase long term, for wildlife habitat or other uses, periodic use of this community pathway is necessary to prevent community pathway 2.2A, which happens inevitably unless natural succession is set back through disturbance.

Pathway 2.3A
Community 2.3 to 2.2

The herbaceous early successional phase naturally moves towards the shrub-dominated successional phase through natural succession. The process takes approximately 3 years on average, barring any major disturbances capable of inhibiting natural succession.

State 3
Managed Pine Plantation State

This converted state is dominated by planted timber trees. Commonly planted species include loblolly pine (*Pinus taeda*), Virginia pine (*Pinus virginiana*), and eastern white pine (*Pinus strobus*). Even-aged management is the most common timber management system. Note: if the user wishes to convert stands dominated by hardwoods to planted pine, clearcutting will usually be necessary first, allowing herbaceous pioneers to establish on the site in the weeks or months prior to planting. Users should utilize measures described in transition T2B under these circumstances.

Resilience management. Hardwood Encroachment: Hardwood encroachment can be problematic in managed pine plantations. Good site preparation, proper stocking, and periodic thinning are advisable to reduce hardwood competition. Overstocking: The overstocked condition commonly occurs in naturally regenerated stands. When competition from other pines begins to impact the health and productivity of the stand, precommercial thinning should be considered. At this point, the benefit of thinning usually outweighs the potential for invasion and competition from non-pine species. As the target window for thinning passes, the condition of the stand can slowly deteriorate if no action is taken. Under long-term overstocked conditions, trees are more prone to stresses, including pine bark beetle infestation and damage from wind or ice. High-grading: In subsequent commercial thinnings, care should be taken in tree selection. High quality specimens should be left to reach maturity, while slower growing trees or those with defects should be removed sooner. If high quality specimens are harvested first, trees left behind are often structurally unsound, diseased, genetically inferior, or of poor form. This can have long-term implications for tree genetics and for the condition of the stand (Felix III 1983; Miller et al. 1995, 2003; Megalos 2019).

Dominant plant species

- loblolly pine (*Pinus taeda*), tree
- Virginia pine (*Pinus virginiana*), tree
- eastern white pine (*Pinus strobus*), tree
- blackgum (*Nyssa sylvatica*), tree
- sassafras (*Sassafras albidum*), tree
- red maple (*Acer rubrum*), tree
- oak (*Quercus*), tree
- blueberry (*Vaccinium*), shrub
- muscadine (*Vitis rotundifolia*), shrub
- greenbrier (*Smilax*), shrub
- blackberry (*Rubus*), shrub
- St. Johnswort (*Hypericum*), shrub
- rosette grass (*Dichanthelium*), grass
- poverty oatgrass (*Danthonia spicata*), grass
- striped prince's pine (*Chimaphila maculata*), other herbaceous

State 4
Pasture State

This converted state is dominated by herbaceous forage species.

Dominant plant species

- dallisgrass (*Paspalum dilatatum*), grass
- purpletop tridens (*Tridens flavus*), grass
- hairy crabgrass (*Digitaria sanguinalis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- broomsedge bluestem (*Andropogon virginicus*), grass
- Bermudagrass (*Cynodon dactylon*), grass
- smooth crabgrass (*Digitaria ischaemum*), grass
- white clover (*Trifolium repens*), other herbaceous
- Japanese clover (*Kummerowia striata*), other herbaceous
- sericea lespedeza (*Lespedeza cuneata*), other herbaceous
- black medick (*Medicago lupulina*), other herbaceous
- field clover (*Trifolium campestre*), other herbaceous

- narrowleaf plantain (*Plantago lanceolata*), other herbaceous

Transition T1A
State 1 to 2

The reference state can transition to the secondary succession state through clearcut logging or other large-scale disturbances that cause canopy removal.

Transition T1B
State 1 to 4

The reference state can transition to the pasture/hayland state through 1) mechanical tree/brush/stump/debris removal, 2) seedbed preparation, and 3) planting of perennial grasses and forbs.

Context dependence. Herbicide applications, fire, and/or root-raking can be helpful in transitioning treed land to pasture. This is done in part to limit coppicing, as many woody plants are capable of sprouting from residual plant structures left behind after clearing. Judicious use of root-raking is recommended, as this practice can have long-term repercussions with regard to soil structure. Applications of fertilizer and lime can also be helpful in establishing perennial forage species. Grazing should be deferred until grasses and forbs are well established.

Transition T2A
State 2 to 1

The secondary succession state can transition to the reference state through long-term natural succession. This process can be accelerated to some degree by a combination of prescribed burns and selective harvesting of pines and opportunistic hardwoods.

Transition T2B
State 2 to 3

The secondary succession state can transition to the managed pine plantation state through site preparation and planting of timber trees. Thinning alone may be sufficient for portions of the forest if pines have already established, though it is rarely sufficient for an entire forest patch.

Transition T2C
State 2 to 4

The secondary succession state can transition to the pasture/hayland state through through 1) mechanical tree/brush/stump/debris removal, 2) seedbed preparation, and 3) planting of perennial grasses and forbs.

Context dependence. A broad spectrum herbicide, fire, and/or root-raking can be helpful in transitioning wooded or semi-wooded land to pasture. This is done in part to limit coppicing, as many woody pioneers are capable of sprouting from residual plant structures left behind after clearing. Judicious use of root-raking is recommended, as this practice can have long-term repercussions with regard to soil structure. Applications of fertilizer and lime can also be helpful in establishing perennial forage species. Grazing should be deferred until grasses and forbs are well established.

Transition T3A
State 3 to 2

The managed pine plantation state can transition to the secondary succession state through abandonment of forestry practices (with or without timber tree harvest).

Transition T3B
State 3 to 4

The managed pine plantation state can transition to the pasture/hayland state through 1) timber harvest, 2) mechanical stump and debris removal, 3) seedbed preparation, 4) planting of perennial grasses and forbs.

Context dependence. Applications of fertilizer and lime can be helpful in establishing perennial forage species. Grazing should be deferred until grasses and forbs are well established.

Transition T4A
State 4 to 2

The pasture/hayland state can transition to the secondary succession state through long-term cessation of grazing.

Transition T4B
State 4 to 3

The pasture/hayland state can transition to the managed pine plantation state through site preparation and tree planting.

Additional community tables

Inventory data references

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

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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	05/21/2025
Approved by	Charles Stemmans
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:**