Ecological site F148XY031PA
Hydric, Triassic, Riparian Zone, Swamp Meadow-Shrub-Forest

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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): 148X–Northern Piedmont

This ecological site description was developed for the Northern Piedmont Major Land Resource Area (MLRA) 148 as defined by USDA Handbook 296. The Northern Piedmont is a major land resource area within the North Atlantic Slope Diversified Farming Land Resource Region (LRR). The Northern Piedmont MLRA extends from northeast to southwest for approximately 325 miles (525 km) and is approximately 100 miles (160 km) inland from the Atlantic coast. It is approximately 12,800 square miles (33,150 square kilometers) and is spread across portions of Virginia (30%), Maryland (21%), Pennsylvania (38%), Delaware (1%), and New Jersey (10%) (USDA-NRCS, 2006).

Most of the land in the Northern Piedmont is privately owned. Farming is highly diversified, and common crops include truck crops, horticultural trees, fruits, soybeans, grain, forage, poultry, beef, and dairy cattle. The Washington D.C. to Boston “megalopolis” development corridor dominates an important extent of the land (1/3 or more), and urban areas are encroaching on farmland and woodlands across the region. The remaining forests commonly are on steep slopes, rocky soils, or riparian zones where both agriculture and development are difficult (USDA-NRCS, 2006; Woods et al., 1999).

The extent to which indigenous peoples altered the precolonial vegetation of the region is unclear. Some evidence indicates that savannah-like woodlands and grasslands occupied portions of the Northern Piedmont at the onset of European settlement. The evidence suggests that the indigenous communities may have used fire as a land-management tool.

The vegetation communities across the Northeast began experiencing significant influences from European settlers in approximately 1650. These influences included widespread agricultural land clearing, forest harvesting, charcoal production, and the introduction of exotic species, insects, and disease vectors, especially chestnut blight. The loss of American chestnut has been significant across the entire eastern United States. This loss, however, may be less ecologically significant in portions of the Northern Piedmont. For example, little evidence exists to suggest that American chestnut was an important constituent of forests growing on soils derived from carbonate parent materials (Virginia DCR, 2016).

The acreage of forest across the Northern Piedmont reached its low in the mid-nineteenth century. The acreage then increased as agriculture expanded to the Midwest and industrialization concentrated populations into urban areas. The Northern Piedmont includes some of the most productive farmland in the East, so farm abandonment was not as common in MLRA 148 as in other parts of the Northeast. Regionally, widespread farm abandonment led to a trend of reforestation. The recovering forest appears to have included all native forest species, with the notable exception of American chestnut. The proportions, however, were different (maples are notably more common) and more homogenous. The current forest vegetation communities in the Northern Piedmont likely do not show the same level of sorting by local climatic and edaphic factors as influenced precolonial forest composition. Urban sprawl is once again removing land from vegetation cover, but, in the Northern Piedmont, this impact is on both forested and agricultural lands. Additionally, the continued and increasing introduction of exotic and invasive plants, insects, and disease vectors remains a profound threat to forest stability (Thompson et al., 2013).

In the Northern Piedmont, Pinus virginiana (Virginia pine) and Liriodendron tulipifera (tulip-poplar) are common early-successional forest pioneers, especially on uplands. The composition of the more mature forest stands tends to vary with soils, topography, and succession. Dry, nutrient poor sites tend to be dominated by an oak-heath forest community. More mesic sites on soils that have a more basic chemistry tend to support an oak-hickory forest cover. Quercus alba (white oak) is a relative generalist, and it is a common component in all types of upland oak forest of the Northern Piedmont. Quercus rubra (northern red oak) and Quercus velutina (black oak) commonly join the overstory on mesic and submesic sites. Quercus montana (chestnut oak), Quercus coccinea (scarlet oak), and Quercus falcata (southern red oak) prefer drier sites. Quercus stellate (post oak) and Quercus marilandica var. marilandica (blackjack oak) tend to do well on the most drought-prone sites.

Carya (hickories) show a preference for sites that have a higher base saturation, so they are common in both the overstory and understory of the more basic oak-hickory types. Overall species richness tends to be higher on these higher base saturation sites as well. Common constituents include Carya ovata (shagbark hickory), Fraxinus americana (white ash), and Cercis canadensis var. canadensis (eastern redbud). Ericaceous (heather) shrubs tend to be absent on these alkaline sites, but herbaceous species richness tends to be high. Hickories are also common on intermediate oak-hickory sites. The understories, however, are more dominated by Cornus florida (flowering dogwood), Viburnum acerifolium (mapleleaf viburnum), and dry-mesophytic herbaceous generalists.

Most oak-heath forests support few hickories and have few herbaceous species in the understory. These forest communities tend to have an understory dominated by Acer rubrum (red maple), Nyssa sylvatica (blackgum), and deciduous ericad (plants that dislike alkaline soils) shrubs, such as Vaccinium pallidum (early lowbush blueberry), Gaylussacia baccata (black huckleberry), and other heathers (Virginia DCR, 2016).

In cool, moist ravines that have acidic soils, a mesic mixed hardwood forest of American beech (Fagus grandifolia), white oak, northern red oak, and tulip-poplar is common. This forest community is thought to be replacing upland oak-hickory forests in many areas where fire has been excluded for long periods or where oak recruitment has declined for other reasons (Zimmerman et al., 201). In cool, moist ravines that have more mafic or calcareous substrates, similar mesic mixed hardwood forests also commonly include Fraxinus americana (white ash), Carya cordiformis (bitternut hickory), Tilia americana (basswood), Quercus muehlenbergii (chinquapin oak), Acer saccharum (sugar maple), and dense, species-rich understories where overstory shade is not too extreme.

Riparian forests and flood-plain forests grow widely across the Northern Piedmont. Along larger rivers, these forests tend to be dominated by flood-tolerant trees, such as Acer saccharinum (silver maple), Platanus occidentalis (sycamore), Ulmus americana (American elm), Acer negundo (eastern boxelder), Celtis occidentalis (common hackberry), and Betula nigra (river birch). In high energy environments, these flood-plain forest types are commonly broken by flood-scoured deposition bars, outcrops, and early successional vegetation communities. Along stretches that do not flood as deeply, hydrophytic oaks—such as Quercus palustris (pin oak), Quercus bicolor (swamp white oak), Quercus phellos (willow oak), Quercus lyrata (overcup oak), and Quercus michauxii (swamp chestnut oak)—may dominate the overstory, and Carex (sedges) commonly form large, dense understory communities.

Some additional minor, small-patch forest types (such as eastern white pine-hardwood types and eastern hemlock-hardwood types) and some rock outcrop barrens are scattered across the Northern Piedmont in isolated areas. The eastern hemlock ecological communities are much more consistent with the MLRA concepts of the Northern Blue Ridge and the Ridge and Valley. In the Northern Piedmont, the eastern hemlock communities are thought to represent the last vestiges of a community that is migrating to cooler sites in response to global climate change over the past several thousand years (Virginia DCR, 2016).

Classification relationships

Several modern classification systems for vegetation are used across the United States. The Federal Geographic Data Committee suggests that the U.S. National Vegetation Classification (USNVC) should be the Federal standard. An analysis of the existing vegetation cover using the U.S. Geological Survey, Gap Analysis Program (2011) indicates that the natural vegetation areas in the Northern Piedmont MLRA are predominantly Appalachian-Northeastern Oak-Hardwood-Pine Forest and Woodland (USNVC Macrogroup, 502). A few additional USNVC macrogroups are also present. On a finer scale, USNVC Groups 15 and 650 dominate nearly all site types across the MLRA. This dominance supports the theory that extreme anthropogenic disturbances near the turn of the century significantly homogenized the forests of this region. At any specific field site, existing vegetation may not be a good indication of the best suited potential vegetation. Representative USNVC groups are listed for each ecological site. Groups have been identified by analyzing both existing vegetation cover indicated by GAP/Landfire (USGS, 2011) as well as the vegetation inventory data from the Natural Heritage programs.

The Northern Piedmont MLRA as defined in USDA Handbook 296 (USDA-NRCS, 2006) very nearly matches the Northern Piedmont Level III Ecoregion as defined by the U.S. Environmental Protection Agency. The U.S. EPA Level III Ecoregions have also been further subdivided into Level IV Ecoregions. Within MLRA 148 Northern Piedmont, the EPA Level IV Ecoregions are:

- Triassic Lowlands
- Trap Rock (Diabase) and Conglomerate Uplands
- Piedmont Uplands
- Piedmont Limestone/Dolomite Lowlands
- Passaic Basin Freshwater Wetlands

These Level IV Ecoregions explain much of the ecological variation across the MLRA and have been used extensively to assist with defining the Ecological Sites.

Triassic Lowlands
The Triassic Lowlands are dominated by Alfisols derived from Triassic sedimentary rocks. These soils are relatively fertile and typically have a moderate to high level of base saturation in the subsoil. The landscape is comparatively flat and is not highly dissected. The region is characterized by wide undulating ridges; broad, nearly level valleys; and limited local relief. Streams and wetlands are important in the Triassic Lowlands. Wetlands are becoming rarer, especially adjacent to the urban sprawl of megalopolis (Woods et al., 1999).

Trap Rock and Conglomerate Uplands
The Trap Rock and Conglomerate Uplands are often also referred to as the Diabase and Conglomerate Uplands. Trap rock is a common term for diabase and other mafic igneous intrusions. This landscape was developed during the Triassic and Jurassic eras as diabase sills, and dikes intruded the sedimentary rocks of the surrounding Triassic Lowlands. The landscape is characterized by wooded, stony hills and steep ridges underlain by a mixture of highly resistant rocks rising relatively sharply above the Triassic Lowlands. The soils are mostly thin (shallow), fine-textured, clayey, non-acidic Alfisols that are hard to till and best suited to forest or pasture. The forests of these uplands are somewhat distinct from those of the rest of the Northern Piedmont because acid loving plants are largely absent, especially on soils derived from diabase. Woodlands continue to be comparatively common in this landscape, especially on steep slopes and in areas where surface rocks and boulders are common (Woods et al., 1999).

Piedmont Uplands
The Piedmont Uplands are dominated by deep Ultisols and Inceptisols that developed from crystalline bedrock. The Piedmont Uplands have substantially higher relief than the Triassic Lowlands. The region is characterized by rounded hills, low ridges, and narrow valleys. The eastern edge of the piedmont creates a relatively abrupt “fall line” as the landscape drops down to the adjacent sediments of the coastal plain. The drop includes high stream gradient, waterfalls, and exposed bedrock. Due to the mixed source materials, the mineralogy of the soils of the Piedmont Uplands varies. The typical piedmont upland is comprised of soils derived from felsic crystalline rocks, but some piedmont soils are derived from more mafic rocks. Some locations have chrome soils derived from ultra-mafic serpentine, which is low in calcium but high in magnesium, chromium, and nickel. Variations in geologic parent material commonly create soils that support corresponding variations in vegetation communities. Serpentine soils support unique “barrens” vegetation communities of oak and pine, greenbrier, and prairie grass (Woods et al., 1999).

Piedmont Limestone/Dolomite Lowlands
The Piedmont Limestone/Dolomite Lowlands are comprised of Hapludalfs derived from carbonate bedrock. Hapludalfs are soils that have a horizon of clay accumulation with a significant decrease in clay content within a depth of 150 centimeters. The soils are potentially highly fertile. The carbonate bedrock weathered to create a landscape of undulating terrain that includes karst features, such as sinkholes, caves, and underground streams. Nearly all the forests on these carbonate lowlands have been replaced by agriculture. This is one of the most productive farming regions of the eastern United States. The predominant natural vegetation community is oak forests dominated by red oak and white oak, but the flora on these basic carbonate soils is distinct from the heath communities on the acidic and less fertile soils of the surrounding areas (Woods et al., 1999).

The Northern Piedmont (MLRA 148) is within the U.S. Forest Service Eastern Broadleaf Forest Province (biome). The Eastern Broadleaf Forest Province is mesophytic and dominated by the drought-resistant oak-hickory forest association, which includes Quercus alba (white oak), Quercus rubra (northern red oak), Quercus falcate (southern red oak), Quercus velutina (black oak), Carya cordiformis (bitternut hickory), and Carya ovata (shagbark hickory). It has well-developed understories of Cornus spp. (dogwood), Sassafras albidum (sassafras), and Carpinus spp. and Ostrya spp. (hornbeam). Ulmus americana (American elm), Liriodendron tulipifera (tuliptree), and Liquidambar styraciflua (sweetgum) are common on somewhat richer sites (Bailey, 1995).

As defined by USDA (USDA-NRCS, 2006), MLRA 148, the Northern Piedmont, coincides well with the U.S. Forest Service ecological section the Northern Appalachian Piedmont. The northwest corner of MLRA 148 also includes a small portion of the Lower New England ecological section (the Reading Prong), where some glacial landforms intermingle with typical piedmont landforms. The main cover types in Northern Appalachian Piedmont Section, as defined by the U.S. Forest Service, are oak-hickory and loblolly-shortleaf pine (McNab et al., 2007).

U.S. Forest Service ecological subsections that coincide with MLRA 148 include the Reading Prong Subsection of the Lower New England Section, the Gettysburg Piedmont Lowland, the Northern Piedmont, the Piedmont Upland, and the Triassic Basins. Note the high level of coincidence between the U.S. Forest Service ecological subsections and the EPA level IV ecoregions.

Ecological site concept

This ecological site is highly variable, occupies a variety of landscape positions, and supports a variety of vegetation communities. Many vegetation communities on these hydric sites grow both on flood plains and in isolated upland basins. The hydric riparian zone sites all represent locations where the soils are hydric. They are in areas of flood plains, oxbows, back channels, slack waters, extensive wetland complexes, springs, seeps, stream heads, depressions behind levees, and other isolated basins commonly associated with impoundments. On flood plains, the hydric riparian zone sites are where the soil is frequently saturated for long periods. Many of these sites are either in protected areas of slower flow or in distance slack-water locations, such as oxbows. Some hydric sites experience seasonal wet-dry cycles (especially dry periods in late summer), but all meet hydric soil criteria. Hydric riparian zone sites tend to be at or slightly below the water level in areas where frequency and duration of flooding are high.

Distribution of flood energy directly affects particle-size distribution during deposition. The resulting variations in soil texture can significantly affect vegetation communities. Soils on the ecologically hydric riparian zone sites are either (nearly) permanently saturated or inundated, or they are fine textured soils with impeded drainage overlain by (sometimes thick) fibric organic materials. Persistent saturation tends to increase the accumulation of any layer of fibrous organic material in comparison to more mesic riparian sites. Exposure to flood energy has the potential to scour out fibric surface materials.

Vegetation communities in the riparian zone are highly influenced by hydrography, especially duration of soil saturation and exposure to flood energy. In very general terms, vegetation communities that are closer to a body of water are likely to be flooded more often, for longer periods of time, and with a higher energy disturbance than those communities that are farther away. Flowing water (streams and rivers) exerts higher energy disturbance than standing water (lakes and ponds). The larger the stream, upstream watershed, valley-or-channel-width restriction, and stream gradient, the greater the increase in frequency, duration, and energy of disturbance of flooding. Regional climate across the Northern Piedmont makes flood-entrained ice (with its unique scouring potential) a notable possibility during winter and spring flooding.

The impact of hydric soil conditions on vegetation community composition commonly overwhelms any potential impact of soil and soil water chemistry, so many hydric communities that are on typic Piedmont-felsic sites are also on sites with a high base saturation. As such, there are phases for most of these sites to reflect generalist vegetation communities as well as those communities with a greater affinity to the chemistry of the geologic parent material (Zimmerman et al., 2012).

This ecological site corresponds with:

US National Vegetation Classification (USGS, 2011)

• Oak-Hickory (USNVC Groups 15 and 650)
• Swamp Chestnut Oak-Laurel Oak-Sweetgum Floodplain Forest (USNVC Group 34)
• Silver Maple-Green Ash-American Sycamore Floodplain Forest (USNVC Group 652)
• Silver Maple-Green Ash-Black Ash Floodplain Forest (USNVC Group 653)
• Silver Maple-Sugarberry-Sweetgum Floodplain Forest (USNVC Group 673)
• Red Maple-Swamp White Oak-American Beech (Central Hardwood) Flatwoods & Swamp Forest (USNVC Group 597)

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Northern Piedmont (MLRA 148) is surrounded by the Northern Appalachian Ridges and Valleys (MLRA 147), the Northern Blue Ridge (MLRA 130A), the Northern Coastal Plain (MLRA 149A), the Southern Piedmont (MLRA 136), and the New England and eastern New York Uplands (MLRA 144A). From the northwest to southeast, the landscape transitions between three dominant physiographic regions: mountains, piedmont, and coastal plain. This transition is much narrower across the Northern Piedmont than across the Southern Piedmont. The Northern Piedmont has a cooler climate than the Southern Piedmont (MLRA 136). The Northern Piedmont also has taller intrusive dikes and sills of resistant rocks which, along with differential erosion, have created sharp ridges. These ridges have longer and steeper slopes in 148, and are more common in MLRA 148 than in MLRA 136.

The dominant feature (besides climate) that distinguishes the Northern Piedmont from the ecoregions further to the north is that the Northern Piedmont has never been glaciated (with the minor exception of the Reading Prong area). The glaciated regions to the north are dominated by mineral soils that have not yet differentiated into distinct horizons (Entisols). The Northern Piedmont transitions to the west and northwest into the Northern Blue Ridge (MLRA 130A) and Northern Appalachian Ridges and Valleys (MLRA 147), which have increased mountainous topography, and to the east into the flat sedimentary landscapes of the Northern Coastal Plain (USDA-NRCS, 2006).

The Northern Piedmont is a transitional region between the flat coastal plain to the southeast and the mountains to the northwest. It is comprised of low, rounded hills and open valleys. Along the northeast edge of the MLRA, the low areas are below sea level. Some areas have elevations as low as 165 feet below sea level (-51 meters). In the central and western areas of the Northern Piedmont, the highest elevations rise to 2,125 feet (649 meters). These highest elevations are not typical and are formed by diabase intrusions. Crested elevations typically range from about 325 feet (99 meters) on limestone to 1,300 feet (396 meters) on more resistant crystalline rock (Woods et al., 1999).

As a transition zone between distinctly different ecoregions, the Northern Piedmont is a landscape of diverse landforms. Across the MLRA, less than 5 percent of the landscape is covered by depositional landforms and 75 to 95 percent of the landscape is distinctly erosional.

Landform Percent of MLRA
Flat* 3%
Summit 2%
Ridge 15%
Shoulder 2%
Spur 17%
Slope 30%
Hollow 11%
Footslope 3%
Valley 14%
Depression 2%
* Flat landforms include surface water features

The geology of the Northern Piedmont is highly complex and variable. The eastern boundary of the MLRA marks the “fall line;” that is, the transition from the crystalline bedrock of the interior to the Coastal Plain sediments of the east. The eastern third of the MLRA is dominated by metamorphic gabbro, gneiss, serpentine, marble, slate, and schist as well as intrusive granite. The central portions of the Northern Piedmont are comprised of Triassic period sandstone, shale, and conglomerate basin deposits dissected by Jurassic diabase and basalt dikes and sills. The western portion of the Northern Piedmont includes large areas underlain by limestone (USDA-NRCS, 2006; USGS, 2011).

Areas of metamorphic and igneous bedrock are typically covered by a mantle of soil that formed in residuum (Ultisols) and saprolite that weathered in place. Areas of mixed sedimentary rock are typically derived from sediments deposited in basins created by Mesozoic (Triassic and Jurassic) rift-valley drop blocks. The Culpepper Basin is a typical Triassic basin in the Virginia range of the Northern Piedmont.

Ultisols are the dominant soil order in the Northern Piedmont, but Alfisols and Inceptisols are also widespread and locally dominant. Entisols occur locally in high-energy fluvial and colluvial settings (USDA-NRCS, 2006; Virginia DCR, 2016). Ultisols, Alfisols, Inceptisols, and Entisols are 4 of the 12 orders in the USDA system of soil classification. Ultisols have low base status and a clay-enriched subsoil. Alfisols are naturally fertile and have high base saturation and a clay-enriched subsoil horizon. Inceptisols have a weak, but noticeable degree of horizon development. Entisols have little or no horizon development. Details regarding soil classification are available from the USDA (USDA-NRCS, 2018).

The Ultisols in the Northern Piedmont are commonly leached, acidic, and infertile (deficient in calcium, magnesium, potassium, and total base saturation) and have well-developed, red or yellowish red, clay subsurface horizons. The Alfisols tend to be deep, well-developed, and moderately to highly fertile, especially those soils that have a high base saturation and that formed in material weathered from calcareous or mafic bedrock. The Inceptisols vary highly in texture and composition. In the Northern Piedmont, they are most common on the erosive slopes of the inner (western) Piedmont foothills.

Udalfs, Udults, Udepts, and fragipans are common across the North Atlantic Slope Diversified Farming Region (of which the Northern Piedmont is a sub-division). In low, wet depressions, Aquults and Aquepts are common. Udepts and Fluvents are typically on flood plains and in riparian areas. The soil temperature regime is predominantly mesic. The soil moisture regime is predominantly udic, and the dominant soil mineralogy across the region is micaceous, kaolinitic (Ultisols), or mixed (Alfisols and Inceptisols) (USDA-NRCS, 2006).

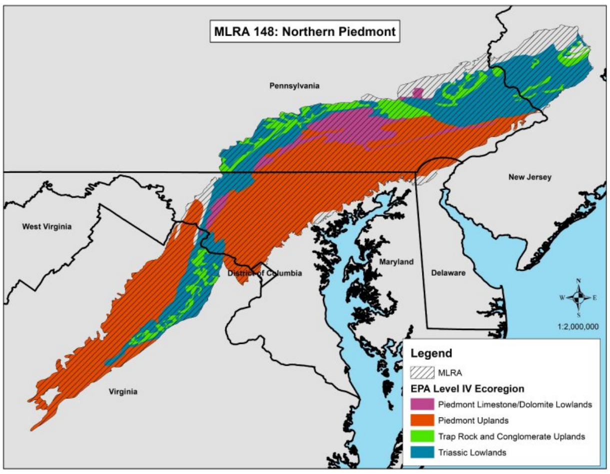


Figure 1. EPA Level IV ecoregions across MLRA 148.

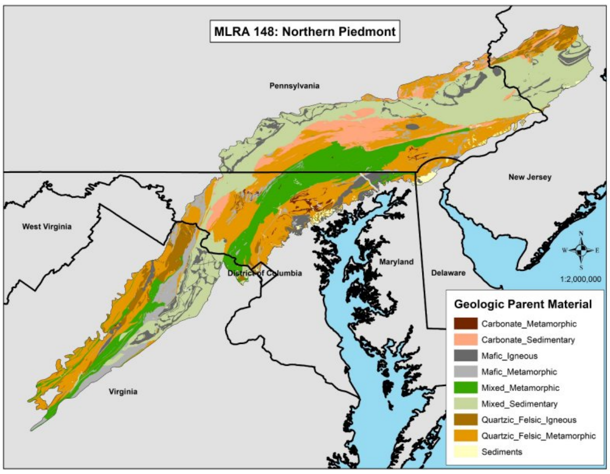


Figure 2. Geologic parent material across MLRA 148.

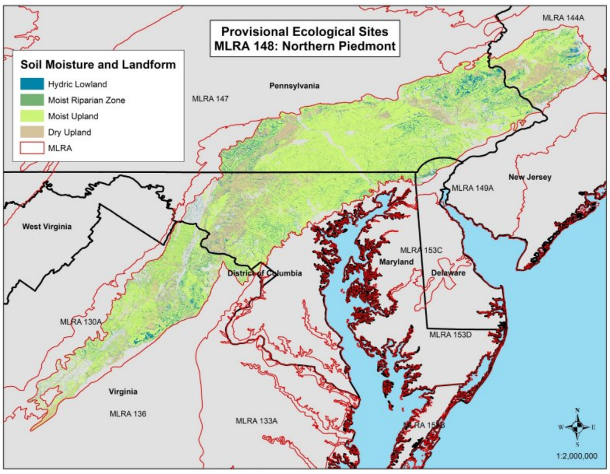


Figure 3. Ecological Site soil moisture and landform groups across MLRA 148.

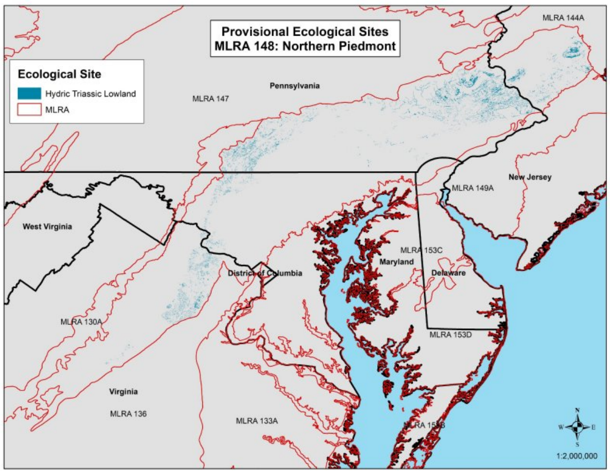


Figure 4. The Hydric Triassic Lowland Ecological Site footprint.

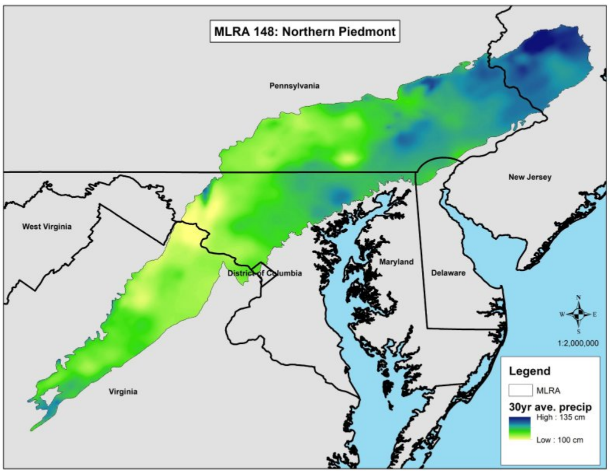


Figure 5. PRISM 30 year mean annual precipitation across MLRA 148.

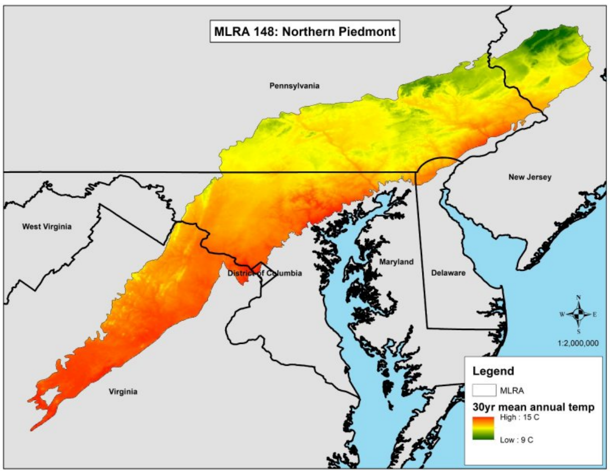


Figure 6. PRISM 30 year mean annual temperature across MLRA 148.

Climatic features

The climate of the Northern Piedmont is humid, temperate, and continental with variable weather patterns across the region. The four seasons are distinctly different. Winters are cold and moist. Occasionally, the jet stream dips south over the Northern Piedmont during the winter, resulting in brief periods of bitter cold. Both spring and fall tend to be cool and wet. Summers are hot, humid, and have short periods of drought that can be interrupted by intense thunderstorms (USDA-NRCS, 2006; Woods et al., 1999).

The average annual precipitation for the Northern Piedmont is 40 to 55 inches (100 to 135 cm). The average is higher in the northern areas of the region and on the eastern edge nearer the Atlantic. Most of the precipitation for this region is received during the spring and fall. Precipitation is moderate in the winter and is mainly from snow. Occasionally, hurricanes and “nor’easters” produce extreme-precipitation events, but the typical maximum-precipitation events occur as high intensity, convective thunderstorms in spring and early summer. Local droughts of 10 to 14 days are common in the region during summer (USDA-NRCS, 2006).

The northern part of the MLRA tends to be on the cooler and wetter end of the range. The southern part tends to be warmer and drier. The average annual temperature in the Northern Piedmont ranges from 48 to 58 degrees Fahrenheit (9 to 14 degrees C). The hottest average temperatures are in the southern parts of the region. The freeze-free period averages 205 days across the region and ranges from 170 to 240 days (USDA-NRCS, 2006).

Precipitation (mm)
Month Min Mean Max
Jan 61 80 97
Feb 59 70 89
March 82 96 113
April 79 93 112
May 96 108 127
June 77 101 125

July 85 111 138
Aug 70 91 116
Sept 95 111 154
Oct 76 95 122
Nov 81 92 111
Dec 68 88 107
Annual1,009 1,136 1,337

Precipitation (inches)
Month Min Mean Max
Jan 2.4 3.1 3.8
Feb 2.3 2.8 3.5
March 3.2 3.8 4.4
April 3.1 3.7 4.4
May 3.8 4.3 5.0
June 3.0 4.0 4.9
July 3.3 4.4 5.4
Aug 2.7 3.6 4.6
Sept 3.7 4.4 6.1
Oct 3.0 3.7 4.8
Nov 3.2 3.6 4.4
Dec 2.7 3.5 4.2
Annual 39.7 44.7 52.6

Temperature (Celsius)
Month Min Mean Max
Jan -5.3 -0.3 4.6
Feb -4.2 1.2 6.5
March -0.4 5.5 11.4
April 5.0 11.4 17.9
May 10.2 16.6 23.0
June 15.4 21.6 27.7
July 18.0 24.0 29.9
Aug 17.1 23.1 29.0
Sept 12.9 19.1 25.2
Oct 6.5 12.8 19.0
Nov 1.7 7.4 13.0
Dec -3.0 1.9 6.7
Annual 6.2 12.0 20.5

Temperature (Fahrenheit)
Month Min Mean Max
Jan 23 31 40
Feb 25 34 44
March 31 42 52
April 41 53 64
May 50 62 73
June 60 71 82
July 64 75 86
Aug 63 74 84
Sept 55 66 77
Oct 44 55 66
Nov 35 45 55
Dec 27 35 44
Annual 43 54 69

Table 2. Representative climatic features

Frost-free period (actual range)	
Freeze-free period (actual range)	
Precipitation total (actual range)	1,016-1,346 mm
Frost-free period (average)	
Freeze-free period (average)	205 days
Precipitation total (average)	1,143 mm

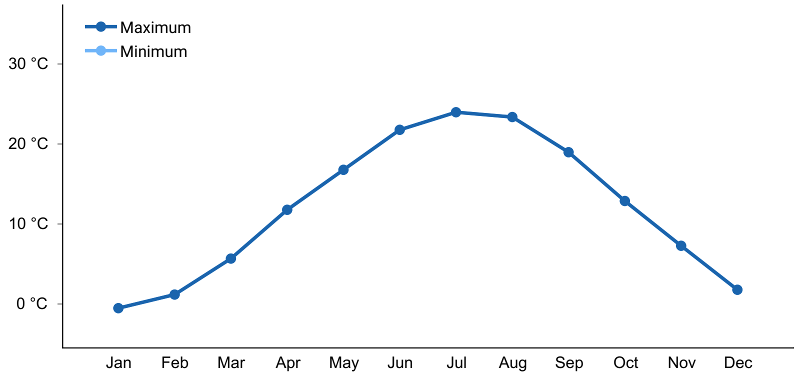


Figure 7. Monthly average minimum and maximum temperature

Influencing water features

Fresh surface water is abundant in this region, and groundwater springs are common. Abundant precipitation, numerous perennial streams, and good aquifers provide ample supplies of fresh water. Surface water quality is marginal but generally sufficient for all uses across the region. It can be good for public supply if treated properly. Many streams and rivers have been degraded by sedimentation, mining waste, and municipal and industrial discharges.

Major rivers in the Northern Piedmont include the Delaware River, which separates Pennsylvania and Delaware from New Jersey; the Susquehanna River; and the Potomac River, which separates Washington D.C. and Maryland from Virginia. The Susquehanna River valley is unique in this ecoregion because the river is large and incised with local relief as high as 590 feet (180 m) along the valley margins. Gorges flowing into the Susquehanna contain high-gradient streams and waterfalls, including Otter Creek, Tucquan Glen, Wildcat Run, Counselman Run, Kelly Run, Ferncliff Run, and Oakland Run. The Northern Piedmont also includes several National Wild and Scenic Rivers, including the Schuylkill, Octoraro, Patuxent, Monocacy, and Rappahannock Rivers and Goose Creek and Deer Creek (USDA-NRCS, 2006; Woods et al., 1999).

For the purposes of these ecological site descriptions, the riparian zone is the area that is adjacent to surface waters and that should be managed specifically for its potential to deliver water-quality-related riparian services, including soil stabilization, filtration, and infiltration of overland flow. Many of the hydric soils in the Northern Piedmont are along the riparian zones of rivers and streams. Some are in small, isolated wetlands. Although small, isolated wetlands are not always in a classic riparian setting, the distinction is largely irrelevant for general considerations related to vegetation management. The vegetation-management solutions that are used in classic riparian settings would also filter and infiltrate overland flow in small, isolated wetlands. Additionally, many small isolated wetlands are in the slack regions of larger riparian systems. Those in isolated upland depressions commonly consist of a local seep outlet in a zone where ground water intermittently surfaces before eventually accumulating as first-order surface waters. Such areas are intermittent riparian zones, and represent hydrologic ecotones by there very nature. An important aspect of ecological site development for riparian zones is the exceptional difficulty in defining exactly where a riparian zone begins.

Even more difficult is classifying the energy environment within a riparian zone. It is nearly impossible to tie that variation to field sites at the spatial and temporal scale used by the USDA Soil Survey Geographic Database (SSURGO). The probability, intensity, frequency, and duration of fluvial energy varies in both space and time across a riparian system, and these variables have critical impacts on the soils and vegetation communities. The size of the adjacent creek, stream, or river, the size of the watershed, the position in the watershed, the position on the flood plain, upstream land use, and local hydrodynamics are all variables affecting soil. Some of these variables are not directly represented in SSURGO. Also, SSURGO map units do not always have perfect fidelity with these variables. In the timeframes and spatial scales in which hight-energy fluvial events occur, it may not be possible to remap SSURGO with sufficient frequency at the series level. Mapping might best capture the concept, but it does not always capture a potential soil or ecological state at any specific location. Delivering user-friendly, site-specific management recommendations in an ESD based on such mapping is therefore difficult and is impossible without real time field verification by a conservation planner.

Soil features

All ecological sites in MLRA 148 listed as “hydric” are poorly drained. These sites are on soils that are listed on the State hydric soils lists for Virginia, Maryland, Pennsylvania, Delaware, or New Jersey.

Representative soil components on this ecological site include:

Aden
Albano
Croton
Doylestown
Holly
Knauers
Lamington
Parsippany

Table 3. Representative soil features

Drainage class	Somewhat poorly drained to very poorly drained

Table 4. Representative soil features (actual values)

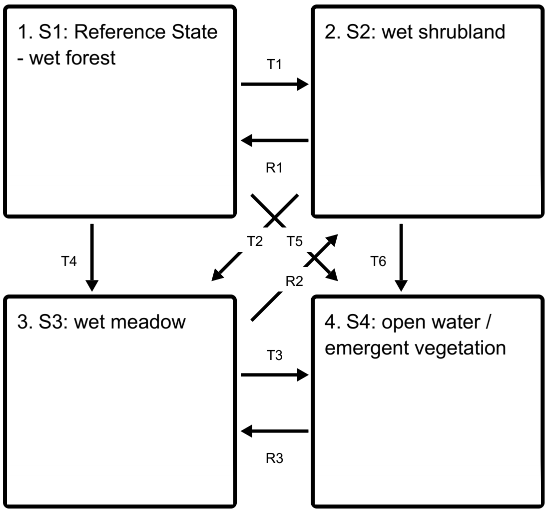
Drainage class	Somewhat poorly drained to very poorly drained

Ecological dynamics

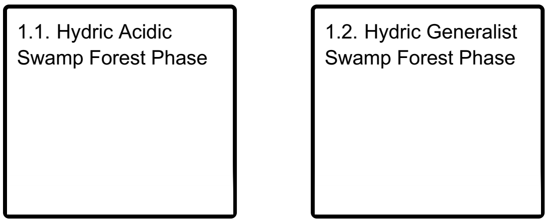
Three vegetation community structures are common in the riparian zones of the Northern Piedmont: grasslands, shrub thickets, and forests. In some areas, the vegetation community might progress through a classic successional sequence from grass to shrub to forest following a stand replacement disturbance. On these hydric sites, wet conditions resist succession somewhat. Additionally, riparian zone grasslands and shrub thickets commonly persist as disturbance-driven climax communities. Within broader timeframes, the fluvial processes of erosion, deposition, and aggradation are highly dynamic; consequently, so are the vegetation structure and composition within a riparian zone. Vegetation community dynamics are especially intense where flood energy is relatively high (Zimmerman et al., 2012).

State and transition model

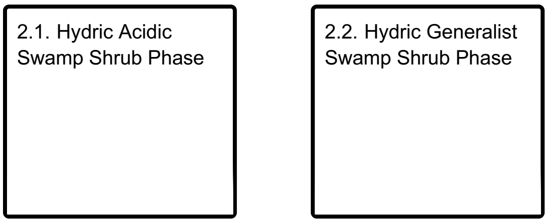
Ecosystem states



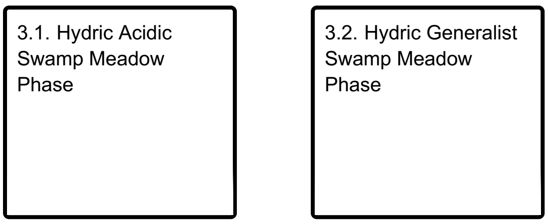
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
S1: Reference State - wet forest

Community 1.1
Hydric Acidic Swamp Forest Phase

This phase of this ecological site corresponds with: International Vegetation Classification Associations (Zimmerman et al., 2012) Red Maple-Blackgum Basin Swamp (CEGL006014) Pennsylvania Communities (Zimmerman et al., 2012) • Red maple–black-gum palustrine forest

Dominant plant species

- red maple (*Acer rubrum*), tree
- yellow birch (*Betula alleghaniensis*), tree
- blackgum (*Nyssa sylvatica*), tree
- eastern white pine (*Pinus strobus*), tree
- swamp white oak (*Quercus bicolor*), tree
- swamp chestnut oak (*Quercus michauxii*), tree

- pin oak (*Quercus palustris*), tree
- black willow (*Salix nigra*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- alder (*Alnus*), shrub
- flowering dogwood (*Cornus florida*), shrub
- dogwood (*Cornus*), shrub
- common winterberry (*Ilex verticillata*), shrub
- highbush blueberry (*Vaccinium corymbosum*), shrub
- sedge (*Carex*), grass
- sensitive fern (*Onoclea sensibilis*), grass
- cinnamon fern (*Osmunda cinnamomea*), grass
- skunk cabbage (*Symplocarpus foetidus*), grass
- violet (*Viola*), grass
- sphagnum (*Sphagnum*), grass

Community 1.2
Hydric Generalist Swamp Forest Phase

This phase of this ecological site corresponds with: International Vegetation Classification Associations (Zimmerman et al., 2012) • Silver Maple Floodplain Bottom Forest (Sensitive Fern Type) (CEGL006176) • Silver Maple Floodplain Levee Forest (CEGL006147) • Silver Maple-Elm Forest (CEGL002586) • New River Sycamore-Ash Floodplain Forest (CEGL006458) • Piedmont/Central Appalachian Rich Floodplain Forest (CEGL004073) • Sycamore-Silver Maple Calcareous Floodplain Forest (CEGL007334) • Green Ash-Mixed Hardwood Floodplain Forest (CEGL006575) • Northeastern Pin Oak-Swamp White Oak Forest (CEGL006240) • Pin Oak Small River Floodplain Forest (CEGL006185) • Northern Piedmont/Central Appalachian Maple-Ash Swamp Forest (CEGL006548) • Red Maple/Tussock Sedge Wooded Marsh (CEGL006119) Pennsylvania Communities (Zimmerman et al., 2012) • Silver maple floodplain forest • Sycamore floodplain forest • Green ash-mixed hardwood floodplain forest • Oak-mixed hardwood palustrine forest • Red maple-elm-willow floodplain forest • Red maple-sedge palustrine woodland The list of representative herbaceous species is longer than the database allows, so that list is provided here: Herbs • *Agrostis scabra* (fly-away grass) • *Arisaema dracontium* (green dragon) • *Arisaema triphyllum* (Jack in the pulpit) • *Bidens frondosa* (beggartick) • *Boehmeria cylindrica* (false nettle) • *Calamagrostis canadensis* var. canadensis (Canada bluejoint) • *Caltha palustris* (marsh-marigold) • *Carex bromoides* (sedge) • *Carex canescens* (sedge) • *Carex crinita* var. crinita (short hair sedge) • *Carex intumescens* (sedge) • *Carex lurida* (sedge) • *Carex stipata* (sedge) • *Carex stricta* (tussock sedge) • *Carex tribuloides* (sedge) • *Chelone glabra* (turtlehead) • *Cinna arundinacea* (wood reedgrass) • *Dulichium arundinaceum* var. arundinaceum (three-way sedge) • *Elymus riparius* (riverbank wildrye) • *Glyceria melicaria* (slender mannagrass) • *Glyceria septentrionalis* (floating mannagrass) • *Glyceria striata* (fowl mannagrass) • *Hydrophyllum canadense* (Canadian waterleaf) • *Impatiens capensis* (jewelweed) • Juncus spp. (rushes) • *Laportea canadensis* (woodnettle) • *Leersia oryzoides* (rice cutgrass) • *Leersia virginica* (cutgrass) • *Lilium superbum* (Turk’s-cap lily) • *Lycopus uniflorus* (bugleweed) • *Matteuccia struthiopteris* (ostrich fern) • *Onoclea sensibilis* (sensitive fern) • *Osmunda cinnamomea* (cinnamon fern) • *Peltandra virginica* (arrow-arum) • Persicaria punctata (dotted smartweed) • Persicaria sagittata (tearthumb) • Persicaria virginiana (jumpseed) • *Pilea pumila* (clearweed) • *Sagittaria latifolia* (wapato) • Solidago spp. (goldenrods) • *Symplocarpus foetidus* (skunk cabbage) • *Teucrium canadense* (wild germander) • *Thelypteris palustris* (marsh fern) • *Triadenum virginicum* (marsh St. Johnswort) • *Urtica dioica* (stinging nettle) • *Verbesina alternifolia* (wingstem) • *Viola sororia* (common blue violet) Vines • *Parthenocissus quinquefolia* (Virginia creeper) • *Toxicodendron radicans* (poison ivy) • *Vitis riparia* (riverbank grape) Bryophytes • Sphagnum spp. (sphagnum) Exotic Species • *Alliaria petiolata* (garlic mustard) • *Berberis thunbergii* (Japanese barberry) • Fallopia japonica (Japanese knotweed) • *Glechoma hederacea* (Gill-over-the-ground) • *Hesperis matronalis* (dame’s-rocket) • *Ligustrum vulgare* (common privet) • *Lonicera morrowii* (Morrow’s honeysuckle) • *Microstegium vimineum* (Japanese stiltgrass) • *Rosa multiflora* (multiflora rose)

Dominant plant species

- boxelder (*Acer negundo*), tree
- black maple (*Acer nigrum*), tree
- red maple (*Acer rubrum*), tree
- silver maple (*Acer saccharinum*), tree
- river birch (*Betula nigra*), tree

- bitternut hickory (*Carya cordiformis*), tree
- shagbark hickory (*Carya ovata*), tree
- common hackberry (*Celtis occidentalis*), tree
- black ash (*Fraxinus nigra*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- black walnut (*Juglans nigra*), tree
- blackgum (*Nyssa sylvatica*), tree
- eastern white pine (*Pinus strobus*), tree
- American sycamore (*Platanus occidentalis*), tree
- swamp white oak (*Quercus bicolor*), tree
- pin oak (*Quercus palustris*), tree
- black willow (*Salix nigra*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- American elm (*Ulmus americana*), tree
- slippery elm (*Ulmus rubra*), tree
- hazel alder (*Alnus serrulata*), shrub
- common buttonbush (*Cephalanthus occidentalis*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- silky dogwood (*Cornus amomum*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- common winterberry (*Ilex verticillata*), shrub
- northern spicebush (*Lindera benzoin*), shrub
- common ninebark (*Physocarpus opulifolius*), shrub
- black willow (*Salix nigra*), shrub
- silky willow (*Salix sericea*), shrub
- American black elderberry (*Sambucus nigra ssp. canadensis*), shrub
- steeplebush (*Spiraea tomentosa*), shrub
- highbush blueberry (*Vaccinium corymbosum*), shrub
- southern arrowwood (*Viburnum recognitum*), shrub

State 2
S2: wet shrubland

Community 2.1
Hydric Acidic Swamp Shrub Phase

This phase of this ecological site corresponds with: International Vegetation Classification Associations (Zimmerman et al., 2012) • Northern Peatland Shrub Swamp (CEGL006158) • Highbush Blueberry Bog Thicket (CEGL006190) • Highbush Blueberry Poor Fen (CEGL005085) Pennsylvania Communities (Zimmerman et al., 2012) • Acidic mixed shrub-sphagnum wetland • Highbush blueberry-sphagnum wetland

Dominant plant species

- red maple (*Acer rubrum*), tree
- gray birch (*Betula populifolia*), tree
- speckled alder (*Alnus incana ssp. rugosa*), shrub
- hazel alder (*Alnus serrulata*), shrub
- black chokeberry (*Aronia melanocarpa*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- catberry (*Ilex mucronata*), shrub
- sheep laurel (*Kalmia angustifolia*), shrub
- maleberry (*Lyonia ligustrina*), shrub
- rhodora (*Rhododendron canadense*), shrub
- swamp azalea (*Rhododendron viscosum*), shrub
- highbush blueberry (*Vaccinium corymbosum*), shrub
- withe-rod (*Viburnum nudum var. cassinoides*), shrub
- sedge (*Carex*), grass
- cinnamon fern (*Osmunda cinnamomea*), grass

- bristly dewberry (*Rubus hispidus*), grass
- eastern marsh fern (*Thelypteris palustris*), grass
- sphagnum (*Sphagnum*), grass

Community 2.2
Hydric Generalist Swamp Shrub Phase

This phase of this ecological site corresponds with: International Vegetation Classification Associations (Zimmerman et al., 2012) • Willow River-Bar Shrubland (CEGL006065) • Northeastern Buttonbush Shrub Swamp (CEGL006069) Pennsylvania Communities (Zimmerman et al., 2012) • Black willow floodplain thicket • Buttonbush wetland There are more representative herbaceous species than the database will allow, so those species are listed here: Herbs • *Boehmeria cylindrica* (false nettle) • *Carex crinita* var. crinita (short hair sedge) • *Carex lupulina* (sedge) • *Carex lurida* (sedge) • *Carex vesicaria* (sedge) • *Dulichium arundinaceum* var. arundinaceum (three-way sedge) • *Impatiens capensis* (jewelweed) • *Justicia americana* (water-willow) • *Lycopus uniflorus* (bugleweed) • Nuphar advena (spatterdock) • Nuphar variegata (spatterdock) • *Osmunda regalis* (royal fern) • Persicaria amphibia (water smartweed) • Persicaria hydropiperoides (mild water-pepper) • Persicaria punctata (dotted smartweed) • *Proserpinaca palustris* var. crebra (common mermaid-weed) • *Scirpus atrovirens* (black bulrush) • *Scirpus cyperinus* (woolgrass) • *Scirpus georgianus* (bulrush) • *Thelypteris palustris* (marsh fern) • *Torreyochloa pallida* (pale meadowgrass) • *Triadenum virginicum* (marsh St. Johnswort) • *Woodwardia virginica* (Virginia chain fern) Vines • *Calystegia sepium* (hedge bindweed) • *Cuscuta gronovii* (common dodder) Bryophytes • Sphagnum spp. (sphagnum) Exotic Species • *Lysimachia vulgaris* (garden loosestrife) • *Lythrum salicaria* (purple loosestrife)

Dominant plant species

- red maple (*Acer rubrum*), shrub
- silver maple (*Acer saccharinum*), shrub
- river birch (*Betula nigra*), shrub
- common buttonbush (*Cephalanthus occidentalis*), shrub
- silky dogwood (*Cornus amomum*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- swamp loosestrife (*Decodon verticillatus*), shrub
- swamp azalea (*Rhododendron viscosum*), shrub
- swamp rose (*Rosa palustris*), shrub
- Missouri River willow (*Salix eriocephala*), shrub
- shining willow (*Salix lucida ssp. lucida*), shrub
- black willow (*Salix nigra*), shrub
- silky willow (*Salix sericea*), shrub
- American black elderberry (*Sambucus nigra ssp. canadensis*), shrub
- highbush blueberry (*Vaccinium corymbosum*), shrub

State 3
S3: wet meadow

Community 3.1
Hydric Acidic Swamp Meadow Phase

International Vegetation Classification Associations (Zimmerman et al., 2012) • Central Appalachian Cutgrass Marsh (CEGL006461) Pennsylvania Communities (Zimmerman et al., 2012) • Mixed forb-graminoid wet meadow The list of representative herbaceous species is too long for the database, so those species are listed here: Herbs • Bidens spp. (beggartick) • *Calamagrostis canadensis* var. canadensis (Canada bluejoint) • *Carex canescens* (sedge) • *Carex cristatella* (sedge) • *Carex lurida* (sedge) • *Carex stipata* (sedge) • *Carex stricta* (tussock sedge) • *Carex tribuloides* (sedge) • *Carex vesicaria* (sedge) • *Dulichium arundinaceum* var. arundinaceum (three-way sedge) • Eleocharis spp. (spike-rushes) • *Eupatorium perfoliatum* (boneset) • Eutrochium spp. (Joe pye weed) • *Glyceria canadensis* (rattlesnake mannagrass) • *Hypericum canadense* (Canadian St. Johnswort) • *Hypericum mutilum* (dwarf St. Johnswort) • *Juncus effusus* (soft rush) • *Leersia oryzoides* (rice cutgrass) • *Lycopus uniflorus* (bugleweed) • *Osmunda cinnamomea* (cinnamon fern) • *Osmunda regalis* (royal fern) • Persicaria spp. (smartweeds) • *Scirpus atrovirens* (black bulrush) • *Scirpus cyperinus* (woolgrass) • *Scirpus pendulus* (bulrush) • Solidago spp. (goldenrods) • *Thelypteris palustris* (marsh fern) • *Torreyochloa pallida* (pale meadowgrass) •

Triadenum virginicum (marsh St. Johnswort) • *Vernonia noveboracensis* (New York ironweed) • *Woodwardia virginica* (Virginia chain fern) Exotic Species • *Lythrum salicaria* (purple loosestrife) • *Phalaris arundinacea* (reed canarygrass)

Dominant plant species

- common buttonbush (*Cephalanthus occidentalis*), shrub
- silky dogwood (*Cornus amomum*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- steeplebush (*Spiraea tomentosa*), shrub
- southern arrowwood (*Viburnum recognitum*), shrub

Community 3.2
Hydric Generalist Swamp Meadow Phase

This phase of this ecological site corresponds with: International Vegetation Classification Associations (Zimmerman et al., 2012) • Bluejoint–Spotted Joe-pyeweed Herbaceous Vegetation (CEGL005174) • Bulrush Deepwater Marsh (CEGL006275) • Eastern Cattail Marsh (CEGL006153) • Eastern Reed Marsh (CEGL004141) • Golden-saxifrage Forested Seep (CEGL006193) • Floodplain Pool (CEGL007696) • Skunk-cabbage–Orange Jewelweed Seep (CEGL006567) • Eastern Tussock Sedge Meadow (CEGL006412) • Water-willow Rocky Bar and Shore (CEGL004286) • Northeastern Leafy Forb Marsh (CEGL006191) • Water-lily Aquatic Wetland (CEGL002386) NatureServe Ecological Systems (not in USNVC) (Zimmerman et al., 2012) • High Allegheny Wetland (CES202.069) • Southern and Central Appalachian Bog and Fen (CES202.300) Pennsylvania Communities (Zimmerman et al., 2012) • Bluejoint–reed canary-grass marsh • Bulrush marsh • Cat-tail marsh • Common reed marsh • Golden saxifrage–Pennsylvania bitter-cress spring run • Lizard's-tail emergent bed • Mixed forb marsh • Skunk-cabbage-golden saxifrage seep • Tussock sedge marsh • Water-willow (*Justicia americana*)-smartweed riverbed community • Pickerel-weed–arrow-arum–arrowhead emergent wetland • Spatterdock–water-lily emergent wetland The list of representative herbaceous species is too long for the database, so those species are listed here: Herbs • *Agrostis scabra* (fly-away grass) • *Alisma subcordatum* (broad-leaved water-plantain) • *Arisaema triphyllum* (Jack in the pulpit) • *Bidens laevis* (showy bur-marigold) • Bidens spp. (beggartick) • *Boehmeria cylindrica* (false nettle) • *Calamagrostis canadensis* var. canadensis (Canada bluejoint) • *Cardamine bulbosa* (bittercress) • *Cardamine pensylvanica* (Pennsylvania bittercress) • *Cardamine rotundifolia* (mountain watercress) • *Carex baileyi* (sedge) • *Carex canescens* (sedge) • *Carex comosa* (sedge) • *Carex crinita* var. crinita (short hair sedge) • *Carex folliculata* (sedge) • *Carex gynandra* (sedge) • *Carex hystericina* (sedge) • *Carex lacustris* (sedge) • *Carex lurida* (sedge) • *Carex prasina* (sedge) • *Carex projecta* (sedge) • *Carex scoparia* (broom sedge) • *Carex stipata* (sedge) • *Carex stricta* (tussock sedge) • *Carex tribuloides* (sedge) • *Chelone glabra* (turtlehead) • *Chrysosplenium americanum* (golden saxifrage) • *Cicuta bulbifera* (water hemlock) • Cyperus spp. (nutsedges) • *Dryopteris carthusiana* (spinulose wood fern) • *Dulichium arundinaceum* var. arundinaceum (three-way sedge) • *Eleocharis palustris* (creeping spikerush) • Eleocharis spp. (spike-rushes) • Eupatorium spp. (Joe pye weed) • Euphorbia maculata (spotted spurge) • *Glyceria melicaria* (slender mannagrass) • Glyceria spp. (mannagrass) • *Hibiscus laevis* (halberdleaf rosemallow) • *Impatiens capensis* (jewelweed) • *Juncus acuminatus* (sharp-fruited rush) • Juncus spp. (rushes) • *Justicia americana* (water-willow) • *Leersia oryzoides* (rice cutgrass) • *Lemna minor* (duckweed) • Lemna spp. (duckweed) • *Ludwigia palustris* (marsh-purslane) • *Lysimachia vulgaris* (garden loosestrife) • *Lythrum salicaria* (purple loosestrife) • *Mentha arvensis* (field mint) • Nuphar advena (spatterdock) • Nuphar variegata (spatterdock) • *Onoclea sensibilis* (sensitive fern) • *Orontium aquaticum* (goldenclub) • *Peltandra virginica* (arrow-arum) • Persicaria amphibia (water smartweed) • Persicaria arifolia (halberdleaf tearthumb) • Persicaria hydropiperoides (mild water-pepper) • Persicaria punctata (dotted smartweed) • Persicaria sagittata (tearthumb) • *Phalaris arundinacea* (reed canarygrass) • *Pilea pumila* (clearweed) • *Poa annua* (annual bluegrass) • *Pontederia cordata* (pickerelweed) • *Rubus hispidus* (swamp dewberry) • *Sagittaria latifolia* (wapato) • *Sagittaria rigida* (arrowhead) • *Saururus cernuus* (lizard's tail) • *Saxifraga micranthidifolia* (lettuce saxifrage) • *Saxifraga pensylvanica* (swamp saxifrage) • *Schoenoplectus acutus* (hardstem bulrush) • Schoenoplectus fluviatilis (river bulrush) • *Schoenoplectus pungens* (threesquare) • Schoenoplectus purshianus (bulrush) • *Schoenoplectus tabernaemontani* (soft-stemmed bulrush) • *Schoenoplectus torreyi* (Torrey's bulrush) • *Scirpus cyperinus* (woolgrass) • *Sium suave* (water-parsnip) • *Sparganium americanum* (bur-reed) • Sparganium spp. (bur-reed) • *Symplocarpus foetidus* (skunk cabbage) • *Thalictrum pubescens* (tall meadow-rue) • *Triadenum virginicum* (marsh St. Johnswort) • *Typha angustifolia* (narrowleaf cattail) • *Typha latifolia* (common cattail) • *Utricularia macrorhiza* (common bladderwort) Bryophytes • *Brachythecium rivulare* • *Bryhnia novae-angliae* • *Rhizomnium punctatum* • Rhynchostegium serrulatum •

Sphagnum spp. (sphagnum) • *Thuidium delicatulum* Exotic Species • *Acorus calamus* (sweet flag) • *Epilobium hirsutum* (hairy willow-herb) • Fallopia japonica (Japanese knotweed) • *Lysimachia vulgaris* (garden loosestrife) • *Lythrum salicaria* (purple loosestrife) • *Phalaris arundinacea* (reed canarygrass) • *Phragmites australis* ssp. australis (common reed) • *Rorippa sylvestris* (creeping yellowcress) • *Typha angustifolia* (narrowleaf cattail)

Dominant plant species

- red maple (*Acer rubrum*), tree
- silver maple (*Acer saccharinum*), tree
- river birch (*Betula nigra*), tree
- American sycamore (*Platanus occidentalis*), tree
- alder (*Alnus*), shrub
- American hornbeam (*Carpinus caroliniana*), shrub
- dogwood (*Cornus*), shrub
- common winterberry (*Ilex verticillata*), shrub
- northern spicebush (*Lindera benzoin*), shrub
- black willow (*Salix nigra*), shrub
- viburnum (*Viburnum*), shrub

State 4
S4: open water / emergent vegetation

Transition T1
State 1 to 2

This transition pathway can occur as a result of any disturbance that directly impacts an existing forest tree canopy. Examples include abnormal flooding events and/or changes to hydrology which cause increased duration and depth and flooding, increased flood energy and scour, deposition of significant flood transported material, ice, wind, insects, disease, and timber extraction.

Conservation practices

Early Successional Habitat Development/Management
Forest Stand Improvement

Transition T4
State 1 to 3

This transition pathway can occur as a result of any disturbance that directly impacts established woody vegetation including both trees and brush. Examples include abnormal flooding events and/or changes to hydrology which cause increased duration and depth and flooding, increased flood energy and scour, deposition of significant flood transported material, ice, wind, insects, and disease

Context dependence. Some wildlife habitat management objectives (or other objectives) might call for the reduction of woody vegetation and the enhancement of herbaceous meadow vegetation, so this transition can potentially be a restoration as well.

Conservation practices

Brush Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Prescribed Grazing

Transition T5
State 1 to 4

This transition pathway can occur as a result of any disturbance that changes hydrology and creates increased depth and duration of ponding of water on the soil surface.

Constraints to recovery. Recovery would require significant hydrologic restoration

Conservation practices

Wetland Restoration
Wetland Creation
Wetland Enhancement

Restoration pathway R1
State 2 to 1

This restoration pathway is a normal successional pathway that can occur in the absence of high-energy flooding with scour, in the absence of flooding with high rates of deposition, and with a stable hydrologic regime. The normal successional pathway on these sites is towards wet forest conditions. Soil and hydrologic conditions may resist succession, even for long periods of time. However, shrubland conditions ultimately create an increasing abundance of microsites suitable for the recruitment of trees. Some type of tree killing disturbance is typically necessary to reverse that trend of increasing tree cover.

Conservation practices

Brush Management
Riparian Forest Buffer
Tree/Shrub Establishment
Herbaceous Weed Control

Transition T2
State 2 to 3

This transition pathway can occur as a result of any disturbance that directly impacts established woody vegetation including both trees and brush. Examples include abnormal flooding events and/or changes to hydrology which cause increased duration and depth and flooding, increased flood energy and scour, deposition of significant flood transported material, ice, wind, insects, and disease.

Context dependence. Some wildlife habitat management objectives (or other objectives) might call for the reduction of woody vegetation and the enhancement of herbaceous meadow vegetation, so this transition can potentially be a restoration as well.

Conservation practices

Brush Management
Early Successional Habitat Development/Management
Prescribed Grazing

Transition T6
State 2 to 4

This transition pathway can occur as a result of any disturbance that changes hydrology and creates increased depth and duration of ponding of water on the soil surface.

Constraints to recovery. Recovery would require significant hydrologic restoration

Restoration pathway R2
State 3 to 2

This restoration pathway is a normal successional pathway that can occur in the absence of high-energy flooding with scour, in the absence of flooding with high rates of deposition, and with a stable hydrologic regime. The normal successional pathway on these sites is from wet meadow to wet shrubland and ultimately towards wet forest conditions. Soil and hydrologic conditions may resist succession, even for long periods of time. However, wet meadow conditions ultimately create an increasing abundance of microsites suitable for the recruitment of trees and shrubs. Some type of woody vegetation killing disturbance is typically necessary to reverse that trend of increasing woody cover. Some wildlife habitat management objectives (or other objectives) might call for the reduction of woody vegetation and the enhancement of herbaceous meadow vegetation, so some management objectives will be designed to resist this "restoration" pathway.

Conservation practices

Riparian Forest Buffer
Tree/Shrub Establishment
Early Successional Habitat Development/Management

Transition T3
State 3 to 4

This transition pathway can occur as a result of any disturbance that changes hydrology and creates increased depth and duration of ponding of water on the soil surface.

Constraints to recovery. Recovery would require significant hydrologic restoration

Conservation practices

Wetland Restoration
Wetland Creation
Wetland Enhancement

Restoration pathway R3
State 4 to 3

This restoration would require significant hydrologic restoration.

Conservation practices

Riparian Herbaceous Cover
Early Successional Habitat Development/Management

Additional community tables

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Approval

Curtis Talbot, 3/10/2021

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Rangeland health reference sheet

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

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Date	09/28/2018
Approved by	Curtis Talbot
Approval date	
Composition (Indicators 10 and 12) based on	

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):**

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**
