USDA Natural Resources Conservation Service

Ecological site F147XY004PA
Sandstone Upland

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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): 147X–Northern Appalachian Ridges and Valleys

Major Land Resource Area 147 is in the Middle section of the Valley and Ridge Province of the Appalachian Highlands. Characteristic features include folded and faulted parallel ridges and valleys that are carved out of anticlines, synclines, and thrust blocks. The variability of weathering of the underlying bedrock has resulted in resistant sandstone and shale ridges separated by less resistant limestone and shale narrow to moderately broad valleys. The ridges are strongly sloping to extremely steep and have narrow, rolling crests, and the valleys are mainly level to strongly sloping. The Great Valley is a salient feature of the eastern portion and runs the entire length of the MLRA where it is called the Shenandoah Valley in the south. The western side of the MLRA is dominantly hilly to very steep and is rougher and much steeper than the rolling hills to the east. Parts of the northernmost section of the MLRA were subjected to pre-Illinoian glaciation (>770,000 years ago). Anthracite coal underlies some areas in the north and has been mined since the 1700's.

Elevation in MLRA 147 generally ranges from 330 to 985 feet (100 to 300 meters) in the valleys and from 1,310 to 2,625 feet (400 to 800 meters) on the ridges and mountains. It is as high as 2,955 feet (900 meters) on some mountain crests and is nearly 4,430 feet (1,350 meters) on a few isolated, linear mountain ridges. Local relief in the valleys is about 15 to 165 feet (5 to 50 meters). The ridges rise about 660 feet (200 meters) above the adjoining valleys. (USDA, 2006).

Classification relationships

This ecological site is found in Major Land Resource Area 147- Northern Appalachian Ridges and Valleys, 148. MLRA 147 is located within Land Resource Region S - Northern Atlantic Slope Diversified Farming Region (USDA 2006), and in United States Forest Service ecoregion M221 – Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province (Bailey, 1995). In addition, MLRA 147 falls within area #67 of EPA Ecoregion Level III – the Ridge and Valley (US EPA, 2013) and 67b, Northern Sandstone Ridges of EPA Ecoregion IV (Woods et. al., 1996). Parts of this ecological site fall within 67d, the Northern Dissected Ridges and Knobs, and 67b, Northern Shale Valleys.

Ecological site concept

The Sandstone Upland ecological sites occur throughout MLRA 147 primarily on sandstone ridgetops and mid to upper slopes. Depth to bedrock is generally 40 to 60 inches (100 to 152 cm) but can be shallower than 20 inches (50 cm) in the most convex areas. Soils are relatively infertile sandy loams to loamy sands with numerous rock fragments. Water infiltrates easily. Areas can be well drained to excessively well drained. The soil pH ranges from 4.0 to 5.5. Compared to the sandstone and shale foothills, these higher elevation ridges have coarser soil textures, are generally more acidic, have less moisture holding capacity, and can be quite stony and full of boulders. The forests are dominated by xeric (dry) Quercus species (oaks) in the canopy with an understory dominated by heath species like Vaccineum spp. (blueberry), Gaylussacia spp. (huckleberry), and *Kalmia latifolia* (mountain laurel). In some places the understory can be quite dense.

The convex summits and ridgetops generally have sparser canopy cover, smaller trees, and more stones on the surface. Below the summits, the upper slopes will have thicker canopy cover, depth to bedrock is usually greater than on the convex ridgetops, but the soil surface may still have many rock fragments.

Similar sites

F147XY002PA	**Mixed Sedimentary Upland** Deep Acid Sedimentary Upland

Table 1. Dominant plant species

Tree	(1) *Quercus montana* (2) *Quercus coccinea*
Shrub	(1) *Kalmia latifolia* (2) *Vaccinium pallidum*
Herbaceous	Not specified

Physiographic features

The Sandstone Upland ecological sites are found within the Northern Appalachian Ridges and Valleys region on ridge tops and upper and middle slopes of mountains and hills that are underlain by medium to coarse textured sandstone bedrock. Other types of bedrock associated with this ecological site are conglomerate, quartzite, shale and siltstone. The underlying geology is acidic although occasional outcroppings of calcareous rock do occur. This ecological site is not subjected to flooding or ponding. Depth to bedrock can range from 22 to over 80 inches (56 to 203 cm), with the shallower sites occupying shoulder and convex ridgetop positions. Typically these sites contain many sandstone fragments. In some areas, boulders are common and can cover most of surface area. Elevation can range from 245 to 3000 feet (75 to 914m) although sandstone uplands are most commonly associated with elevations around 1300 feet (close to 400m). Most slopes are steep, but plateaus and ridge tops generally are level to gently sloping.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Mountain slope (3) Hill
Runoff class	Very low to very high
Elevation	245–3,000 ft
Slope	0–80%
Water table depth	60 in
Aspect	Aspect is not a significant factor

Climatic features

The climate of this region is temperate and humid. The Ridge and Valley Province is not rugged enough for a true mountain type of climate but it does have many of the characteristics of such a climate (Daily 1971). The influence of the high and low topography on air movement causes somewhat greater temperature extremes than are experienced in the Piedmont region to the east. The differences in elevation also affect the length of the frost free season on the ridges verses that in the valleys. The cooler temperatures and the shorter freeze-free periods occur at the higher elevations and in the more northern latitudes. The maximum precipitation occurs from early spring through mid-summer, and the minimum occurs in January and February. The average annual snowfall ranges from 16 to more than 51 inches (40 to 130 centimeters). The average annual temperature is 44 to 57 degrees F (7 to 14 degrees C). A portion of this region that extends from Maryland southward through most of the Shenandoah Valley in Virginia falls within a rain shadow cast by the Appalachian Mountains to the west and the Blue Ridge Mountains to the east. The mountains on either side block moist flowing air from either the east or the west causing the valleys to be drier. Average annual precipitation in this shadow area can average 34 to 36 in/year (86 to 91cm) compared to 40 to 42 in/year (102 - 107 cm) for the rest of the region (PRISM 2013).

Data for mean annual precipitation, frost-free and freeze-free periods and monthly precipitation for this ecological site are shown below. The original data used in developing the tables was obtained from the USDA-NRCS National Water & Climate Center (2015) climate information database for 7 weather stations throughout MLRA 147 at elevations near and in proximity to this ecological site. All climate station monthly averages for maximum and minimum temperature and precipitation were then added together and averaged to make this table.

Table 3. Representative climatic features

Frost-free period (characteristic range)	131-142 days
Freeze-free period (characteristic range)	161-175 days
Precipitation total (characteristic range)	39-44 in
Frost-free period (actual range)	121-144 days
Freeze-free period (actual range)	146-179 days
Precipitation total (actual range)	37-45 in
Frost-free period (average)	134 days
Freeze-free period (average)	167 days
Precipitation total (average)	40 in

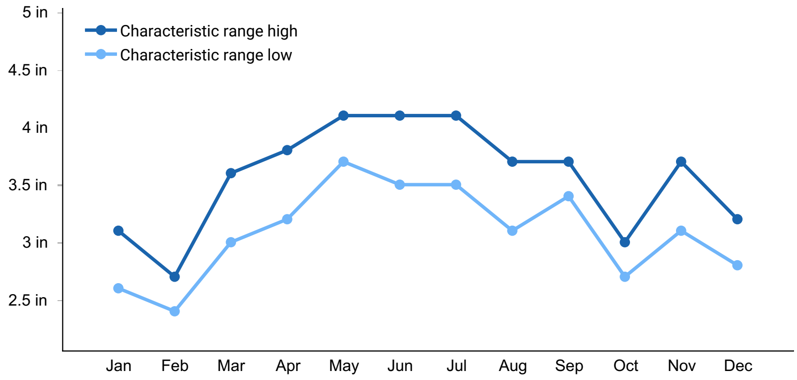


Figure 1. Monthly precipitation range

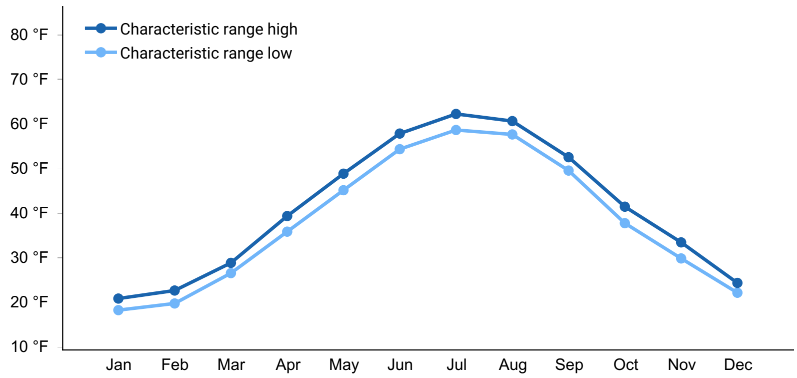


Figure 2. Monthly minimum temperature range

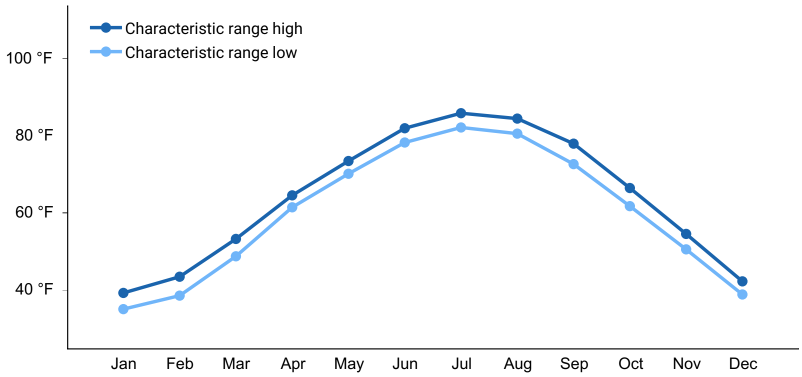


Figure 3. Monthly maximum temperature range

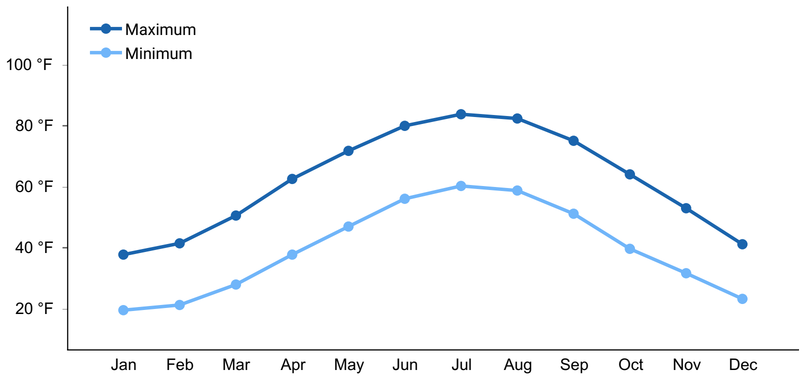


Figure 4. Monthly average minimum and maximum temperature

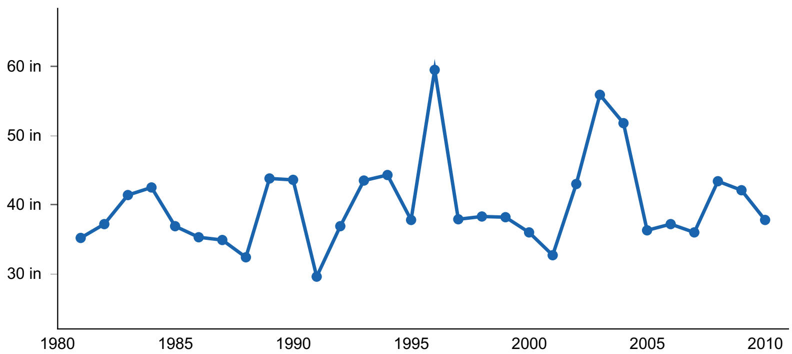


Figure 5. Annual precipitation pattern

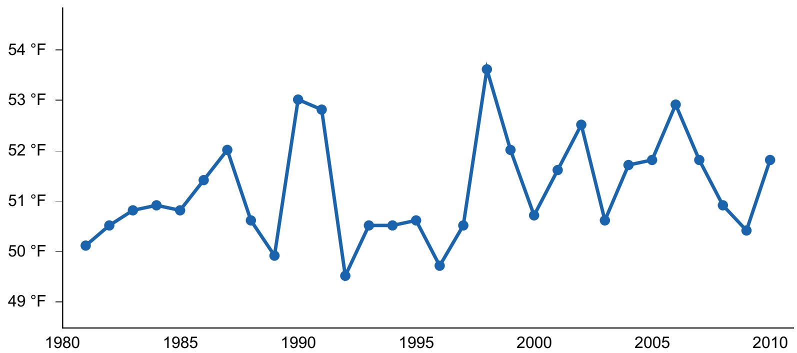


Figure 6. Annual average temperature pattern

Climate stations used

- (1) BEAR GAP [USC00360457], Coal Township, PA
- (2) STATE COLLEGE [USC00368449], State College, PA
- (3) EVERETT [USC00362721], Everett, PA

- (4) MUSTOE 1 SW [USC00445880], Monterey, VA
- (5) CACAPON ST PRK # 2 [USC00461324], Great Cacapon, WV
- (6) KEYSER 2 SSW [USC00464840], Keyser, WV
- (7) WARDENSVILLE RM FARM [USC00469281], Wardensville, WV

Influencing water features

This ecological site is not influenced by wetland or riparian water features.

Soil features

The representative soil series associated with the Sandstone Upland ecological site are: Wallen, Schaffenaker, Pocono, Oriskany, Massanutten, Lily, Lehew, Leetonia, Hazleton, Fleetwood, Edgemont, Drall, Dekalb, Covegap, Clymer, Arendtsville, and Alticrest. They are derived primarily from sandstone, orthoquartzite, quartzite, and conglomerate, but may include areas of shale and siltstone. They are well drained to excessively well drained, and often contain greater than 50 percent rock fragments by volume within the soil profile. Surface textures are sandy loams and loams. Sandstone rock fragments are common on the soil surface. Some areas have boulders. Most of these soils are residual meaning they have formed from the weathering of bedrock in place. Some soils may be colluvial in nature, resulting from the mass movement and subsequent deposition of material downslope. Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

Depth to bedrock is as shallow as 22 inches (56 cm) in the most convex landscapes, usually on the shoulders of hills. Generally, depth to bedrock is greater than 60 inches (152 cm), although rock fragment content will increase with depth.

These soils are typically sandy and acidic with available water capacity ranging from 1.4 to 5.5 inches (3.5 to 14 cm). Permeability is rapid.

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone (2) Colluvium–conglomerate
Surface texture	(1) Channery sandy loam (2) Very channery loam (3) Very stony
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Rapid
Soil depth	22–85 in
Surface fragment cover <=3"	0–55%
Surface fragment cover >3"	1–55%
Available water capacity (0-40in)	1.4–5.5 in
Soil reaction (1:1 water) (0-40in)	4–5.3
Subsurface fragment volume <=3" (Depth not specified)	0–63%
Subsurface fragment volume >3" (Depth not specified)	0–70%

Ecological dynamics

The vegetation groupings described in this section are based on the terrestrial ecological system classification and vegetation associations developed by NatureServe (Comer 2003) and the Natural Heritage Programs of

Pennsylvania (Zimmerman et al. 2012), Virginia (Fleming et al. 2013), West Virginia (WVDNR 2014), and Maryland (Harrison 2004). Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. They are intended to provide a classification unit that is readily mappable, often from remote imagery, and readily identifiable by conservation and resource managers in the field. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. A vegetation association is a plant community that is much more specific to a given soil, geology, landform, climate, hydrology, and disturbance history. It is the basic unit for vegetation classification. Each association will be named by the dominant species that occupy the different strata (tree, sapling, shrub, herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

The Sandstone Uplands Ecological Site is located in the Ridge and Valley region of the Appalachian Highlands, an area that has undergone extensive human disturbance since pre and post-European settlement times (Braun, 1950). The topography and landscape position range from convex sandstone ridgetops to steep upper slopes on acidic sandstone, and conglomerate rock. Depth to bedrock is generally 40 to 60 inches (100 to 152 cm) but can be shallower than 20 inches (50 cm) in the most convex areas. Soils are relatively infertile sandy loams to loamy sands with numerous rock fragments. Water infiltrates easily. These sites tend to create dry, xeric conditions with moderate to low forest productivity.

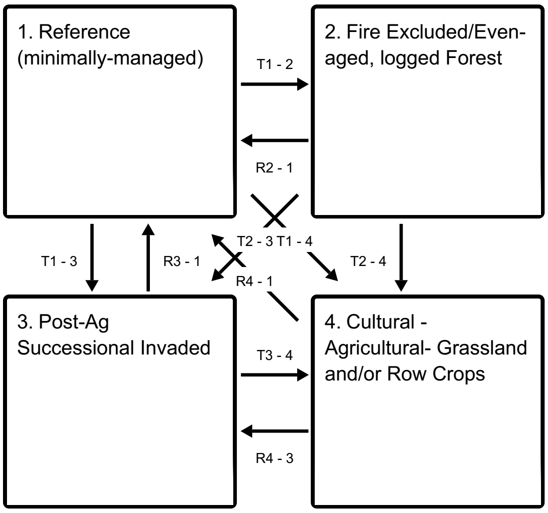
The reference state is a combination of several vegetation associations within the Central Appalachian Dry Oak-Pine Forest System (CES202.591) as defined by NatureServe (NatureServe 2009) but can be broadly described as a dry oak and heath community. The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but may include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species, most typically Quercus prinus (Chestnut oak), *Pinus virginiana* (Virginia pine), *Pinus rigida* (Pitch pine), and *Pinus strobus* (White pine), but sometimes *Quercus alba* (White oak) and/or *Quercus coccinea* (Scarlet oak). The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. *Vaccinium pallidum* (Lowbush blueberry), *Vaccinium stamineum* (Deerberry), Vaccinium angustofolium (Low sweet blueberry), *Gaylussacia baccata* (Black huckleberry), and *Kalmia latifolia* (Mountain laurel) were commonly observed in the understory during field reconnaissance of this ecological site within the Ridge and Valley region.

Windthrow, fire, and ice storms are natural disturbances in these habitats. Oak forests historically have been maintained by periodic fire. Fire suppression since the early 20th century in the eastern United States is believed to be leading to the overall replacement of oaks with fire sensitive, non-oak species like maples, beeches, birches, tulip poplars, and black cherry (Brose et. al., 2008). Oak forest regeneration is also hindered by heavy deer browsing (Latham et. al. 2005). Deer will selectively consume many native species including oak seedlings and acorns over less palatable species like hay-scented fern and several non-native species including Japanese barberry, honeysuckle, and garlic mustard. Despite these factors, oak forests in the sandstone upland areas, seem to be maintaining their dominance. Large oak roots are able to survive in xeric uplands and can resprout multiple times, thus enabling these landscapes to continually reproduce and accumulate oak seedlings. This accumulation of reproduction results from the combined effects of periodic seed production, the relatively large food reserves in acorns that sustain seedlings through the first year, the high sprouting capacity of seedlings, drought tolerance and the ability of seedlings to persist under at least moderate shade. In the eastern United States, the accumulation of oak reproduction generally increases with decreasing site quality and over story density (Johnson 2009). In parts of Pennsylvania, however, within the Sandstone Uplands, *Betula lenta* (Sweet birch) was dominating the understory, preventing the establishment of oak seedlings.

Cropped fields or pasture do exist on this ecological site as alternative states, although due to the amount of surface stones, the steepness of the sideslopes and ridgetops, and the relative infertility of the soils, the Sandstone Uplands are for the most part unsuitable for agriculture, and are dominated by forests. Most areas have a history of repeated logging. Very convex ridgetops and sideslopes occasionally are dominated by a grassy bald or savannah-like state. The ecological mechanisms that create this state are unclear, although it may be due to a combination of logging disturbance, fire, and exposed south-facing slope aspect.

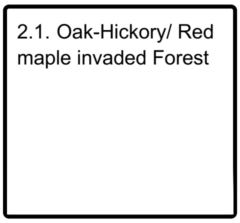
State and transition model

Ecosystem states

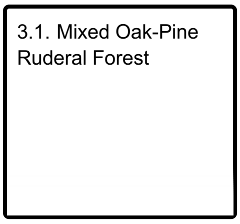


State 1 submodel, plant communities

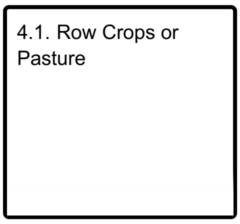
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Reference (minimally-managed)

The reference state is a combination of several vegetation communities within the Central Appalachian Dry Oak-Pine Forest, the Northeastern Interior Dry-Mesic Oak Forest, and the Central Appalachian Pine-Oak Rocky Woodland Forest Systems as defined by NatureServe (NatureServe 2009). These forests are mostly closed-canopy but can include patches of more open woodlands and grasslands. The coarse, acidic, well drained soils, will host a variable mixture of dry-site oak and pine species. Heath shrubs are common in the understory. Convex, shallow, exposed ridgetop, and rocky areas will tend to have more open canopies and will include pine species and herbaceous species that tolerate very dry conditions. The reference community listed below is one of several that have been documented on the Sandstone Uplands and although it is representative, it is not intended to describe every situation or the full range of conditions for this site.

Community 1.1
Chestnut Oak - (Scarlet Oak, Northern Red Oak) / Mountain Laurel / Blue Ridge Blueberry Forest

Quercus prinus - (*Quercus coccinea*, *Quercus rubra*) / *Kalmia latifolia* / *Vaccinium pallidum* Forest Chestnut Oak - (Scarlet Oak, Northern Red Oak) / Mountain Laurel / Blue Ridge Blueberry Forest, also known as the Central Appalachian-Northern Piedmont Chestnut Oak Forest (CEGL006299; NatureServe 2017), occurs at relatively low elevations, mostly <900 m, (2950 feet) in the Central Appalachians and adjacent areas (e.g., northern Piedmont and Northern Blue Ridge) and is well documented in the Ridge and Valley region. This community can be readily identified by its dry, infertile, sandy loam soils, and quite species-poor vegetation overwhelmingly dominated by Quercus prinus (Chestnut oak) and *Kalmia latifolia* (Mountain laurel) often with *Vaccinium pallidum* (Blue Ridge blueberry). The canopy, which may be rather short, is strongly dominated by Quercus prinus. The most characteristic canopy associates are *Quercus coccinea* (Scarlet oak), which varies from sparse to codominant, and *Quercus rubra* (Northern red oak). Minor associates frequently include *Quercus velutina* (Black oak), *Quercus alba* (White oak), *Nyssa sylvatica* (Sourgum), *Sassafras albidum* (Sassafras), and/or *Robinia pseudoacacia* (Black locust). Root sprouts of *Castanea dentata* (American chestnut) are present in some areas. *Acer rubrum* (Red maple) and *Nyssa sylvatica* (Sourgum) are often abundant in the understory tree layers. Tall shrubs include *Kalmia latifolia* (Mountain laurel) (usually dominant), *Viburnum acerifolium* (Mapleleaf viburnum), and *Rhododendron periclymenoides* (Pink azalea). The short-shrub layer is well-developed and includes *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (Deerberry), and *Gaylussacia baccata* (Black huckleberry), any one of which can exhibit patch-dominance. The herb layer generally has sparse cover but sometimes includes scattered individuals of *Aureolaria laevigata* (Entireleaf yellow false foxglove), *Chimaphila maculata* (Striped prince's pine), *Comandra umbellata* (Bastard toadflax), *Cypripedium acaule* (Moccasin flower), *Danthonia spicata* (Poverty oatgrass), *Epigaea repens* (Trailing arbutus), *Gaultheria procumbens* (Eastern teaberry), *Hieracium venosum* (Rattlesnake weed), *Lysimachia quadrifolia* (Whorled yellow loosestrife), *Medeola virginiana* (Indian cucumber), *Monotropa uniflora* (Indianpipe), *Pteridium aquilinum* (Western brackenfern), and/or *Uvularia puberula* (Mountain bellwort).

State 2
Fire Excluded/Even-aged, logged Forest

Community 2.1
Oak-Hickory/ Red maple invaded Forest

Quercus spp. – Carya spp. Disturbed Forest The existence of this Oak-Hickory alternative state (Similar to CEGL008515; NatureServe 2017) is assumed based on the history of the Appalachians and field observations. We assume that the post logging, fire excluded oak – hickory forests are similar to the reference state with the exception that overall species diversity is less, and trees are even-aged due to logging. The understory of these sites are dominated by fire sensitive species, most notably *Acer rubrum* (Red maple). *Pinus strobus* (eastern white pine) and *Pinus virginiana* (Virginia pine) may be part of the canopy as well. Early successional species like *Robinia pseudoacacia* (black locust), *Liriodendron tulipifera* (tuliptree), and *Prunus serotina* (black cherry) are also present. A heavy colonization of *Betula lenta* (Sweet birch) has also been documented on similar landscapes and vegetation communities.

State 3
Post-Ag Successional Invaded

The dominance of Pinus Virginiana (Virginia pine) in some areas strongly points to historic agricultural disturbance, or in cleared and/or burned over areas. Oaks may or may not be present. The bare mineral soil of cultivated sites facilitates the germination requirements of Pinus Virginiana, and other early successional species.

Community 3.1

Mixed Oak-Pine Ruderal Forest

Pinus virginiana Ruderal Forest The Virginia Pine Ruderal Forest (similar to CEGL002591, NatureServe 2017 and to the Virginia pine - mixed hardwood forest -Zimmerman et. al. 2012) occurs in areas where canopy removal has created dry, open conditions and bare mineral soil, allowing for the establishment of Virginia pine. It is common on abandoned farmland. Virginia pine as well as admixtures of other Pinus species (e.g., *Pinus taeda* (Loblolly pine), *Pinus echinata* (Shortleaf pine), *Pinus rigida* (Pitch pine), *Pinus strobus* (Eastern white pine) may contribute to 25 percent or more of the overstory. Hardwood associates vary; common species include *Quercus rubra* (Red oak), *Quercus velutina* (Black oak), *Quercus coccinea* (Scarlet oak), *Quercus alba* (White oak), *Prunus serotina* (Wild black cherry), *Acer rubrum* (Red maple), *Liriodendron tulipifera* (Tuliptree), *Betula lenta* (Sweet birch), Carya spp. (Hickory), *Sassafras albidum* (Sassafras), and *Fraxinus americana* (White ash). Shrubs include Smilax spp. (Greenbrier), *Juniperus virginiana* (Red-cedar), Rhus copallina (Shining sumac), *Rubus allegheniensis* (Allegheny blackberry), *Toxicodendron radicans* (Poison-ivy), and *Parthenocissus quinquefolia* (Virginia creeper).

State 4
Cultural - Agricultural- Grassland and/or Row Crops

Community 4.1
Row Crops or Pasture

The agricultural state is planted either to row crops like corn and soybeans, or in managed pastures of non-native forages. Non-native grasses may include cool season species such as *Schedonorus arundinaceus* (Tall fescue), Phleum pretense (Timothy) and *Dactylis glomerata* (Orchardgrass). Other species included *Sorghum halepense* (Johnsongrass), Setaria spp. (Foxtails), Panicum spp. (Panic grass), Amaranthus spp. (Amaranth), *Taraxacum officinale* (Common dandelion), and *Cirsium arvense* (Canada thistle). Surface fragments, low organic matter content and soil acidity make agriculture harder to maintain in a healthy, productive state on this ecological site.

Transition T1 - 2
State 1 to 2

Logging followed by natural regeneration and fire suppression.

Transition T1 - 3
State 1 to 3

Clearcutting, conversion to agricultural land, then successional forest regrowth.

Transition T1 - 4
State 1 to 4

Clearcutting; tillage; conversion to agricultural land; fertilizer and lime application; active management.

Restoration pathway R2 - 1
State 2 to 1

Understory removal to promote growth of oak seedlings; implement a prescribed fire plan; control invasive species. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide can be used for restoration efforts (FOTG-USDA): Brush Management-314; Forest Stand Improvement-666; Herbaceous Weed Control-315; Upland Wildlife habitat management-645; Prescribed burning-338.

Conservation practices

Brush Management
Prescribed Burning
Upland Wildlife Habitat Management
Forest Stand Improvement

Herbaceous Weed Control

Transition T2 - 3
State 2 to 3

Clearcutting, conversion to agricultural land, then successional forest regrowth.

Transition T2 - 4
State 2 to 4

Clearcutting; tillage; conversion to agricultural land; fertilizer and lime application; active management.

Restoration pathway R3 - 1
State 3 to 1

Remove understory, plant native seeds and seedlings, eliminate and manage nonnative species, implement a prescribed fire plan. Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance (Dyer, 2010). Aggressive control of nonnative species and invasive species will be ongoing. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide can be used for restoration efforts (FOTG-USDA): Brush Management-314; Critical Area Planting-342; Early Successional Habitat Development-647; Fence-382; Forest Stand Improvement-666; Herbaceous Weed Control-315; Tree/Shrub site Preparation-490; Upland Wildlife habitat management-645; Prescribed burning-338.

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Fence
Tree/Shrub Establishment
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Herbaceous Weed Control

Transition T3 - 4
State 3 to 4

Clearcutting; tillage; conversion to agricultural land; fertilizer and lime application; active management.

Restoration pathway R4 - 1
State 4 to 1

Cease agricultural management, exclude grazing, plant native seeds and seedlings, eliminate and manage nonnative and aggressive species, implement prescribed fire plan. Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance (Dyer, 2010). Aggressive control of nonnative species and invasive species will be ongoing. The following conservation practices from the Natural Resources Conservation Service Field Office Technical Guide can be used for restoration efforts (FOTG-USDA): Brush Management-314; Critical Area Planting-342; Early Successional Habitat Development-647; Fence-382; Forest Stand Improvement-666; Herbaceous Weed Control-315; Tree/Shrub site Preparation-490; Upland Wildlife habitat management-645; Prescribed burning-338

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Fence
Tree/Shrub Site Preparation
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Herbaceous Weed Control

Restoration pathway R4 - 3
State 4 to 3

Cease agricultural management, exclude grazing, and allow natural forest succession.

Conservation practices

Fence

Additional community tables

Inventory data references

Site Development and Testing Plan
Future work is needed, as described in a future project plan, to validate the information presented in this provisional ecological site description. Future work includes field sampling, data collection and analysis by qualified vegetation ecologists and soil scientists. As warranted, annual reviews of the project plan can be conducted by the Ecological Site Technical Team. A final field review, peer review, quality control, and quality assurance reviews of the ESD are necessary to approve a final document.

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Approval

Nels Barrett, 9/27/2024

Acknowledgments

This current draft provisional ecological site (PES) report is a generalized description of landform, climate, physiography, soils and associated vegetation. Future work is needed to validate this information and further refine the report into an ecological site description (ESD). An ESD will include detailed plant floristic inventory data on the reference state and most commonly occurring alternate states, interpretations for different land use, site productivity data, as well as descriptions of the ecological dynamics. Development of ESDs will require field data collection of soils and vegetation and subsequent data analysis. Production of ESDs will begin after draft provisional ecological site reports have been completed for most soil survey areas. The target completion date for PES is 2020, therefore the development of ESDs will not start until 2021. ESD development prioritization will be based on national priorities, state priorities, soil survey regional priorities, and funding and staffing limitations.

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/11/2025
Approved by	Nels Barrett
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:

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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:**
