# Ecological site F147XY003PA
# Mixed Limestone Upland

Last updated: 5/20/2025
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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). The Mixed Limestone Ecological Site occurs within 67a, Northern Limestone/Dolomite Valleys of EPA Ecoregion IV (Woods et. al. 1996).

## Ecological site concept

The Mixed Limestone Upland Ecological sites occur throughout MLRA 147 on hills and low ridges within valleys underlain by limestone, dolomite, and calcareous shales and siltstones. This ecological site includes shallow and moderately deep areas that are often intermixed with the deeper soils, due to the karst nature of these landscapes. Limestone bedrock that underlies these areas is typically tilted on end and will weather into pinnacles and sinkholes, often within a few meters of each other. In some areas, limestone outcrops occur on the surface. Depth to bedrock in the deeper soils is typically greater than 40 inches (101 cm) and can quite often be greater than 60 inches (152cm). Under shallower sites, bedrock will occur less than 20 inches (51 cm) from the surface. The soils are relatively high in pH compared to the acidic sandstones and shales in the surrounding higher elevation ridges. Landscapes are well drained, and in some cases water movement through the profile can be quite rapid if there are significant cracks and fissures in the underlying bedrock. The majority of these areas are cleared for agricultural production. Existing woodlands and forests generally contain Quercus alba (White oak), Quercus muehlenbergii (Chinquapin oak), Quercus rubra (Northern red oak), Quercus velutina (Black oak), various Carya spp. (Hickory), Fraxinus Americana (White ash), Liriodendron tulipifera (Tuliptree), Juglans nigra (Black walnut), and Acer saccharum (Sugar maple). Quercus muehlenbergii (Chinquapin oak) is indicative of the limestone substrate.

## Similar sites

| | |
|---|---|
| **F147XY006PA** | **Mixed Limestone Lower Slope**<br><br>Mixed Limestone Lower Slope |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus muehlenbergii*<br>(2) *Quercus alba* |
| Shrub | (1) *Viburnum prunifolium* |
| Herbaceous | Not specified |

## Physiographic features

The Mixed Limestone Upland Ecological sites are found on gently rolling hills, slight to steep slopes, and in karst topography within the limestone valleys of MLRA 147. The parent material is limestone, dolomite, with some calcareous shales, siltstones and fine-grained sandstones. This site differs from the hills and mountains of the surrounding higher elevation ridges that are underlain by acidic shales, siltstones, and sandstones, and from similar but steeper landscapes on limestone soils that are shallow to moderately deep. Depth to bedrock in the mixed limestone uplands ecological site is typically greater than 40 inches (101cm) and often is below 60inches (152cm). Shallower sites may have bedrock less than 20 inches (51cm) from the surface. In some areas, limestone crops out at the surface, but generally soils are moderately deep to deep, well drained, and not subject to flooding or ponding.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Valley<br>(2) Hill |
| Runoff class | Very low to very high |
| Elevation | 30 – 910 m |
| Slope | 0 – 60 % |
| Water table depth | 70 – 150 cm |
| 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 8 weather stations throughout MLRA 147 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) | 140-150 days |
| Freeze-free period (characteristic range) | 170-190 days |
| Precipitation total (characteristic range) | 940-1,090 mm |
| Frost-free period (actual range) | 120-160 days |
| Freeze-free period (actual range) | 160-190 days |
| Precipitation total (actual range) | 910-1,140 mm |
| Frost-free period (average) | 140 days |
| Freeze-free period (average) | 180 days |
| Precipitation total (average) | 1,020 mm |

- (1) EVERETT [USC00362721], Everett, PA
- (2) DALE ENTERPRISE [USC00442208], Dayton, VA
- (3) FRANKLIN 2 NE [USC00463215], Franklin, WV
- (4) HAMBURG [USC00363632], Hamburg, PA
- (5) LEWISBURG [USC00364976], Lewisburg, PA
- (6) STATE COLLEGE [USC00368449], State College, PA
- (7) WINCHESTER 7 SE [USC00449186], Winchester, VA
- (8) CHAMBERSBURG 1 ESE [USC00361354], Chambersburg, PA

## Influencing water features

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

## Soil features

The representative soil series associated with this site are: Wurno, Westmoreland, Webbtown, Watahala, Washington, Vertrees, Vanella, Timberville, Swimley, Swanpond, Ryder, Opequon, Poplimento, Pecktonville, Oaklet, Nollville, Needmore, Morrison, Millheim, Mertz, Lodi, Litz, Hublersburg, Hayter, Hagerstown, Groseclose, Frederick, Frankstown, Faywood, Endcav, Elliber, Edom, Dunmore, Duffield, Christian, Chilhowie, Carbo, Caneyville, Bookwood, Belmont,and Allenwood. They have weathered from limestone, dolomite, calcareous shales, siltstones, sandstones, phyllite, quartzite, and cherty limestone. The soils have developed from bedrock that has weathered in place, called residuum, and in some cases from materials that have moved from upper to lower slope positions, called colluvium, or less commonly, from pre-Illinoian glacial till (>770,000 years before present). Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

The soils are well drained with the seasonal high water table at 27 to 60 inches (68 to 152cm) depth or deeper. Depth to bedrock varies from less than 20 inches (51cm) to greater than 60 inches (152 cm). Soil surface textures are mostly silt loams and fine sandy loams, but can be silty clay loam if they have undergone extensive erosion. Subsurface textures are clayey. Water movement through the soil profile can be very slow to rapid depending on the underlying bedrock. In areas where the underlying limestone has many fissures and cracks, water movement can be quite rapid. Soil pH is generally around 5.0 to 6.0, but can be higher than 7.0 in the shallowest areas where limestone or calcareous bedrock outcrops are present.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Residuum – limestone<br>(2) Colluvium – dolomite<br>(3) Till – calcareous shale |
| Surface texture | (1) Channery silt loam<br>(2) Very channery silty clay loam<br>(3) Gravelly |
| Family particle size | (1) Loamy |
| Drainage class | Moderately well drained to well drained |
| Permeability class | Very slow to rapid |
| Soil depth | 20 – 230 cm |
| Surface fragment cover <=3" | 0 – 10 % |
| Surface fragment cover >3" | 0 – 10 % |
| Available water capacity (0-101.6cm) | 2.54 – 18.54 cm |
| Soil reaction (1:1 water) (0-101.6cm) | 4.6 – 7.3 |
| Subsurface fragment volume <=3" (Depth not specified) | 0 – 50 % |
| Subsurface fragment volume >3" (Depth not specified) | 0 – 80 % |

## 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, and herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL).

The Mixed Limestone Upland 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). This ecological site is found on hills and steep to moderately steep slopes, and in karst topography within the limestone valleys of MLRA 147. The parent material is limestone, dolomite, with some calcareous shales, siltstones and fine-grained sandstones.

The reference state is a combination of several associations of the Northeastern Interior Dry-Mesic Oak Forest System (CES202.592)and the Central Appalachian Alkaline Glade and Woodland System (CES202.602) as described by NatureServe (NatureServe 2009). The Northeastern Interior Dry-Mesic Oak Forests are one of the most widespread forest systems throughout the northeastern and northcentral U.S. They occur in dry-mesic settings, are typically closed canopy forests, and cover large expanses at low to mid elevations. Particular tree species found on the Limestone Uplands ecological site are Quercus muehlenbergii (Chinquapin oak), Quercus alba (White oak), Quercus rubra (Northern red oak), Quercus velutina (Black oak), various Carya spp. (Hickory), Fraxinus Americana (White ash), Liriodendron tulipifera (Tuliptree), Juglans nigra (Black walnut), and Acer saccharum (Sugar maple). Quercus muehlenbergii (Chinkapin oak) is indicative of the limestone substrate and will appear where bedrock is closer to the surface, slopes are steeper, and the soil is less weathered resulting in areas of relatively higher pH.

Forests and woodlands occupying the shallowest, steepest, and most convex parts of this ecological site are part of the Appalachian Alkaline Glade and Woodland System. These communities occupy mid-elevation ridges, slopes, and outcrops where soil is thin over calcareous bedrock and forest cover is patchy. Juniperus virginiana (Eastern redcedar) is a common tree, filling in areas with the absence of fire. Quercus muehlenbergii (Chinquapin oak), Rhus aromatic (Fragrant sumac), Cercis canadensis (Eastern redbud), and Ostrya virginiana (Hophornbeam) may occur and prairie grasses are the dominant herbs. These may include Andropogon gerardii (Big bluestem), Schizachyrium scoparium (Little bluestem), and Bouteloua spp. (Grama grass).

Mature forest stands today may be quite different than those of pre-European settlement. Due to the inherent fertility and good drainage of these limestone derived landscapes, most areas have been converted to agriculture with the exception of some of the steepest, most shallow, or rocky sites. The most common alternative state associated with this ecological site is cropland. In limited areas where cropland has been abandoned, the vegetation community is an invaded successional woodland. Common species are Juniperus virginiana (Eastern redcedar), Robinia pseudoacacia (Black locust), Liriodendron tulipifera (Tuliptree), and Prunus serotina (Black cherry). Nonnative species include Lonicera japonica (Japanese Honeysuckle), Berberis thunbergii (Japanese Barberry), Alliaria petiolata (Garlic mustard), and Microstegium vimineum (Japanese stiltgrass).

## State and transition model

## Additional community tables

**Table 5. Community 1.1 plant community composition**

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

**Table 6. Community 1.2 plant community composition**

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

**Table 7. Community 1.3 plant community composition**

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

**Table 8. Community 2.1 plant community composition**

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

**Table 9. Community 3.1 plant community composition**

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

## 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

Greg Schmidt, 5/20/2025

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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 | 03/04/2025 |
| Approved by | |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    **Dominant:**

    **Sub-dominant:**

    **Other:**

    **Additional:**

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

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

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

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

17. **Perennial plant reproductive capability:**