USDA Natural Resources Conservation Service

Ecological site F147XY014PA
Mine Spoil Land

Last updated: 9/27/2024
Accessed: 05/10/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 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 Mine Spoil Land ecological site occurs in 67e, and 69a of EPA Ecoregion IV – Anthracite Subregion, and the Uplands and Valleys of Mixed Land Use respectively (Woods et. al. 1996).

Ecological site concept

The Mine Spoil Land ecological sites are found on hillslopes and mountainsides that were formerly surface mined (strip mined) for coal and are now being reclaimed. The underlying parent material is strip mine spoil composed of sandstone, shale, siltstone, coal, and sometimes soil. Strip mining involves the removal of soil and rock to expose a coal seam. Heavy earth moving equipment is used and the loose soil and rock is piled up and referred to as spoil. Depth to bedrock is variable and can be less than 20 inches (51 cm) or greater than 60 inches (152 cm). Slopes are level to very steep. The soils have loam or sandy loam textures, and are generally strongly acid with pH's below 5.0.

Mine spoil is practically devoid of any plant parts that are capable of sprouting. Therefore, plant succession will proceed first with those pioneer species which propagate from windborne seeds or ones that are brought in by birds and animals and will reflect the composition of nearby forests and fields. Typical species which colonize mine spoil

are *Populus tremuloides* (Quaking aspen), *Populus grandidentata* (Bigtooth aspen), *Acer rubrum* (Red maple), *Prunus pensylvanica* (Pin cherry), *Prunus serotina* (Black cherry), *Betula lenta* (Sweet birch), *Rhus typhina* (Staghorn sumac), and *Rhus glabra* (Smooth sumac). Some herbs and grasses include Andropogon viginicus (Broomsedge), *Danthonia spicata* (Poverty grass), *Rubus flagellaris* (Dewberry), and various Asters and goldenrods. *Robinia pseudoacacia* (Black locust) is often planted to stabilize and enrich the soils. Plant recolonization depends on the site conditions that allow seedlings to become established. The reference state is assumed to be a combination of several vegetation communities within the Central Appalachian Dry Oak-Pine Forest, and the Northeastern Interior Dry-Mesic Oak Forest as defined by NatureServe (NatureServe 2009).

Table 1. Dominant plant species

Tree	(1) *Quercus* (2) *Carya*
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Mine Spoil Land ecological sites are found on hillslopes and mountainsides that were formerly surface mined for coal and are now being reclaimed. The underlying parent material is strip mine spoil composed of sandstone, shale, siltstone, and coal. Depth to bedrock is variable and can be less than 20 inches (51 cm)or greater than 60 inches (152 cm). Slopes are level to very steep. This ecological site is typically not subject to flooding or ponding.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	700–2,100 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 3 weather stations throughout MLRA 147 at elevations in which this ecological site occurs. 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)	152-173 days
Freeze-free period (characteristic range)	179-207 days
Precipitation total (characteristic range)	38-43 in
Frost-free period (actual range)	147-178 days
Freeze-free period (actual range)	171-215 days
Precipitation total (actual range)	36-44 in
Frost-free period (average)	163 days
Freeze-free period (average)	193 days
Precipitation total (average)	40 in

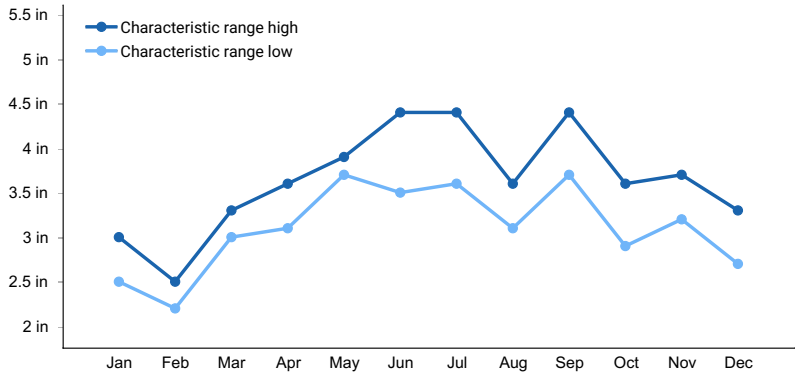


Figure 1. Monthly precipitation range

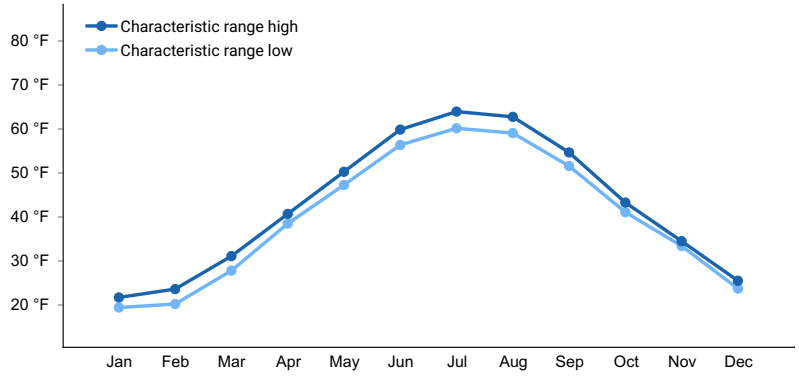


Figure 2. Monthly minimum temperature range

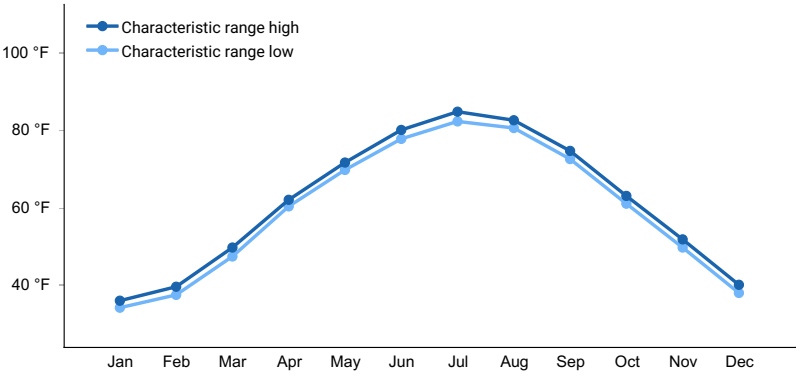


Figure 3. Monthly maximum temperature range

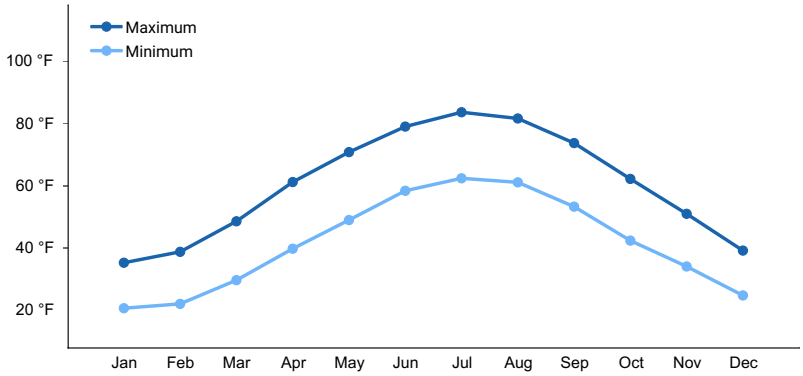


Figure 4. Monthly average minimum and maximum temperature

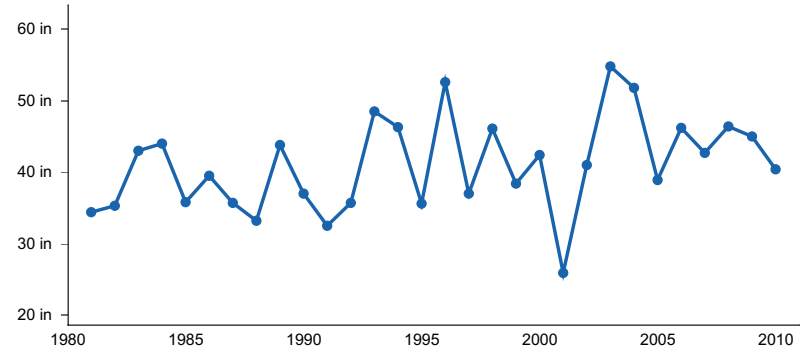


Figure 5. Annual precipitation pattern

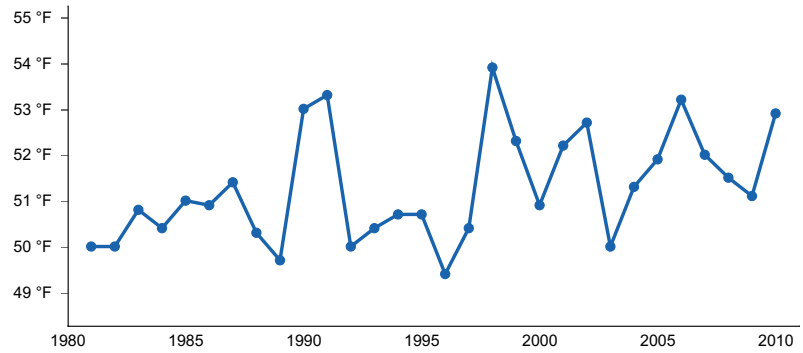


Figure 6. Annual average temperature pattern

Climate stations used

- (1) BEAR GAP [USC00360457], Coal Township, PA
- (2) MIDDLETOWN HARRISBURG INTL AP [USW00014711], Middletown, PA
- (3) ALTOONA BLAIR CO AP [USW00014736], Martinsburg, PA

Influencing water features

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

Soil features

The Mine Spoil Land ecological site includes the soil series Cedar Creek and areas mapped as Udorthents. The parent material is mine spoil or earthy fill derived from sandstone, shale, siltstone, and coal. Many areas are being reclaimed from surface mining. Depth to bedrock is variable ranging from less than 20 inches (51 cm) to greater than 60 inches (152 cm). There is little data on the height of the seasonal high water table or drainage. Rock fragment volume can range from 15 to 80 percent. The soils are generally strongly acid with pH’s below 5.0. Parts of the soil may have red, yellow, and gray mottles which may resemble features typically found in wet soils, but in this case are the colors of the rocks which the mine spoil contains. Surface textures are loam or sandy loam and

subsurface soils are loamy. Permeability is moderately rapid to rapid. Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

Table 4. Representative soil features

Parent material	(1) Mine spoil or earthy fill–shale and siltstone
Surface texture	(1) Extremely channery loam (2) Very channery sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid to rapid
Soil depth	60–90 in
Surface fragment cover <=3"	0–9%
Surface fragment cover >3"	2–9%
Available water capacity (0-40in)	1.9–4.7 in
Soil reaction (1:1 water) (0-40in)	4.6–6.5
Subsurface fragment volume <=3" (Depth not specified)	4–35%
Subsurface fragment volume >3" (Depth not specified)	1–28%

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). 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 Mine Spoil 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 occurs in Pennsylvania in the anthracite coal region in the northeast, and in a section of Bedford County in the southern central part of the state. Mine Spoil land is highly variable in terms of depth to bedrock, amount of rock fragments, type of rock fragments, drainage, acidity, slope shape, slope steepness, and stability and compaction.

It is assumed that the reference forest is some combination of oak and hickory. The characteristic forest system being part of the Central Appalachian Dry Oak Forest and/or the Northeastern Interior Dry-Mesic Oak Forest (NatureServe 2009). These are oak-dominated, mostly closed canopy forests composed of oak species characteristic of dry to mesic conditions and hickories. Pines may also be present as well as heath species like blueberry and mountain laurel.

The post coal mining material that becomes Mine Spoil land is for all practical purposes devoid of all plant parts including seeds, stems, leaves, and roots from which new plants can sprout. Therefore, plant succession will proceed first with species that propagate through windborne seeds or ones that are brought in by birds and animals

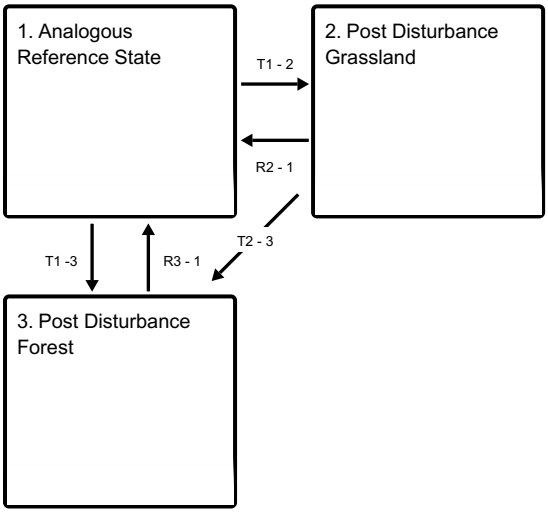
from nearby forests and fields. These pioneer species tend to be the first colonizers on most highly disturbed areas (Bramble 1955; Groninger et. al. 2007). These include *Populus tremuloides* (Quaking aspen), *Populus grandidentata* (Big tooth aspen), *Acer rubrum* (Red maple), *Prunus pensylvanica* (Pin cherry), *Prunus serotina* (Black cherry), *Betula lenta* (Sweet birch), Robinia Pseudoacacia (Black locust) *Rhus typhina* (Staghorn sumac), and *Rhus glabra* (Smooth sumac). Some herbs and grasses include Andropogon viginicus (Broomsedge), *Danthonia spicata* (Poverty grass), *Rubus flagellaris* (dewberry), and various Asters spp. (Asters), and Solidago spp. (Goldenrods).

Plant recolonization depends on the site conditions that allow seedlings to become established. Factors include the amount of actual soil material, wind exposure, surface temperature, looseness or compactness of the spoil, acidity, and other factors including those that affect the sites ability to retain moisture (Bramble 1955; and Hedin 1988). Once trees are able to establish, bare soil disappears, leaf litter increases, and forests can eventually develop (Hedin 1988). Where pH is relatively high (>5.0) grasses and herbaceous communities may rapidly invade and form a ground cover that dominates the plant community. Sites where pH is relatively low (<5.0) seem to favor establishment of trees (Skousen et. al 1994). Some areas of reclaimed surface mined land represented by the Cedarcreek soil series, which is included in this ecological site, have established forest stands of naturally seeded *Liriodendron tulipifera* (tulip poplar), *Betula lenta* (Black birch), *Robinia pseudoacacia* (Black locust), and *Platanus occidentalis* (American sycamore) (Soil Survey Staff 2016).

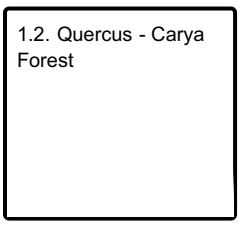
Alternative ecological states that exist on Mine Spoil include grassland and some orchards. The information presented is representative of very complex vegetation communities. Key indicator plants and ecological processes are described to help inform land management decisions. Plant communities will differ across the major land resource region because of the naturally occurring variability in weather, soils, and aspect. The reference plant community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities

2.1. Schizachyrium scoparium - (Andropogon virginicus) - Solidago spp. Ruderal Meadow

State 3 submodel, plant communities

3.1. Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana Ruderal Forest

State 1
Analogous Reference State

Due to the disturbed nature of the parent materials, a true reference conditions does not exist. However, depending on the nature of the restored site the refence condition may be considered analogous by approximating a more native native condition. Due to the heterogeneity of this provisional ecological unit, the vegetation associations listed are not intended to cover every situation or the full range of conditions and species for this site.

Community 1.1
Quercus - Carya Forest

It is assumed that the reference forest is some combination of oak and hickory. The characteristic forest system being part of the Central Appalachian Dry Oak-Pine Forest (CES202.591), and/or the Northeastern Interior Dry-Mesic Oak Forest Systems (CES202.592) as defined by Nature Serve (NatureServe 2009). These are oak-dominated, mostly closed canopy forests composed of oak species characteristic of dry to mesic conditions and hickories. Dominant species may include *Quercus rubra*, *Quercus alba*, *Quercus velutina*, Quercus prinus and *Quercus coccinea* (Red, White, Black, and Scarlet oaks) and Carya spp. (hickories). *Castanea dentata* (American chestnut) was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Pinus virginiana* (Virginia pine), and *Pinus strobus* (Eastern white pine) and heath shrubs such as *Vaccinium pallidum* (Blue Ridge blueberry), *Gaylussacia baccata* (Black huckleberry), and *Kalmia latifolia* (Mountain laurel) may also be present.

State 2
Post Disturbance Grassland

Community 2.1
Schizachyrium scoparium - (Andropogon virginicus) - Solidago spp. Ruderal Meadow

The Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Ruderal Meadow, also called the Little Bluestem Old-field Meadow (CEGL006333; NatureServe 2017) is a broadly defined vegetation type which occurs on well-drained soils that are either sandy or shallow to bedrock. The vegetation arises spontaneously after soil disturbance. It is characterized by dominance of warm-season grasses. *Schizachyrium scoparium* (Little bluestem) is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus* (Broomsedge bluestem), *Eragrostis spectabilis* (Purple lovegrass), *Festuca rubra* (Red fescue), *Deschampsia flexuosa* (Wavy hairgrass), *Danthonia spicata* (Poverty oatgrass), *Nuttallanthus canadensis* (Canada toadflax), *Rubus flagellaris* (Dewberry), *Panicum virgatum* (Switchgrass), *Dichanthelium depauperatum* (Stared panicgrass), *Potentilla simplex*, *Dichanthelium meridionale* (Matting rosette grass), *Dichanthelium dichotomum* (Cypress panicgrass), *Solidago rugosa* (Wrinkleleaf goldenrod), and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including Comptonia peregrine (Sweet fern), *Gaylussacia baccata* (Black huckleberry), and scattered tree saplings, such as *Prunus serotina* (Black cherry), *Sassafras albidum* (Sassafras), and *Juniperus virginiana* (Eastern redcedar). Polytrichum moss species are

common bryophytes.

State 3
Post Disturbance Forest

Community 3.1
Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana Ruderal Forest

The Black Cherry - Tuliptree - Red Maple - White Ash - (Black Locust) Ruderal Forest (CEGL006599; NatureServe 2017) is an early-successional woody vegetation community of the northeastern United States that occurs on sites that are becoming reforested after having been cleared for agriculture or otherwise heavily modified in the past. Characteristics of this community are highly variable ranging from closed forest, to woodland, to open to dense shrub land. Tree species often include some combination of *Prunus serotina* (Black cherry), *Liriodendron tulipifera* (Tuliptree), Fraxinus Americana (White ash), *Robinia pseudoacacia* (Black locust), and *Acer rubrum* (Red maple). Other associates can include *Juglans nigra* (Black walnut), *Sassafras albidum* (Sassafras), *Betula populifolia* (Gray birch), *Juniperus virginiana* (Eastern redcedar), *Acer negundo* (Boxelder), *Acer saccharinum* (Silver maple), *Ailanthus altissima* (Tree of heaven), Ulmus Americana (American elm), Quercus spp. (Oaks), *Betula lenta* (Sweet birch), Amelanchier spp. (Serviceberry), *Pinus strobus* (Eastern white pine), and *Populus grandidentata* (Bigtooth aspen). The low-shrub layer, if present, is usually characterized by the presence of Rubus spp. (Blackberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (Common buckthorn), Crataegus spp. (Hawthorn), *Rosa multiflora* (Multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima* var. altissima (White snakeroot), *Polygonum persicaria* (Spotted ladysthumb), *Impatiens capensis* (Jewelweed), *Glechoma hederacea* (Ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium* ssp. Sepium (Hedge false bindweed), *Galium aparine* (Stickywilly), *Oxalis stricta* (Common yellow oxalis), *Polygonum virginianum* (Jumpseed), *Dennstaedtia punctilobula* (Eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (Wild garlic), and *Veronica officinalis* (Common gypsyweed), among many others. The invasive species *Alliaria petiolata* (Garlic mustard), *Microstegium vimineum* (Nepalese browntop), and Polygonum caespitosum (Oriental lady's thumb) can be abundant in this disturbed forest type. These forests are often young and recent disturbance or abundant invasive species give these forest stands a weedy character. It is unlikely that these stands will succeed to a natural plant community dominated by native species.

Transition T1 - 2
State 1 to 2

Logging followed by mining. Some stockpiled topsoil may be replaced. Application of fertilizer and lime may encourage colonization by grasses.

Transition T1 -3
State 1 to 3

Logging followed by mining. Some stockpiled topsoil may be replaced. Natural succession allowed to progress. If surrounding forests are still intact, they can provide native seed sources.

Restoration pathway R2 - 1
State 2 to 1

Mine spoil sites can be reclaimed to productive mature forests when the following practices are used to accelerate natural succession: 1) Create a suitable rooting medium for good tree growth comprised of topsoil, weathered sandstone, and/or the best available material; 2) Loosely grade the topsoil or topsoil substitute to create a non-compacted growth medium; 3) Use ground covers that are compatible with growing trees; 4) plant two types of trees – early successional species for wildlife and soil stability, and commercially valuable crop trees; 5) Use proper tree planting techniques (Groninger et. al. 2007). 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 subjected to mining will 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. 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. These communities are distinctly different from the reference forest state (Dyer, 2010). 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
Tree/Shrub Site Preparation
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Forest Stand Improvement
Herbaceous Weed Control

Transition T2 - 3
State 2 to 3

Successional forest regrowth. If surrounding forests are still intact, they can provide native seed sources. If surrounding forests are not intact, or area is surrounded by agriculture, or other human development, nonnative species may become dominant.

Restoration pathway R3 - 1
State 3 to 1

Mine spoil sites can be reclaimed to productive mature forests when the following practices are used to accelerate natural succession: 1) Create a suitable rooting medium for good tree growth comprised of topsoil, weathered sandstone, and/or the best available material; 2) Loosely grade the topsoil or topsoil substitute to create a non-compacted growth medium; 3) Use ground covers that are compatible with growing trees; 4) plant two types of trees – early successional species for wildlife and soil stability, and commercially valuable crop trees; 5) Use proper tree planting techniques (Groninger et. al. 2007). 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 subjected to mining will 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. 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. These communities are distinctly different from the reference forest state (Dyer, 2010). 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

Additional community tables

Inventory data references

Site Development and Testing Plan
Future work is needed, as described in a 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.

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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	05/10/2025
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:

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:**