





South Mountain from White Rock, Monroe Township



Introduction

Pennsylvania is blessed with diverse and abundant natural resources. Protection of these resources for future generations has always been important to our citizens and is incorporated into our State constitution.

“The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic, and aesthetic values of the environment. Pennsylvania’s resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.”

- Section 27, Article 1 of the Pennsylvania State Constitution

The development of Land Partnerships involved a comprehensive exploration of Cumberland County’s natural resources to inventory physical features and land characteristics that contribute to the unique natural setting of a place or area. The inventory of natural resources is followed by a discussion of the benefits of, and threats to, those natural resources. Lastly, the plan documents tools and strategies for natural resource protection.

Natural Resources of Cumberland County

Cumberland County is fortunate to encompass significant natural features that deliver essential ecological services⁸ to the County. Additionally, these natural resources contribute to its scenic beauty and the quality of life it offers residents. The wooded ridges of Blue Mountain and South Mountain, the stream corridors of the Yellow Breeches Creek and Conodoguinet Creek, and the Susquehanna River along the eastern boundary are natural resources that define Cumberland County. The valley lands between the ridges with its rich agricultural soils, wetlands, and riparian areas add to the diversity of the County’s natural resources.

The following sections include a comprehensive examination of the natural environment including descriptions of the important natural resources of the County.

Climate

Cumberland County is dominated by atmospheric flow patterns common to Humid Continental type climate. The complex weather systems that influence the area originate in the Central Plains of the United States. As they travel eastward, they are gradually modified by the characteristics of the underlying topography. Moisture in the



form of precipitation is lost due to orographic uplift, as the weather systems moving eastward are lifted over the Appalachian Mountain Chain. A secondary flow pattern, and primary source of heavy precipitation associated with cyclonic circulation, originates in the Gulf of Mexico and travels northward through the County. The moist airflow from the Atlantic Ocean is a modifying rather than a controlling climatic factor. Periodically, considerable moisture is picked up by storms developing and moving up along the southeastern coastline of the United States. A disturbance of this type usually brings moderate to heavy precipitation to the Lower Susquehanna River Area due to the general upslope motion of moist air over the area's rugged terrain. In the colder months when temperatures are near or below freezing, these storms often deposit heavy amounts of wet snow throughout the area.

The normal succession of high and low pressure systems moving eastward across the United States produce weather changes in the area every few days in the winter and spring of the year. In the summer and fall, the weather changes are less frequent due to a slowing down of the general atmospheric circulation during the warmer months. Low-pressure cyclonic systems usually dominate the area with southerly winds, rising temperatures, and some form of precipitation. The high-pressure anticyclonic systems normally bring west to northwest winds, lowering temperatures, and clearing skies in the area.

Hurricanes or tropical disturbances, as they move northward, follow a northeasterly path in the middle latitudes and produce heavy rainfalls and strong surface winds in the study area. Frequently affecting water supplies and causing floods, these tropical storms are observed during the hurricane season - June through November.

Weather elements or activities of the atmosphere, such as precipitation, temperature, wind direction and speed, relative humidity, and sunshine are measurable quantities that affect the study area.

The study area normally receives about 46 inches of precipitation annually. Normal monthly precipitation totals average from a minimum of 2.6 inches in February to a maximum of 4.3 inches in August. Snowfall is light to moderate averaging about 30 inches annually, while the mean annual number of days with snow cover of one inch or more is about 50 days.

Air temperatures are important to the management of water resources and water quality. The average annual temperature for the study area is about 50 degrees Fahrenheit (F). The mean freeze-free period is about 175 days. Because of the rugged terrain, the freeze-free season is variable, ranging between 170 days in the

mountains to 180 days in the lowlands. The summer mean temperature is about 76 degrees F, and the winter mean is about 32 degrees F.

Winds are important hydrologic factors because of their evaporative effects and their association with major storm systems. The prevailing wind directions in the area are from the northwest in winter and from the west in spring. The average wind speed is 10 miles per hour (mph); with an extreme wind speed of 68 mph from the west-northwest reported in the Lower Susquehanna area during severe storm activity in March of 1955.

Relative humidity also affects evaporation processes. The mean monthly relative humidity for the months of January, April, July, and October are about 68 percent, 62 percent, 70 percent, and 75 percent, respectively.

Sunshine, which varies with latitude and time of the year, is a factor to be considered in the various aspects of water resources. The mean annual sunshine in hours per year is about 2,500 hours.

The evaporation process is controlled by temperature, wind, sunshine, and humidity. The rate of evaporation during the warmer months has an important impact on water storage in reservoirs and on irrigation. The mean May to October evaporation accounts for about 72 percent of the total annual evaporation.

The climate should be considered when developing in the County. Windbreaks in the form of evergreen tree lines and in-ground finished floor levels should be located on the northwest side of buildings to create warmer microclimates during the winter. By breaking the velocity of the northwest winds, energy conservation can be realized by reducing heat loss. Conversely, deciduous shade trees should be provided along southwest facades of buildings to provide shade in the summer and heating solar rays during the winter when the tree is defoliated. To take advantage of the sun for passive or active solar systems, buildings should have generous south facing walls and shorter north facing walls. Although the climate will not have a major effect on land uses, it should be considered in the layout of buildings for energy conservation purposes.

Geology

Geologists state that at one time the eastern part of the United States sank below sea level and formed a great inland body of water known as the Appalachian Gulf. Sediments and dissolved material



from surrounding areas settled or precipitated out in uniform layers resulting in the formation of sedimentary rocks of shale, limestone, and sandstone. Continued deposition of sediments exerted extreme pressure on the deeper layers forming flat hard sheets. This was followed by a period of upward movement caused by great horizontal compression. Folding and faulting of the flat sheets of rock formed a series of ridges and valleys, which follow a parallel pattern northeast to southwest. Most of Cumberland County is composed of sedimentary rock formations.

In a later period, molten material, originating within the earth, heated the sedimentary rocks and caused them to expand and crack. The molten material filled the cracks and cavities in the surface and solidified to form igneous rock. Cumberland County contains very little of this type of rock. The most prominent igneous formation is a diabase dike, oriented north – south through the County. Metamorphic rocks result from the intense heat and pressure associated with tectonic activity changing the texture and/or component minerals of sedimentary and igneous rocks. Metamorphic rock formations are located primarily in the southern portion of the County and comprise much of South Mountain.

The rocks found in Cumberland County were formed during six periods of geologic time. The following information describes the major geologic formations in Cumberland County and are depicted on the Geology Map (Map 6-1).

The oldest rocks in the County are from the Precambrian Age and are represented by three formations in the South Mountain area. The Metabasalt is made up of basalt flows. Metarhyolite, of altered gray to red rhyolite flows, shows a flow of banded quartz and feldspar phenocrysts. Greenstone Schist forms belts in rhyolite areas.

The next younger geologic period is called the Cambrian. The eight identified formations of this period include four containing limestone and dolomite.

- The Shadygrove Formation is a light-gray to pinkish-gray micritic limestone with abundant nodules of brown chert.
- The Zullinger Formation is composed of thick beds of medium-gray, sand to pebble-sized detrital limestone.
- The Elbrook Formation is a light gray to yellowish gray fine laminated siliceous limestone with interbeds of dolomite; weathers to earthy buff soil.
- The Tomstown Formation is a massive dolomite with thin shaly interbeds.

Limonite, an iron-bearing mineral, is found on the upper part of the Tomstown dolomite formation. In the past, it was mined at Pine Grove Furnace. Magnetite, a high-grade iron ore, was also mined at one time in this same area. The remaining Cambrian formations are listed below.

- The Antietam formation is a gray to buff weathered quartzite and quartz schist.
- The Harpers formation is a dark greenish gray phyllite schist with thin quartzite layers.
- The Weverton formation is a gray to purplish gray, feldspathic quartzite and quartz conglomerate.
- The Waynesboro formation is an interbedded red to purple shale and sandstone with some beds of dolomite and impure limestone.

These formations occupy approximately 60 percent of the South Mountain area. The quartzite has been used chiefly for building stones. The Antietam Formation in highly weathered areas is quarried for sand. On top of the Antietam is sericite schist weathered to white clay, which is quarried and used as filler for paper.

The next younger geologic formations are of the Ordovician Age, which underlies the northern half of the County. It includes eleven identified formations.

The Juniata and Bald Mountain Formations comprise the slopes of Blue Mountain and are fine grained to conglomeritic quartzitic sandstone with red shale interbeds. Large fragments of this sandstone occupy very steep slopes near the mountaintops. Little use has been made of the Juniata and Bald Eagle formations.

The Martinsburg Formation is a gray to dark gray, light gray to olive, easily weathered shale underlying 30 percent of the County's land area. The rolling shale hills are adaptable to real estate development. Construction of roads, cuts and fills, grading for homes, schools, and industrial sites are not difficult, but extensive grading may be necessary. The Martinsburg shale is used as an ingredient in cement manufacture, and in a mixture of topsoil and shale for seedbed preparation of road cuts and fills. The broken shale is used in the sub grade of roads to insure adequate under-drainage and firm foundation.

Limestone and dolomites are found in eight identified formations of the Ordovician period. The limestone and dolomites of the Cambrian



and Ordovician geologic periods form a band of five to ten miles wide from east to west occupying 45 percent of the County's area. These limestone and dolomites have long been a source of building stone, coarse aggregate in concrete, cement manufacture, and agriculture lime. Concrete, road building and steel industries have increased their use tremendously. Clay, a by-product of limestone weathering, is used in brick manufacturing. The Ordovician limestone and dolomites include the following formations.

- The Chambersburg Formation is a dark gray, thin-bedded limestone at the top; a gray argillaceous limestone in the middle; and dark gray, cobbled and thin irregularly bedded limestone at the bottom.
- The Hershey and Myerstown Formations are a dark gray to black, thin-bedded argillaceous limestone.
- The St. Paul Group is a buff colored, even grained dolostone, containing numerous layers of blocky chert.
- The Pinesburg Station Formation is a thick bedded, light to medium gray laminated dolomite with interbeds of blue-gray limestone.
- The Epler Formation is a very fine crystalline, bluish gray limestone, interbedded with gray dolomite; coarse crystalline limestone lenses are present.
- The Rockdale Run Formation is a medium bedded, finely laminated to homogeneous chert bearing micritic limestone.
- The Stonehenge Formation is a gray finely crystalline limestone and dark gray laminated limestone with numerous edgewise-conglomerate beds.

These limestone and dolomite weathered formations have given rise to a highly productive soil area. Flow from springs and streams are excellent in these limestone dolomite areas, but the potential for pollution of springs and underground water supplies is high.

The Silurian Age is the next younger period and is represented only by the Tuscarora Formation. It is a very hard, fine-grained, white to gray, medium to thick, bedded rock that caps Blue Mountain on the northern and western boundary of the County. This sandstone is used as a source of silica for silica brick and sand. The bottom fifty to one hundred feet is a mixed color of white and red; a property making it highly sought for by homebuilders.

The second youngest formation is from the Triassic period, which is represented by the Gettysburg Formation. It is composed of a red to brown, fine to coarse-grained quartz or sandstone with red shale and limestone conglomeritic interbeds. Because of its resistance to weathering, the limestone conglomerate has often been utilized in construction.

The youngest rocks in Cumberland County are igneous from the Triassic and Jurassic Ages and include the diabase and diabase dikes. One narrow dike about 100 to 200 feet wide starts at the County's northern boundary east of Donnellytown and runs to the south, leaving the County about one mile southeast of Goodyear. Two small areas of diabase are found east of Shepherdstown.

Quarrying of these areas for commercial purposes is too costly because of the resistance to crushing and splitting. Fieldstone has been used in house construction. Small pockets of fine grain material have been quarried where the diabase weathered rapidly.

The geology of an area must be considered in land use planning, as the ultimate or best use of land is initially determined by its characteristics and quality. On-lot sewage disposal, drainage, and construction costs are some of the factors affected by bedrock geology. The rock types found in Cumberland County present some specific inherent limitations. For example, the porosity of the limestone formations could contribute to the rapid spread of groundwater contaminants. In some cases, on-site evaluation of geologic factors may be necessary to determine the feasibility and impacts of a proposed project.

The engineering aspect of the bedrock geology is also important. These characteristics give an indication of such things as ease of excavation, cut-slope stability, and foundation stability. Generally, the rock formations in the County provide strength and support for heavy structures such as dams, highways, bridges, and large buildings. Those areas, which are underlain by limestone and dolomites, however, may pose some problems to foundation engineering. Cavernous areas and areas known to be susceptible to sinkholes should be investigated thoroughly before construction of heavy structures and roads. Again, most of these problems would be site specific and require an on-site evaluation to determine the appropriateness of a project.

Mineral Resources

Important mineral reserves within Cumberland County are extremely limited. Although many types of minerals can be found in the County, most of these are of interest only to the student or collector. Limestone is quarried for use in construction and industrial operations. Sand and gravel are also extracted from the South Mountain region for use in building and manufacturing.



Soils

Soil is a product of the geology, topography, climate, and vegetation. Alterations in any of these variables cause major changes in soil type. Soil formation and soil erosion are continuing actions; the latter of which has been greatly accelerated by man's misuse of the land.

Soils have many properties by which they are identified. Knowledge of these properties is fundamental to an intelligent determination of land use. Some soils are deep and well drained and thus suited to most types of urban or agriculture uses. In contrast, shallow and poorly drained soils have definite use limitations. Applying various engineering practices to the land may alter such soils. This is always a costly and frequently unwarranted expenditure. It is to avoid such expenditures that soil maps are utilized as a basis for land use decisions and planning.

The upland soils of Cumberland County are closely related to the underlying bedrock. Along the river valleys and on the benches adjacent to the main valleys, the soils are developed in material transported by running water and deposited with some degree of stratification.

The United States Department of Agriculture, Soil Conservation Service, has made a detailed soil survey of Cumberland County. It classifies the soils according to depth, texture (coarseness or fineness), natural drainage, thickness, and arrangement of the various layers, kind of parent material, slope, erosion, flooding, and other characteristics. Soils change within short distances and the detailed soil survey shows many small areas.

Using Soil Associations, general soil information can be provided. These are groups of soils, which ordinarily occur together in the landscape. Each soil has its characteristic place depending on slope or kind of material. The Soil Associations of Cumberland County are shown in Map 6-3.

The following Soil Associations occur in Cumberland County:

- Berks-Weikert-Bedington Association: Shallow to deep, gently sloping to very steep, well drained soils that formed in material weathered from gray and brown shale, siltstone, and sandstone; on uplands.
- Hagerstown-Duffield Association: Deep, nearly level to moderately steep, well drained soils that formed in material weathered from limestone; on uplands.
- Hazleton-Laidig-Buchanan Association: Deep, nearly level to very steep, well drained to somewhat poorly drained soils that formed in material weathered from gray and brown quartzite, sandstone, siltstone, and shale; on uplands.

- Monongahela-Atkins-Middlebury Association: Deep, nearly level and gently sloping, moderately well drained to poorly drained soils that formed in alluvium; on terraces and flood plains.
- Murrill-Laidig-Buchanan Association: Deep, nearly level to moderately steep, well drained to somewhat poorly drained soils that formed in colluvium from gray sandstone, conglomerate, quartzite, and limestone, on uplands.
- Athol-Neshaminy Association: Deep, gently sloping and sloping, well drained soils that formed in material weathered from conglomerate, breccias, and diabase; on uplands.
- Hazleton-Clymer Association: Deep, nearly level to very steep, well drained soils that formed in material weathered from gray sandstone and quartzite; on uplands.
- Highfield-Glenville Association: Deep, nearly level to moderately steep, well drained to somewhat poorly drained soils that formed in material weathered from schist and rhyolite; on uplands.

The Soil Survey of Cumberland and Perry Counties, published in April 1986, is the primary source for information regarding soils in the County. The Soil Survey has established capability classes for soils and are designated by Roman numerals I through VIII. The higher the numeral, the greater the limitations for agricultural use. The classes are defined as follows:

- Class I – few limitations that restrict their use.
- Class II – moderate limitations that require moderate conservation practices.
- Class III – severe limitations that require special conservation practices.
- Classes IV – VIII – very severe limitations that require careful management or are unsuitable for cultivation.

“Prime Farmland” in Cumberland County includes Class I and Class II soils (Map 5-1). The Soil Conservation Service has identified approximately 136,700 acres⁹, or 39 percent of the County, as prime farmland. These are the most productive soils for crop production, are well drained, not highly erodible, and do not flood during the growing season.

Pennsylvania has also designated Class III soils as “soils of statewide importance” due to their productive capabilities. About 60 percent of Cumberland County is covered by productive soils in the categories of Class I, II, and III soils. Much of this land is currently in crop production; however, nearly 90,000 acres of farmland was



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converted to development between 1940 and 2002. Because these desirable agricultural soil areas coincide with flat, level topographic features, development pressure will continue to affect the prime farmlands.

Historically, agriculture has been very important to the culture and economy of Cumberland County. Agriculture is dependent upon the quality of the soil, and once prime agricultural soils are taken out of production by development they cannot be replaced. Chapter 5 addresses policy on Agriculture Preservation.

A few of the soil types are known to pose severe limitations on development and major construction projects. These limitations include such factors as slow percolation rates for on-lot sewage disposal, shallow depth to bedrock, and erodibility. Individual soil tests are recommended prior to construction on sites where the soil type indicates that such limitations may exist. The majority of the County can expect unsatisfactory performance of septic tank absorption of effluent; surfacing of effluent, and hillside seepage all of which can effect public health. Map 6-3 depicts Soil Limitations for On-Lot Septic.

Groundwater can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field; if slope is excessive; or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively or the groundwater will become polluted.

Slopes - Topography

The topographic features of the landscape are derived from the structure and weathering characteristics of the underlying bedrock. The more weather-resistant rock is responsible for areas of higher elevation, while less resistant rock, such as limestone, has eroded to form low lying valleys of moderate relief.

The features of Cumberland County showing the most prominent topographic relief are Blue Mountain, which forms the northern boundary of the County, and South and Piney Mountains, which form the southern boundary. Steep slopes greater than 15 percent characterize the terrain here. The foothills of the mountains consist of a 2 to 4 mile strip of land running the length of the County and having moderate slopes between 8 and 15 percent. The central valley floor, a broad expanse of land running east to west through Cumberland County, has generally mild slopes of less than 8 percent. However, a considerable number of localized ridges and steep slopes are evident within the Valley, especially along the Conodoguinet and Yellow Breeches Creek.



Michaux State Forest

Topography has been a determining factor in the distribution of population throughout Cumberland County. Due to the relative ease of development in flatter areas, the more desirable lands are those located in the central valley. Thus, the more densely populated and urbanized areas are located on these mostly level lands. The steeper slopes of the mountain and hill areas of the County have presented physical barriers to the development of these lands, which are, therefore, the least populated areas of the County.

Agricultural uses also occur predominantly in the more level areas, as these lands allow for more efficient farming operations. In Cumberland County, this factor is enhanced by the occurrence of the best agricultural soils with the lower, flatter lands. Additional competition for the flatter lands is intensified because commerce and industry, along with residential and agricultural uses, seek flatter, more easily developed areas.

In planning for the development of an area, the slope of the land is a major factor. The Slope Map (Map 6-4) illustrates the areas of slope from 15 to 24.9 percent (approximately 5 percent of the county or 17,910 ± acres) and slopes exceeding 25 percent (approximately 7 percent or 23,650± acres)¹⁰.

In discussing the slope of the land, it is important to keep in mind the erosional forces trying to establish a stable condition creating the natural gradients. Sometimes when these slopes are altered through development, the balance can be upset and landslides, rock falls, mudslides, and soil creep may result as nature tries to restore equilibrium.

In the County, soil creep is prevalent and may at times be severe in areas where shales occur. Adequate drainage leading water away from the face of a steep slope and keeping it from entering the top of the slope is advisable where it is necessary to curtail the soil creep.

The publicly owned land of Michaux State Forest protects a significant amount of the steep slopes in the southern portion of the County, but there are several significant areas that are not protected. These unprotected areas include the southern portion of Penn Township, a portion of Dickinson Township west of Mt. Holly Springs, and the southeast portion of South Middleton Township and the southwestern portion of Monroe Township. The steep slopes to the north are much more vulnerable except where they coincide with Tuscarora State Forest, Colonel Denning State Park and State Game Lands.



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Woodlands

Prior to clearing by European settlers, most of Cumberland County was covered by forests. Today, approximately 35 percent (125,240± acres¹¹) of the County is covered by woodlands. Most of the forested areas are concentrated on the slopes and ridges of the mountains on the northern and southern boundaries of the County. There are scattered areas of woodland throughout the remaining areas of the County. The Woodland Map (Map 6-5) illustrates the wooded areas of the County.

Much of South Mountain is protected through State ownership of Michaux State Forest, Kings Gap Environmental Education Center and Pine Grove Furnace State Park. Unlike South Mountain, Blue Mountain, within Cumberland County, is largely in private ownership. Portions of the Tuscarora State Forest, State Game Lands, Waggoner's Gap Hawk Watch and Colonel Denning State Park afford public protection of the Blue Mountain ridge area in Cumberland County.

The main forest cover type is mixed oak-hickory stands consisting mainly of white oak, red oak, hickory, black oak, and chestnut oak. Other species to be found include yellow poplar, shagbark hickory, white ash, red maple, beech, elm, birch, sycamore, hemlock, white pine, and Virginia pine.

Forests affect water resources in both a protective and a depletive manner. They offer protection from floods and erosion, while at the same time contributing to the depletion of stream flows. The latter occurs primarily during the growing season.

Forest soils are covered with litter (leaves and twigs), which acts as a protective layer to the soil and reduces the possibility of sheet erosion. In addition, litter decays and becomes humus, which helps to form a highly permeable layer of soil, in which infiltration rates usually exceed rainfall intensities. This absorbs runoff from heavy rainfall, thus reducing downstream flood peaks. However, where the forest floor becomes disturbed, particularly through activities associated with the construction of roads and basements, the potential for erosion increases. Soil loss then depends on soil erodibility, as well as, the length and steepness of slopes.

Hydrology

Management of water resources requires knowledge of the quantity of water that is available for use and which must be managed in order to provide for the safety and welfare of the public. For studies of water use and quality, low flow conditions are of general concern, however for flood management, it is necessary to know the high flow characteristics of streams.



Kings Gap Environmental Education Center

Watershed level planning most appropriately manages water resources. A watershed is the entire land area drained by a particular watercourse. Land use activities and waste water discharges within the watershed determine the quality of the water, which eventually flows out of the drainage area. The concept of the watershed has practical planning application, as it is the primary geographic region in which to collect water resource related information. Several volunteer based watershed associations existing in the County and are concerned with water quality and quantity issues within a particular watershed.

The first factor affecting water flow conditions is runoff, which is primarily influenced by precipitation distribution. However, other factors such as land cover and use, geology and topography influence the variability of flows from individual watersheds.

Runoff has a distinct seasonal variation; with the period of highest runoff occurring in late winter or early spring, and the period of lowest runoff occurring in late summer and early fall.

Low water flow deficiencies develop after prolonged periods of little or no precipitation and persist until sufficient rainfall relieves the situation. Flow deficiencies of significant duration may cause new water supply problems and may magnify existing water quality problems.

Although floods occur in all seasons, studies of the relationships among storm intensity, duration, affected area, and seasonality suggest a tendency for flooding on principal streams to occur in winter and for floods on small streams to occur mostly in summer. Large flood areas are caused by storms of low rainfall intensity and long duration covering the entire area of principal watersheds. Small area floods, on the other hand, are caused by storms of high rainfall intensity and relatively short duration. An exception to this is tropical storms, which normally occur during the summer months and cause extensive flooding over large areas. The result of such flooding over long periods of time is the creation of flood plains.

The water resources of Cumberland County are illustrated on the Water Resources & Impaired Streams Map (Map 6-6). The Susquehanna River forms the eastern boundary of Cumberland County. The Susquehanna River is the nation's sixteenth largest river and is the largest river lying entirely in the United States that flows into the Atlantic Ocean. The Susquehanna and its hundreds of tributaries drain 27,510 square miles, an area nearly the size of South Carolina, spread over parts of the states of New York,



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Pennsylvania, and Maryland. The river meanders 444 miles from its origin at Otsego Lake near Cooperstown, New York, until it empties into the Chesapeake Bay at Havre de Grace, Maryland. The Susquehanna contributes one-half of the freshwater flow to the Bay. In 2009, the Chesapeake Bay Executive Order was adopted which identified the Chesapeake Bay as a national treasure and calls on the federal government to lead a renewed effort to restore and protect the nation's largest estuary and its watershed.

In Cumberland County, the river's edge and areas in close proximity to the Susquehanna River have been developed over time with industry, transportation routes, residential development, and other uses. The open space along the river corridor is fragmented and primarily in private ownership.

The County's two main stream corridors, the Yellow Breeches Creek and the Conodoguinet Creek, traverse the valley from west to east as tributaries to the Susquehanna River. The Yellow Breeches Creek encompasses a 219 square mile watershed and includes Adams, Cumberland and York counties with 21 municipalities and approximately 368 stream miles. The creek is classified as High Quality Cold Water Fisheries between the source and Locust Point Road (SR 1007, near Williams Grove); between Locust Point Road and the mouth it is classified as a Cold Water Fisheries stream. Additionally, the Yellow Breeches Creek is classified as a Pennsylvania Scenic River. The Yellow Breeches Creek is also a renowned trout-fishing stream that draws anglers from well beyond the area to fish in its limestone cooled waters. In 2005, the Yellow Breeches Watershed Association completed a River Conservation Plan and Watershed Assessment for the Yellow Breeches. The project scope included creating an inventory of watershed resources, identifying and ranking watershed problems, and developing strategies to solve these problems.

The Conodoguinet Creek originates in Horse Valley, Franklin County, next to the Kittatinny Mountain at an elevation of 1,680 feet. From there, the Conodoguinet flows through the fertile Cumberland Valley, and joins the Susquehanna River near Harrisburg. The Conodoguinet Creek is classified as a Warm Water Fisheries stream within Cumberland County and is enjoyed for canoeing and recreational fishing.

The Conodoguinet Creek is approximately 90 miles in length and drains 540 square miles of diverse lands. Forested areas cover the upland basin, giving way to intense agriculture throughout the valley. Much of the Conodoguinet Creek watershed still has a strong agricultural flavor, including numerous cozy villages and small towns. While farming remains a prominent land use in the western part of the valley, dramatic growth in the Carlisle to Camp Hill area has



Conodoguinet Creek, Silver Spring Township

converted much agricultural land to residential and commercial uses. The Conodoguinet meanders toward the suburban west shore of Harrisburg through a series of elaborate bends and loops. "Conodoguinet" comes from an Indian word meaning "a long way with many bends." The Conodoguinet Creek Watershed Association completed a River Conservation Plan for the middle section of the creek in 2003.



Mountain Creek, Mount Holly Springs

The LeTort Spring Run is a tributary to the Conodoguinet located in South Middleton, Carlisle, North Middleton, and Middlesex townships. It is renowned as a trout stream with native brown trout. Specific areas of the stream are designated as "No Harvest Fly-Fishing Only" locations. The LeTort is also designated as a Pennsylvania Scenic River. The scenic corridor stretches from Route 34 to its confluence with the Conodoguinet Creek. The LeTort Regional Authority was formed to address flooding concerns and promote conservation of the stream corridor.

The Big Spring Creek is another important tributary of the Conodoguinet Creek. The Big Spring Watershed encompasses a 12.9 square mile area and the creek is approximately 5.1 miles long. Big Spring Creek is the 5th largest spring in Pennsylvania. It is one of the world's most productive limestone spring creeks and at one time was considered the best brook trout stream in the United States. The Big Spring Watershed Association (BSWA) was organized in mid-2001 to coordinate efforts to improve and protect the health of the Big Spring Watershed. They hope to restore the stream and reestablish a wild, natural reproducing brook trout population in its waters. The BSWA developed a River Conservation Plan in 2007 for the corridor.

Cumberland County is well known for its high yielding springs. Three of the ten largest springs in Pennsylvania are found in the County – Boiling Springs, Big Spring and Baker Spring. All have a median yield of more than 10,000 gallons per minute.

Protection of the river and stream corridors of Cumberland County is important for sustainable growth and a healthy environment. The Water Resources & Impaired Streams Map (Map 6-6) illustrates impaired streams based on an assessment used by the Pennsylvania Department of Environmental Protection. There are approximately 72 miles¹² of impaired streams in Cumberland County. Agriculture is the primary source of impairment. Impaired streams should be targeted for mitigation including nutrient reduction measures and use of Best Management Practices (BMPs).



Floodplains

Floodplains are defined as low lying, flat areas adjacent to streams, which are subject to frequent, periodic flooding. The 100-year floodplain is the area that is most frequently mapped and referenced in planning. A 100-year flood is a flood having a one percent chance of being equaled or exceeded in magnitude in any given year. The 100 year floodplain is the area adjoining a river or stream covered by water in the event of a 100 year flood. The 100-year floodplain has been adopted by the Federal Insurance Administration as the base flood for purposes of floodplain management measures. Cumberland County has approximately 17,400 acres of 100-year floodplain, equating to approximately 4.9 percent of the County land area¹³. The Wetlands & Floodplain Map (Map 6-7) illustrates the 100-year floodplain.

Floodplains are an intrinsic and beneficial aspect of the natural landscape. They allow for an increase in drainage during rainy periods and buffer the stream from any detrimental effects of surrounding land uses. Floodplain areas should be protected to retain the many ecological benefits they provide. Floodplains carry flood waters and should not be developed or built upon with structures that could diminish their carrying capacity. Additionally, floodplains provide areas for groundwater infiltration and riparian buffer vegetation which stabilize stream banks and filters sediment.

Wetlands

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands are identified by unique soils (hydric soils), by plants adapted to life in wet environments (hydrophytic vegetation) and by the presence of water (hydrology) during the growing season. Cumberland County has approximately 5,360 acres of National Wetland Inventory (NWI) wetlands, encompassing 1.5 percent of the County¹⁴. Cumberland County's wetlands are primarily associated with stream corridor and floodplain areas. Wetlands are protected by State and Federal regulations.

Wetlands should be protected for their numerous benefits including groundwater recharge, wildlife habitat, flood and sediment control, and stormwater management. They are essential to maintaining a sound ecosystem. Wetlands identified through the National Wetlands Inventory mapping are shown on the Wetlands & Floodplains Map (Map 6-7). The NWI wetlands mapping provides generalized locations for wetlands and should not to be used for regulatory or jurisdictional wetland identification.



Bog Turtle, US FWS

Natural Areas Inventory

A Natural Areas Inventory (NAI) was completed for Cumberland, Dauphin, and Perry counties by the Pennsylvania Science Office of The Nature Conservancy in 2000. The NAI documents the known outstanding natural features of flora, fauna, and geology in the County. The inventory provides maps of natural communities and locations of animal and plant species of special concern for preservation of biological diversity in Cumberland County.

In 2005, the NAI was revised. The update incorporated newly found sites and updated information based on field visits. Not all NAI sites were visited and reevaluated during the update process. The 2005 update identified sixty-four sites of statewide or local significance.

Of these sixty-four sites, eleven areas were identified as top priority natural areas. These sites are most critical for maintaining biodiversity. These sites are generally associated with North and South Mountain and the water resources of the Yellow Breeches, Conodoguinet and Susquehanna River. Of the eleven sites, six are permanently protected via publicly owned lands (Big Pine Flat, Iron Run, Sage Run/Mountain Creek Seeps, Mount Holly Marsh, Lambs Gap/Trout Run Headwaters and McCormick's Island). Thomson Hollow Pond is afforded some protection through the Michaux State Forest. The remaining sites are not protected. The Burd Run Caves site is extremely vulnerable due to its location in the targeted Growth Area, Route 81 traversing the site, and the close proximity of a Route 81 exit. The Conodoguinet Creek sites are in a highly developed portion of the County and on-going man-made activities have the potential to degrade the resource. The Hunters Run Site is not in the path of development but is not permanently protected.

In addition to the priority sites, the NAI documents three exceptional natural features: the Susquehanna River, the Kittatinny Ridge (Blue Mountain) and South Mountain. Conservation at the landscape level is emphasized in order to conserve the greater ecological function of each natural system.

The Natural Area Inventory Sites Map (Map 6-8) generally locates the NAI core habitat (statewide and locally significant NAI sites), supporting landscapes and prioritizes sites for conservation efforts. Core habitat areas are intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance without substantial impact to the natural features. The supporting landscape identifies areas surrounding or adjacent to core habitat that are not considered the primary habitat of the species of concern or natural community, but may serve as a secondary habitat.¹⁵



LAND PARTNERSHIPS

The Natural Areas Inventory is intended to be used as a tool for local decision-making. The site specific information and maps are useful to guide land use planning, for preserving open space and for setting priorities for the preservation of vulnerable natural areas. The NAI includes general management recommendations that would help to ensure the protection and continued existence of these rare plants, animals and natural communities.

Wildlife

Cumberland County has an abundance of wildlife. There are a variety of non-game species of birds, amphibians, reptiles, and small mammals. Game species include black bear, white-tailed deer, gray squirrel, cottontail rabbit, turkey, grouse, ring-neck pheasant, woodcock, mourning dove, and various waterfowl. There are also red and gray fox, coyote, mink, muskrat, raccoon, weasel, opossum, and beaver.

Due to the Kittatinny Ridge's (North Mountain) important value for bird migration, nesting, and science, it has been officially designated by Audubon Pennsylvania as the state's largest "Important Bird Area." The Kittatinny Ridge is recognized as a "globally significant" migration flyway in spring and fall. This 150 mile-long ridge concentrates 14,000 to 20,000 migrating raptors from August through December each year along its entire length. Millions of songbirds also use the ridge's forest as stopover habitat during their migration through Pennsylvania.



Benefits of and Threats to Cumberland County's Natural Resources

Examining the benefits and threats to Cumberland County's natural resources is an important step to developing strategies and recommendations for their protection. Table 6-1 lists the variety of benefits each resource provides to the County and the threats to their sustainability.

Table 6-1 Benefits and Threats to Natural Resource Protection	
BENEFITS	THREATS
<i>Land Resources – Geology, Mineral Resources, Soils, Slopes, Woodlands</i>	<i>Land Resources – Geology, Mineral Resources, Soils, Slopes, Woodlands</i>
<p>Geology, Mineral Resources, Soils</p> <ul style="list-style-type: none"> • Supports resource based industries and economic development (ex. commercial agriculture and quarries/extraction operations) <p>Woodlands</p> <ul style="list-style-type: none"> • Provides renewable forestry resources • Stabilizes slopes with root systems to minimize erosion • Slow runoff to maximize groundwater infiltration • Protect groundwater by protecting headwaters and filtering stormwater runoff <p>Woodlands/Slopes</p> <ul style="list-style-type: none"> • Provides critical wildlife habitat • Enhances scenic landscape • Supports nature based recreational opportunities and tourism 	<ul style="list-style-type: none"> • Lack of adequate zoning and subdivision/land development regulations protect important natural resources • Poorly managed industrial and commercial operations • Inappropriate engineering and construction practices
<i>Water Resources – Hydrology, Floodplains, Wetlands</i>	<i>Water Resources – Hydrology, Floodplains, Wetlands</i>
<p>Hydrology-Water Supply</p> <ul style="list-style-type: none"> • Sustained source of clean drinking water • Supports economic development • Supports water based recreation such as fishing and boating <p>Floodplains & Wetlands</p> <ul style="list-style-type: none"> • Prevent property damage • Protect public safety • Carry flood waters and reduce flooding • Provide groundwater recharge • Capture sediment and pollutants • Improve water quality • Stabilize stream banks • Stormwater management • Wildlife habitat • Enhance scenery 	<ul style="list-style-type: none"> • Lack of adequate zoning and subdivision/land development regulations to protect important environmental features • Pollutants from agricultural, industrial and sewer treatment operations • Failed on-lot disposal systems • Surface runoff from roadways and developed areas • Erosion and sedimentation from agriculture and land development
<i>Biotic Resources – Wildlife and Natural Area Inventory Sites</i>	<i>Biotic Resources – Wildlife and Natural Area Inventory Sites</i>
<ul style="list-style-type: none"> • Maintains biodiversity • Supports nature based recreation and tourism including hunting, fishing and birding 	<ul style="list-style-type: none"> • Habitat loss • Forest fragmentation • Proliferation of invasive species • Changing land use patterns • Degradation of ecosystems • Pollution



Tools for Natural Resource Protection – Acquisition & Development

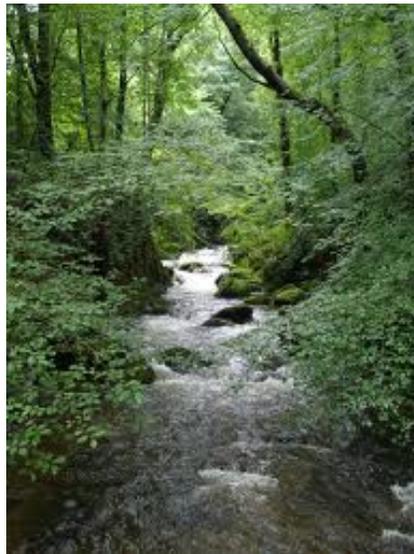
Priority Conservation Areas

An analysis of Cumberland County's natural resources was completed to help prioritize preservation of those resources. Using Geographic Information System (GIS), the landscape was ranked using the following layers: hydrology (200 foot buffer), 100 year floodplain, woodlands, slopes (15+ percent), NAI sites and wetlands. This analysis was run to determine the most critical areas based on overlapping sensitive features. The Conservation Areas Map (Map 6-9) illustrates areas with low, medium, high and very high conservation value.

The landscape features of Blue Mountain and South Mountain contains some of the most important natural features. Additionally, the stream corridors and headwaters of our waterways contain high priority resources. These areas should be prioritized for permanent preservation through voluntary, fee simple acquisition or conservation easements.

Riparian Buffers

The establishment and protection of riparian buffers has been identified as a priority best management technique for natural resource protection. Riparian buffers provide a variety of ecosystem services and achieve multiple natural resource protection goals. There are a number of federal, state and local initiatives/programs available for establishment, maintenance and protection of buffers.



Urban Forestry

In addition to protection of large wooded areas and establishment of riparian buffers, urban forestry is an important natural resource protection issue. Street tree programs as well as tree planting/landscaping in commercial and public spaces should be encouraged. There are a variety of environmental, aesthetic and social benefits associated with urban trees¹⁶:

- Reduce annual heating and cooling costs for a typical residence by 8-12%
- Improve air quality by absorbing hundreds of pounds of air pollutants that effect our health

6. Natural Resource Protection

- Improve water quality and reduce community flooding by absorbing and intercepting rainfall in their canopies, thus reducing stormwater that often carries pollutants to waterways
- Stimulate retail and commercial business districts by attracting shoppers, increasing sales and revitalizing declining downtowns
- Increase property values by 10-15%
- Reduce stress, fatigue, and aggression in humans
- Reduce a hospital patient's recovery time when there are views of trees and greenery
- Improve the concentration of children with Attention Deficit Hyperactivity Disorder (ADHD)
- Calm and slow down traffic along streets
- Reduce crime and increase social ties
- Reduce exposure to harmful UV rays that are causing increases in skin cancer and cataracts



Urban Riparian Buffer Restoration in Fairfax, VA

Tools for Natural Resource Protection – Planning

Land use planning is an important tool to protect natural resources for the benefit of current and future residents.

Municipalities Planning Code

The Pennsylvania Municipalities Planning Code (MPC) is intended to empower local municipalities to preserve important natural resources. The comprehensive plan, zoning ordinance, subdivision and land development ordinance and official map are all tools available for natural resource protection.



Article III, Section 301 of the MPC specifies that County and Municipal Comprehensive Plans shall provide a plan for the protection of natural resources. This clause includes, but is not limited to, wetlands and aquifer recharge zones, woodlands, steep slopes, floodplains and unique natural areas.

A plan for protection should include establishing goals and objectives for preservation of natural resources and identifying important natural resources that should be preserved. Further, the Comprehensive Plan shall include a plan for reliable supply of water, considering current and future water resource availability, uses and limitations, including provisions adequate to protect water supply resources.

Zoning, Article VI, of the MPC authorizes municipalities to enact ordinances that protect and preserve natural resources. Moreover, provisions in the subdivision and land development ordinance help support implementation of those provisions. Examples of natural resource ordinance provisions include but are not limited to:

- Conservation subdivision and zoning
- Steep slope management
- Woodland Management, Tree Protection
- Floodplain management
- Riparian Buffer Protection
- Wetland Protection
- Source Water and Wellhead Protection
- Stormwater Best Management Practices

The MPC also empowers municipalities to adopt an Official Map for flood control and stormwater management purposes.

Tools for Natural Resource Protection – Partnerships & Education

Partnerships and education are also critical to natural resource protection. Residents, visitors, businesses, and elected officials should be aware of the presence, value, and threats to the natural resources found in the County. Only when such stakeholders understand the natural resources in the County can they make a concerted effort to secure their long term management and protection.

Many partner organizations promote natural resource education and preservation in the County. Through their efforts, natural resource focused policies and projects are developed and implemented. Table 6-2 lists the prominent natural resource organizations in the County and their respective focus areas.

Table 6-2 Stakeholders and Focus Areas for Natural Resource Protection	
Stakeholders	Program/Initiative
Alliance for the Chesapeake Bay www.allianceforthebay.org	<ul style="list-style-type: none"> • Stream Restoration • Stormwater Management
American Rivers www.americanrivers.org	<ul style="list-style-type: none"> • Dam removal • Stream restoration
Audubon PA www.kittatinnyridge.org www.pa.audubon.org	<ul style="list-style-type: none"> • Kittatinny Ridge Conservation Project • Important Bird Area (IBA) Program
Appalachian Trail Conservancy www.appalachiantrail.org www.southmountainpartnership.org	<ul style="list-style-type: none"> • South Mountain Partnership
Appalachian Mountain Club www.outdoors.org	<ul style="list-style-type: none"> • The Highlands Coalition
Central Pennsylvania Conservancy www.centralpaconservancy.org	<ul style="list-style-type: none"> • Land Trust - Acquisition • Education
Chesapeake Bay Foundation www.cbf.org	<ul style="list-style-type: none"> • Riparian Buffer Technical Assistance
Cumberland County Conservation District www.cumberlandcd.com	<ul style="list-style-type: none"> • Stormwater Management • Erosion & Sedimentation Control • Envirothon
Pennsylvania Department of Conservation and Natural Resources www.dcnr.state.pa.us	<ul style="list-style-type: none"> • River Conservation Planning • Funding Assistance
Pennsylvania Department of Environmental Protection and EPA www.depweb.state.pa.us www.epa.gov	<ul style="list-style-type: none"> • Chesapeake Bay Watershed Improvement Plan (WIP)
Pennsylvania Department of Agriculture www.agriculture.state.pa.us	<ul style="list-style-type: none"> • Resource Enhancement and Protection (REAP) Program
Pennsylvania Department of Conservation & Natural Resources www.dcnr.state.pa.us www.treevitalize.net	<ul style="list-style-type: none"> • TreeVitalize Program • Funding assistance • South Mountain Partnership



Table 6-2 continued Stakeholders and Focus Areas for Natural Resource Protection	
Pennsylvania Fish & Boat Commission www.fishandboat.com	<ul style="list-style-type: none"> • Stream Restoration • Fish Habitat • Fishing & Boating Access Improvement
Pennsylvania Game Commission www.pgc.state.pa.us	<ul style="list-style-type: none"> • Wildlife Habitat
Susquehanna Greenway Partnership www.susquehannagreenway.org	<ul style="list-style-type: none"> • Greenway Planning and Implementation
The Nature Conservancy www.nature.org	<ul style="list-style-type: none"> • Land Trust – Acquisition
The Conservation Fund www.conservationfund.org	<ul style="list-style-type: none"> • Land Trust – Acquisition
Trout Unlimited www.patROUT.org	<ul style="list-style-type: none"> • Watershed Restoration • Habitat Improvement
USDA-NRCS/FSA www.pa.nrcs.usda.gov www.fsa.usda.gov	<ul style="list-style-type: none"> • Conservation Reserve Enhancement Program (CREP), Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), Wildlife Habitat Incentive Program (WHIP), Conservation Stewardship Program (CSP)
USDA Forest Service www.fs.fed.us	<ul style="list-style-type: none"> • Forest Stewardship Program
Watershed Organizations: Big Spring Watershed Association www.bigspring-pa.org LeTort Regional Authority www.letort.org Conodoguinet Creek Watershed Association http://conocreek.org Middle Spring Creek Association www.middlepringwatershed.org Yellow Breeches Watershed Association www.ybwa.org	<ul style="list-style-type: none"> • River Conservation Plan Implementation • Stream Clean-Ups • Stream Restoration • Education/Outreach • Water Trail Implementation