Fishing Creek Watershed Assessment

May 2006

Prepared for:

Lancaster County Conservancy
117 South West End Avenue
Lancaster, PA 17608
www.lancasterconservancy.org

Lancaster County
CONSERVANCY
Protecting natural places for people & wildlife

Prepared by:
RETTEW

Fishing Creek Watershed Assessment Plan

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May 2006

Fishing Creek Watershed Assessment Project Advisory Council and Contributors:

Thomas Amico	*Lancaster County Bird Club*
Jineen Boyle	*Pennsylvania Department of Environmental Protection*
Victor Brutout	*Lancaster County Conservancy*
Mary Frey	*Lancaster County Planning Commission*
Doug Gibson	Watershed Landowner
Ralph Goodno	*Lancaster County Conservancy*
Wayne Herr	*Providence Township*
Emily Kauffman	*Lancaster County Conservancy*
Matt Kofroth	*Lancaster County Conservation District*
Judy O'Brein	Watershed Resident
Ben Seigrist	*Providence Township*
Linda Shoemaker	Watershed Resident
Linda Swank	*Pennsylvania Game Commission*
Linda Thomas	*Valley Lea Riding Club*
Dr. John Wallace	*Millersville University of Pennsylvania*
Jim Wingler	*Pennsylvania Game Commission*
	Pennsylvania Fish & Boat Commission

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EXECUTIVE SUMMARY

Introduction

The Fishing Creek Watershed encompasses 14.2 square miles of rolling farmland and forested woodlots and ravines in southern Lancaster County, Pennsylvania. The watershed is drained by the main stem of Fishing Creek (12.2 miles in length), which is fed by 18 unnamed tributaries of varying lengths (totaling 17 miles). Fishing Creek originates just east of the village of Rawlinsville, PA in Providence Township and flows south through Drumore Township and the steep river hills to its confluence with the Susquehanna River. The rural watershed is predominantly comprised of agricultural lands including fields, pastureland, barnyards and farmsteads. Deciduous, coniferous and mixed forests (comprising less than a third of the watershed) are concentrated along Fishing Creek and most of its tributaries. Institutional, residential and urban land uses also dot the watershed's landscape. Designated as a High Quality-Cold Water Fishery, Fishing Creek supports a diverse aquatic macroinvertebrate community and a wild brown trout fishery that has the potential of even becoming better through the implementation of agricultural Best Management Practices (BMPs) and restoration remedies at various impaired stream segments in the watershed.

The various terrestrial and aquatic habitats that co-exist with agricultural lands provides an abundance of plant and wildlife species, while topographic and geologic features provides scenic hollows in the southern section of the watershed. The watershed provides opportunities for bird watching, hiking, fishing, hunting and horseback riding, while other recreational potentials remain untapped. Since the Lancaster County Conservancy owns and manages a chunk of scenic real estate along the main stem known as the Fishing Creek Nature Preserve in the southern section of the watershed, the Conservancy has emerged as the key steward of the Fishing Creek Watershed. With their *Long Range Protection Plan* for Lancaster County completed in 2004, the Conservancy has further embraced planning, protection and management of sensitive areas and resources on a watershed basis.

This Fishing Creek Watershed Assessment has been prepared through the guidance of the Conservancy to help the public better appreciate the natural resources that exist in the watershed and guide residents, community organizations, and local government to sound conservation and use of its resources by current and future generations. The assessment can be used as a roadmap and catalyst for the Conservancy and other entities to accomplish goals of advancing ideas and implementing projects that preserve, enhance and restore valued resources and features of the watershed.

Background and Purpose

The Conservancy received a grant from the Chesapeake Bay Small Watershed Program for the Fishing Creek Watershed Assessment in 2004. That portion of the watershed assessment's funding is administered by the National Fish and Wildlife Foundation. The remainder of the assessment's funding came through a grant awarded by the Keystone Recreation, Park and Conservation Fund under the administration of the Pennsylvania Department of Conservation and Natural Resources' (DCNR) Bureau of Recreation and Conservation. The Conservancy also provided an in-kind service match to these funds to help with assessment studies. To guide the preparation of the Watershed Assessment, the Conservancy formed an advisory committee comprised of residents, municipal officials, natural resource and conservation agency staff and county planning commission representatives. The goals of this assessment are to assist communities, landowners and recreational users of the watershed in protecting and improving the quality of the natural resources, reducing pollution to Fishing Creek, the Susquehanna River and ultimately the Chesapeake Bay and helping the watershed's municipalities to make "Smart Growth" decisions.

Watershed Resources

Demographics

Lancaster County's population is estimated to exceed one half-million people by the next census. By 2040, the population may increase by as much as 350,000. This will put a tremendous strain on the County's natural, housing, and recreational resources. Economic prosperity would likely be sufficient to sustain infrastructure such as roads, schools and public utilities. However, the County's land resources are of a finite amount, and valuable open space (such as agricultural and forested areas) could be consumed.

The vast majority of the Fishing Creek Watershed (89.5%) is situated in Drumore Township. Its headwaters, in the northern section of the watershed, are located in Providence and Martic Townships, which comprises approximately 9.7% of the watershed. A very small percentage of the watershed is located in East Drumore Township (0.6%) and includes some small areas of land that reach across State Route 272 (Lancaster Pike). Based on current trends, each municipality in the Fishing Creek Watershed is expected to grow during the next four decades. Even though Drumore Township may retain the smallest population of the four municipalities in the watershed, it should expect a minimum of several hundred new residents over the next forty years. Even by the most conservative estimates, the watershed will likely experience growth, putting pressure on agricultural land, the housing market, as well as the demand for services and businesses.

Land Resources

Fishing Creek Watershed is located in the Piedmont Upland Section of the Piedmont Physiographic Province, which consists of broad, rounded to flat-topped hills and shallow valleys. The majority of the watershed (approximately 65.3%) is dominated by agricultural-related uses including croplands, pasturelands, barnyards and farmsteads. Forested areas, concentrated along the ridges, slopes and stream bottoms comprise approximately 26.3% of the watershed. Since southern Lancaster County and the river hills are very rural with a low population density, it comes as no surprise that residential parcels only account for approximately 5.13% of the watershed's land use. Residential areas (not including houses on farmsteads) are concentrated along the various secondary roads that traverse the Fishing Creek Watershed.

Other minor land covers within the watershed includes successional field/shrubland, stream and ponds, emergent wetlands, urban, institutional and recreational areas. Even though commercial & industrial (urban) land uses and institutional uses comprise less than 1% of the watershed's land use and cover, land development pressures are growing along State Route 272 (Lancaster Pike).

The Fishing Creek Watershed supports approximately 3,452 acres of Prime Farmland Soils, thus the strong agricultural heritage and dominant land use. It also exhibits steep ravines and slopes that support soils with large stones and bedrock outcrops comprised of schists interbedded with quartzite. Such areas are dominated by forested woodlots and riparian buffers that help reduce impacts from upgradient agricultural areas through trapping, filtering and converting sediments, nutrients and other chemicals; and, reducing thermal impacts to streams through canopy shading.

Biological Resources

The mixture of agricultural and forested areas, unique topographic features and streams within the Fishing Creek Watershed provides for many niches to support numerous habitats and species of wildlife. Over 26 species of mammals, 147 species of birds, 34 species of reptiles and amphibians, and at least 26 species of fish occur in the watershed's ecosystems. Such species provide much enjoyment for the casual hiker or wildlife observer. Wildlife game and fish species also provide hunting and fishing recreation opportunities within the watershed. The watershed's habitats are comprised of many native species of trees, shrubs and vines, herbaceous plants, grasses, ferns and club mosses. Several non-native and invasive plant species also exist in the watershed. Invasive species pose a threat to native plant communities by aggressively colonizing habitats and crowding or choking out native plant species.

In addition, the watershed and adjacent areas support up to eight plant species and two animal species listed as threatened, endangered or rare species of Pennsylvania. Wetlands within the watershed are predominantly situated along the main stem and tributaries of Fishing Creek and their floodplains. Types of wetlands within the watershed include riverine, forested, scrub/shrub,

emergent and open water wetland ecosystems. Wetlands are considered sensitive habitats that are protected by federal and states laws.

Aquatic Resources

The main stem of Fishing Creek receives drainage from 13 perennial and five intermittent tributaries, all of which are unnamed. Waters of the main stem and the tributaries combine for a total of 29.2 miles of stream channel within the watershed. A freestone stream underlain by schists and quartzite geology, Fishing Creek and its tributaries are not buffered by alkaline limestone deposits such as streams in central and northern Lancaster County. Regardless, according to field measurements, Fishing Creek appears to have a neutral to slightly basic pH and appears not to be affected by acid precipitation.

Macroinvertebrates (aquatic insects, worms, clams, snails, leeches and others) are desirable indicators of water quality because they are fairly sedentary and are more or less confined to living in the stream year round. Both the Pennsylvania Fish & Boat Commission (PFBC) and the Pennsylvania Department of Environmental Protection (PADEP) have completed water quality studies on Fishing Creek utilizing macroinvertebrates as water quality indicators. Likewise, macroinvertebrate collection and analyses were conducted under the scope of this watershed assessment. Pollution-sensitive macroinvertebrates such as stoneflies, mayflies and caddisflies were very common at the majority of the 15 sampling stations sampled on Fishing Creek for this watershed assessment. Therefore, their presence throughout most of the watershed suggests that the water quality in the Fishing Creek Watershed is very good.

As previously mentioned, a total of 26 species of fish occur in the Fishing Creek Watershed. Although the PFBC stocks Fishing Creek with rainbow trout and brown trout for recreational fishing, the presence of a wild reproducing brown trout population in Fishing Creek reflects and supports PADEP's High Quality, Cold Water Fishery (HQ-CWF) stream designation. Both trout species are coldwater fish that require water temperatures of less than 70 degrees Fahrenheit to grow and reproduce and are intolerant of poor water quality.

Electrofishing efforts for this watershed assessment proved that wild brown trout are present at all nine sampling station locations on the **main stem** of Fishing Creek! Six of the most upgradient sampling stations had brown trout fingerlings (young of year) present, while four of the six stations on unnamed tributaries produced at least one wild brown trout.

Options to consider for managing the trout fishery on Fishing Creek that should be explored with the PFBC include: Class A Wild Brown Trout Waters designation, Catch and Release Special Regulations Areas (wild trout areas), Delayed Harvest Special Regulations Areas (hatchery trout areas) and Delayed Harvest Artificial Lure Only Areas. The Class A Wild Trout Waters Designation for qualifying sections of Fishing Creek can only be made through more detailed field studies conducted by the PFBC. However, it is the recommendation of this assessment that **Catch and Release Areas** be considered for the main stem of Fishing Creek from the electric power line easement (near Penny and Deaver Roads) downstream to Silver Springs Road; and,

the main stem of Fishing Creek from the confluence of the unnamed tributary (Subwatershed 7) along Scalpy Hollow Road downstream to River Road. It is also recommended that a **Delayed Harvest Artificial Lures Only Area** be considered for the stretch of Fishing Creek (main stem) between Furniss Road and the confluence with the unnamed tributary (Subwatershed 19) at Fernglen Road.

Recreational Resources

Presently, recreational use of land within the Fishing Creek Watershed is segmented between private and public/semi-public uses. In addition to those within the watershed, a number of substantial recreation areas occupy land in close proximity to the watershed.

The majority of the land within the Fishing Creek Watershed is private. Prime recreational activities within the private properties in the watershed are most often exclusionary, but include hunting and fishing. Christian church summer camps and horse riding clubs exist within the watershed, but again such recreational facilities and opportunities are normally limited to members. The Conservancy owns and manages the Fishing Creek Nature Preserve along Fishing Creek Road, which includes 167 acres of semi-contiguous forested parcels following the stream. In addition to fishing, the preserve attracts picnickers, hikers, horseback riders (primarily along Fishing Creek Road), geocachers and hunters. The only other public recreational area within the watershed is a portion of Drumore Township Park property located along Furniss Road. This park includes ballfields, picnic pavilions, and playground equipment and is available for short walks and low-intensity hiking.

Other recreational areas owned by the Conservancy located just outside the Fishing Creek Watershed includes the Ferncliff Wildflower and Wildlife Preserve situated to the southeast and the Wissler Run Nature Preserve situated to the northwest. Hiking and passive outdoor recreation opportunities are available at both preserves.

Additional recreational lands that are open to the public exist in close proximity to the Fishing Creek Watershed. The Susquehannock State Park, the only State Park in Lancaster County, sits upon a wooded plateau overlooking the Susquehanna River. The 224-acre park offers hiking, camping, picnicking and bird watching opportunities. The Muddy Run Recreation Area, owned by the Excelon Corporation, includes hundreds of acres surrounding their pumped storage power generating facility that are available for public recreation. Such opportunities include hiking, camping, boating, fishing, hunting, picnicking and bird watching. Both recreational areas are situated just northwest of the southern section of the Fishing Creek Watershed and are located on either side of the Conservancy's Wissler Run Nature Preserve (Muddy Run to the north and Susquehannock State Park to the south).

New recreational opportunities that could be developed as part of the Fishing Creek Watershed experience include the following key elements:

- Using the Conservancy's Fishing Creek Nature Preserve as a core property and a central node in a future recreational network.

- Developing educational points of interest stations to provide interpretive panels and signs displaying various issues of importance within the watershed.

- Designating a network of bike routes of various lengths and levels of difficulty, each with its origin in the central property, and designed in a looping course that connects points of interest throughout the watershed.

- Developing a trails network (hiking and equestrian) to connect various points of interest throughout the watershed.

- Designating areas for "Creeking" routes along Fishing Creek for kayak touring.

- Developing a recreation management program to encourage future recreational uses (such as geocaching, orienteering, cross-country skiing, special regulation fishing and primitive weapons hunts) while discouraging uses that are detrimental to the watershed.

Additional information regarding the resources of the Fishing Creek Watershed can be found in Sections II through VI and Section VII of the Watershed Assessment.

Identifying Watershed Problems and Solutions

Although Fishing Creek is designated as a High Quality-Cold Water Fishery by PADEP's Chapter 93 Water Quality Standards, the watershed also has its problem areas and impaired sections of stream. Problem areas within the Fishing Creek Watershed were assessed via windshield surveys from roadways throughout the watershed and through walking stream segments and recording areas of concern via photography. Where access was not available, other impacted areas of the watershed were identified and photographed via aerial reconnaissance from a helicopter.

Common problems in the Fishing Creek Watershed include non-point source pollution prevalent to agricultural areas such as increased soil erosion and deposition and nutrient runoff from barnyard wastes and livestock loafing in waterways. The lack of vital habitat components along streams and drainage ways (such as forested riparian buffers) and wetland impacts from livestock are also a cause of impairment. Degradation to floodplain and stream habitat due to poor road drainage, unrestricted parking and all terrain and 4-wheel drive vehicles is also very common on Conservancy properties located along Fishing Creek Road.

Even though land development has not affected the Fishing Creek Watershed at the same rate as other areas of Lancaster County, future potential problems were assessed. Problems resulting from increased land development could include increased stormwater runoff from impervious surfaces such as roofs, parking lots, roads and driveways. The increase in stormwater volumes and velocities could result in accelerated erosion and sedimentation, while thermal and chemical pollution from roads and large parking lots could further degrade water quality. Increased sediment from existing or future impacts may also lead to the destruction of natural stream channel geometry and aquatic habitat.

Identifying problem areas and recommending improvements and restoration solutions were key components of this assessment. Such components included:

- A description and prioritization of the discovered problem areas and impaired stream segments (especially non-point source water quality problems).
- Solutions and alternatives for correcting problems and impaired stream segments.
- Estimation of costs associated with correcting discovered problems and restoring impaired stream segments.
- Ideas for teaming and building support.
- Monitoring progress of project implementation and water quality improvement.

- Recommendations for tapping potential recreational opportunities in the watershed as a way of increased enjoyment of its resources and creating a self-policing and protection mentality of its users.

Recommended Solutions

As part of the Watershed Assessment, the identification of impaired stream segments and prioritization of restoration projects were made by each subwatershed in order to improve water quality and protect the natural resources of Fishing Creek Watershed. A total of 14 High Priority projects, 19 Medium Priority projects and six (6) Low Priority projects were identified as being obvious places to start for water quality improvement and restoration initiatives. Other problems may exist or could appear in the future however, being able to recognize and identify the most critical problem areas and prescribe and implement the correct remedy is of utmost importance. To remediate the most common problems and impaired stream segments identified in the Fishing Creek Watershed, the following Best Management Practices (BMPs) and stream restoration solutions were identified:

- Reducing and Treating Barnyard Runoff
- Crop Residue Management – (Conservation Tillage)
- Cover Crops
- Grazing Land Management
- Nutrient Management and use of Manure Storage Facilities
- Strip Cropping/Contour Farming
- Terraces and Diversions
- Roof Runoff Management (Farm Buildings)
- Use of Watering Troughs for Livestock
- Streambank Stabilization & Restoration (Natural Stream Design & In-stream Structures)
- Riparian Buffer Strips
- Streambank Fencing
- Cattle Crossings
- Utilizing Lancaster County Conservation District's *Long Term Workplan for Fishing Creek Road*
- Developing Municipal Watershed Resource Protection Ordinances

Although planning and zoning policies are created at the municipal and county levels, some of the desired outcomes will require actions to protect watersheds and their water quality. Options considered for providing better protection and management of Fishing Creek Watershed's resources include developing resource protection ordinances, forming comprehensive plan partnerships, strengthening land use ordinance enforcement, incorporating the use of riparian buffers and protecting all stream reaches. Other tools and strategies that could be utilized to meet planning objectives for the watershed include open space easement funding, the use of

county bonds, open space transfer of development rights and improving public knowledge on planning and zoning practices.

In general, implementation of agricultural BMPs, protection of existing forested lands, riparian buffers and wetlands coupled with limited development of the watershed is the key to improving the Fishing Creek Watershed and ensuring continued good water quality.

I. INTRODUCTION

A. Background and Objectives

With its clear flowing waters, wild brown trout populations and the scenic beauty of its steep ravines and large tracts of mature woodlands, Fishing Creek Watershed supports many exceptional natural features that are rare in Lancaster County. Designated as a High Quality – Cold Water Fishery (HQ-CWF), the rural 9,183-acre watershed supports the 12-mile long main stem of Fishing Creek and 17 miles of unnamed tributaries that flow through rural agricultural lands, forested riparian corridors and the river hills of the Susquehanna River. The vast majority of the Fishing Creek Watershed (89.5%) is situated in Drumore Township located in southern Lancaster County (Figure I-1). Its headwaters, in the northern section of the watershed, are located in Providence and Martic Townships, which comprises approximately 9.7% of the watershed. A very small percentage of the watershed is located in East Drumore Township (0.6%) and includes some small areas of land that reach across State Route 272 (Lancaster Pike).

Because of the watershed's HQ-CWF designation and many unique amenities, the Lancaster County Conservancy (the Conservancy) recognized its significance, its vulnerability and its future potential. The Conservancy's response was to start the Fishing Creek Nature Preserve by acquiring and expanding onto a group of contiguous properties along lower Fishing Creek. Beginning with one single property acquisition in 1995, the Conservancy's goal to preserve undeveloped woodland, agricultural land and open space has expanded to 167 acres on several tracts so that the watershed's unique natural treasures could be enjoyed by the public. The acquisition and management of such properties has helped to protect some of the watershed's beautiful and sensitive landscape and its habitat and wildlife, but this is just a drop in the bucket.

Therefore, as a steward and important stakeholder of the Fishing Creek Watershed, the Conservancy spearheaded the effort of completing a detailed watershed assessment to complete a comprehensive baseline inventory of the watershed's resources and to determine the existing health and needs of the watershed. The goals of this assessment are to assist communities, landowners and recreational users of the watershed in improving the quality of the natural

INSERT

Figure I-1
Fishing Creek Watershed
Location Map

environment, reducing pollution to Fishing Creek, the Susquehanna River and ultimately the Chesapeake Bay and helping the watershed's municipalities to make "Smart Growth" decisions. It should be noted that this assessment expands upon the *Fishing Creek Preliminary Watershed Assessment* the Conservancy completed with a grant from the Coldwater Heritage Partnership from the Commonwealth of Pennsylvania in 2002.

The Conservancy acquired the environmental consulting services of RETTEW Associates, Inc. (RETTEW) to help complete field investigations and prepare this watershed assessment report. RETTEW began conducting field investigations of the watershed beginning in January 2005 and lasting through the spring, summer and fall of 2005. The watershed assessment scope included habitat and wildlife community surveys, aerial photography, documentation of impacted stream segments, the examination of physical in-stream conditions, collection of benthic macroinvertebrates, electrofishing to determine fish community diversity and recreation and restoration planning. RETTEW also utilized existing geographical information system (GIS) data available from Lancaster County to prepare project area mapping.

Since all of the tributaries in the Fishing Creek Watershed are unnamed, the watershed was broken down into 19 manageable subwatershed units and assigned number designations (in a clockwise direction starting with the main stem) for identification purposes and ease of description. The location, size and percentage of each subwatershed are illustrated on Map 1 of Appendix A. To help the reader with orientation and location of specific sites or resources of interest, the subwatershed unit designation is utilized to identify focus areas throughout this assessment.

B. Project Funding and Team

As previously mentioned, the Conservancy has acquired several different parcels within the watershed to comprise the core of the Fishing Creek Nature Preserve in Drumore Township. Recently, the Conservancy secured grant funding through the Pennsylvania Department of Conservation & Natural Resources' (DCNR) Community Conservation Partnership Program to help purchase an additional 88 acres of mature forest with stream frontage along Scalpy Hollow Road. With such a track record for stewardship in the Fishing Creek Watershed, it was not surprising that the Conservancy was able to obtain funding for this watershed assessment.

To help manage resources and issues on their properties and determine future preservation endeavors in the watershed, the Conservancy received a $40,000.00 grant from the Chesapeake Bay Small Watershed Program for this watershed assessment in 2004. That portion of the watershed assessment's funding is administered by the National Fish and Wildlife Foundation. The remainder of the assessment's funding came through a grant awarded through the Keystone Recreation, Park and Conservation Fund under the administration of DCNR's Bureau of Recreation and Conservation. As required by the grant programs, the Lancaster County Conservancy also provided an in-kind service match to these funds to help with assessment studies.

The Fishing Creek Watershed Assessment Advisory Committee and individual contributors that provided their expertise or volunteered their time and/or species inventory data to make this Natural Resource Inventory Plan possible can be found on the inside front cover of this assessment report.

II. PROJECT AREA CHARACTERISTICS AND LAND RESOURCES

A. Location (Geographic)

Fishing Creek Watershed is located in the Piedmont Upland Section of the Piedmont Physiographic Province, which consists of broad, rounded to flat-topped hills and shallow valleys (DCNR, 2000a). Oriented in a north to south direction, the watershed is situated in the Lower Susquehanna River Basin that encompasses drainages within the "river hills" of southern Lancaster County. Fishing Creek Watershed is predominantly bordered to the west by the Muddy Run Watershed and to the east by the Conowingo Creek Watershed. Subwatersheds of smaller streams (such as Wissler Run and Peters Creek) that drain the river hills also flank the lower third of Fishing Creek. The main stem of Fishing Creek is a second order tributary that receives drainage from 18 first order tributaries. As with its neighboring watersheds, Fishing Creek flows directly into the Susquehanna River.

Located approximately 5.8-miles south of Willow Street, PA, the headwaters of Fishing Creek originate between the villages of Rawlinsville, Truce and Buck, PA. State Route 272, (that slices through the eastern edge of the watershed) and State Route 372 (Holtwood Road) are major arterial highways that cross through the watershed and intersect near the northeastern boundary of the watershed at the Buck. Encompassing approximately 14.2 square miles, the irregular tear drop-shaped watershed has a network of paved and unpaved roads that traverse it in various directions. Some of the larger state and township roads that wind through the watershed include Truce Road, Buck Heights Road, Penny Road, Deaver Road, Silver Springs Road, River Road, and Furniss Road. Other notable roads that follow tributaries and the main stem of Fishing Creek include Scalpy Hollow Road, Osceola Road, Fernglen Road and Fishing Creek Road.

B. Land Use

As seen in Maps 1 and 3 of Appendix A, the majority of the watershed (approximately 65.3%) is dominated by agricultural-related land uses including croplands, pasturelands, barnyards and farmsteads. Forested areas, concentrated along the ridges, slopes and stream bottoms comprise approximately 26.3% of the watershed. Since southern Lancaster County and the river hills are

very rural with a low population density, it is no surprise that residential parcels only account for approximately 5.13% of the watershed's land use. Residential areas (not including houses on farmsteads) are concentrated along the various secondary roads that wind through the Fishing Creek Watershed.

Other minor land uses within the watershed (in descending order) includes successional field/shrubland, stream and ponds, urban, institutional, recreation and emergent wetlands. Even though urban land uses (commercial & industrial) and institutional uses comprise less than 1% of the watershed's land use and cover, land development pressures are growing along State Route 272 (Lancaster Pike) from the Buck south, of which some commercial uses have been proposed within the Fishing Creek Watershed. More detailed descriptions and the characteristics of land cover within Fishing Creek watershed is discussed in greater detail in Section IV of this assessment report.

C. Topography

As depicted on Map 1 of Appendix A, topography varies greatly in the Fishing Creek Watershed. As per Map 2 (Soil Types) and Map 4 (Unique Landscape Features), slopes range from nearly level (0-3%) slopes to steep (greater than 25% slopes). The gentlest slopes (0 to 3%) are confined to the agricultural fields and forested areas situated on the ridge and hill tops and, the floodplain and bottomlands of Fishing Creek and its unnamed tributaries. The steepest slopes (25-60%) are predominantly located along steep side slopes of the main stem and unnamed tributaries (ravines) in the southern three quarters of the watershed. Elevations in the watershed range from 920 feet in the northwestern most section of the watershed in Providence Township to approximately 135 feet above mean sea level near the confluence of Fishing Creek with the Susquehanna River to the south in Drumore Township. While the main stem of Fishing Creek generally flows in a north to south direction to the Susquehanna River, the unnamed tributaries in the northern half of the watershed drain towards the west, while the unnamed tributaries in the southern half (south of River Road) drain from the east and west towards the center of the watershed.

D. Soils

The Soil Survey of Lancaster County (Custer 1985) indicates that the Baile silt loam (Ba), Chester silt loam (CbA, CbB, CbC), Comus silt loam (Cm), Glenelg silt loam (GbB, GbC, GbD), Glenville silt loam (GdB), Holly silt loam (Hg), Manor silt loam (Mab, MaC, MaD), Manor very stony silt loam (MbB, MbD, MbF), Newark silt loam (Nc) and the Udorthents loamy (Ud) as the soil mapping units located in the Fishing Creek Watershed. Three soil series (Manor, Chester and Glenelg) comprise approximately 93.54% of the soils within the Fishing Creek Watershed. The Manor soils are the dominant series (38.03%) mapped throughout the watershed, with the Manor silt loam soils occurring on the ridges and hillsides of the watershed, while the Manor very stony silt loam soils are situated on the steep side slopes of the main stem and the tributaries of Fishing Creek.

As can be seen in the adjacent photo, large stones, boulders and bedrock outcrops are associated with the Manor very stony silt loam soils. The Chester series (29.48%) and the Glenelg series (26.03%) are the other two dominant soils in the watershed. Both soil types are predominantly found in the rolling agricultural areas (broad ridge tops and side slopes) of the watershed. The Baile, Comus, Glenville, Holly and Newark soils occur in the drainage ways, floodplain and bottomlands of Fishing Creek and its unnamed tributaries. Finally, the Udorthents loamy series are situated in areas where the landscape has been altered and comprise a very small (<0.1%) portion of the watershed. The location and distribution of all soil mapping units are shown on Map 2 (Soil Types) of Appendix A.

The Manor soils are comprised of deep, well drained soils found on hill tops and side slopes, while the Chester and Glenelg soils are deep, well drained soils found on broad dissected ridge tops and side slopes. The Manor, Chester and Glenelg soils were formed in residuum weathered from mica schist and quartzite. With the exception of the disturbed Udorthents soils, the remaining soils found along the floodplains and drainage ways are alluvium formed from residuum weathered from mica, schist and quartzite. The listing of the major soil types mapped in the watershed and a description of their characteristics including their limitations for recreational opportunities are provided in Table II-1.

Insert Table II-1 (Soils)

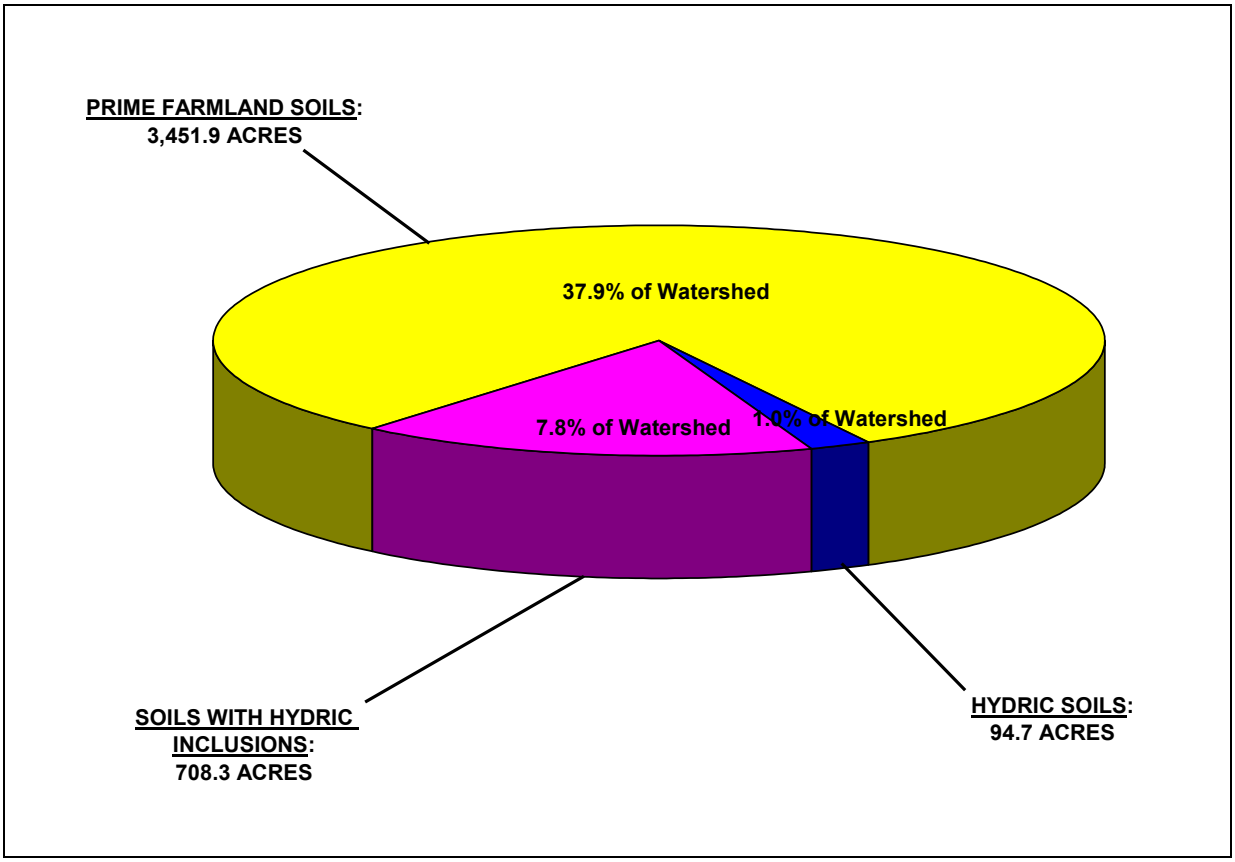
Insert Table II-1 (Soils)

Insert Table II-1 (Soils)

Insert Table II-1 (Soils)

Of the 18 soil mapping units found in the watershed, the Chester, Glenelg, Glenville and Manor silt loam (3-8% slopes) and the Comus silt loam soils are considered to be **prime farmland soils**. As seen in Figure II-1 below, these prime farmland soils comprise approximately 37.9% of the soils of significance (i.e., worthy of preservation) within the Fishing Creek Watershed. Two other soil groups of significance in the watershed include **hydric soils** and **soils with hydric inclusions**. Such soils have a good probability for the presence of wetlands because of their poor drainage, shallow water table, or location along a drainageway. Only the Baile silt loam and the Holly silt loam (comprising only 1.0% of the total watershed) are considered hydric (high wetland potential) by the Natural Resources Conservation Service. Four other soils, the Chester silt loam (0-3% slopes), Comus silt loam, Glenville silt loam (3-8 % slopes) and Newark silt loam are considered of possibly having hydric inclusions. These latter soils may support wetlands or uplands, depending on the specific site and soil conditions. Soils with hydric inclusions comprise approximately 7.8% of the total watershed. Consequently, the majority of the soils that are listed as being hydric or having hydric inclusions are situated along main stem or tributaries of Fishing Creek. It should be noted however that jurisdictional wetlands must, at least periodically, support hydrophytic vegetation, have predominantly undrained hydric soils as their substrate and be saturated or covered by shallow water at some time during the growing season of each year.

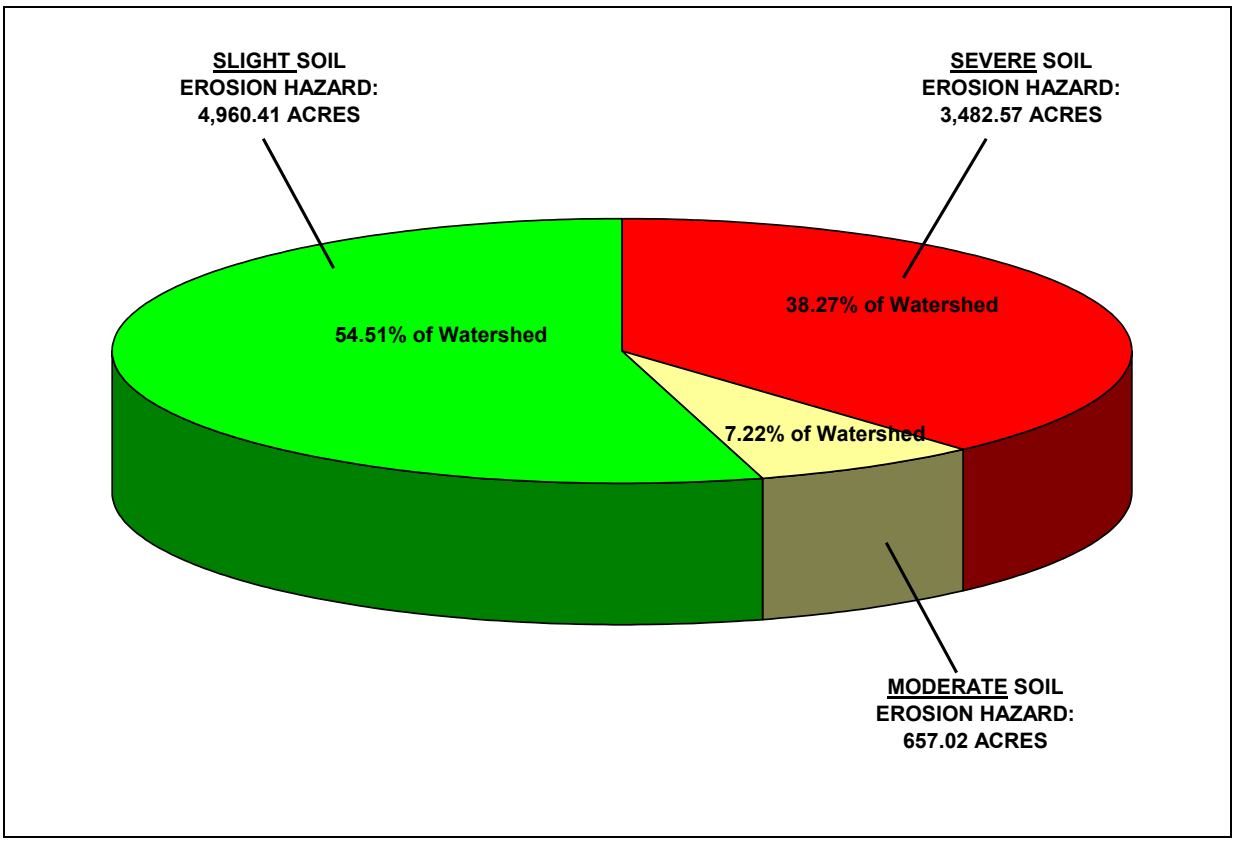
FIGURE II-1 FISHING CREEK WATERSHED SOILS OF SIGNIFICANCE



Since the Conservancy is interested in developing some hiking trails on their properties and horse riding clubs create and use equestrian trails in the watershed, it's important to know what soils are conducive to erosion and should be avoided. As seen in Figure II-2 below, approximately half (54.51%) of the soils mapped in the watershed are suitable (i.e., slight soil erosion hazard) for recreational trails and paths. These soils include the Chester, Comus and Glenelg silt loams (0-15% slopes) and Manor very stony silt loam (3-8% slopes). However, the Glenelg silt loam (15-25% slopes) and the Manor very stony silt loam (8-25% slopes) have a moderate erosion hazard for trail use and comprise around 7.22% of the watershed's soils.

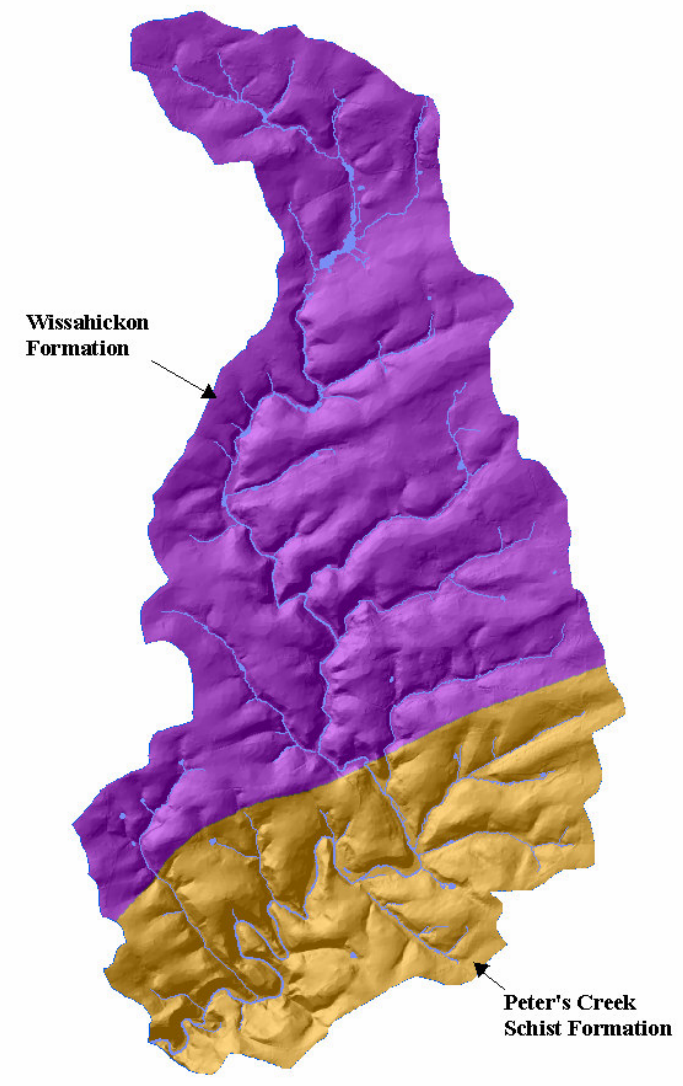
The soils that are at risk for severe soil erosion hazards (due to wetness, steep slopes and soil structure) comprise approximately 38.27% of the watershed's soils. Soils that are at severe risk of erosion for trails due to wetness include the Baile, Glenville, Holly and Newark silt loams (0-8% slopes). These series also happen to be soils that are hydric or have hydric inclusions. Soils that are of high risk for erosion for trails and paths due to steep slope and soil structure include the Manor silt loam (3-25% slopes), and the Manor very stony silt loam (25-60% slopes). Because of the concentration of this latter soil mapping unit in the area known as Fishing Creek "hollow" south of Furniss Road, it's not surprising that erosion problem areas exist along that section of Fishing Creek Road. In general, soils with severe and moderate erosion hazard levels should be avoided for any future recreational trails or paths.

FIGURE II-2 SOIL EROSION HAZARDS FOR RECREATIONAL TRAILS



E. Geology

Fishing Creek Watershed is located in the Piedmont Upland Section of the Piedmont Physiographic Province. The underlying rock in the southern Lancaster County (including Fishing Creek) is from the Lower Paleozoic Era (430-570 million years ago). During the Lower Paleozoic Era, this area of Pennsylvania was submerged beneath a shallow sea where sediments were deposited and eventually became sandstones and shale. The sedimentary rocks were later subjected to folding, faulting and metamorphism, uplift and erosion. The primary type of bedrock that the shale metamorphosed into were schists. The northern three quarters of the Fishing Creek Watershed is underlain by the Wissahickon Formation while the southern quarter of the Watershed is the Peter's Creek Schist Formation. Both geologic formations are primarily comprised of schists interbedded with thin layers of quartzite.



With the Fishing Creek Watershed being so rural, residential and farming communities solely depend on ground water for potable water supplies. Both the Wissahickon Formation and Peters Creek Schist Formation support a crystalline rock aquifer that have little storage capacity and a low yield. The median ground water yield of the Wissahickon Formation is approximately 20 gallons per minute (gpm) while the median yield for the Peters Creek Schist Formation is approximately 10 gpm (Gehringer-Roth, 1994). Such yields are very small compared to carbonate rock (limestone and dolomite) aquifers located in central and northern Lancaster County which can yield ground water volumes of up to several thousand gpm. It should be noted that if the Fishing Creek Watershed were to become more developed with impervious areas in the future, ground water recharge to the local aquifer and the base flow of Fishing Creek could be in jeopardy.

III. LOCAL GOVERNMENT

As previously stated, four municipalities comprise the watershed: Drumore, East Drumore, Martic and Providence Townships. This creates a patchwork of municipal authority over land within the watershed and complicates any regulatory perspective. However, as seen in Table III-1, Drumore Township has the biggest stake in watershed protection in regards to its municipal area within the Fishing Creek Watershed.

Table III-1 Municipal Areas and Estimated 2000 Population

	Population Density[1]	Area[2]	Estimated Population in Watershed
Drumore	93.8	12.72	1,193
East Drumore	152.2	0.13	20
Martic	172.0	0.04	6
Providence	330.3	1.33	440
Total	**116.7[3]**	**14.22**	**1,659**

[1] - Persons per Square Mile (2000 U.S. Census)
[2] - Square Miles within the Fishing Creek Watershed
[3] - Geographically weighted estimate

Census data does not allow for aggregation by watershed, so estimates are based on municipal population densities, and area within the watershed. These numbers are far below the County average of 496 persons per square mile, indicating the rural nature of these townships.

While each municipality has developed guiding documents for development and land use, or deferred to the County on such issues, most of these documents are in excess of 10 years old, and some, as old as 25 (see Table III-2). Additionally, no municipality in the watershed has developed a park plan or a zoning ordinance with specific watershed protection and management regulations.

Table III-2 Municipal Plan Document Status (Lancaster County Planning Commission)

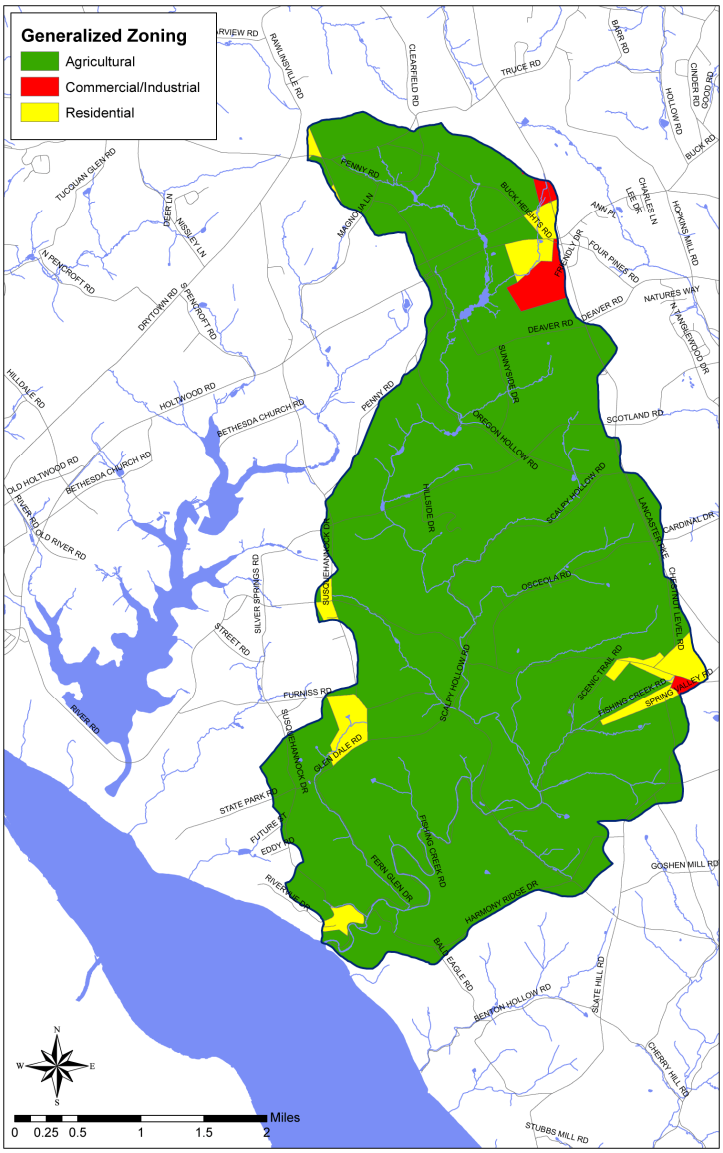
	Subdivision and Land Development Ordinance	Zoning	Comprehensive Plan	Park / Recreation Plan
Drumore	County	1994	1994	None
East Drumore	1998	1980, amended 1998	1980	None
Martic	County	1972, amended 1992	1991	None
Providence	1992	1983, amended 1992	1991	None

While zoning ordinances differ across the watershed by municipality, when stated in a generic sense, the land use constraints break down as shown in Table III-3:

Table III-3 Generalized Zoning Districts (Lancaster County Planning Commission)

Square Miles	Percent

Agricultural	13.50	95.0%
Commercial/Industrial	0.18	1.2%
Residential	0.54	3.8%



Throughout the watershed, agricultural districts comprise the majority of local zoning. This has a mixed impact on the watershed. While these districts provide assistance for agricultural viability that somewhat deters open-space conversion, they do allow residential development as a permitted use, and do not enforce Best Management Practices (BMPs) as a condition of land use. This can lead to scattered, inconsistent land development, making for difficult greenway preservation, as well as stream degradation from non-point source pollution and habitat destruction.

The Comprehensive Plans of the respective townships mark the most out-of-date set of documents. With the most recent plan being 11 years old, these documents are at the ends of their useful lives. Recently, the Lancaster County Planning Commission has begun the process of assembling municipalities in southern Lancaster County for the creation of a joint comprehensive plan. However, given concerns of Drumore Township, particularly apprehension over commercial development near the intersection of PA-272 and PA-372, this project has been put on hold. One positive outlook from all of the various plans, however, is the affirmation of a rural community and rural way of life. Given the age of the plans however, it is questionable as to whether these statements hold the same sway. The adoption of "Village Growth Boundaries" could limit sprawl into productive farmland of the watershed.

IV. ASSESSMENT OF BIOLOGICAL RESOURCES

A. Vegetation Inventory

Vegetative community classification is defined as an assemblage of plant populations sharing a common environment and interacting with each other, with animal populations and with the physical environment (Fike, 1999). Community classification by dominant (overstory) species is a natural and widely used approach for categorizing recurring plant assemblages. Community classification can also be further refined to include dominant species in different strata, not just the overstory. For the Fishing Creek Watershed Assessment, the major land cover types were initially identified through windshield surveys and delineated on aerial photos and GIS field resource maps. The general land cover types were then studied in more detail at different locations in the field through characterizing the vegetative species in the tree, sapling, shrub and herbaceous vegetative layers. Specific vegetation community characteristics were then cross-referenced against *Terrestrial & Palustrine Plant Communities of Pennsylvania* (Fike, 1999) to determine the different habitat community types present within each land cover. The vegetative community types were verified by ground truthing during the field inspections conducted between January and July 2005. The land cover and associated habitat community types include:

Agricultural Field	**4,572.90 acres**
Coniferous Forest	**45.90 acres**
• Coniferous Plantation/Stand	
• Hemlock Forest	
Deciduous Forest	**2,143.02 acres**
• Dry Oak-Mixed Hardwood Forest	
• Red Oak-Mixed Hardwood Forest	
• Sycamore-Box Elder Floodplain Forest	
• Tulip Tree-Beech-Maple Forest	
Emergent Wetlands	**15.81 acres**
• Reed Canary Grass Marsh	
• Wet Meadow	
Farmstead/Barnyard	**202.84 acres**
Forested Wetlands	**38.94 acres**
• Bottomland Palustrine Forested Wetland	
Institutional	**26.31 acres**
Mixed Forest	**186.20 acres**
• Hemlock-Red Oak Mixed Forest	
• White Pine-Oak Mixed Forest	
Pasture	**1,127.13 acres**
Recreation	**16.82 acres**
Residential	**471.32 acres**
Stream, Pond	**35.12 acres**
Successional Field/Shrubland	**266.31 acres**
Urban	**34.20 acres**

General land cover and habitat community type components are shown in the Land Cover and Habitat Community Type Map (Map 3) provided in Appendix A. General land use and cover mapping information for the Fishing Creek Watershed was obtained from Geographic Information System (GIS) data provided by the Lancaster County GIS Department.

Trout Lily (Erythronium americanum)

A listing of the common plant species that were observed within each habitat community was generated through various field investigations that were conducted in 2005. When RETTEW biologists conducting field surveys observed any new vegetative species, the plants would be identified and added to the qualitative list of plant species already observed for each habitat community. A comprehensive list of species was generated for all vegetation observed in the Fishing Creek Watershed throughout the different growing seasons. It should be noted however, that because RETTEW biologists did not have access to all properties within the watershed and because of scope limitations, additional plant species not listed could exist.

Swamp Milkweed (Asclepias incarnata)

Table IV-1 provides a master list of common vegetation present in the Fishing Creek Watershed and the habitat communities where they can be expected. The table presents the different trees, shrub, vines, herbs, grasses, ferns, clubmoss and moss species that were identified in the watershed along with information on native and introduced species, invasive and noxious weed species, wetland indicator status, bloom period, blossom color, height and what habitat communities they can be found in. As presented in Table IV-1, the Fishing Creek Watershed supports at least 44 species of trees, 32 species of shrubs and vines, 110 species of herbs, 9 species of grasses and 14 species of ferns, clubmoss and moss. Of the total number of

vegetative species found in the watershed's habitat communities, 41 species are introduced (non-native) plants.

INSERT TABLE IV-1 (Plants)

INSERT TABLE IV-1 (Plants)

INSERT TABLE IV-1 (Plants)

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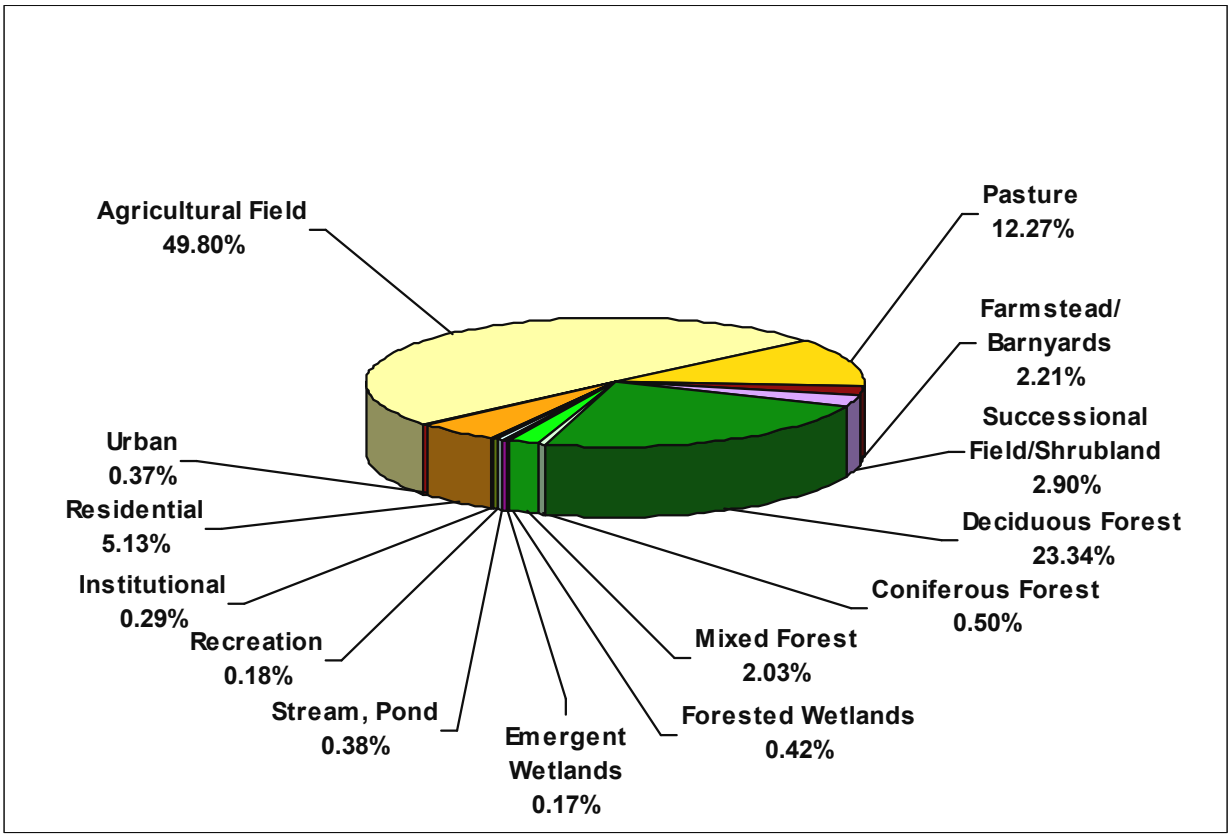
B. Land Cover/Habitat Community Types

As discussed above, a total of fourteen (14) major land cover types were identified and delineated in the 9,183-acre Fishing Creek Watershed. The pie chart shown in Figure IV-1 below illustrates the percent size distribution of each land cover type within the Fishing Creek Watershed. Of these land cover types, Farmstead/Barnyards, Institutional, Recreation, Residential and Urban (8.18%) have been drastically changed by anthropogenic influences that do not support distinctive habitat communities. Agricultural Field and Pasture land cover types also have been altered through man's farming practices, but they still support distinct vegetation communities that comprise and influence a large portion (62.07%) of the Fishing Creek Watershed landscape. The Deciduous, Mixed and Coniferous Forested and the Successional Field/Shrubland covers comprise approximately 28.77% of the watershed. Finally, the remainder of the land cover in the watershed includes Stream/Pond, Emergent Wetlands and Forested Wetlands. These important features comprise diverse ecosystems that account for only 0.97% of the Fishing Creek Watershed. The mapped locations of each land cover type are illustrated in Map 3 of Appendix A.

FIGURE IV-1 FISHING CREEK WATERSHED LAND COVER DISTRIBUTION



The presence of more specific habitat community type components within a general land cover is of notable significance and therefore such habitat communities have been described in more detail below. It should be noted that the purpose of identifying habitats was to simplify the complexity of the watershed's landscape so that major differentiations in vegetative communities could be documented, better explained and understood. When possible, community matches were made to those described in *Terrestrial & Palustrine Plant Communities of Pennsylvania* (Fike, 1999).

1. Agricultural Field (Land Cover)

Agricultural Field (Habitat Community)

Situated on the gently sloping ridges and moderate hillside slopes between the many unnamed tributaries that branch out from the main stem of Fishing Creek, the Agricultural Field habitat community type is the largest (4,573 acres) land cover area in the watershed. Comprising approximately 49.8% of the total watershed, this community is altered on a yearly basis through farming practices that predominantly yields field, vegetable and fruit crops. Because approximately 75% of the watershed's agricultural lands are comprised of Prime Farmland Soils, many different types of crops are planted and cultivated in the Fishing Creek Watershed. The most common crops that are propagated include corn *(Zea mays)*, soy beans *(Glycine sp.)*, wheat *(Triticum sp.)*, hay (timothy and alfalfa), potatoes *(Solanum tuberosum)*, oats *(Avena sp.)*, tomatoes *(Lycopersicon esculentum)*, celery *(Apium sp.)* and strawberries *(Fragaria sp.)*. The incorporation of conservation practices such as contour farming, grass-lined waterways and contour grass buffer strips by some farmers have helped to reduce large scale soil erosion from agricultural fields in the watershed. The areas located on the outside edges of the active agricultural fields have also become colonized by herbaceous species and provide transitional buffer zones between the agricultural and forested areas. Common herbaceous species found in areas bordering agricultural fields include foxtail grass (*Setaria sp.)*, Canada goldenrod *(Solidago canadensis)*, pokeweed *(Phytolacca americana)*, horse nettle *(Solanum carolinense)*, ryegrass *(Lolium sp.)*,

bull thistle *(Cirsium vulgare)*, burdock *(Arctium minus)*, Canada thistle *(Cirsium arvense)*, common milkweed *(Asclepias syriaca)*, curled dock *(Rumex crispus)*, dandelion *(Taraxacum officinale)*, evening primrose *(Oenothera biennis)*, field mustard *(Brassica rapa)*, garlic mustard *(Alliara petiolata)*, hemp dogbane *(Apocynum cannabinum)*, Queen Anne's lace *(Daucus carota)*, and amaranth *(Amaranthus sp.)*. The interface of forested areas and the Agricultural Field community provides an abundance of ecotone areas that are very attractive to wildlife.

2. Coniferous Forest (Land Cover)

Coniferous Plantation/Stand (Habitat Community)

The Coniferous Plantation/Stand habitat community consists of small scattered patches or rows of conifer (evergreen) species that were likely planted near homesteads and roads for aesthetic reasons and to function as wind breaks. Such stands may exist as a mono-culture of one coniferous species or a mixture of a few species. Dominant conifer species found in this habitat community primarily includes eastern white pine *(Pinus strobus)*, Norway spruce *(Picea abies)*, and red pine *(Pinus resinosa)*. Although part of the Coniferous Forest land cover, these smaller coniferous stands should not be confused with the larger and naturally occurring eastern hemlock *(Tsuga canadensis)* and eastern white pine trees found in the Mixed and Hemlock Forest habitat communities that occur in the steeper valley sections (river hills) of Fishing Creek in the southern section of the watershed. Regardless, the Coniferous Plantation/Stand community provides habitat for several species of song birds, woodpeckers and squirrels and may occasional harbor some white-tailed deer.

Hemlock Forest (Habitat Community)

The Hemlock Forest habitat community comprises the majority of the 45.9 acres of Coniferous Forest land cover and is scattered along the ridges and higher slopes of Fishing Creek and its tributaries. The Hemlock Forest community is comprised of native eastern hemlock and eastern white pine, of which the two species account for more than 75% of the community's canopy. Stands of the Hemlock Forest community can be found adjacent to and intermixed with the Hemlock-Red Oak Mixed Forest and the White Pine-Oak Mixed Forest communities of the Mixed Forest land cover (described below). Because of the thick canopy that the conifer (evergreen) species provide year round, the understory often contains thick, shade-loving shrub species and/or limited deciduous sapling growth. Some black birch *(Betula lenta)*, American beech *(Fagus grandifolia)*, American holly *(Ilex opaca)*, red oak *(Quercus rubrum)*, chestnut oak *(Quercus prinus)*, red maple *(Acer rubrum)* and tulip tree *(Liriodendron tulipifera)* saplings are present, with mountain laurel *(Kalmia latifolia)* and Rhododendron *(Rhododendron maximum)* dominating the shrub layer. Because the floor of this community gets little light from the dense evergreen canopy and the dense shrub layer, very few herbaceous species are present. However, flat-branched ground pine *(Lycopodium obscurum)* and Christmas fern *(Polystichum acrostichoides)* can be found growing in sporadic clumps on the forest floor. The Hemlock Forest habitat community does provide unique cover that is inhabited by songbirds, and is also utilized by the white-tailed deer as a yarding area (a gathering area that provides protection from the wind) during the winter and deep snows.

3. Deciduous Forest (Land Cover)

Dry Oak-Mixed Hardwood Forest
(Habitat Community)

One of the key components of the deciduous forested areas that buffer Fishing Creek and its unnamed tributaries from agricultural areas of the watershed, the Dry Oak-Mixed Hardwood Forest habitat community is often situated on ridges and south and southwest-facing slopes in the watershed. This community is dominated by several upland oak and mixed hardwood species. The dominant oaks include white oak, *(Quercus alba)*, chestnut oak, scarlet oak *(Quercus coccinea)*, red oak *(Quercus rubra)* and black oak *(Quercus velutina)*. Other hardwood species occurring in this community type include black birch, red maple, tulip tree, American beech, black gum *(Nyssa sylvatica)*, pignut hickory *(Carya glabra)*, sassafras *(Sassafras albidum)*, white ash *(Fraxinus americana),* and sugar maple *(Acer saccharum)*. American chestnut (*Castanea dentata)* stump sprouts were also observed in this community. The shrub layer of this community includes tree and shrub species such as mountain laurel, flowering dogwood *(Cornus florida)*, maple-leaf viburnum *(Viburnum acerifolium)*, black haw *(Viburnum prunifolium)*, spicebush *(Lindera benzoin)*, red raspberry *(Rubus idaeus)*, eastern burning bush *(Euonymus atropurpureus)* and pink azalea *(Rhododendron nudifolium)*.

Several native species of wildflowers can be found growing in the Dry Oak-Mixed Hardwood Forest habitat community, some of which include birds foot violet *(Viola pedata)*, bloodroot *(Sanguinaria canadensis)*, false solomon's seal *(Smilacina racemosa)*, May apple *(Podophyllum peltatum)*, rattlesnake plantain *(Goodyera pubescens)*, roundleaf yellow violet *(Viola rotundifolia)*, rue anemone *(Anemonella thalictroides)*, partridge berry *(Mitchella repens)*, showy orchis *(Orchis spectabillis)*, spring beauty *(Claytonia virginica)*, trout lily *(Erythronium americanum)*, two-leaf toothwort *(Cardamine diphylla)*, white avens *(Geum canadense)*, wild geranium, (*Geranium maculatum)*, wild licorice *(Galium circaezans)*, and wood anemone *(Anenome quinquefolia)*. Ferns observed on the forest floor of this community included

Christmas fern, hay-scented fern *(Dennstaedtia punctilobula)*, marginal wood fern *(Dryopteris marginalis)* and New York Fern *(Thelypteris noveboracensis)*. Flat-branched ground pine was also observed in this community.

Red Oak-Mixed Hardwood Forest
(Habitat Community)

Perhaps the most dominant habitat community within the Deciduous Forest land cover of the Fishing Creek Watershed is the Red Oak-Mixed Hardwood Forest. Located on both slopes and ridges, the dominant tree species observed in this community includes red oak, white oak, black oak, chestnut oak, black birch, American beech, tulip tree, pignut hickory, red maple, black gum and sassafras. The under story of this habitat community is very dense and comprised of mountain laurel, flowering dogwood, blackhaw *(Viburnum prunifolium),* witch hazel *(Hamamelis virginiana)*, spicebush, maple-leaf viburnum, red raspberry, northern arrowwood *(Viburnum recognitum)*, lowbush blueberry (*Vaccinium angustifolium)*, frost grape, and Virginia creeper *(Parthenocissus quinquefolia)*. The forest floor supports several spring wildflowers including false-solomon's seal, spring beauty, mayapple, trout lily, wild licorice, blood root, Jack-in-the-pulpit *(Arisaema triphyllum)*, roundleaf yellow violet, blue violet *(Viola sororia)*, honewort *(Cryptotaenia canadensis)*, and wood sorrel *(Oxalis Montana)*. Christmas fern, hay-scented fern, intermediate wood fern (Dryopteris intermedia) and marginal wood fern were also observed on the forest floor of this community.

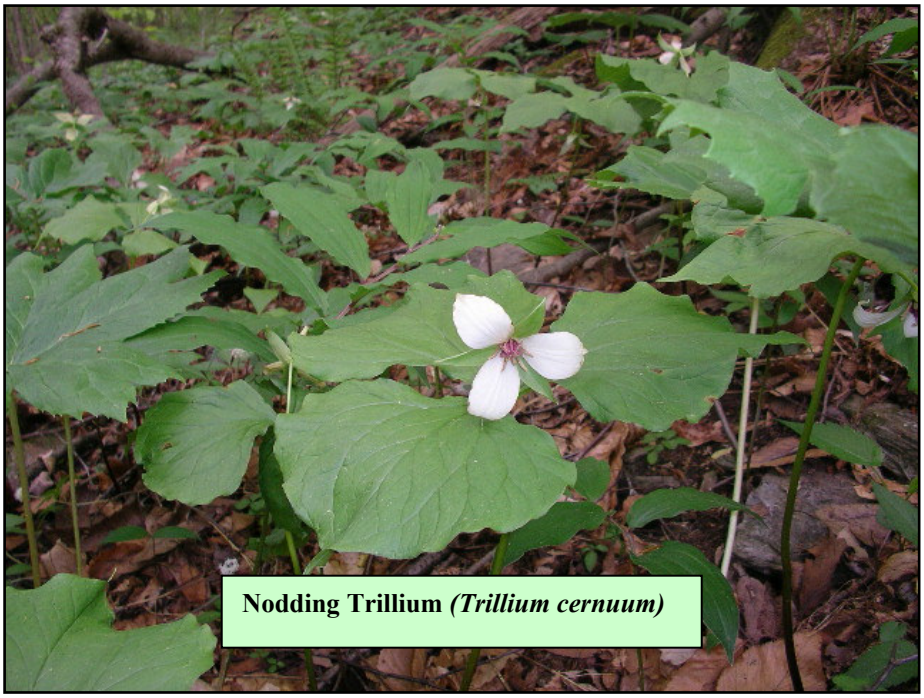
Sycamore-Box Elder Floodplain Forest (Habitat Community)

The Sycamore-Box Elder Floodplain Forest habitat community occurs along the floodplains of mid-size rivers and stream systems that receive periodic or seasonal flooding. Typically this may be a palustrine (wetland) community, but there are areas that are considered terrestrial upland (Fike, 1999). This is the case with some sections of floodplain areas along the main stem and tributaries of Fishing Creek. While the majority of this habitat community is comprised of uplands on the Fishing Creek floodplain, sections of the community may be jurisdictional wetlands even though the vegetation of the community is the same. The Reed Canary Grass Marsh and the Wetland Meadow habitat communities are other examples of wetland systems that exist along the Fishing Creek floodplain and border the Sycamore-Box Elder Floodplain Forest community. The most common tree species in this community include box elder *(Acer negundo)*, American sycamore *(Platanus occidentalis)*, black willow *(Salix nigra),* red maple, slippery elm *(Ulmus rubra)*, green ash *(Fraxinus pennsylvanica)* and black walnut *(Juglans nigra)*, all of which are common floodplain trees. Common species observed in the shrub and vine layer of this habitat include, spicebush, silky dogwood *(Cornus amomum)*, multiflora rose *(Rosa multiflora)*, red raspberry, blackberry *(Rubus allegheniensis)*, riverbank grape *(Vitis riparia)*, poison ivy *(Toxicodendron radicans)* and Japanese honeysuckle (*Lonicera japonica).* Common herbaceous plants in this community include jewelweed *(Impatiens capensis)*, mayapple, trout lily, day lily *(Hemerocallis fulva)*, garlic mustard, curled dock, stilt grass *(Microstegium vimineum)* and onion grass (*Allium canadense)*.

Tulip Tree-Beech-Maple Forest (Habitat Community)

The Tulip Tree-Beech-Maple Forest habitat community occurs in fairly deep, strongly acidic soils at a mid-to lower-slope position. When present with tulip tree, American beech can often be co-dominant (Fike, 1999). Within the Fishing Creek Watershed, this community was common on lower slopes and coves in the hilly forested areas along the main stem of Fishing Creek and along Scalpy Hollow Road.

Common tree species that occur in this community in addition to tulip tree and American beech includes red maple, sugar maple, black birch, red oak and chestnut oak. The understory includes shrubs such as witch hazel, flowering dogwood, spicebush, and black haw. Herbaceous vegetation observed on the forested floor included Mayapple, Jack-in-the pulpit and spring beauty. Two additional wildflowers that were observed along a lower slope of this habitat community and adjacent to an unnamed tributary included nodding trillium *(Trillium cernuum)* and dwarf ginseng *(Panax trifolius)*.



Nodding Trillium *(Trillium cernuum)*

4. Emergent Wetlands (Land Cover)

Reed Canary Grass Marsh (Habitat Community)

The Reed Canary Grass Marsh habitat community consists of palustrine emergent wetlands that occur within some floodplain areas of Fishing Creek and its tributaries. The largest community of this type (as seen in the aerial photo) is situated just upstream and north of Silver Springs Road at the confluence of the main stem and tributary of Subwatershed 5. Located adjacent to agricultural areas within the watershed, these areas are typically not used for pasture due to their extreme wetness and lack of palatable vegetation for livestock. The dominant species found in this community is (of course) reed canary grass *(Phalaris arundinacea)*, which is known to form a dense monoculture community through spreading rhizomes. Other less common species in this community includes sensitive fern *(Onoclea sensibilis)*, jewelweed, skunk cabbage *(Symplocarpus foetidus)*, woolgrass *(Scirpus cyperinus)*, arrow-leaf tearthumb *(Polygonum sagittatum)*, tussock sedge *(Carex stricta)*, crowded sedge *(Carex stipata)*, fringed sedge *(Carex crinita)*, prickly sedge *(Carex spicata)*, soft rush *(Juncus effuses)*, teasel *(Dipsacus sylvestris)* and blue vervain *(Verbena hastata)*. Depending on the season, this habitat community is often saturated just beneath the surface or inundated with up to 3 inches of water.

Wet Meadow (Habitat Community)

The Wet Meadow habitat community is most often found in low, open areas containing mineral soils and a layer of muck at the surface. This community is typically flooded early in the growing season (Fike, 1999). In the Fishing Creek Watershed, the Wet Meadow habitat community is a palustrine emergent wetland situated on the floodplain of Fishing Creek and its tributaries. In some cases, the wet meadow habitat is fed by springs. The Wet Meadow community is often saturated with water to the surface and drains to the nearest stream.

As seen in the aerial photograph to the left, the Wet Meadow habitat community also comprises the unique wetlands located in old stream oxbows situated along the floodplain of the tributary in Subwatershed 9. The dominant herbaceous species found in this community include soft rush, blue vervain, New York ironweed *(Vernonia noveboracensis)*, tussock sedge, crowded sedge, lurid sedge *(Carex lurida)*, fringed sedge, arrow-leaf tearthumb, jewelweed, New England aster (*Aster novae-angliae)* and purple-leaved willow herb *(Epilobium coloratum)*. Smaller Wet Meadow communities also contained sweet flag *(Acorus calamus)*. Since this habitat commonly consists of a diverse emergent wetland plant community, the proper water regime and a mucky substrate, it could possibly support the bog turtle *(Glyptemys*

muhlenbergii) which is listed as a state endangered and federally threatened species by the Pennsylvania Fish & Boat Commission and the U.S. Fish and Wildlife Service.

5. Farmstead/Barnyard (Land Cover)

The Farmstead/Barnyard land cover is always present with the Agricultural Field and Pasture habitat communities. Located at the heart of any crop production, livestock or dairy farm, the Farmstead/Barnyard land cover supports a farmhouse, barns, out buildings and grain silos in a relatively concentrated area. Since Agricultural Field and Pasture land cover comprise and influence approximately (62.07%) of the landscape, the Farmstead/Barnyard land cover type dots the landscape of the Fishing Creek Watershed.

While the farmhouse provides shelter and living space for farmers and their families, the barns and outbuildings house their machinery and animals. With livestock and dairy farms, where poultry, beef cattle, or dairy cows congregate for feeding, watering or loafing, barnyard grounds are often comprised of bare soil worn from constant animal activity. Also, because of farm animal concentration, the barnyard becomes a major source of farm animal waste. If not properly managed, the waste often becomes a source of non-point source runoff that can pollute streams. Although sparse, the vegetation that can be found in these areas varies greatly, but often consists of grasses and various weed species.

6. Forested Wetlands (Land Cover)

Bottomland Palustrine Forested Wetland (Habitat Community)

The Bottomland Palustrine Forested Wetland community type consists of forested and scrub/shrub wetland complexes primarily located along bottomlands of Fishing Creek's main stem and its forested tributaries in the northern half of the watershed. The largest Bottomland Palustrine Forested Wetland community in the watershed is situated between Holtwood Road and an electric utility line easement owned by PECO Energy and Pennsylvania Power and Light Company. This habitat community is very diverse and is a sight to behold in the spring time when skunk cabbage plants carpet the forest floor. Dominant tree species include red maple, box elder, tulip tree, green ash, black birch, and ironwood *(Carpinus caroliniana)*. Common shrub and vine species in this community include blackhaw, spicebush, northern arrowwood, silky dogwood, multiflora rose, greenbrier *(Smilax rontundifolia)* and riverbank grape. Herbaceous species consist of skunk cabbage, false hellebore *(Veratum viride)*, jewelweed, sensitive fern, spring beauty, trout lily, curled dock, and Jack-in-the-pulpit. Wildlife is plentiful in this habitat and supports beaver along the main stem.

7. Institutional (Land Cover)

This land cover is very small in size and predominantly includes a church camp known as the Rawlinsville Methodist Episcopal Camp Association (aerial photo) located in the northern part of the watershed and Chestnut Level Presbyterian Church located in the south eastern section of the watershed. Buildings occupy most of this land area, but some deciduous trees and vegetation exist.

8. Mixed Forest (Land Cover)

Hemlock-Red Oak Mixed Forest (Habitat Community)

This habitat community is similar to the Red Oak-Mixed Hardwood Forest described above with the addition of the eastern hemlock, a conifer that contributes more than 25% of the relative cover (Fike, 1999). In the Fishing Creek Watershed, this habitat community is predominantly concentrated in the southern Fishing Creek Road "hollow area" where the hillsides are steep. The dominant vegetative species that are present in addition to eastern hemlock include red oak, chestnut oak, white oak, pignut hickory, American beech and red maple. Some eastern white pine trees can also be found growing within the community. The understory is dominated by spicebush and witch hazel. However, wild hydrangea *(Hydrangea arborescens)* is also quite common along the edges of this community on Fishing Creek Road. The forest floor is well covered by leaf litter and little light penetrates the dense canopy. With the exception of Christmas fern very little grows in the herbaceous layer of this habitat community. The dense cover and availability of mast crop from the community does provide unique habitat that is utilized by the white-tailed deer as a bedding, feeding and yarding area.

White Pine- Oak Mixed Forest (Habitat Community)

The White Pine-Oak Mixed Forest habitat community type consists of scattered patches of conifer species mixed with a few species of hardwoods. The small stands occur as "islands" amongst the large Deciduous Forest land cover in the southern section of the watershed in the Fishing Creek Road hollow area. However, this community is found higher up on the slopes and ridges than the Hemlock-Red Oak Mixed Forest habitat community. The dominant conifer species is eastern white pine with some eastern hemlock present. Deciduous tree species in this community includes chestnut oak, red oak, black birch, American beech and American holly *(Ilex opaca)*. Unlike the Hemlock-Red Oak Mixed Forest habitat, this community's understory is primarily comprised of mountain laurel. Again, this community does provide cover that is utilized by the white-tailed deer as a bedding area and a yarding area.

9. Pasture (Land Cover)

Pasture (Habitat Community)

The pasture land cover is found amongst the various dairy and cattle farms within the Fishing Creek Watershed. They are always found adjacent to Agricultural Field and Farmstead/Barnyard Land Cover types. However, they are commonly situated in the least productive soils of an agricultural area including very stony, shallow soil or wet areas. With wet soils being unproductive for growing crops, many pastures are situated along floodplains of Fishing Creek's headwaters and its tributaries and within potential wetlands. Pastures in emergent wetlands are very common on dairy farms, however even forested wetlands are being impacted by draft horses in the Fishing Creek Watershed.

Unrestricted livestock along streams is a big problem in the Fishing Creek Watershed, with the lack of riparian buffers, accelerated erosion and water pollution from animal wastes being the most common impacts. However, pastures do manage to support a greener carpet of vegetation than barnyards do.

Some of the more common vegetative species in the Pasture Land cover includes clover, curled dock, jewelweed, reed canary grass, soft rush, burdock, climbing nightshade *(Solanum dulcamara)*, and dandelion. Other grasses and vegetation found in the Agricultural Field habitat community are also common in the pasture lands of the watershed. Multiflora rose, princess tree *(Paulownia tomentosa)* and red cedar *(Juniperus virginiana)* can also be found in pastures.

10. Recreation (Land Cover)

This land cover is very small in size and is limited to Drumore Township Park (aerial photo) located along the east side of Furniss Road in the southern section of the watershed; and, Camp Andrews located on the south side of Silver Springs Road in the central section of the watershed. Drumore Township Park includes a ball field, swing set, pavilion and picnic tables, while Camp Andrews (a private Christian Camp) has various buildings, a sports area, swimming pool, hiking trails, ropes course and nature center. In general, although the watershed does not have much "active recreation land", forested tracts of Lancaster County Conservancy's Fishing Creek Nature Preserve are open to public hiking, fishing and hunting. Private horse riding clubs and trails are also situated in the lower half of the watershed within other land cover.

11. Residential (Land Cover)

Not including houses on farmsteads, residential areas are concentrated along the various roads that wind through the Fishing Creek Watershed (similar to the aerial photo of Penny Road located in the headwaters). Single and multi-family dwellings, one-unit attached dwellings and mobile homes comprise the residential land cover in the watershed. Since most residential parcels have yards, various grasses, native trees and ornamental shrubs can be found growing in this land cover.

12. Stream, Pond (Land Cover)

Streams and ponds are very important to the Fishing Creek Watershed and its inhabitants. As previously mentioned, approximately 12 miles of Fishing Creek (main stem) and 17 miles of tributaries flow through the watershed. Farm ponds dot the watershed and are predominantly situated adjacent to streams and pasture land.

13. Successional Field/Shrubland (Land Cover)

Successional Field/Shrubland (Habitat Community)

The Successional Field/Shrubland habitat community primarily consists of fallow and old agricultural fields or pastures supporting various stages of successional plant growth. Additional habitat that fits into this category includes lands found in electric powerline and pipe line easements that traverse the watershed. This habitat community provides plenty of ecotone areas that are very attractive to wildlife such as songbirds, small mammals and the white-tailed deer. Successional Field/Shrubland are found throughout the watershed and support various tree, shrub and herbaceous species. Some of these communities include previous agricultural areas that are purposely being replanted with trees and shrubs and tall cover grasses for wildlife. Utility easements are purposely managed for low vegetative growth for compatibility purposes. The dominant species found in this habitat community includes red cedar, catalpa *(Catalpa speciosa)*, princess tree, red oak, white ash, tulip tree, sassafras and red maple saplings. Common shrubs and vines include staghorn sumac, autumn olive, multiflora rose, black raspberry, blackberry, wineberry *(Rubus phoenicolasius)* and Japanese honeysuckle. Herbaceous species in this community include tall goldenrod *(Solidago altissima)*, teasel, garlic mustard, curled dock, great ragweed *(Ambrosia trifida)*, evening primrose, pokeweed, wild parsnip *(Pastmaca sativa)*, milkweed, hemp dogbane, bull thistle, foxtail, broomsedge *(Andropogon virginicus)*, deer tongue *(Dicanthelium clandestinum)*,

stilt grass, Queen Anne's lace, Johnson grass *(Sorhgum halepense)* and lespedeza *(Lespedeza michx.)*.

14. Urban (Land Cover)

The Urban land cover is comprised of a mixture of commercial and industrial land uses. State Route 272 (Lancaster Pike) slices through the eastern edges of the Fishing Creek Watershed. Along its path is the infamous intersection at "the Buck" (which is actually located just outside the Fishing Creek Watershed). This area has a concentration of Urban land in the form of commercial and industrial businesses extending south from Holtwood Road. Additional "Urban" land use areas exist along the 272 corridor and the eastern section of the watershed. Other commercial and industrial businesses exist in the Fishing Creek Watershed, but not with the concentration that is found near "the Buck" intersection. Urban land areas are often covered with buildings, roads and parking lots that are impervious cover and do not allow for much vegetative plant cover (other than some ornamental landscape plants). With impervious cover, increased stormwater runoff becomes an issue within this cover type. Other Urban type land uses found within the watershed includes an automotive junkyard that is situated along Buck Heights Road in the Providence Township section of the watershed.

C. Wildlife Inventory

RETTEW biologists also inventoried and recorded wildlife species (mammals, birds, reptiles and amphibians) that were observed or expected to occur in the habitats found in the Fishing Creek Watershed. In addition to field observations, RETTEW utilized several field guides and databases of natural resource agencies and conservation organizations to obtain a list of expected and recorded wildlife in the vicinity of Fishing Creek Watershed. To ensure that the most comprehensive list of species was obtained for migratory or seasonal species (such as birds) aid was obtained from local specialists, including members of the Lancaster County Bird Club, the Pennsylvania Game Commission and Pennsylvania Fish & Boat Commission. Such individual contributors of species inventory data for this watershed assessment have been recognized on the inside front cover of this plan. Specific information on the terrestrial and aquatic wildlife species inventory for Fishing Creek Watershed is presented below.

Mammals

Because the many diverse habitat communities located in Fishing Creek Watershed and its connectiveness to the river hills, agricultural lands and the Susquehanna River, an abundance of wildlife species exist in Fishing Creek Watershed and its vicinity. As presented in Table IV-2, at least 26 different species of mammals have either been observed or have the potential to occur in Fishing Creek Watershed. Even if not directly observed during field inspections, mammals that have the potential to occur in the park have been listed since Fishing Creek Watershed supports suitable habitat and is located within the correct geographical range for those species. Such mammals may include small burrowing or nocturnal animals. Of the mammals, common game animals that inhabit Fishing Creek Watershed include the white-tailed deer, gray squirrel, cottontail rabbit, and woodchuck. Furbearing mammals occurring in Fishing Creek Watershed that may be trapped or hunted include the red fox, gray fox, raccoon, opossum, weasels, striped skunk, mink, and muskrat. As can be seen in the photo to the right, beavers are active in the watershed. A beaver dam and lodge have been observed in the vicinity of the electric power line crossing of the main stem of Fishing Creek downstream of Deaver Road in the northern section of the watershed. In addition to these furbearers, the eastern coyote has been observed by local residents and Pennsylvania Game Commission Wildlife Conservation Officers. Historical sightings of bobcats have also been reported in the area but not confirmed. Non-game mammals

that are likely to be present but seldom seen include species such as the little brown bat, mice, voles, and moles. Although not observed in Fishing Creek, a locally known Lancaster County wildlife biologist (Bob Schutsky), noted that he has observed river otters in the neighboring Conowingo Creek and Pequea Creek Watersheds. The relative abundance and habitat community types the mammals occur in are also provided in Table IV-2.

INSERT TABLE IV-2 (Mammals)

Birds

Bird life observed within or flying over the Fishing Creek Watershed landscape includes 147 species of herons, waterfowl, vultures, birds of prey, game birds, wading birds, sea birds, non-perching land birds and perching birds (songbirds). Of these birds, it is estimated that approximately 82 species likely breed and nest in the watershed. A complete list of all bird species observed is provided in Table IV-3. It should be noted that although some of these birds were observed during the field inspections, a more comprehensive list was provided by a Lancaster County Bird Club member that lives in the watershed. The largest group of birds (88 species) listed in Table IV-3 are comprised of perching birds. Several species of game birds that may be observed in the watershed include wild turkey, Northern bobwhite quail, ring-necked pheasant (stocked), mourning dove, Canada geese, wood duck and mallard. All other birds identified in the watershed are considered non-game birds. Common birds of prey in the watershed include vultures, hawks and owls. With the Susquehanna River adjacent to the watershed, the bald eagle and osprey have been observed flying through the Fishing Creek Watershed. Such piscivore (fish eating) birds of prey are attracted to this section of the lower Susquehanna River for the obvious source of food and the remote habitat of the river hills. Nesting bald eagles and ospreys are in the vicinity and are closely monitored by the Pennsylvania Game Commission and bird watchers.

Herpetofauna

According to the *Pennsylvania Amphibians and Reptiles* (Shaffer, et. al., 1999) and Indiana University of Pennsylvania's *Lancaster County List of Herpetofauna* (IUP, 2001), the region in and adjacent or the Fishing Creek Watershed provides acceptable habitat and is within the home range for several salamander, frog, toad, turtle, lizard and snake species. These groups may be represented by as many as eight (8) species of salamanders, eight (8) species of frogs and toads, six (6) species of turtles, two species of lizards and ten (10) species of snakes. Some of the more common species of amphibians and reptiles that were sighted within Fishing Creek Watershed during the field investigations include the northern red salamander, two-lined salamander, eastern American toad, bull frog, green frog, pickerel frog, wood frog, northern water snake and eastern garter snake. For a complete list of amphibians and reptiles that may occur within Fishing Creek Watershed, please refer to Table IV-4 that follows.

Pickerel Frog *(Rana palustris)*

INSERT TABLE IV-3 (Birds)

INSERT TABLE IV-3 (Birds)

INSERT TABLE IV-3 (Birds)

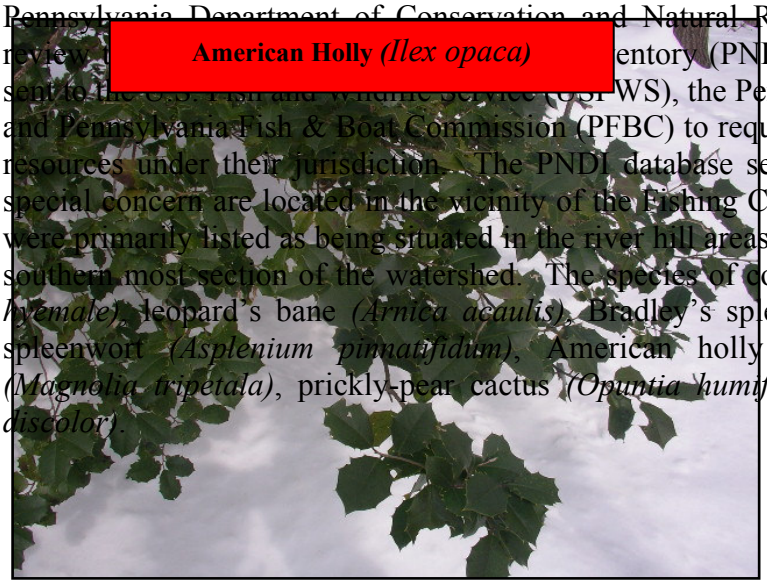
INSERT TABLE IV-3 (Birds)

INSERT TABLE IV-3 (Birds)

INSERT TABLE IV-4 (Herpetofauna)

D. Threatened and Endangered Species

To determine the presence of threatened or endangered species or critical habitat in Fishing Creek Watershed, coordination letters were sent to various natural resource agencies. The Pennsylvania Department of Conservation and Natural Resources (DCNR) was requested to review the Pennsylvania Natural Diversity Inventory (PNDI) database files. Letters were also sent to the U.S. Fish and Wildlife Service (USFWS), the Pennsylvania Game Commission (PGC) and Pennsylvania Fish & Boat Commission (PFBC) to request a list of any federal or state listed resources under their jurisdiction. The PNDI database search resulted in eight (8) species of special concern are located in the vicinity of the Fishing Creek Watershed. These plant species were primarily listed as being situated in the river hill areas to the northwest and southeast of the southern most section of the watershed. The species of concern included puttyroot *(Aplectrum hyemale)*, leopard's bane *(Arnica acaulis)*, Bradley's spleenwort *(Asplenium bradleyi)*, lobed spleenwort *(Asplenium pinnatifidum)*, American holly *(Ilex opaca)*, umbrella magnolia *(Magnolia tripetala)*, prickly-pear cactus *(Opuntia humifusa)* and cranefly orchid *(Tipularia discolor)*.

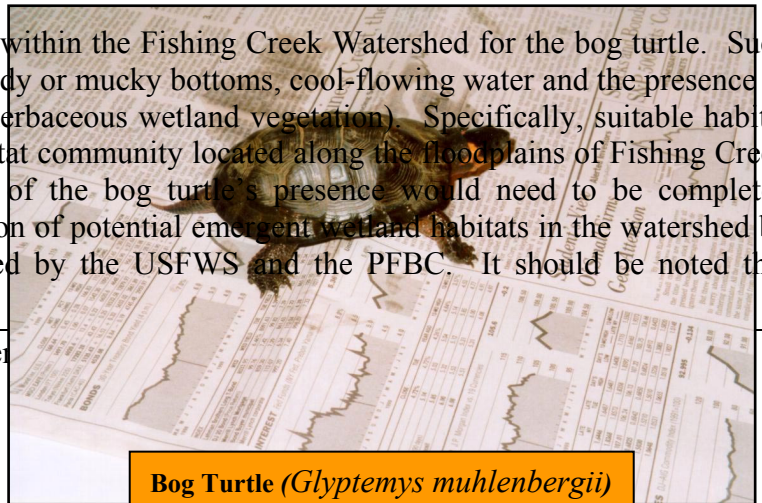


American Holly *(Ilex opaca)*

Of these plants, puttyroot, prickly-pear cactus, and cranefly orchid are listed as being Pennsylvania Rare species; Bradley's spleenwort, lobed spleenwort, American holly and umbrella magnolia are listed as being Pennsylvania Threatened species; and, leopard's bane is listed as being a Pennsylvania Endangered species. Of these eight species, RETTEW positively identified American holly (shown above) during a mid-January 2005 investigation on a ridge within a Hemlock-Red Oak Mixed Forest habitat community in the southern section of the Fishing Creek Watershed. Although the other species of concern may exist in the Fishing Creek watershed, they were not observed by RETTEW during the biologists' field investigations.

The USFWS' review of their database of threatened and endangered species in Pennsylvania revealed that the bog turtle *(Glyptemys muhlenbergii)* and the bald eagle *(Haliaeetus leucocephalus)* are federally threatened listed species under their jurisdiction that occur in Lancaster County. Bald eagles have been sighted flying over the watershed by local bird watchers and are known to nest and breed in the Susquehanna River valley. However, the USFWS response letter only stated that the Fishing Creek Watershed is within the known range of the bog turtle, not that its presence was confirmed.

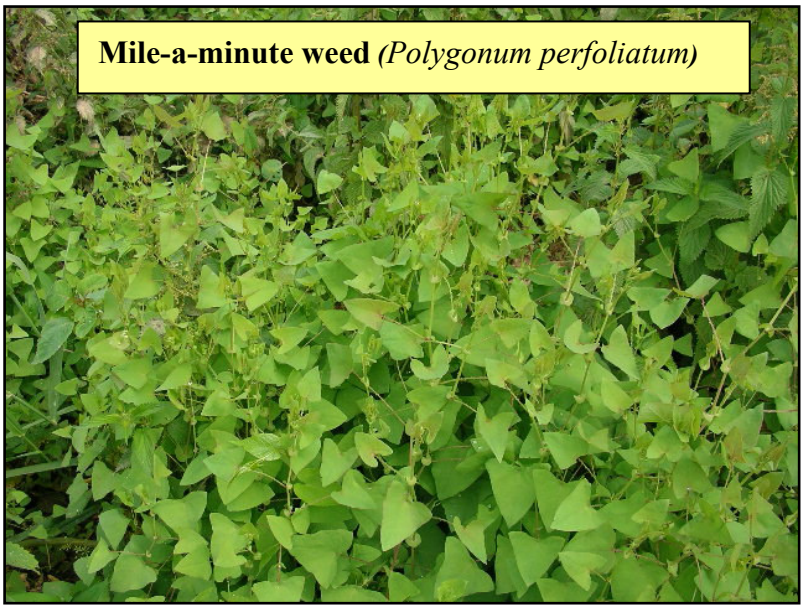
Suitable wetland habitat may exist within the Fishing Creek Watershed for the bog turtle. Such habitat is characterized by soft muddy or mucky bottoms, cool-flowing water and the presence of low growing grasses and sedges (herbaceous wetland vegetation). Specifically, suitable habitat may exist in the Wet Meadow habitat community located along the floodplains of Fishing Creek and its tributaries. Confirmation of the bog turtle's presence would need to be completed through a more detailed investigation of potential emergent wetland habitats in the watershed by a qualified herpetologist recognized by the USFWS and the PFBC. It should be noted that



Bog Turtle *(Glyptemys muhlenbergii)*

conservation easement zones of up to 300 feet are required by state and federal jurisdictional agencies for encroachments of streams or wetlands in the vicinity of known bog turtle habitat. However, such reviews are done on a case by case basis.

E. Invasive Species



In addition to indigenous vegetative species that inhabit Fishing Creek Watershed, there are also several exotic plants that are present. Such species that choke out native plants are known as invasive plants. Invasive plants tend to appear more on previously disturbed ground or waste areas; however, they can also colonize other areas and invade existing native ecosystems. As provided in Table IV-1, a total of 17 invasive plant species were observed in the Fishing Creek Watershed. Of those plants, five species are also considered noxious weeds by the Pennsylvania Department of Agriculture. As per the Federal Noxious Weed Act of 1974, a noxious weed is defined as: "any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind which is of foreign origin, is new to or not widely prevalent in the U.S., and can directly or indirectly injure crops, other useful plants, livestock, poultry or other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or the public health."

Multiflora rose, mile-a-minute weed, bull thistle, Canada thistle and Johnson grass are considered noxious weeds. Of these plants, multiflora rose and mile-a-minute weed are the biggest threat to native plants and habitat communities in the non-forested areas of Fishing Creek Watershed.

Of the 17 invasive plant species, only reed canary grass is a native plant to Pennsylvania. Multiflora rose occurs at least four habitat communities, garlic mustard occurs in six communities, mile-a-minute weed occurs in three communities and Japanese honeysuckle occurs in two communities. Other invasive species found in the watershed include tree-of-heaven, autumn olive, Japanese barberry, Tartarian honeysuckle, wineberry, bull thistle, Canada thistle, Dames rocket, star-of-Bethlehem, wild parsnip, Johnson grass, and stilt grass.

V. AQUATIC COMMUNITY

Even though some of the mammal, bird, reptile and amphibian species mentioned above may depend on water for some crucial part of their reproduction cycle, habitat or food source, this section focuses on species of benthic macroinvertebrates and fish that occur in Fishing Creek and its unnamed tributaries.

By closely examining a stream's macroinvertebrate community, one can learn a great deal about the stream's water quality and overall health. Macroinvertebrates (aquatic insects, worms, clams, snails, leeches and others) are desirable indicators of water quality because they are fairly sedentary and are more or less confined to living in the stream year round. Fish are also good indicators of water quality, but typically not to the extent of macroinvertebrates. Fish, depending on the circumstance, can simply leave an impacted area or flee from a pollution event. Physical and chemical measurements of a stream are instantaneous and tend to only describe current conditions or a "snap shot" data of a specific time that water parameters were measured and/or analyzed. Still, a thorough water quality investigation or monitoring program should be comprised of and consider all the above.

This section of the assessment report provides information on the macroinvertebrate and fish communities that inhabit the Fishing Creek Watershed. The following information provides photo exhibits and locations of each sampling station and presents a summary of the macroinvertebrate and the electrofishing data results. Where possible, comparisons were also made to historical macroinvertebrate and fisheries data collected by PADEP and the PFBC.

A. Sampling Stations

RETTEW biologists conducted macroinvertebrate sampling at 15 different sampling stations strategically located around the Fishing Creek Watershed (as can be seen on Map 1 of Appendix A). Physical habitat and fisheries data (via electrofishing) was also collected at each sampling station. Each RETTEW sampling station was located using a Trimble Pathfinder Pro XLS Global Positioning System (GPS) receiver and plotted on Map 1. Because physical habitat parameters and conditions of a stream can affect both the water quality of the stream and the condition of its resident aquatic community, a habitat assessment of each sampling station was conducted and scored accordingly to the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers Periphyton, Benthic Macroinvertebtrates, and Fish, Second Edition* (US EPA, 1999). The habitat assessment score was based on a visual assessment of ten habitat parameters (each worth 20 points) within a 100 meter reach of stream known as the Sampling Station. More information on the physical characterization of Fishing Creek and its aquatic habitat is provided in Appendices B and C. Representative photos of the stream's condition at each sampling station are provided below along with their location and field estimated habitat assessment score out of a possible 200 points.

Sampling Station #1A: Located along the main stem of Fishing Creek just downstream of Holtwood Road (PA Route 372), this station is situated below the confluence of Sub watershed 2.

Habitat Assessment Score: 119 out of 200
(From US EPA Rapid Bioassessment Protocol Form 3 – Appendix C)

Sampling Station #1B: This station is situated in a pasture on the main stem Fishing Creek just downstream of Deaver Road.

Habitat Assessment Score: 89

Sampling Station #1C: Located on residential property along the main stem of Fishing Creek just upstream of Oregon Hollow Road and downstream of a large forested area of the watershed.

Habitat Assessment Score: 131

Sampling Station #1D: Located on property owned by Camp Andrews, this station is located just downstream of Silver Springs Road.

Habitat Assessment Score: 112

Sampling Station #1E: Located in perhaps one of the most natural and unspoiled sections of the Fishing Creek Watershed, this station is situated within a large forested area on the main stem along Scalpy Hollow Road.

Habitat Assessment Score: 184

Sampling Station #1F: Located on the main stem within a large forested area along Scalpy Hollow Road just downstream of the confluence with the tributary of Subwatershed 8.

Habitat Assessment Score: 143

Sampling Station #1G: Parallel to Fishing Creek Road, this station is located on Lancaster County Conservancy Property just downstream of Furniss Road and the tributary of Subwatershed 13.

Habitat Assessment Score: 145

Sampling Station #1H: Located on the main stem of Fishing Creek upstream of the confluence of the Subwatershed 17 tributary on Lancaster County Conservancy property.

Habitat Assessment Score: 155

Sampling Station #1I: Located on the main stem of Fishing Creek downstream of the confluence with the tributary of Sub watershed 17.

Habitat Assessment Score: 127

Sampling Station #7A: Accessible from Scalpy Hollow Road, this station is located on the tributary of Sub watershed 7, which is upstream of Fishing Creek and Station 1E.

Habitat Assessment Score: 126

Sampling Station #8A: Also accessible from Scalpy Hollow Road, this station is located on the tributary of Subwatershed 8 in a forested area upstream of Fishing Creek (between Stations 1E and 1F).

Habitat Assessment Score: 125

Sampling Station #9A: This station is located in a pasture area just downstream of River Road along the tributary of Subwatershed 9.

Habitat Assessment Score: 91

Sampling Station #10A: Located along the tributary of Subwatershed 10 and upstream of Fishing Creek, this station is located in a pasture area that is accessible from Fishing Creek Road.

Habitat Assessment Score: 88

Sampling Station #17A: This station is located on the tributary of Subwatershed 17 (which parallels Fernglen Road), just upstream of the main stem of Fishing Creek and downstream of Fishing Creek Road.

Habitat Assessment Score: 98

Sampling Station #19A: Located within a successional field/pasture area on the tributary of Subwatershed 19, this station is situated just downstream of Furniss Road.

Habitat Assessment Score: 102

B. Benthic Macroinvertebrates

RETTEW's macroinvertebrate investigations were accomplished using the United States Environmental Protection Agency's "rapid bioassessment protocols", which are very similar to protocols used by Pennsylvania Department of Environmental Protection biologists involved in Pennsylvania's "Surface Waters Assessment" program (SWAP). Previously, the PFBC and the PADEP had sampled macroinvertebrates at several locations on Fishing Creek in 1993 and in 1999, respectively. PADEP's three sampling stations are shown on the Map 1 of Appendix A. PADEP's watershed assessment sampling was conducted under a program previously known as the Instream Comprehensive Evaluation (ICE). However, the PFBC's sampling data for Fishing Creek only referred to Sections 01 and Section 02, of which the former refers to samples that were collected upstream of Silver Springs Road and the latter refers to samples collected below Silver Springs Road.

Collected organisms were identified in the lab to the taxonomic "family" level using a dissecting scope and reference keys such as *Aquatic Insects of North America* by R.W. Merrit and K.W. Cummins and *Freshwater Macroinvertebrates of Northeastern North America* by Barbara Peckarsky.

Macroinvertebrates most commonly include the aquatic larval stages of insects. As seen in Table V-1, there are numerous species of macroinvertebrates that inhabit Fishing Creek. Macroinvertebrates from eleven different Orders (35 families) were collected by RETTEW at the 15 different sampling stations on Fishing Creek. PFBC sampling efforts identified insects from four additional macroinvertebrate families during their 1993 sampling event. No additional macroinvertebrate families were identified by PADEP. Overall (in all investigations), the most common macroinvertebrate Orders that were observed in the Fishing Creek Watershed included Ephemeroptera (mayflies - 9 taxa), Plecoptera (stoneflies - 7 taxa), Trichoptera (caddisflies - 5 taxa) and Coleoptera (aquatic beetles - 3 taxa). Invertebrates from the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are considered to be pollution-sensitive species so their presence throughout most of the watershed is generally an indicator of good water quality, since their sensitivity precludes them from inhabiting degraded areas. Organisms from the Order Diptera (true flies) had a total of five taxa, but they were not common or abundant within Fishing Creek, which is a good sign since they are generally pollution tolerant organisms. Macroinvertebrate data sheets from RETTEW's field survey are provided in Appendix D.

INSERT TABLE V-1

INSERT TABLE V-1

For RETTEW's macroinvertebrate results, four biological indices/metrics were utilized and computed at each of the 15 monitoring stations. They are as follows:

Taxa Richness

This metric is simply the number of taxa in a particular community. In this study, taxa were identified to the taxonomic "family" level so the taxa richness value determined for the sampled macroinvertebrate community at each monitoring station refers to the number of different discovered macroinvertebrate families.

Hilsenhoff Biological Index (HBI)

This index involves assigning pollution tolerance values (ranging from zero (0) to ten (10) with a 0 value assigned to taxa with the least amount of pollution tolerance and a 10 value assigned to the most pollution tolerant organisms) to the various collected taxa. All collected organisms within the sample are identified, counted and matched with the appropriate tolerance values. A final value for the entire macroinvertebrate sample is then computed allowing comparison and referencing of HBI scores with other sampled sites and streams. The macroinvertebrate community is suspected of being impaired if the HBI score was higher than 4.80.

EPT Index

The EPT Index is the summation of all identified mayflies (***E****phemeroptera*), stoneflies (***P****lecoptera*) and caddisflies (***T****richoptera*) families. These insect orders are used in this particular index because of their general intolerance for pollution.

Percent EPT

Percent EPT is the percentage of mayflies (***E****phemeroptera*), stoneflies (***P****lecoptera*) and caddisflies (***T****richoptera*) individuals within the sample. Again these insect orders are used in this particular metric because of their general intolerance for pollution.

Tables V-2 and V-3 provide the calculated scores of these four biological indices/metrics for both RETTEW's 2005 sampling data and PADEP's 1999 data.

TABLE V-2 FISHING CREEK – MACROINVERTEBRATE COMMUNITY SCORES (Collected by the RETTEW in June 2005)

SAMPLING STATION #	TAXA RICHNESS # OF FAMILIES		HBI SCORE		EPT INDEX SCORE		% EPT	
	May 05	Sept. 05	May 05	Sept. 05	May 05	Sept. 05	May 05	Sept. 05
Fishing Creek								
1A	13	13	4.40	4.41	10	5	82.2	63.5
1B	14	18	3.76	4.23	7	9	84.9	63.2
1C	12	15	3.42	4.40	7	8	87.9	71.4
1D	13	13	3.50	3.79	9	8	86.0	71.0
1E	14	14	4.06	3.77	9	7	85.1	66.7
1F	14	10	3.35	3.55	9	5	89.2	77.6
1G	12	17	4.03	4.02	8	11	83.5	67.0
1H	14	11	3.85	4.07	9	6	80.2	58.2
1I	12	14	3.39	3.85	7	7	84.3	63.9
7A	13	17	3.31	3.50	10	9	95.0	72.2
8A	11	17	3.57	3.33	6	9	88.6	71.8
9A	9	15	4.61	4.94	6	5	88.8	48.9
10A	12	16	4.41	3.90	7	6	75.6	49.4
17A	12	14	4.29	3.44	7	8	73.2	82.7
19A	12	13	3.58	3.23	11	9	97.4	87.5
Comparable 2005 Sampling Stations with PADEP's 1999 ICE survey in PINK			Hilsenhoff Biological Index scores exceeding 4.80 threshold in RED – Indicates impairment				EPT % scores of concern in BLUE	

TABLE V-3 FISHING CREEK – MACROINVERTEBRATE COMMUNITY SCORES (Collected by the PADEP in June 1999)

PADEP JUNE 1999 SAMPLING STATION ID #	TAXA RICHNESS # OF FAMILIES	HBI SCORE	EPT INDEX SCORE	% EPT
1 (1C)	17	3.73	8	73.8
2 (1F)	19	3.67	9	69.7
3 (1I)	17	3.85	9	62.9

For PADEP's sampling stations (Stations 1, 2 and 3) that were comparable to this current assessment (Stations 1C, 1F and 1I, respectively), RETTEW typically found a little less diversity (i.e., Taxa Richness) in the macroinvertebrate community than did PADEP's sampling effort in 1999. Data for PFBC's 1993 sampling effort illustrated similar diversity to PADEP's study.

For sampling stations that were comparable, RETTEW tended to find similar numbers of EPT taxa to that of PADEP, with RETTEW's calculated %EPT taxa values slightly higher than PADEP's values.

Also, for sampling stations that were comparable, RETTEW calculated Hilsenhoff Biological Index scores were very similar to those calculated for PADEP's data, which indicates similar water quality between 1999 and 2005.

Data collected by RETTEW supports PADEP's findings that Fishing Creek is a High Quality stream. The only exception where macroinvertebrate data showed an impairment of water quality (high HBI score and a low %EPT) was during the September sampling event at Sampling Station #9A. This Station is located just downstream of River Road in a subwatershed that is predominantly comprised of pastureland and lacks a riparian buffer upstream of the sampling location. Sampling Station #10A also exhibited a lower %EPT during the September sampling event that was of concern. However, it should be noted that Sampling Stations #9A and 10A both exhibited very low Habitat Assessment Scores, are frequently impacted by cattle and had very low flows during the September sampling event.

RETTEW believes the composition of the macroinvertebrate community at Sampling Stations #9 and #10 do indicate a degree of impairment during low flow conditions through their low percentages of mayflies, stoneflies, and caddisflies. Again, the major factors in these subwatersheds are the dominance of pastureland along the tributaries and the lack of riparian buffers. The tributary draining Subwatershed 8 is also flanked by pastureland and lacks a riparian buffer along much of its length. However, the water quality and the benthic macroinvertebrate community at Sampling Station #8 have a chance to recover due to a larger forested area situated between the pastureland and the station location. Forested areas and riparian buffers greatly reduce impacts of upgradient sources through trapping, filtering and converting sediments, nutrients and other chemicals while also reducing thermal impacts through canopy shading.

In general, as reflected in past studies by PFBC and PADEP and through this assessment's results, the macroinvertebrate communities along the main stem and most tributaries suggest that the water quality in the Fishing Creek Watershed is very good. <u>Protection of existing forested lands, riparian buffers and wetlands coupled with controlled or limited development of the watershed is the key to keeping Fishing Creek a high quality watershed.</u> However, problem areas do exist where the primary land use is pasture and riparian buffers are lacking. Improvements to these areas could be easily made to further protect and improve Fishing Creek's water quality.

C. Fish Community

On June 20 and 21, 2005, RETTEW biologists conducted a qualitative fisheries survey of the Fishing Creek Watershed at the same 15 sampling stations where macroinvertebrates were collected. Through the use of electrofishing equipment and dip nets (shown in the photo to the right), biologists collected a total of 14 species of fish in Fishing Creek including **many wild brown trout** *(Salmo trutta)* and a few stocked rainbow trout *(Oncorhynchus mykiss)*. Both trout species are coldwater fish that require water temperatures of less than 70 degrees Fahrenheit to grow and reproduce and are intolerant of poor water quality. Although the PFBC stocks Fishing Creek with trout, the presence of wild reproducing brown trout in Fishing Creek reflects and supports PADEP's High Quality, Cold Water Fishery (HQ-CWF) designation of the stream. The PFBC also conducted a fisheries investigation on Fishing Creek in the vicinity of stations located upstream and downstream of Silver Springs Road in August 1993. They also observed the presence of wild brown trout and a few stocked rainbow in Fishing Creek.

Other fish species that were collected in Fishing Creek and its unnamed tributaries included minnows (rosyside dace, cutlips minnow, satinfin shiner, blacknose dace, longnose dace and creek chub), suckers (white sucker and northern hog sucker), catfish (margined madtom), sunfish (pumpkinseed and bluegill) and perch (tessellated darter). The PFBC's 1993 fisheries survey also found nine (9) additional species of fish in the downstream section of Fishing Creek (above the confluence with the Susquehanna River). Additional species that the PFBC collected on the main stem of Fishing Creek included the gizzard shad (a herring), additional minnows (common carp, common shiner, spottail shiner and bluntnose minnow), yellow bullhead (a catfish), rock bass, green sunfish, smallmouth bass and largemouth bass (all sunfish). A comprehensive list of the fish species that were collected by RETTEW and the PFBC are listed in Table V-4, and data sheets are provided in Appendix E.

INSERT FISH Table V-4

INSERT FISH Table V-4

INSERT FISH Table V-4


Brown Trout Fingerling

Fishing Creek is stocked in mid-March and early May with brown trout and rainbow trout by the PFBC from Silver Springs Road downstream to the mouth. Unlike brook trout *(Savelinus fontinalis)*, brown trout are not native to Pennsylvania, but have become naturalized throughout the Commonwealth. However, the wild brown trout population in the Fishing Creek Watershed is something to get excited about and to protect! Because of their sensitivity to water pollution, the occurrence of wild reproducing brown trout are excellent indicators of high quality water. As can be seen from the photographs on this page, various growth stages of wild brown trout were collected throughout the Fishing Creek Watershed. The occurrence of fingerling (young of year) and juvenile trout with "parr marks" and less than six inches long are positive signs of wild trout. (Juvenile fish have a series of vertical, oval parr marks along each side from cheek to tail). Red spots on a brown trout further signify that they are wild, stream bred trout. In general, all nine Sampling Station locations on the **main stem** of Fishing Creek (Subwatershed 1) exhibited a population of wild brown trout. Sampling Stations 1A, 1B, 1C, 1D, 1E, and 1F had brown trout fingerlings present, while four of the six Stations (7A, 8A, 17A and 19A) on unnamed tributaries produced at least one wild brown trout. It was interesting to note that the only two stations where


Juvenile Wild Brown Trout


Mature Wild Brown Trout

brown trout (wild and stocked) were not present were at Sampling Stations 9A and 10A, the same two stations that the benthic macroinvertebrate data indicated impaired conditions.

Additional noteworthy items from electrofishing results in regards to trout populations in the Fishing Creek Watershed include:

- Station 1E produced the most brown trout (21 larger trout over six inches and six fingerlings). This is no surprise since that station has some of the watershed's most natural and best fish habitat.
- Stations 1C and 1H harbored the largest brown trout (16 & 13 inches, respectively).
- Three stations (1D, 1G & 1H) produced stocked rainbow trout.
- Three hold over brown trout were collected at Stations 1D and 1H.
- Some very large trout were able to retreat into the streambanks and tree roots and were missed by the nets of RETTEW biologists.

Although no native brook trout were found at Fishing Creek sampling stations, that does not rule out that they do not exist somewhere in the headwaters of Fishing Creek or its tributaries. According to Greg Wilson of the Donegal Chapter of Trout Unlimited, Greg has caught native wild brook trout in the headwaters of Muddy Creek Watershed located just west of Fishing Creek.

D. Fisheries Management Options

Wild Trout Waters

Although Fishing Creek has already been designated as a High Quality-Cold Water Fishery, it is not designated as being a wild trout stream or "Class A Wild Trout Waters" by the PFBC. Class A Wild Trout Waters are defined as "Streams that support a population of naturally produced trout of sufficient size and abundance to support a long-term and rewarding sport fishery" (PFBC, 2005). However, three sections of streams in the immediate vicinity of Fishing Creek Watershed have been designated as "Class A Wild Trout Waters". Those streams include Conowingo Creek (5.5 miles from the headwaters downstream to SR3005) and an unnamed tributary to Conowingo Creek (1.6 miles from headwaters downstream to mouth). Both of those stream sections have been designated as **"Wild Brown Trout Waters"** and are situated just east the Fishing Creek Watershed in the Conowingo Creek watershed (see Map 4). A third nearby stream, an unnamed tributary to Trout Run (1.9 miles from headwaters downstream to confluence with Trout Run) has been designated as **"Wild Brook Trout Waters"**. The latter

stream section is situated in the Trout Run Watershed located just northwest of Fishing Creek's headwaters (see Map 4).

The goal of the Class A Wild Trout Waters program is to provide recreational trout angling opportunities in waters where wild trout populations are capable of supporting an attractive fishery without stocking. The wild trout waters option is designed to provide anglers with an opportunity to catch and harvest (if desired) wild trout from a population totally sustained by natural reproduction. This option is proposed for stream sections that support populations of brook trout, brown trout, mixed brook-brown trout, and rainbow trout capable of providing a desirable fishery without stocking. Some of these waters may be judged to have a low potential to produce an obvious biological response to the application of highly restrictive regulations PFBC, 1997).

For any sections of Fishing Creek to be designated as "Wild Brown Trout Waters", a quantitative fisheries survey that measures brown trout biomass would have to be conducted by the PFBC and the minimum brown trout community criteria must be met. These criteria include:

- Total brown trout biomass of at least 40 kg/ha (35.6 lbs/acre)
- Total biomass of brown trout less than 15 cm (5.9 in.) total length of at least 0.1 kg/ha
- Total brown trout biomass must comprise at least 75% of total trout biomass

Catch-and-Release (Special Regulations Area – Wild Trout Areas)

Catch-and-release management for wild trout fisheries is intended to provide anglers with the opportunity to fish over an essentially natural population of fish where hatchery fish and fishing mortality are not major factors in determining population structure. Catch-and-release or no-kill management is designed to permit trout populations to attain pristine densities and age/size composition. This option is directed primarily at wild brown trout; however, it may also be extended to enhance wild brook and/or wild rainbow trout fisheries (PFBC, 1997).

Delayed Harvest (Special Regulations Area – Hatchery Supported Areas)

The goal of Delayed Harvest is to extend special regulations trout angling opportunities to a broader geographic region of Pennsylvania by utilizing the planting of hatchery trout to provide an angling experience that emphasizes "recycling" trout rather than harvesting them.

The Delayed Harvest option was designed to extend the special regulation angling experience to a broader geographic region of Pennsylvania in comparison to what could be accomplished through the use of special regulation management provided by wild trout fisheries. This option is directed toward stream sections that require the planting of hatchery trout to maintain a recreational trout fishery. Delayed Harvest management provides for an extended period of catch and release angling, then, as angler interest for trout fishing declines and stream conditions become less favorable for survival, allow some harvest utilizing a low creel limit so that emphasis remains on the angling experience rather than harvest. The harvest season has been set to allow for some harvest before hatchery trout are lost to natural mortality (PFBC, 1997).

Artificial Lures Only

To add a twist to delayed harvest option, another fisheries management option that could be considered for part of the Fishing Creek Watershed is angling through the use of artificial lures only. With this option, no bait can be used for any species in any section of stream designated as Delayed Harvest Artificial Lures Only. Lure fishing can only be done with artificial lures only constructed of metal, plastic, rubber, or wood, or with flies and streamers constructed of natural or synthetic materials. All such lures may be used with spinning or fly fishing gear. In areas with such a designation, the season would extend from June 15 to Labor Day with a minimum size of nine (9) inches. The daily creel limit would be three trout (combined species).

Recommendations

The Class A Wild Trout Waters Designation of qualifying sections of Fishing Creek can only be made through more detailed field studies conducted by the PFBC. Designated areas would naturally include those areas that meet the criteria for wild brown trout listed above. Regarding the use of other fisheries management options and future designations, the Lancaster Conservancy would need to make a petition to the PFBC to consider Special Regulation Areas on sections of Fishing Creek. Perhaps that too would be best known after future brown trout biomass studies were completed.

However, knowing what we know now about the fish community of Fishing Creek, RETTEW recommends a **Catch and Release Areas** be considered for the following areas: the main stem of Fishing Creek from the electric power line easement (near Penny and Deaver Roads) downstream to Silver Springs Road; and, the main stem of Fishing Creek from the confluence of the unnamed tributary (Subwatershed 7) along Scalpy Hollow Road downstream to River Road.

RETTEW would also recommend a **Delayed Harvest Artificial Lures Only Area** for the stretch of Fishing Creek (main stem) between Furniss Road and the confluence with the unnamed tributary at Fernglen Road.

VI. PHYSICAL AND CHEMICAL WATER QUALITY

A. Physical

1. Temperature

As previously mentioned, Fishing Creek is designated as a High Quality, Cold Water Fishery (HQ-CWF) according to Title 25 Chapter 93 (Water Quality Standards) of PADEP. High Quality Waters are defined by Chapter 93 as "Surface Waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying the water quality chemistry and biology of Chapter 93.4b(a)." A Cold Water Fishery's maximum temperatures of any receiving stream must maintain temperatures ranging from 38 degrees Fahrenheit (3.3° Celsius) during the winter to 66 degrees Fahrenheit (18.8° C) in the summer as listed in Chapter 93.7.

Heated stormwater runoff from impervious surfaces such as roofs, parking lots, roads and driveways can result from increased land development and cause thermal pollution to Fishing Creek. Likewise, the lack of or decrease in riparian buffers along any section of the stream would reduce shading and increase water temperature.

Thus, maintaining the proper stream temperature in Fishing Creek's coldwater fishery is important in protecting the aquatic inhabitants that live there. If the overall water temperature of the stream is altered, a change in the aquatic community can be expected. As mentioned in Section V above, Fishing Creek supports a good wild brown trout population. Coldwater fish, such as brown trout, will disappear as a result of egg and fry mortality, direct adult mortality or reduced reproductive activity, and be replaced by warmwater fish, such as sunfish. Brown trout thrive and reproduce in water temperatures less than 70 degrees (21° C), although their preferred temperature is between 50 and 65 degrees Fahrenheit (10-18.3° C). The lethal upper limit for brown trout is approximately 79.5 degrees Fahrenheit (26.4° C). Pennsylvania's native brook trout has colder (lower) temperature requirements than that of the brown trout, but if they were to occur or survive in Fishing Creek, it would have to support a very well forested and shaded headwaters area that preserved cold water temperatures year round.

Currently, only one known study has measured monthly physical and chemical parameters (including temperature) of Fishing Creek at a single location. As part of a larger study on the impacts of individual streams on the Chesapeake Bay, water quality testing was completed by the Maryland Department of the Environment (MDE) in 1999 at a sample location situated just downstream of Harmony Ridge Drive in the southern part of the Fishing Creek Watershed (US EPA, 2005). This location was very similar to PADEP's Station # 3 and downstream of RETTEW's Sampling Station 1I. As seen in Table VI-1, PADEP Chapter 93 Cold Water Fishery temperature criteria were exceeded twice during the July and August events. Likewise, PADEP and RETTEW observed temperature exceedances during their June 1999 and April 2005 studies, respectively at their downstream stations. However, it should be noted

INSERT WQ SAMPLING RESULTS TABLE VI-1

that all three sample station locations were near the terminus of the watershed near roadways and in an unforested electric utility line easement where the stream is at its widest. Such landscape factors could have influenced water temperature at this location similar to how thermal pollution could affect stream temperatures through the loss of riparian buffers and stormwater runoff from heated impervious surfaces.

2. Dissolved Oxygen

Dissolved oxygen refers to the volume of oxygen that is contained in the water. Oxygen enters water by way of aquatic plant photosynthesis and by the transfer of oxygen across the air-water interface. Wave action and riffle areas in streams serve to aerate the water. The amount of dissolved oxygen water can hold depends on the water's temperature and salinity and the atmospheric pressure at the water's particular elevation. As water temperature increases, the amount of dissolved oxygen water can hold is decreased.

Dissolved oxygen is used for animal respiration and plant respiration. Fish take oxygen in as a gas through their gills. Dissolved oxygen is also involved in the process of microbes aerobically decomposing organic matter. Typically higher levels of dissolved oxygen equate to greater diversity of plant and animal life in the stream; whereas fewer creatures are tolerant and capable of dealing with low oxygen levels. According to Chapter 93 Water Quality criteria, coldwater fishery streams should have a minimum of 7 mg/L. During all monitoring events by MDE and PADEP, dissolved oxygen always met the minimum criteria, with the lowest concentration (8.5 mg/L) occurring during MDE's August sampling event. During the April characterization of stream conditions at each sampling station, RETTEW measured this parameter with a portable Hach Kit. Dissolved oxygen measurements were excellent, ranging from 10.7 mg/L at Sample Station 8A to 14.7 mg/L at Sample Station 1D.

3. pH

Although chemically driven, the pH parameter has been listed as a physical parameter since it can easily be monitored with a field calibrated meter and does not require laboratory analysis. The pH greatly influences how other present, dissolved chemical compounds affect the stream's aquatic life. A reduction in pH (more acidic) may allow the release of toxic metals that would otherwise be attached to sediment. Once mobilized, these metals are available for uptake by organisms. For many metals, the rate of uptake is directly proportional to the levels of metal availability in the environment. Thus a decrease in pH increases metal availability, lending itself to greater metal uptake by organisms. Metal uptake can cause extreme physiological damage to aquatic life (Connell, 1984).

An increase in pH may cause heightened ammonia concentrations. At low pH, ammonia combines with water to produce an ammonium ion and a hydroxide ion. The ammonium ion is non-toxic and not of concern to organisms. Above a pH of 9, ammonia (un-ionized) is formed (NH3) and is very toxic to organisms. Thus organisms experience ammonia toxicity more readily at higher pH levels (Morgan, 1981).

PADEP Chapter 93 Water Quality criteria sets a requirement of pH to be between 6.0 and 9.0. With schists being the underlying geology of the Fishing Creek Watershed, this makes Fishing Creek a freestone stream with limited buffering capacity (compared to limestone streams which have great buffering capabilities). According to MDE's sampling events, Fishing Creek kept a fairly steady pH throughout the 1999 monitoring year ranging from 7.4 to 7.8. RETTEW measured a pH of 8.7 at its downstream sampling location in 2005, while PADEP measured a pH of 6.6. The differences in pH between each monitoring program could be due to a difference in the pH meters used. However, it appears that the pH of Fishing Creek is slightly basic according to MDE and RETTEW's measurements and within the acceptable water quality criteria range. It appears that Fishing Creek is not being affected by acid precipitation.

B. Chemical

As previously mentioned, the majority of the Fishing Creek Watershed (approximately 65.3%) is dominated by agricultural-related uses including croplands, pasturelands, barnyards and farmsteads. For this reason, nutrients such as nitrogen, phosphorous and ammonia from fertilizers and manures are common non-point source pollutants of surface waters in agriculturally dominated watersheds. The affects of such pollutants and MDE sampling results of Fishing Creek are discussed in more detail below.

1. Nitrogen

Nitrate and Nitrite are forms of nitrogen. Nitrogen makes up 78% of the atmosphere as gaseous molecular nitrogen, but most plants can use it only in fixed forms of nitrate and ammonium. Nitrate and nitrite are inorganic ions occurring naturally as part of the nitrogen cycle (Smith, 1990).

The nitrogen cycle is composed of four processes. Three of the processes - fixation, ammonification and nitrification - convert gaseous nitrogen into useable chemical forms. The fourth process, denitrification, converts fixed nitrogen back to the unusable gaseous nitrogen state (Smith, 1990).

Nitrification forms nitrate and nitrite from ammonia. Nitrate can be present in water at higher concentrations than nitrite and ammonia without harming the aquatic system. Nitrate ions are easily released from soil unlike phosphate and ammonia. High levels of nutrients such as nitrate and phosphate lead to increased plant growth which ultimately leads to greater amounts of plant decay and the loss of dissolved oxygen – a process known as eutrophication.

According to Chapter 93 Water Quality criteria, the maximum concentration criteria designed to protect a potable water supply for Nitrogen is 10.0 mg/L. According to MDE's sampling event, total nitrogen (Nitrite + Nitrate) was only exceeded once in April 1999. This could have been due to a slug of nutrients in runoff from manure application in the watershed right before a heavy precipitation event. The concentration limit for a potable water supply for Nitrite is 5.0 mg/L

(AWWA, 1990). Nitrite water quality criteria was not exceeded during any MDE sampling event.

2. Phosphorous

Phosphate is the form of phosphorous normally found in natural water conditions. In turn there are three kinds of phosphates: organic, orthophosphate and condensed. Organic phosphates are found in plant and animal tissues. Orthophosphate and condensed phosphate are inorganic and readily bond to soil particles.

Testing for total phosphate involves putting the water sample through an acid heat digestion process in order to convert all phosphate to dissolved orthophosphate. Excessive phosphate leads to an unnatural increase in algae and aquatic plant growth and the accelerated eutrophication of lakes and ponds. The sudden die off of these massive crops of algae and aquatic plants, due to decomposing bacteria respiration, leads to critical drops in dissolved oxygen.

The maximum concentration criteria designed to protect rivers and streams for total phosphorous is 1.0 mg/L, while the protective criteria for phosphate is 0.01 mg/L. According to MDE's sampling events conducted in 1999, neither criterion was exceeded during their sampling of Fishing Creek.

3. Ammonia

Ammonia, like nitrate and nitrite, is a form of nitrogen. Danger to aquatic life depends on temperature, pH and length of exposure along with dissolved oxygen and carbon dioxide levels. The higher the pH and the warmer the temperature, the more toxic the ammonia. Also, ammonia is much more toxic to fish and aquatic life when the water contains very little dissolved oxygen and carbon dioxide. The general limit for ammonia is 0.002 mg/L however, the concentration of polluted water is 0.1 mg/L. While ammonia was found to slightly exceed the general limit when sampled in Fishing Creek by MDE in 1999, it never attained the higher concentration level that would indicate that Fishing Creek was impaired.

VII. WATERSHED PROBLEMS & SOLUTIONS INSERT

VIII. RECREATION PLANNING INSERT

VII. WATERSHED PROBLEMS & SOLUTIONS

A. Description

In the environmental and biological fields of study, sources and causes of pollution in a watershed (leading to impairment) are typically categorized into two broadly defined categories known as **Point Source Pollution** or **Non-point Source Pollution**. The terms "point source pollution and non-point source pollution" refer not to a specific polluting substance or practice, but rather describe the means by which a pollutant is introduced.

Point source pollution is most often associated with industries or municipalities that discharge wastewater to natural waters through a pipe or ditch (Brooks, et. al., 1997). Point sources of pollution can be measured and treated, therefore discharges of wastewater in the United States are regulated under the provisions of the Clean Water Act and sources must obtain permits issued under the National Pollutant Discharge Elimination System (NPDES) in order to discharge wastewater into streams. An NPDES permit requires the discharger to meet certain technology-based effluent limits and perform effluent monitoring. Raw sewage piped to a stream could be broadly referred to as point source pollution.

Unlike point sources, non-point sources of pollution occur over a wide area and are usually associated with large-scale land activities such as agriculture, livestock grazing, mining, logging and development of impervious surfaces resulting in increased amounts of often polluted stormwater runoff. Since there is not one specific point of discharge, non-point source pollution is difficult to measure, regulate and treat because of the nature of the activities that cause it and the large-scale area that it is derived from (Brooks, et. al., 1997). Non-point source pollution can include stormwater runoff that contains harmful substances. Types of non-point source pollution common to agricultural areas include increased soil erosion and deposition and nutrient runoff from barnyard wastes and livestock loafing in waterways. The lack or the removal of vital habitat components (such as the destruction of forested riparian corridors) is also a cause of impairment.

Agricultural Problems

Nutrients such as phosphorus, nitrogen, and potassium, in the form of fertilizers, manure, sludge, irrigation water, legumes, and crop residues, can create nutrient related pollution. When these nutrients are applied to enhance production in excess of plant needs, they can wash into aquatic ecosystems where they can cause excessive plant growth, by which recreation opportunities decrease, drinking water becomes contaminated, and aquatic life can be killed. Farmers can implement nutrient management plans, which help maintain high yields and save money on the use of fertilizers while reducing non-point source pollution.

Confined Animal Facility Operations (CAFO's) can create runoff, which can carry pathogens (bacteria and viruses), nutrients, and oxygen-demanding substances that contaminate shellfishing areas in the Chesapeake Bay and cause other major water quality problems. Ground water can also be contaminated by seepage.

Overgrazing and unrestricted cattle access to streams exposes soils, increases soil erosion and sedimentation, encourages invasion by undesirable plants and destroys fish habitat.

Land Development Problems

The primary problem resulting from increased land development is the increase in stormwater runoff from impervious surfaces such as roofs, parking lots, roads and driveways. The increase in stormwater volumes and velocities results in accelerated erosion and sedimentation, while thermal and chemical pollution from roads and large parking lots further degrades water quality. The increased sediment can lead to other problems including alterations in the natural configuration of the channel, loss of stream meanders, decreased occurrences of pool, riffle, and run patterns and a destruction of the variety and abundance of aquatic habitat.

The increase in impervious surfaces within the watershed would also reduce infiltration and groundwater aquifer recharge. With the ground water wells being the primary source of potable water for residential and farming communities of the Fishing Creek Watershed and the underlying crystalline rock aquifer having little storage capacity and a low yield, the reduction in aquifer recharge could be a major problem if land development pressures would increase in the future. Ground water that supports the base flow to Fishing Creek and the hydrology to riparian wetlands in the watershed could also be drastically affected with an increase in impervious surfaces.

Although urban land uses (commercial & industrial) and institutional uses comprise less than 1% of the watershed's land use and cover, land development pressures are growing along State Route 272 (Lancaster Pike) from the Buck on south, of which some commercial uses have been proposed within the Fishing Creek Watershed.

Zoning ordinances that are sensitive to the natural resources of Fishing Creek and restrict large scale land development can protect the existing ground water aquifer and preserve and enhance surface water quality. The municipalities (particularly Drumore Township) that comprise the Fishing Creek Watershed need to take the necessary steps to draft and/or update zoning and land development ordinance documents and include ordinance language and regulations that aggressively manage and protect the natural resources and water quality Fishing Creek and other nearby watersheds.

B. Watershed Problems and Solutions

This section focuses on the sources and causes of impairment within the Fishing Creek Watershed and the potential restoration work and agricultural BMPs that can be accomplished to remedy the impacts. To determine the existing impacted areas within the Fishing Creek Watershed in need of most attention, RETTEW conducted windshield surveys from roadways throughout the watershed, walked stream segments and recorded areas of concern by taking on-ground photographs to document conditions. Where access was not permitted, other impacted areas of the watershed were identified via aerial reconnaissance and photographs taken by RETTEW from a helicopter on March 30, 2005. Most of the aerial photographs were taken at an altitude ranging from 300 to 500-feet.

The major problem areas that were photographed have been captioned and arranged by subwatershed (in a clockwise direction starting with the main stem) for identification purposes and so that the information can be easily understood in a logical progression. Each problem area is listed by an impacted stream segment identification number that can be cross referenced with its approximate location on Map 1 of Appendix A.

It should be noted that some of the impacted stream segments identified below are situated in the hollow along Fishing Creek Road. For more detailed solutions to mitigate those problem areas, please refer to the *Long Term Workplan for Fishing Creek Road* included the Lancaster County Conservation District's (LCCD) recommendation from their Dirt and Gravel Road Program. A copy of this document is provided in Appendix F.

Impacted Stream Segment #1-1:
Located in the headwaters of Fishing Creek's main stem (Subwatershed 1) in Providence Township, this farm appears to be a source of barnyard nutrient runoff to Fishing Creek.

Solution:
A riparian buffer, streambank fencing, and permitted cattle crossing would help protect these spring fed headwaters.

Impacted Stream Segment #1-2:

Located just upstream of Deaver Road, this property's aquatic resources have been severely degraded by unrestricted draft horse impacts to Fishing Creek and the forested wetlands located along its floodplain. In addition, streambank erosion has been greatly accelerated by the free roaming livestock.

Solution:
Installation of streambank fencing, restoration of the riparian buffer and providing a livestock access watering ramp or separate watering troughs in the pasture could prevent degradation of the wetlands and stream. Shade could be provided by an alternative structure or through the planting of protected shade trees in the pasture.

Impacted Stream Segment #1-3:

Located within the Sample Station 1B area below Deaver Road, this property exhibits significant streambank erosion and siltation where cattle have unrestricted access to the stream and no riparian buffer exists.

Solution:
Regrading & stabilization of eroded streambanks, restoring natural stream geometry, installation of streambank fencing and restoration of the riparian buffer would improve this segment.

Impacted Stream Segment #1-4:

Situated within the Sample Station 1C area upstream of Oregon Hollow Road, streambank erosion, and invasive plants (Mile-a-minute weed) are concerns along this residential property.

(Downstream reach)
Solution: Regrading & stabilization of eroded streambanks and restoration of the riparian buffer.

Mile-a-minute weed (right)
Solution: Control with the aquatic safe herbicide known as RODEO® and replant native vegetation.

(Upstream reach)
Solution: Streambank stabilization, install in-stream flow control structures (rock deflectors & vanes) and plant riparian buffer.

Impacted Stream Segment #1-5:

Located upstream of Station 1D and Silver Springs Road, streambank erosion and point bar formation are problems of concern on this property

Solution: Streambank stabilization, install in-stream flow control structures and plant riparian buffer.

Impacted Stream Segment #1-6:

Streambank erosion is also a serious problem at Sample Station 1D. Aggradation of sediment from sources upstream also appears to be a problem in the alteration of stream pool habitat.

Solution: Streambank stabilization, install in-stream flow control (J-Hooks) structures and replant a riparian buffer.

Impacted Stream Segment #1-7:

Streambank erosion area located just downstream of Sample Station 1E on the main stem of Fishing Creek along the base of the steep slope that parallels Scalpy Hollow Road.

Solution: Streambank stabilization with rock deflectors and backfill and restore natural stream geometry.

Impacted Stream Segment #1-8:

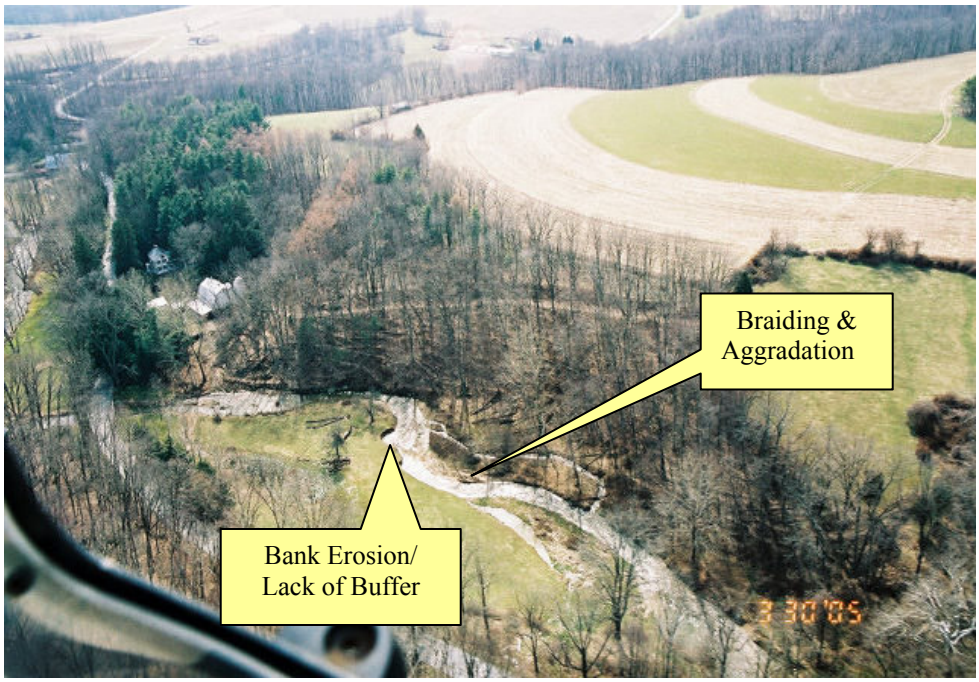
View of streambank erosion occurring along Scalpy Hollow Road on east bank of Fishing Creek. Unfortunately, the depression next to the road has also been used for illegal trash dumping.

Solution: Streambank stabilization, rock deflectors and backfill.

Impacted Stream Segment #1-9:

Streambank erosion, channel braiding and point bar formation on the main stem located just downstream (south side) of River Road.

Solution: Streambank stabilization, install in-stream flow control structures and plant riparian buffer.



Impacted Stream Segment #1-10:

View of streambank erosion in horse pasture along Fishing Creek just upstream of Furniss Road.

Solution: Regrading & stabilization of eroded streambanks, installation of streambank fencing and restoration of the riparian buffer.

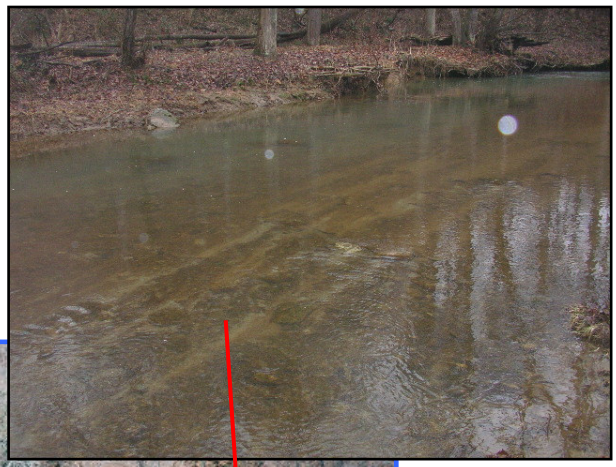
Impacted Stream Segment #1-11:

Vehicle parking problems due to poor drainage and unrestricted parking access had caused muddy, rutted areas and habitat degradation along Fishing Creek Road just downstream of Furniss Road on Lancaster Conservancy Property. Parking areas are used by fisherman, hunters, and hikers.

Solutions: The Lancaster County Conservation District has addressed such issues with their *Long Term Workplan for Fishing Creek Road*, which may use Dirt & Gravel Road Maintenance Program funding to implement recommendations.

Impacted Stream Segment #1-12:

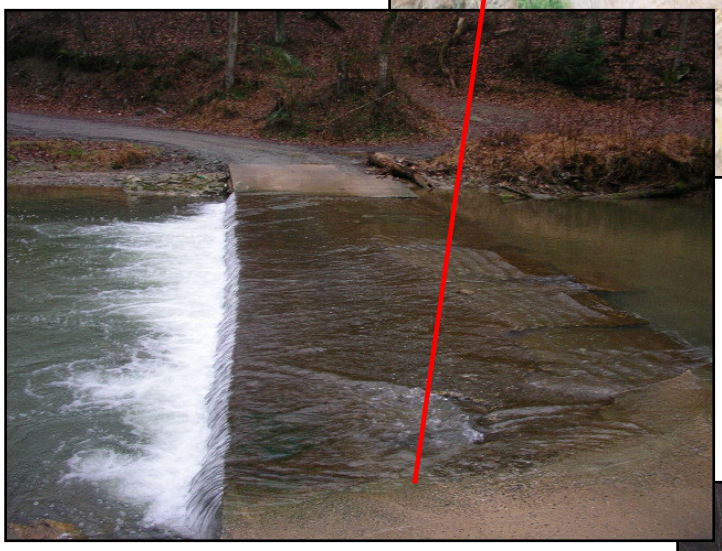
Degradation of forested floodplain habitat and Fishing Creek itself by all terrain and 4-wheel drive vehicles is perhaps the biggest threat to the water quality of Fishing Creek within the lower section of the watershed (a.k.a. "the hollow"). As seen below, impacts on Lancaster Conservancy property are quite recognizable from the ground and from overhead.



Solution:
Implement recommendations in LCCD's *Long Term Workplan for Fishing Creek Road*.

Impacted Stream Segment #1-13:

Additional impacted forested floodplain habitat by off-road recreational and 4-wheel drive vehicles has caused damage just below Ford Crossing #1.



The ford crossing could use repair or replacement with a better design, as it is causing erosion and point bar formation just downstream as seen in these photos. It also serves as a migration barrier for fish.

Solution:
Implement recommendations in LCCD's *Long Term Workplan for Fishing Creek Road*. Replace ford with better design to eliminate scouring and point bar formation. Repair and stabilize banks.

Impacted Stream Segments #1-14, 1-16, 1-17 and 1-18:

Several additional vehicle parking/pull-off problems are present along Fishing Creek Road downstream of Ford #1 and on Lancaster County Conservancy property due to unrestricted parking access and poor drainage.

Solution:
Boulder placement to restrict access to these areas (as recommended in LCCD's *Long Term Workplan for Fishing Creek Road*) may be a solution to mitigate some problem areas. Creation of dedicated parking areas (with stone foundation) for recreational users has also been recommended by LCCD's plan.

Impacted Stream Segment #1-15:

Despite posted sign that reads "No Camping" on Conservancy land in the lower section of Fishing Creek hollow, the area between Fishing Creek and the road shows evidence of continued use.

Solution:
Boulder placement to restrict access and improved signage with fines and increased patrolling of area.

Impacted Stream Segment #1-19:

Accessible hand dug well on the 15.2-acre Lancaster County Conservancy purchased along lower Fishing Creek could be a potential risk for illegal hazardous waste dumping if not properly closed soon. Such a well offers a direct conduit to the shallow groundwater aquifer and Fishing Creek. Streambank erosion is also occurring on this property

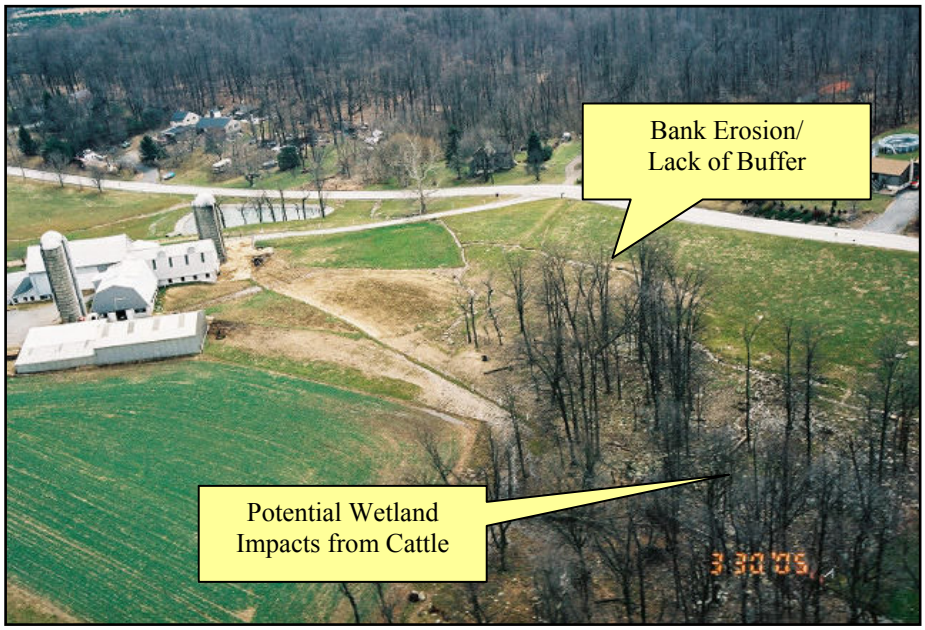
Solutions:

Properly close well as per PADEP specifications. Regrade and stabilize streambank with a live crib wall or toe rip-rap.

Impacted Stream Segment #1-20:

Eroded streambanks in the forested area of Conservancy property sandwiched in between Fishing Creek Road and Harmony Ridge Drive deserves prompt attention.

Solution: Rock deflectors & Toe rip-rap.



Impacted Stream Segment #2-1:

Located in the headwaters of Subwatershed 2 in Providence Township, it appears as if there is unrestricted cattle access to the stream and potential wetlands. Minor streambank erosion is occuring where no buffer exits in the open pasture area.

Solution: Streambank stabilization, install streambank fencing, cattle crossings and riparian buffer.

Impacted Stream Segment #5-1 and #5-2:

Located along Silver Springs Road in Subwatershed 5, cattle seasonally graze unrestricted along a long section of this small unnamed tributary in Drumore Township.

Segment #5-1 (Left)

Segment #5-2 (Right)

Solutions:

The properties and stream could be improved with a riparian buffer and streambank fencing.

Impacted Stream Segment #7-1:

View of streambank erosion along the unnamed tributary that parallels Scalpy Hollow Road near Sample Station 7A. Incising and head cutting of the stream is apparent within the upstream segment (left).

Just downstream of Sample Station 7A, (right), aggradation of sediment from upstream areas also appears to be a problem in the alteration of the stream's aquatic habitat.

Solutions: Streambank stabilization with live crib walls, or rock deflectors and backfill.

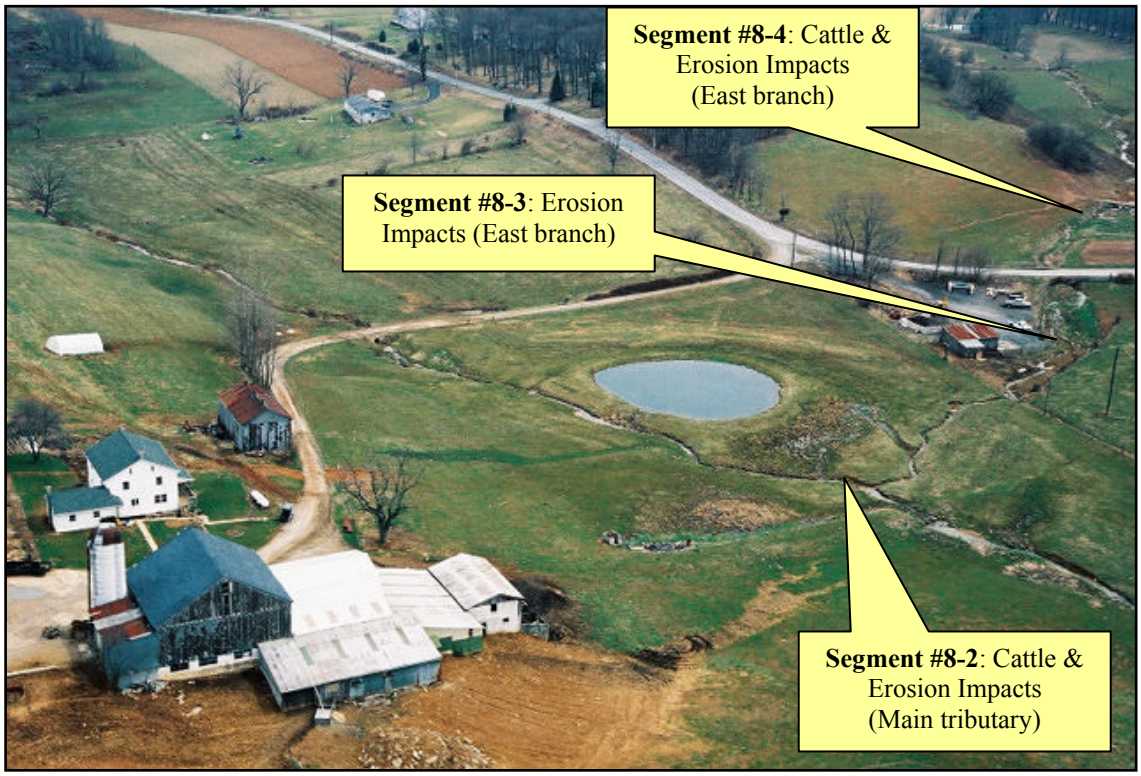
Impacted Stream Segment #8-1:

Agricultural impacts to the tributary in Sub watershed 8 along Osceola Road include unrestricted cattle access, nutrient runoff and degradation to stream and emergent wetlands. Location of large emergent wetland in relation to landmark on the farm property is depicted by red arrow in photo below.

Close up of emergent wetlands in pasture near Segment #8-1

Solutions:

Regrading & stabilization of eroded streambanks, installation of streambank fencing and restoration of the riparian buffer would improve stream segment. Streambank fencing around wetlands to restrict cattle would greatly improve wetland integrity.

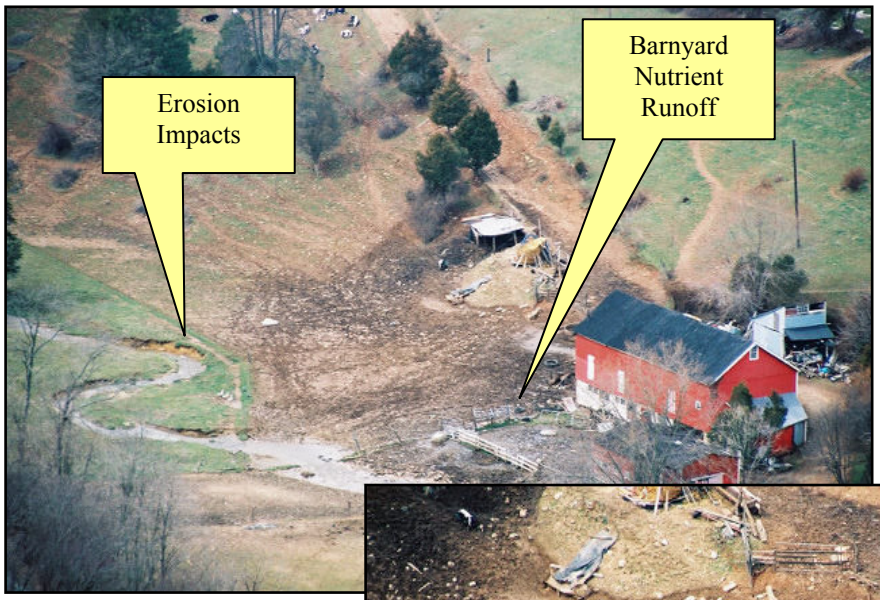


Impacted Stream Segments #8-2, #8-3 and #8-4:
Additional agricultural impacts to the main tributary of Subwatershed 8 and its east branch along Osceola Road (Downstream of Segment #8-1) includes stream erosion, unrestricted cattle access and nutrient runoff on Segments # 8-2 & #8-4. Segment #8-3 contains a parking and storage area that also exhibits streambank erosion along the tributary's east branch.

Solutions:
Regrading & stabilization of eroded streambanks, installation of streambank fencing and restoration of the riparian buffer would improve stream. Cattle crossings could be installed across stream where appropriate. Streambank stabilization adjacent to parking area would be minor improvement.

Impacted Stream Segment #8-5:

Extreme pasture and barnyard related impacts have led to excessive nutrient release and streambank erosion problems on this Osceola Road farm in the lower section of Subwatershed 8.



Front view from Osceola Road.

Solutions:
Complete Nutrient Management Plan with covered manure storage facility, install drainage system for barnyard area, redirect rooftop drainage.

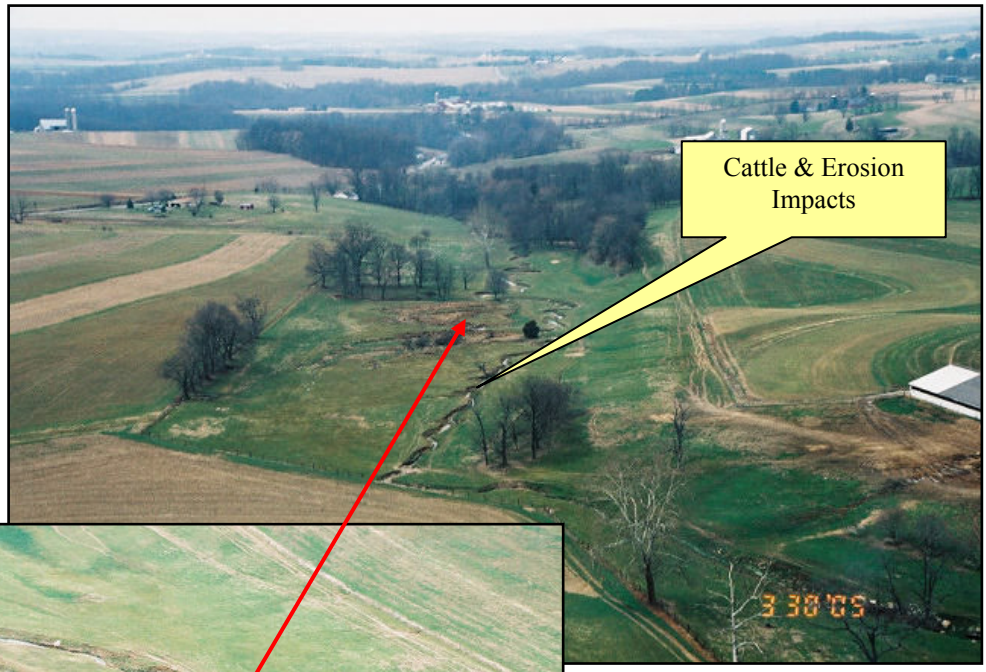
Close up of barnyard and livestock impacts

Rear view of impacted property.

Solutions:
Streambank restoration, streambank fencing, cattle crossings and plant riparian buffer.

Impacted Stream Segment #9-1:

Located in the headwaters of Subwatershed 9 near Chestnut Level, it appears as if there is unrestricted cattle access to the stream. Minor streambank erosion is occuring where no buffer exits in the open pasture.



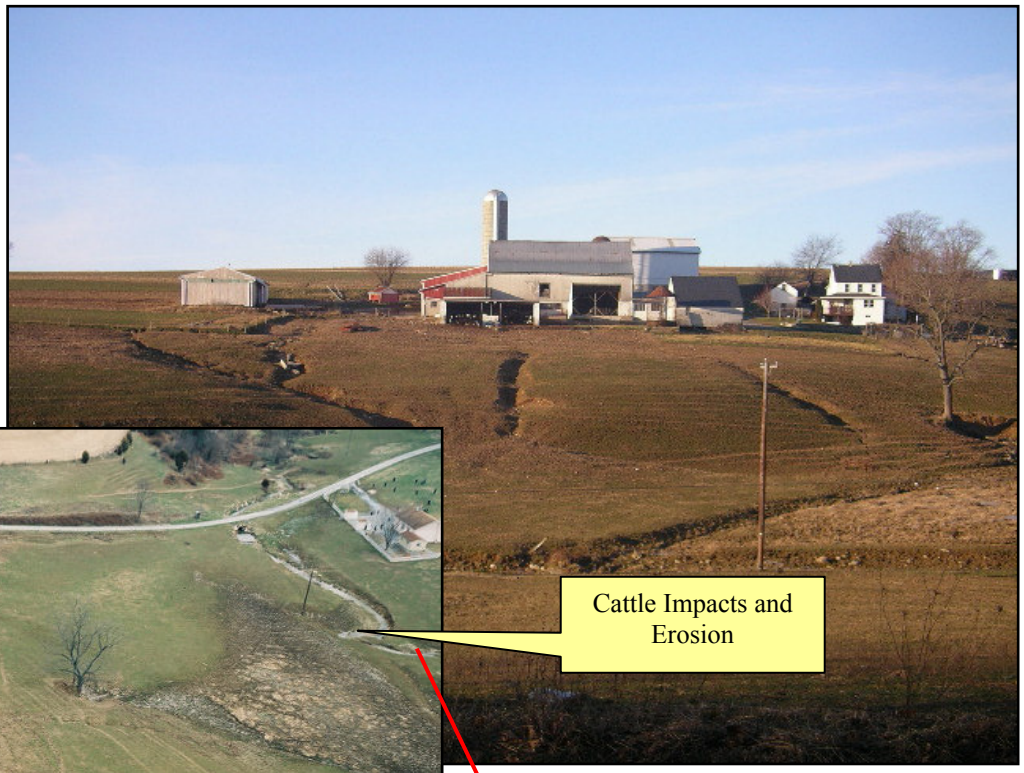
Unique emergent wetlands located in old stream oxbows are situated along the floodplain of this property.

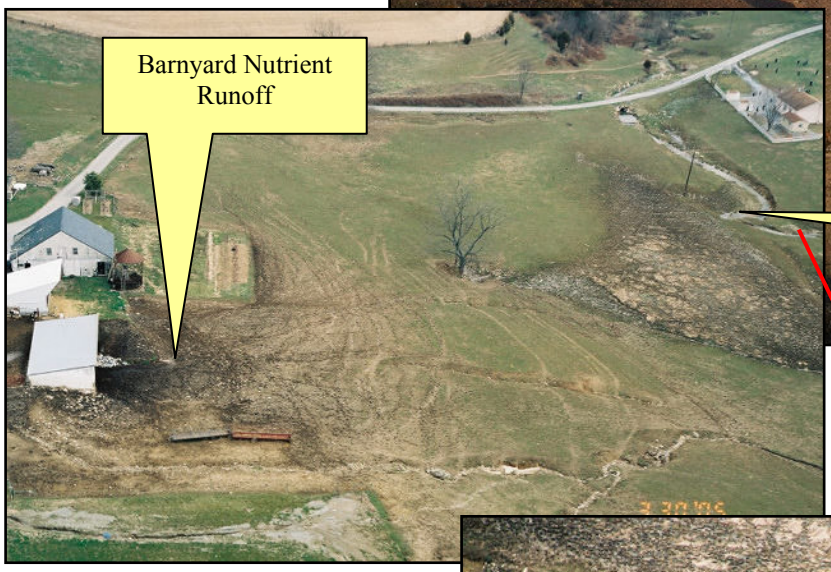
Solutions:

Regrading & stabilization of eroded streambanks, installation of streambank fencing and restoration of the riparian buffer would improve stream segment. Streambank fencing around wetlands to restrict cattle access would improve and protect wetland integrity.

Impacted Stream Segment #9-2:

Located in Subwatershed #9 along River Road, this farm exhibits obvious erosion problems, barnyard nutrient runoff and impacts to stream and emergent wetlands due to unrestricted cattle.





Streambank erosion has been accelerated due ot lack of riparian buffer and unlimited grazing by cattle.

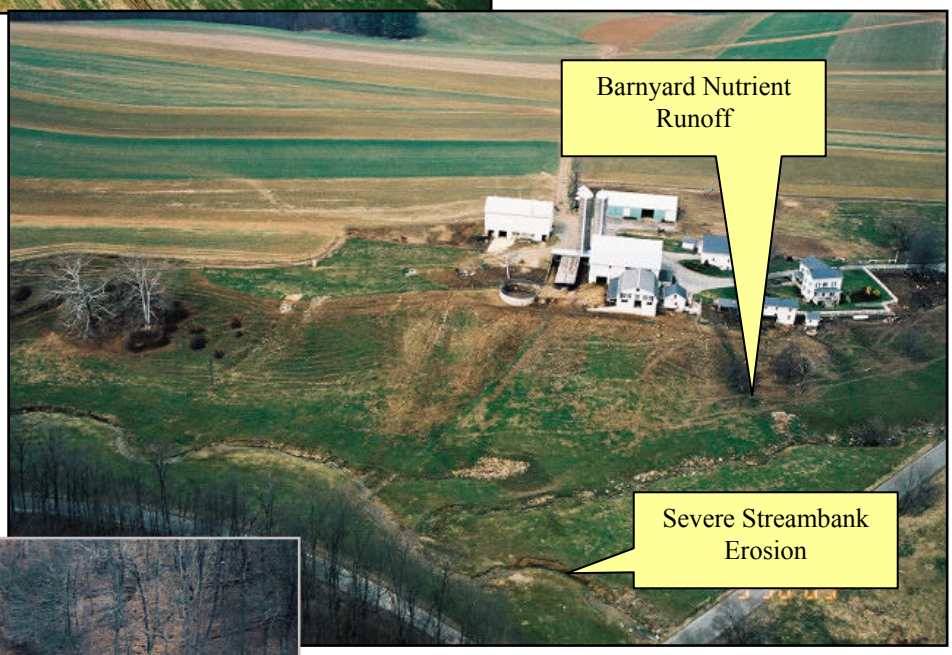
Solutions:
Complete Nutrient Management Plan with covered manure storage facility, install drainage system for barnyard area and redirect rooftop drainage. Relocate stream channel and restore natural stream geometry on floodplain, regrade & stabilize eroded streambanks, install streambank fencing and plant riparian buffer. Install cattle crossings.

Impacted Stream Segment #10-1:

This River Road farm supports the headwaters of Subwatershed #10. Although a narrow riparian buffer exists adjacent to the majority of the tributary, streambank erosion is apparent in the lower right section of the photo. Streambank fencing and riparian buffer expansion would improve this corridor.

Impacted Stream Segment #10-2:

Also situated in Subwatershed 10, this property is largely comprised of crop land. However, the barnyard perched on the hill and pasture land along the stream valley has greatly compromised the stream's aquatic ecosystem.



Severe erosion along a meander bend further downstream is gradually migrating towards Scenic Trail Road. The erosion has left a 12-15 foot high vertical wall that is in dire need of repair or channel relocation.

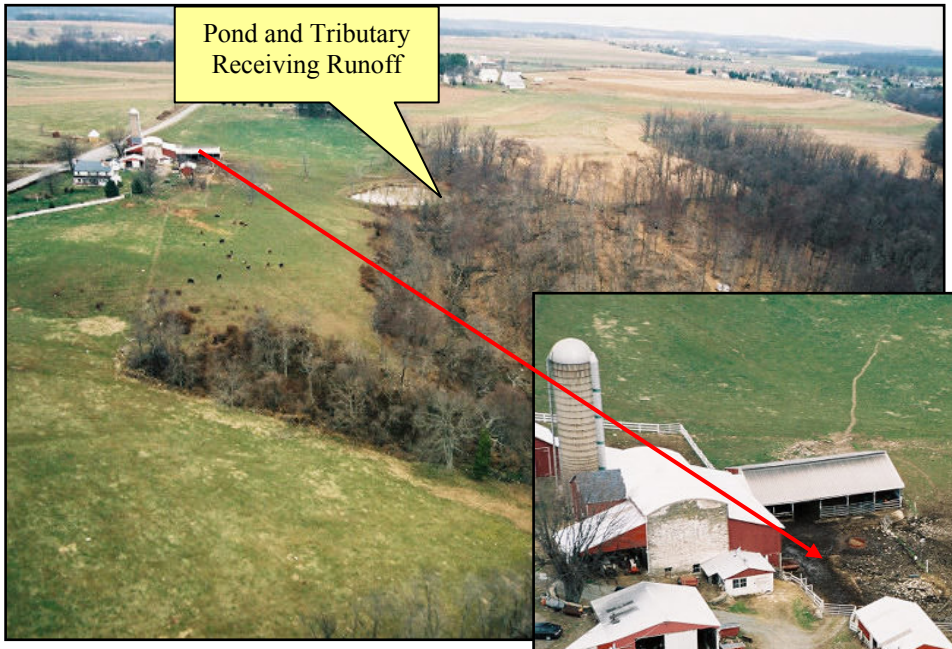
Solutions: Same as Segment #9-2 above.

Impacted Stream Segment #14-1: As the only farm located in Subwatershed #14, typical pasture erosion and barnyard nutrient runoff problems are apparent here in the headwaters area.

Solutions: Covered manure storage facility, install drainage system for barnyard area and redirect rooftop drainage. Install streambank fencing and cattle crossings. Establish riparian buffers.

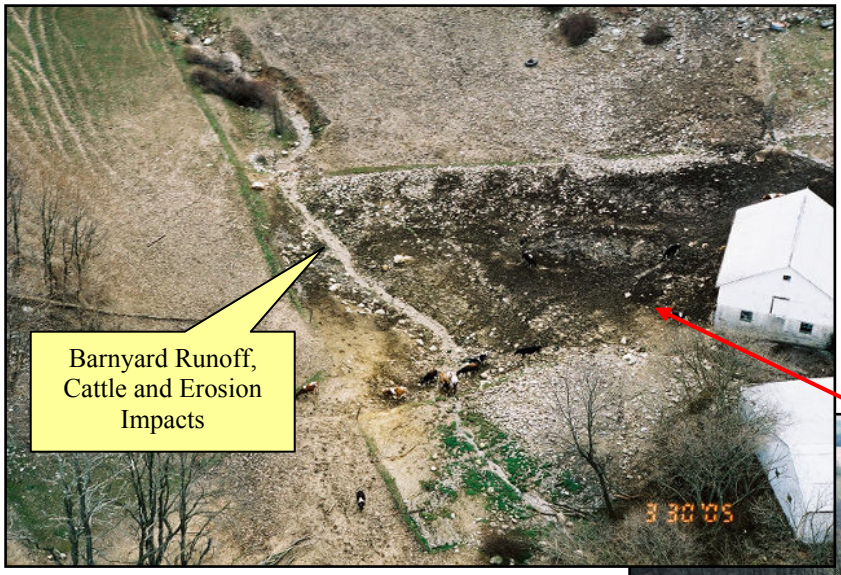
Impacted Stream Segment #17-1: Barnyard nutrient runoff and degradation of emergent wetlands and the tributary parallel to Fernglen Road are occurring from unrestricted cattle on this Drumore Township farm.

Solutions: Same as Segment #14-1 above. Restrict cattle access to emergent wetlands with fencing.

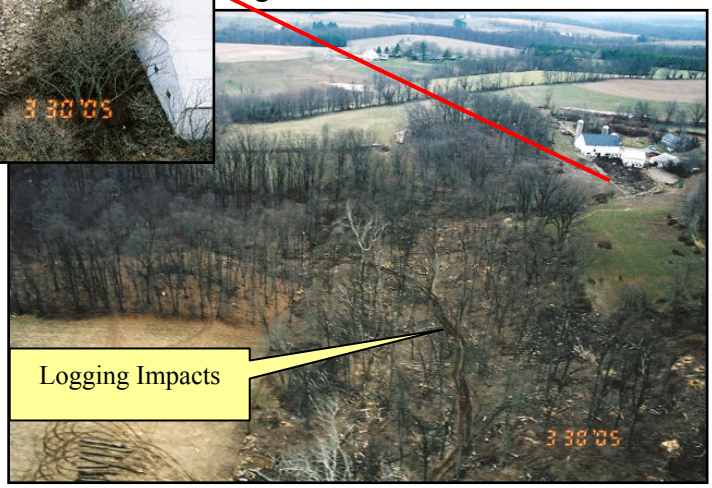


Impacted Stream Segment #17-2: Barnyard nutrient runoff to pond and headwaters of Subwatershed 17 tributary could be reduced.

Solutions: Same as Segment #14-1 above.



Impacted Stream Segment #18-1: Although the overall property was selected as a "Gem" in a recent county wide long range protection plan, barnyard runoff, unrestricted cattle and streambank erosion on this farm in the headwaters of Subwatershed 18 could benefit from implementation of agricultural BMPs.



Solutions: Same as Segment #14-1 above.

A forested section of the same property was selectively cut in March 2005, of which some short term damages were apparent from this aerial photo to the right.

Impacted Stream Segment #19-1: View of pasture impacts to emergent wetlands (upstream of pond) and barnyard nutrient runoff to tributary in Subwatershed 19.

Solutions: Streambank fencing and buffer would help protect wetlands, while the addition of a covered manure storage facility would improve water quality in the receiving tributary.

Impacted Stream Segment #19-2: Additional agricultural impacts to the main tributary of Subwatershed 19 (upstream of Property #19-1) include unrestricted cattle access and nutrient runoff from the barnyard, pasture area and a manure pit.

Solutions: Eliminate manure pit and use covered manure storage facilities, install drainage system for barnyard area and redirect rooftop drainage. Install streambank fencing, cattle crossings and establish riparian buffer.

C. Restoration Solution Details

Implementation of agricultural best management practices (BMPs) and stream restoration solutions in the affected areas should reduce nutrient and sediment loading into Fishing Creek to help improve water quality and protect aquatic life.

Substantial reductions in the amount of sediment reaching the streams can be made through the planting of riparian buffer zones. Contour strips and cover crops would further help reduce sediment loading to Fishing Creek for some Amish farms not yet using them. These BMPs range in efficiency from 20% to 70% for sediment reduction. Implementation of BMPs aimed at sediment reduction will also assist in the reduction of nitrogen and phosphorus. Additional nutrient reductions can be achieved through the installation of more effective animal waste management systems and cattle crossings. Other possibilities for reducing erosion and sedimentation include streambank stabilization and fencing. Further ground truthing along impaired stream segments will be necessary in order to assess both the extent of existing BMPs, and to determine the most cost effective and environmentally protective combination of BMPs and restoration to reduce nutrient and sediment pollution. The following is a brief description of the solutions that could be implemented as remedial measures to reduce pollutants in the Fishing Creek Watershed.

Barnyard Runoff: The collection and reduction of runoff water and wastes from barnyards, feedlots and outdoor livestock concentration areas for bypass, storage or treatment to improve water quality.

Crop Residue Management – (Conservation Tillage): This BMP involves leaving crop residue (plant materials from past harvests) on the soil surface to reduce runoff and soil erosion, conserves soil moisture, keep nutrients and pesticides on the field, and improves soil, water, and air quality.

Cover Crop: Cover crops can either be crops grown between cash crop cycles, or intercropped with the cash crops to cover the bare ground, such as in orchards, groves, and other long-term sites. Used appropriately, cover crops can improve soil structure and fertility, decrease soil erosion, provide foliage and animal feed, and suppress crop pests such as weeds, insects, nematodes, and plant pathogens including fungi. Residues from cover crops can be incorporated for use as green manure to supply nutrients and improve fertility for the next crop. Using cover crops can increase on-farm crop diversity, may enhance some beneficial organisms, and possibly even contribute to carbon sequestration.

Grazing Land Management: The management of lands for farm animal grazing includes the manipulation of the soil-plant-animal complex of the grazing land in pursuit of a desired result. This BMP develops a sound plan that minimizes the water quality impacts of grazing and browsing activities on pasture lands along streams and involves rotational grazing. To reduce the impacts of grazing on water quality, farmers and ranchers can adjust grazing intensity, keep livestock out of sensitive areas, provide alternative sources of water and shade, and revegetate pastureland.

Nutrient Management: Nutrient management is a plan for managing the amount, source, placement, form and timing of the application of animal manure, chemical fertilizer, biosolids (sewage sludge) or other plant nutrients uses in the production of agricultural products to prevent pollution, maintain soil productivity and achieve realistic yield goals. Nutrient management minimizes agricultural non-point source pollution of surface and ground water resources. Manure management facilities provide the opportunity to apply manure when soil conditions are suitable and crop nutrient needs are high. Manure storage facilities eliminate the need to haul and apply manure daily. Properly designed storage facilities are based on herd size, the area draining to the storage, wastewater and the nutrient management plan for the farm.

Strip Cropping/Contour Farming: This BMP is used to control both wind and water erosion. Contour strip cropping involves a planned layout in which the crops follow a definite rotational sequence, and tillage is held closely to the exact contour of the field. If the strips are planted along the contour, damage from water runoff can be minimized.

Terraces and Diversions: Diversions and terraces are designed to intercept water flowing down a slope and direct it across the slope to a stable outlet such as a grassed waterway or underground outlet. Vegetative barriers established above the diversion and terrace channels increase their longevity by promoting sediment deposition above the diversions and channels. Barriers established on top of terraces may provide additional stability; however, barrier vegetation should not be allowed to become established within the terrace channel area.

Roof Runoff Management: Includes a means or facility for collecting, controlling and disposing of runoff water from the buildings located on a farmstead and barnyard area. This practice prevents roof runoff water from flowing across concentrated livestock waste in barnyard areas to reduce pollution to nearby streams and improve drainage.

Watering Trough: A watering trough or tank to provide drinking water for livestock is a great alternative to keeping horses and cows out of the stream. This practice allows for the desired protection from streambanks and riparian vegetation while still providing livestock with water at strategic locations in pastureland.

Streambank Stabilization & Restoration: Streambank stabilization is the most basic step in restoring a degraded stream. Often time, eroded vertical walls or undercut banks are present where erosion has gone unchecked over time in agricultural areas. Traditional stream-bank stabilization involves regrading localized laterally eroded streambanks through grading the banks back to a more stable slope (3:1 horizontal:vertical), stabilizing the slopes with erosion control matting and vegetation and possibly adding in-stream structures or bioengineering techniques on the banks. Traditional in-stream structures may include the use of toe-rip rap and log or rock deflectors. Bioengineering methods that may be incorporated in bank stabilization could include the use of fascines, branch packing, brush mattresses, live cribwalls, tree revetments and live staking.

If a stream has been channelized or lacks stream bend meanders, and space and funds are available, a natural stream channel design (Fluvial Geomorphology) may be appropriate for stream restoration. Natural stream design uses a stable natural channel ("reference reach") as a blueprint or template for the design on the impacted reach. The reference reach provides the pattern, dimension and profile for the design of the restored stream to transport flows and sediment as it dissipates energy through its

particular geometry and in-stream structures. Natural stream design and restoration involves stabilization of an entrenched stream channel in place using in-stream structures and bioengineering. Typical in-stream structures for bank stability include rock cross vanes, J-hook vanes, half rock vanes, single and double wing deflectors, and root wads that divert the thalweg from the streambank and/or absorb water energy. Bioengineering techniques and erosion control matting are often combined and recommended for the implementation of stream restoration designs.

Riparian Buffer Strip: A riparian buffer is an area of vegetation that is maintained along the shores of streams and rivers to protect water quality and help stabilize stream channels and banks. Buffers can reduce pollutants entering a stream by filtering and altering forms of sediments, nutrients and other forms of chemicals in runoff from surrounding lands. Streamside buffers also provide food, wildlife habitat, and shade to protect wildlife and fish from extreme temperatures in the summer. Forested buffers provide the greatest degree of protection and benefits however, narrower forest and shrub buffers and grass buffers also provide benefits to stabilize soils and filter out waterborne pollutants.

For agricultural areas without any buffers, the preferred minimal width of riparian buffers should be 25 to 50 feet however; buffers of 50 to 100 feet wide provide the best function. Containerized stocks of 2 to 3 feet tall native tree and shrub species should be planted on 20 foot centers with slow release fertilizer tablets for the best results. If deer are present in the area, the use of tree shelters may be considered to deter depredation on the newly planted woody vegetation. If dairy cattle are present, streambank fencing should be installed along the outer edges of the buffers to protect the buffer plantings from trampling.

Streambank Fencing: Streambank fencing protects streambanks, promotes re-vegetation, enables forest buffer plantings, protects in-stream habitat and eliminates cattle from entering and loafing in the stream channel. The installation of a two-wire, high-tensile electric fence (powered by AC chargers or solar/battery chargers) is preferred. For construction, eight-foot long locust or pressure treated wooden fence posts should be pounded into the ground on 50-foot centers. Corners should be braced and constructed of 8-foot posts. Temporary poly wire electric fencing can be erected around planted riparian buffers until permanent fencing can be installed.

Cattle Crossing: To direct cattle from barn to pasture or from one pasture to another, cattle crossings can be incorporated as needed into the streambank fence design to allow cattle to cross the stream at selected locations without damaging the integrity of the stream. Cattle crossings should be installed perpendicular across the stream and equipped with electric fence and droppers to deter cattle from entering the stream and wandering upstream or downstream of the crossing. Crossings can be constructed of rock (R-4 rock base covered with 2B stone) or through the use of concrete hog slats set at an 8:1 horizontal/vertical slope cut into streambanks. The center of the crossing should be set at the stream bottom's invert elevation.

D. Restoration Prioritization Strategy by Sub-Watershed

The following is a recommend prioritization of restoration projects by subwatershed to improve water quality and protect the natural resources of the Fishing Creek Watershed.

Subwatershed 1 (Main Stem Fishing Creek)

High Priority (6)

- **Impacted Stream Segment #1-2:** Unrestricted draft horse impacts to Fishing Creek & forested wetlands, streambank erosion (Deaver Road)
- **Impacted Stream Segment #1-3:** Unrestricted cattle access to stream, streambank erosion and sedimentation (Penny Road)
- **Impacted Stream Segment #1-7:** Streambank erosion (Scalpy Hollow Road)
- **Impacted Stream Segment #1-10:** Unrestricted livestock access to stream, streambank erosion (upstream of Furniss Road)
- **Impacted Stream Segment #1-12:** Habitat degradation by off-road recreational vehicles (floodplain and stream habitat destruction along Fishing Creek Road)
- **Impacted Stream Segment #1-19:** Hand dug well on Conservancy Property (potential risk for hazardous waste dumping) & streambank erosion (Fishing Creek Road)

Medium Priority (12)

- **Impacted Stream Segment #1-1:** Barnyard nutrient runoff, unrestricted cattle access to stream (Truce Road)
- **Impacted Stream Segment #1-4:** Streambank erosion, invasive plant eradication needs (Oregon Hollow Road)
- **Impacted Stream Segment #1-6:** Streambank erosion, sediment aggradation (downstream of Silver Springs Road)
- **Impacted Stream Segment #1-8:** Streambank erosion along Scalpy Hollow Road
- **Impacted Stream Segment #1-9:** Streambank erosion, point bar formation, channel braiding (downstream of River Road)
- **Impacted Stream Segment #1-11:** Habitat degradation by vehicles, poor roadway drainage (Fishing Creek Road)
- **Impacted Stream Segment #1-13:** Habitat degradation by vehicles, Ford Crossing #1 in need of replacement, streambank scouring and point bar formation downstream of ford (Fishing Creek Road)
- **Impacted Stream Segment #1-14, 1-16, 1-17 & 1-18:** Habitat degradation by vehicles, poor roadway drainage (Fishing Creek Road)

Subwatershed 1 (Main Stem Fishing Creek - Continued)

- **Impacted Stream Segment #1-20:** Streambank erosion near Harmony Ridge Drive

Low Priority (2)

- **Impacted Stream Segment #1-5:** Streambank erosion, point bar formation, channel braiding (upstream of Silver Springs Road)
- **Impacted Stream Segment #1-15:** Unauthorized camping and habitat degradation (Fishing Creek Road)

Subwatershed 2 (Unnamed Tributary)

Medium Priority (1)

- **Impacted Stream Segment #2-1:** Unrestricted cattle access to headwaters and potential wetlands, streambank erosion (Buck Heights Road)

Subwatershed 5 (Unnamed Tributary)

Low Priority (2)

- **Impacted Stream Segment #5-1:** Unrestricted cattle access, streambank erosion (Silver Springs Road)
- **Impacted Stream Segment #5-2:** Unrestricted cattle access, streambank erosion (Silver Springs Road)

Subwatershed 7 (Unnamed Tributary)

Medium Priority (1)

- **Impacted Stream Segment #7-1:** Streambank erosion, sediment aggradation (Scalpy Hollow Road)

Subwatershed 8 (Unnamed Tributary)

High Priority (4)

- **Impacted Stream Segment #8-1:** Unrestricted cattle access to stream and emergent wetlands, streambank erosion and nutrient runoff (Osceola Road)
- **Impacted Stream Segment #8-2:** Unrestricted cattle access to stream and emergent wetlands, streambank erosion and nutrient runoff (Osceola Road)

Subwatershed 8 (Unnamed Tributary - Continued)

High Priority

- **Impacted Stream Segment #8-4:** Unrestricted cattle access to east branch of stream, streambank erosion and nutrient runoff (Osceola Road)

- **Impacted Stream Segment #8-5:** Extreme barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream, streambank erosion (Osceola Road)

Medium Priority (1)

- **Impacted Stream Segment #8-3:** Streambank erosion of east branch of stream along parking and storage area (Osceola Road)

Subwatershed 9 (Unnamed Tributary)

High Priority (1)

- **Impacted Stream Segment #9-2:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream, severe streambank erosion (River Road)

Medium Priority (1)

- **Impacted Stream Segment #9-1:** Unrestricted cattle access to stream and emergent wetlands, streambank erosion (Chestnut Level Road)

Subwatershed 10 (Unnamed Tributary)

High Priority (1)

- **Impacted Stream Segment #10-2:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream, severe streambank erosion migrating towards Scenic Trail Road

Medium Priority (1)

- **Impacted Stream Segment #10-1:** Unrestricted cattle access to stream, streambank erosion (River Road)

Subwatershed 14 (Unnamed Tributary)

Low Priority (1)

- **Impacted Stream Segment #14-1:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream (Harmony Ridge Road)

Subwatershed 17 (Unnamed Tributary)

Medium Priority (1)

- **Impacted Stream Segment #17-1:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream and wetlands (Susquehannock Drive & Fernglen Road)

Low Priority (1)

- **Impacted Stream Segment #17-2:** Barnyard nutrient runoff to pond and headwaters (Susquehannock Drive)

Subwatershed 18 (Unnamed Tributary)

High Priority (1)

- **Impacted Stream Segment #18-1:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream, streambank erosion (Glendale Drive)

Subwatershed 19 (Unnamed Tributary)

High Priority (1)

- **Impacted Stream Segment #19-1:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream and wetlands (River Road)

Medium Priority (1)

- **Impacted Stream Segment #19-2:** Barnyard and pasture impacts and nutrient runoff, unrestricted cattle access to stream, unlined manure pit ((River Road)

E. COST ESTIMATES

Costs associated with stream restoration work and the installation of best management practices will vary from site to site within the watershed. This is due to a variety of reasons including but not limited to: ease of access to the construction site, weather and soil conditions, availability of rock and other building materials, any available volunteer hours, and permitting and design costs.

It is always good practice to get a minimum of three bids for both design and construction work. Time should be taken to prepare a thorough "request for bid" which specifically outlines work to be performed to the greatest detail currently known. Contractors should be given ample opportunity to see the proposed construction site so proper evaluation can be made. Keep in mind, an experienced contractor may have suggestions to the "scope of work" outlined within the "request for bid" which may save time and money.

Some requested services may need to be bid on a "time and materials" fashion. Plan design and permitting can fall into this category because aspects of the project will not be known until the design advances to a certain point.

However to get a general idea of costs to be expected, the following listing is provided:

<u>Equipment with Operator</u>

Back-hoe	$75/hour
Track-hoe	$115/hour
Bulldozer	$95/hour
Front end loader	$90/hour
Tri-axle dump truck	$85/hour
Mobilization costs for large equipment (Requires Penn DOT permit)	$250

<u>Materials</u>

Rock (rip-rap)	$15.00/ton delivered
	$26/ton installed
	$78/linear foot installed
Erosion control matting	$3.00 – 8.00/square yard installed
Silt fencing	$2.10/foot installed
Super silt fence	$9.00/foot installed
Gabion baskets	$30.00/square yard installed
Geotextile fabric	$2.00/square yard installed
Orange construction fence	$1.90/linear foot installed

Excavation

Earthen swales	$2.50/linear foot
Basin grading	$2.50/cubic yard
Trench work	$5.00/cubic yard
Place or strip topsoil	$2.00/cubic yard
Backfilling on-site soils	$2.50/cubic yard
Clearing and grubbing	$5,000/acre
Large tree removal	$200/tree

Streambank Stabilization Measures – In-stream Habitat Improvements

Rock (rip-rap)	$15.00/ton delivered $26/ton installed $78/linear foot installed
Erosion control matting	$3.00 – $8.00/square yard installed
Gabion baskets	$30.00/square yard installed
Geotextile fabric	$2.00/square yard installed
Live stakes	$1.00 – $4.00/stake installed
Fascines	$5.50 – $22.00/linear foot installed
Natural fiber rolls	$61/linear foot installed
Live crib walls	$11.00 – $28.00/square foot of the front face
Root wads	$250 – $1,125/root wad installed
Boulder placement	$583/ten boulders installed
Log vanes	$400/single wing installed
Rock vanes	$400/single wing installed
"J" Hook vanes	$500/vane installed
Rock deflectors	$400/deflector installed
Log deflectors	$450/deflector installed
Rock weirs (cross-vanes)	$1,300/vane installed

Streamside Buffers – Forest Buffers

Fencing (high tensile, 2 wire)	$1.50 – $1.80/linear foot installed
Cattle crossing	$500 – $700/crossing installed
Stoned watering ramp	$300/ramp installed
Bare root seedling stock	$0.35 – $1.50/seedling – not installed
Semi-transplanted bare root stock	$0.70 – $2.00/seedling – not installed
Containerized stock (1 – 2 gallon)	$6.50 – $8.00/container – not installed
Balled and burlapped stock	$25.00 – $65.00/tree – not installed
Tree tube protectors	$0.50 – $1.30/each – not installed
1 acre of buffer planted in seedlings	$500
Riparian grass buffer seeding	$175 - $400 per acre

Herbicide application	$60/acre

Agricultural Best Management Practices

Consult the Lancaster County Conservation District
Cost sharing available through the Conservation Reserve Enhancement Program (CREP), Chesapeake Bay Program and others

F. Obtaining Support and Monitoring Progress

Obtaining permission and cooperation of landowners within the watershed to implement agricultural BMPs and stream restoration solutions is the key to improving and preserving the natural resources and water quality of the Fishing Creek Watershed. As previously illustrated in Section IV, the agricultural community owns the vast majority of the land in the watershed. Educating farmers and other rural landowners as to why proposed improvements and changes should occur on their property is extremely important and takes tact, courtesy, respect and sometimes, persistence. Often times if you can clearly show what's in it for the landowner and help them visualize the project's goals through actual examples (photographs) of completed projects, they are more likely to want to be a partner in a project. Furthermore, if you are able to communicate what the benefits of sound land management practices could mean to help improve the bottom line of the farmer's business, then they will be even more interested. Increases in crop production through preservation of topsoil and a decrease in veterinary bills for treating water borne and trasmitted diseases such as mastitis (a painful udder infection that occurs in dairy cows) have a positive monetary effect. Improving pastures through simple processes as rotational grazing and conservation programs such as CREP (which allows farmers to receive incentive payments for installing specific conservation practices) are also attractive.

Considering the Lancaster County Conservancy's existing leadership in the watershed protection and preservation already, building landowner partnerships should not be a problem. However, the Conservancy can make even a larger positive impact for restoring and protecting the Fishing Creek Watershed by teaming with other natural resources agencies, special interest groups and educational institutions. Partnering increases your educational resources, brings additional professional natural resources specialists into your projects and helps to further leverage available grant and funding resources. Partnering can also help preserve the watershed's farmland from future land development through farmland preservation. Some of the important teaming opportunities that are available to the Lancaster County Conservancy include:

- Drumore, Providence, East Drumore and Martic Townships & Lancaster County Planning Commission (Adoption of protective municipal ordinance language to protect critical watershed resources)
- Lancaster County Agricultural Preserve Board (Farmland Preservation)
- Lancaster County Conservation District (Agricultural BMP design, soil conservation and nutrient management, watershed consultation)
- Lancaster Farmland Trust (Farmland Preservation)

- Pennsylvania Department of Environmental Protection (Water quality studies and grant opportunities)
- Pennsylvania Department of Conservation & Natural Resources (Land preservation, resource management and grant opportunities)
- Chesapeake Bay Foundation (Riparian buffer plantings and grant opportunities)
- Pennsylvania Fish & Boat Commission (Trout and fisheries management and protection, aquatic habitat improvement)
- Pennsylvania Game Commission (Wildlife protection, habitat improvement and policing)
- Trout Unlimited (Habitat improvement, grant opportunities)
- Valley Lea Riding Club (Trail planning)
- PECO Energy and Pennsylvania Power and Light Company (Opportunities for hiking trails along electric utility easements and environmental education)
- Franklin & Marshall College (Water quality monitoring and watershed studies)
- Millersville University (Wildlife community monitoring, riparian buffer survival studies and macroinvertebrate monitoring)
- Lancaster Country Day School (Riparian buffer volunteer planting)

As the prime steward of the Fishing Creek Watershed and sponsor of this watershed assessment, the Lancaster County Conservancy and its members will need to take the lead on project implementation, management and tracking the success of executed solutions identified in this plan. However, long term water quality studies and continued monitoring of Fishing Creek's macroinvertebrate communities can be accomplished by others in the long term.

For example, state government agencies' staffs cannot handle comprehensive water quality monitoring for all the streams in the Commonwealth, therefore citizen-based groups are becoming educated and have begun volunteer monitoring programs across the state. Even before the formal inception of the Citizen's Volunteer Monitoring Program by PADEP and the Pennsylvania Senior Environment Corps (PASEC), citizen volunteers have been involved in monitoring the quality of the waters in their area since the 1960's. The Citizen's Volunteer Monitoring Program now enables even more watershed groups, interested citizens, schools, clubs and others to learn about and participate in the monitoring of the water quality in their watersheds (PADEP, 2005). Such groups monitor physical and chemical parameter and collect and identify macroinvertebrates as indicators of water quality.

Finally, Lancaster County has private and public colleges and universities, which have the professional staff and students to plan, supervise and implement water quality studies. Educational institutions that already conduct biological, chemical and geological studies of Lancaster County's surface and groundwater resources include Franklin & Marshall College and Millersville University. These institutions not only have volunteers, equipment and laboratories to complete monitoring, they have the need to involve their students in meaningful curricula and

projects. It is a win-win situation for everyone who partners with and uses these educational institutions as a means to monitor and solve water resource problems within Lancaster County's watersheds such as Fishing Creek.

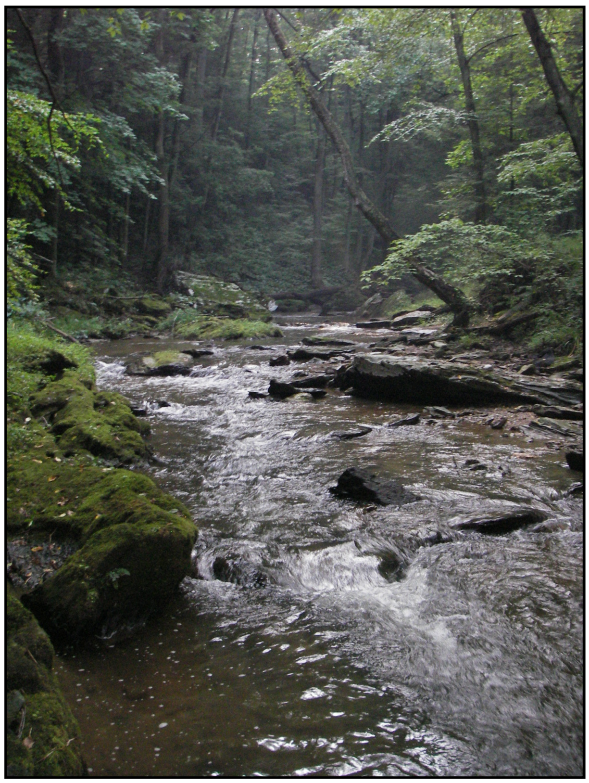
Table VII-1 provides information on potential financial resources (such as grant funds) for future Fishing Creek Watershed projects.

INSERT TABLE VII-1: Potential Financial Resources

INSERT TABLE VII-1: Potential Financial Resources

INSERT TABLE VII-1: Potential Financial Resources

VIII. RECREATION PLANNING



The Fishing Creek Watershed is an area blessed with natural beauty and recreational potential. Though the watershed encompasses less than 15 square miles, it possesses a wealth of natural, agricultural and recreational resources, providing unique opportunities within Lancaster County. This potential is further multiplied when the watershed is viewed in its entirety, with its interconnected components far exceeding the sum of their individual values.

To best realize the benefits of this treasure, this analysis will first focus on existing recreational conditions. In addition, consideration will be given to local municipal and demographic constraints within the watershed. From this point, the analysis moves into projective mode, examining future conditions and trends. This combination of existing conditions and future considerations generates a vision for the watershed. Finally, this vision is realized in concrete recreational goals and opportunities.

A. Existing Uses

At present, recreational use of land within the watershed is segmented between private and public/semi-public uses. In addition to those within the watershed, a number of substantial recreation areas occupy land in close proximity to the watershed, and are worthy of consideration when viewing recreational opportunities within the watershed.

Private

The majority of the land within the Fishing Creek Watershed is held in private hands. The bulk of this land is agricultural, used primarily in animal husbandry and crop cultivation. Along with these uses, much of this land doubles as private recreation space. Prime uses include, but are not limited to hunting, fishing and horseback riding. These uses, particularly hunting and fishing, tend to be exclusionary, providing little opportunity for outside engagement.

Also prominent across the landscape of the watershed are private residences. Apart from farmsteads, these units function as a bedroom community, with residents working outside of the watershed. Recreation here can be described as typical household leisure activities, not

particularly unique to the watershed. As is generally the case, these recreational uses stop at property lines, and form a disintegrated patchwork of interests.

In addition to private, informal uses, the watershed has private space specifically dedicated to recreational uses:

Camp Andrews

Camp Andrews is a private, Christian camp located at 1226 Silver Spring Road. The camp, affiliated with both the Mennonite Camping Association and the Association of Christian Camps and Conferences occupies 35 acres and has a capacity of 140 campers. The facility offers year-round lodging and dining facilities to various Christian groups. Though the camp has a primary focus on passive and outdoor recreation (including stream and cave exploration), the camp offers a number of active recreation areas, including indoor game facilities (air hockey, ping-pong, pool, etc.) and outdoor playing fields and basketball courts.

Valley Lea Riding Club

The Valley Lea Riding Club is located at 1685 Furniss Road, abutting Drumore Township Park to its south. The club, located on roughly 25 acres, is located at the nexus of a number of trails used by horseback enthusiasts, many of which extend beyond the reaches of the riding club. The club is membership based, and offers various facilities, centered on its clubhouse. At the site, registered camping is permitted, along with horses. The club sponsors various social events throughout the year, including large, guided trail rides in the spring and the fall.

Public/Semi-Public

Several regional parks and private preserves open to the public dot the landscape in and surrounding the Fishing Creek Watershed.

Lancaster County Conservancy Properties

Fishing Creek Nature Preserve

The focal property of the Conservancy within the watershed is Fishing Creek Nature Preserve along the aptly named Fishing Creek Road. The 167 acres are formed by a patchwork of semi-contiguous parcels following the stream. This area is surrounded by forests, and transected in several locations by the watercourse, forded in three locations by Fishing Creek Road. Currently, the most prominent use is trout fishing along one of the few streams in Lancaster County offering wild trout populations. In addition to fishing, the preserve attracts picnickers, hikers, horseback riders (primarily along Fishing Creek Road), geocachers and hunters. The high-sloped hills and towering tree canopy create an atmosphere, that due to geologic and development constraints, is unfortunately rare in Lancaster County; these natural features offer participants in various forms of passive recreation an exceptional environment, enhancing the experience of these various activities. Parking is usually done in an ad hoc fashion, with a number of pull-off areas along Fishing Creek Road.

In addition to higher quality uses, the preserve has had a number of issues pertaining to detrimental use of the properties. Of primary concern is the use of all-terrain vehicles (ATVs) along the stream and Fishing Creek Road. Despite attempts to curtail this activity through blockades and signage, the participants in these activities have shown great persistence and ingenuity in defying these efforts. ATVs have caused particular damage during rainy periods, with their riders taking advantage of ample mud and limited surveillance. In addition to motorized recreation, the preserve has at times attracted campers and partiers. While low impact camping would not necessarily represent an adverse use, these camps tend to be of a much more invasive nature, disturbing ground cover and littering the property with bottles, cans, and other refuse. Additionally, particularly during dry spells, open fires from these camps present a serious fire risk to the surrounding woods.

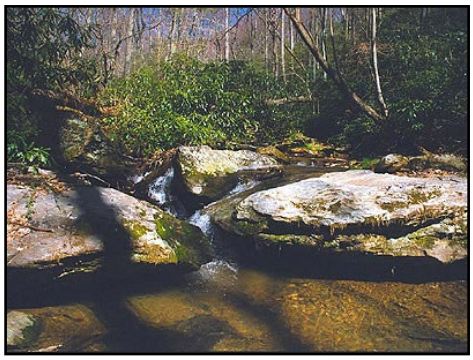
Other Property within the Watershed

Within the watershed, the Conservancy is in the process of acquiring properties farther upstream, along Scalpy Hollow Road. These properties are comprised largely of mature, hardwood timber stands. Due to the property having been in private hands, there are no defined recreation activities at present, though given its location and attributes, it would likely evolve into an area based primarily in passive recreation.

Ferncliff Wildflower and Wildlife Preserve (Outside of Watershed)

The Ferncliff Wildflower and Wildlife Preserve is located just to the southeast of the watershed, along the valley formed over time by Barnes Run. As its name would imply, the preserve has an abundance and diversity of wildflowers and animal life, and is recognized as a National Natural Landmark. In addition, a large hardwood stand envelopes much of the preserve, with a number of unique geologic formations dotting the landscape. Trail based activities, such as hiking and observing nature, are the main attraction of visitors to the property. The property also has two geocache sites to attract visitors.

Wissler Run (Outside of Watershed)



Located between Susquehannock State Park and Exelon's Muddy Run Recreation Area, is the Conservancy's Wissler Run Nature Preserve. The preserve occupies 18 acres of hardwood forests and rhododendron. Though the primary form of recreation would be passive exploration and enjoyment of nature, the absence of marked trails and severely limited access make preserve largely inaccessible. Despite these difficulties, for those who are willing to make the effort to discover the preserve, an area diverse and abundant in natural life is well worth the effort.

Drumore Township Park

Along Furniss Road between Fishing Creek and Scalpy Hollow Roads, Drumore Township owns and maintains a 25.8 acre property, a large portion of which is public park space. This park caters towards active recreation, including ballfields, picnic pavilions, and playground equipment. The majority of the park not directly used for active recreation is wooded, and available for short walks and low-intensity hiking. Ample parking is available at the facility.

Susquehannock State Park

Susquehannock State Park, the only State Park in Lancaster County, sits upon bluffs overlooking the Susquehanna River. The overlook area, popular with site-seers is a notable attraction, though the park also has several miles of well marked hiking trails. For organized groups, camping is available, though not for individuals or families. The park has a number of picnicking pavilions, fire pits, and two ballfields, to cater towards more organized recreation. Of particular interest to bird watchers, visible from the park overlook, is Mt. Johnson Island, site of the world's first designated bald eagle sanctuary. Parking is provided throughout the park.

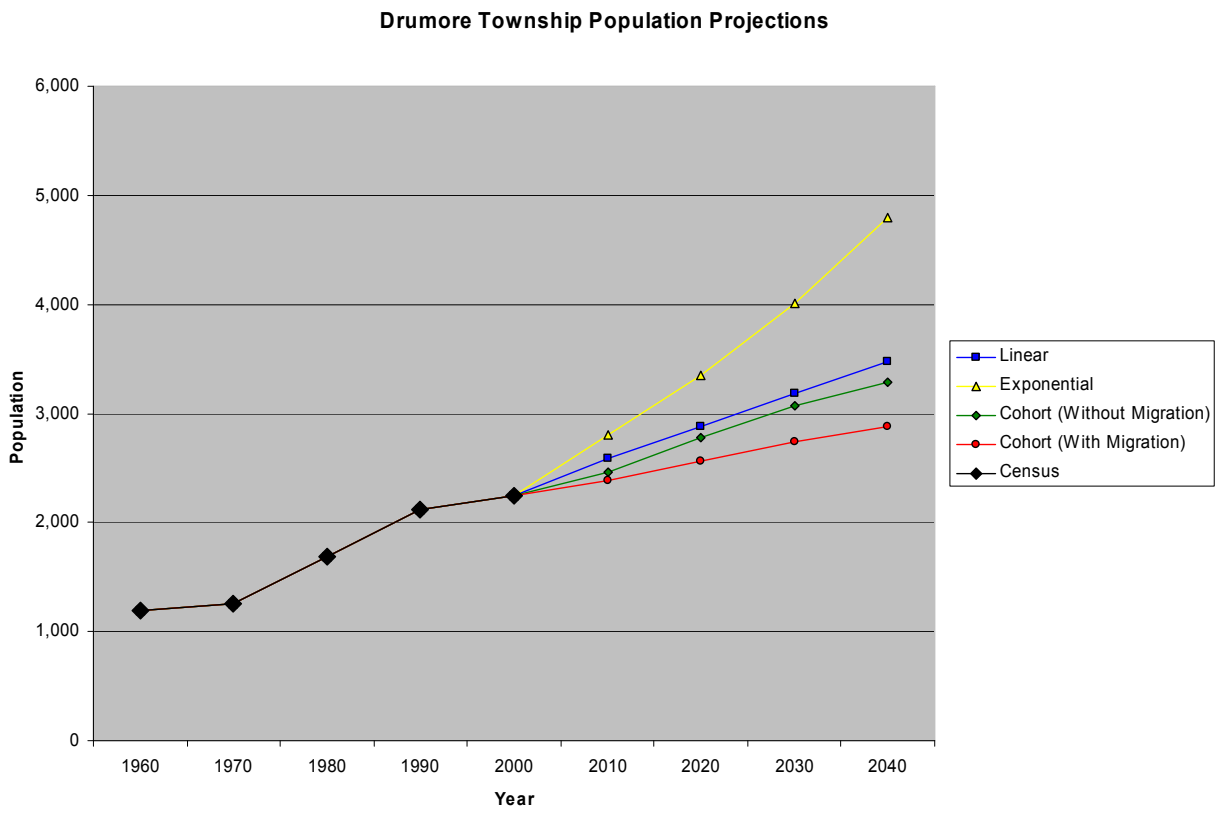
Muddy Run Recreation Area

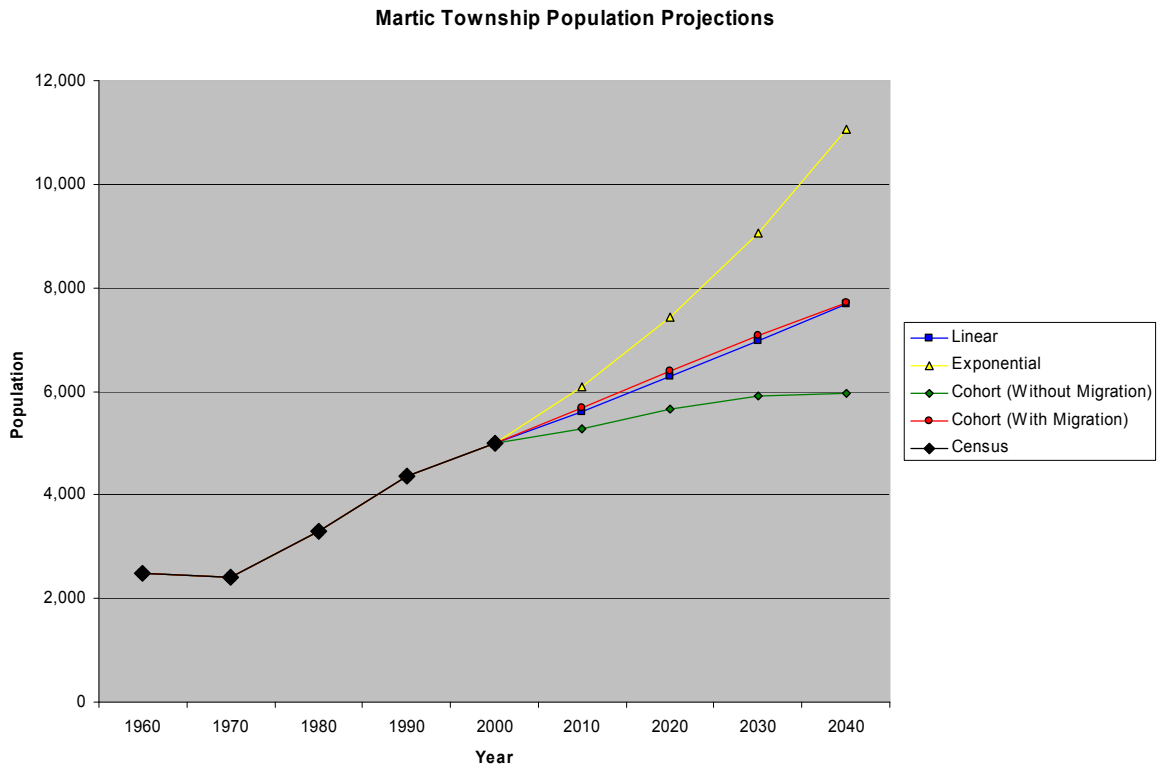
The Exelon Corporation offers public land surrounding its Muddy Run Pump Storage Facility. The facility acts as a large battery, pumping water from the Susquehanna River into the reservoir during off-peak hours, and allowing it to flow back to the river through generating turbines at periods of higher demand. Much of the hundreds of acres surrounding the facility is available for public recreation, including hiking, camping, boating, fishing, picnicking and bird watching. The reservoir is stocked with trout, and is available for fishing during the closure of most approved trout waters. The facility also holds a permitted archery hunt with hunters chosen by lottery. Ample parking is available at the recreation area.

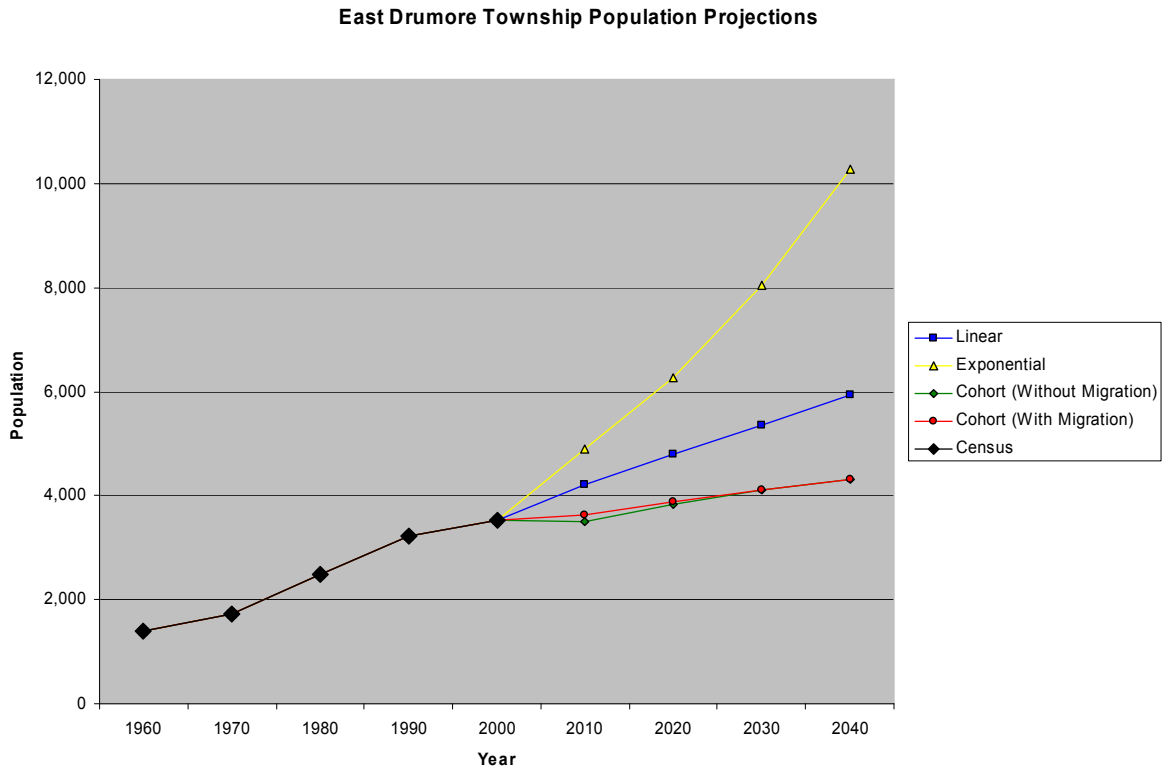
B. New Potential Uses

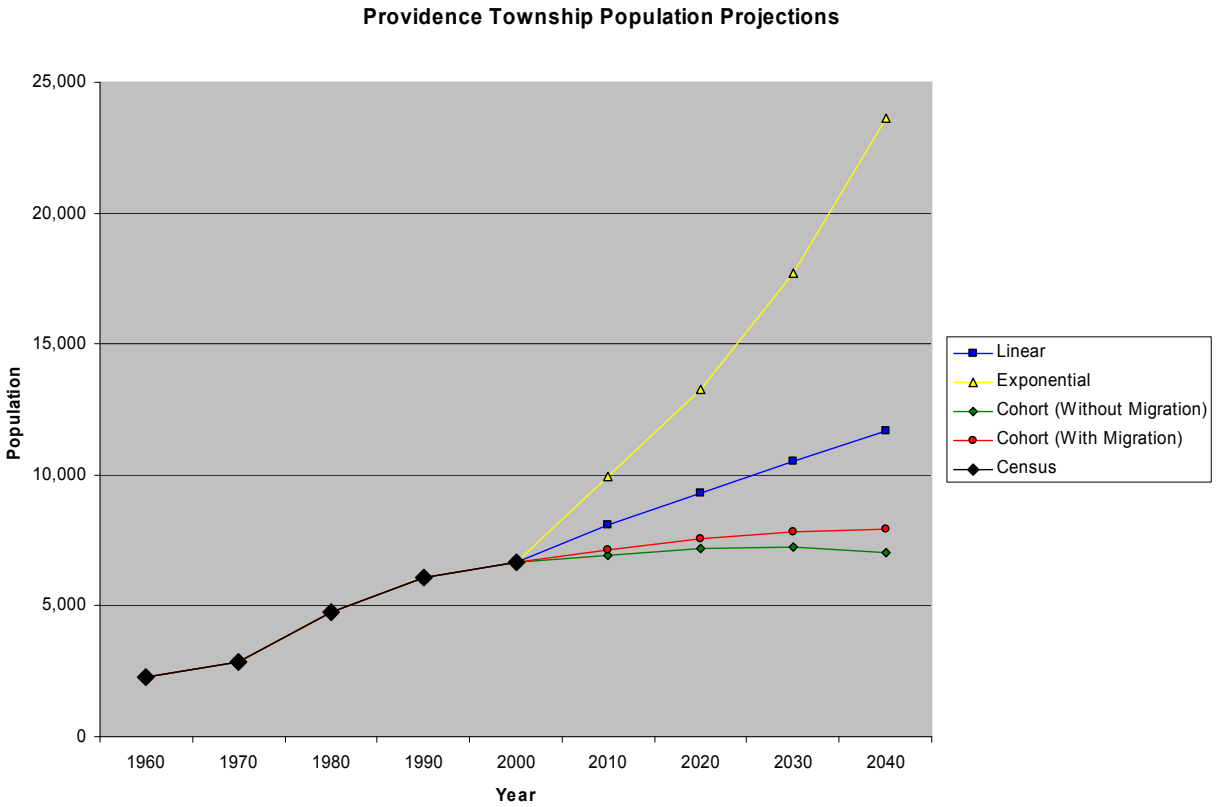
Based on current trends, by nearly every measure, each municipality in the Fishing Creek Watershed is expected to grow over each decennial period. At the heart of the watershed, Drumore Township, while retaining the smallest population of municipalities with portions in the watershed, should expect a minimum of several hundred new residents over the next decades. Even by the most conservative estimates, the watershed will experience growth, putting pressure on the housing markets, as well as the demand for recreation services:

Figures VIII-1 through VIII-4




Martic Township Population Projections
12,000
10,000
8,000
6,000
4,000
2,000
0
Population
1960
1970
1980
1990
2000
2010
2020
2030
2040
Year
Linear
Exponential
Cohort (Without Migration)
Cohort (With Migration)
Census

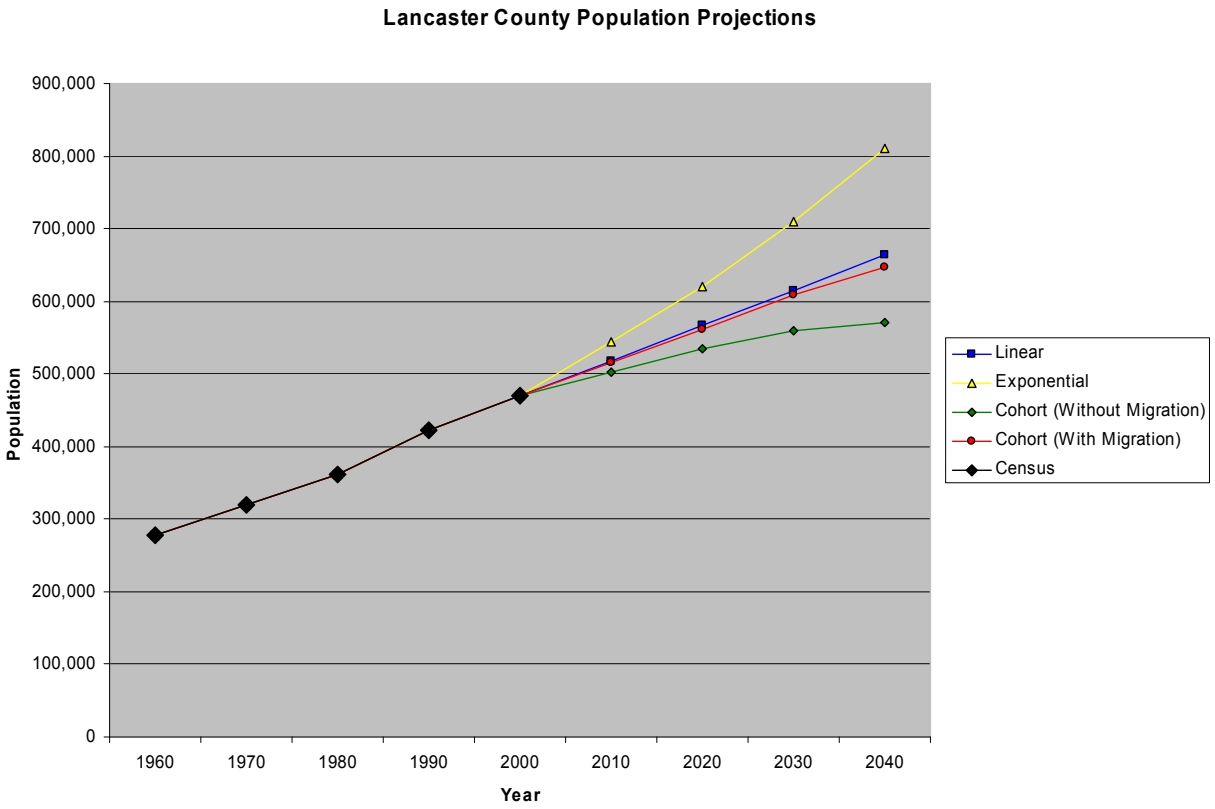

East Drumore Township Population Projections
12,000
10,000
8,000
6,000
4,000
2,000
0
Population
1960
1970
1980
1990
2000
2010
2020
2030
2040
Year
Linear
Exponential
Cohort (Without Migration)
Cohort (With Migration)
Census



Despite this municipal growth, and its resultant increased demand for recreation services, at present, the area surrounding the Fishing Creek Watershed should maintain an excess capacity of recreational opportunities for its residents. This is due almost exclusively to the large amount of per capita open space enjoyed be the residents of this part of the county. Because of the high quality of natural lands, and historically lower development pressures than other regions in the County, a concerted effort has been made to protect areas when similar endeavors may not have been feasible elsewhere. For demand to exceed this capacity, growth would have to exceed even the most generous estimates.

Of far greater concern are the portions of the County beyond the Fishing Creek Watershed. By all estimates, the County's population will exceed one half-million people by the next census. By 2040, the population may increase by as much as 350,000. This will put a tremendous strain on the County's natural, housing, and recreational resources. Economic prosperity would likely be sufficient to sustain infrastructure such as roads, schools and public utilities. However, the County's land resources are of a finite amount, and valuable open space would be consumed.

Figure VIII-5



Having experienced development pressures that have been historically lower than other portions of the county, the Fishing Creek Watershed, through proper land stewardship and management, is positioned very well to provide recreation and open space opportunities throughout the county.

Of particular advantage to the watershed are the abundance, variety and proximity of natural resources and open space opportunities. Given the number of facilities offering various activities, in unique and valued environmental circumstances, there is tremendous opportunity for recreation. The watershed, while offering this diversity, is also of a manageable size to provide a functional open space network. In addition to these existing facilities and natural areas being networked, there are a number of opportunities for future uses on land currently not involved in recreational or natural protection. In short, the watershed offers a large, untapped potential. Key to this vision, however, is viewing these uses as a whole, rather than discrete components. This is the key leadership role for the Conservancy.

Viewing the watershed in its entirety would move the Conservancy away from its traditional property-centric model of management. In many of the Conservancy's popular properties, such as Tucquan Glen, the property is the key and sole focus of the visitor. While this is quite effective in most instances, the unique situation of the Fishing Creek Watershed provides an opportunity to move beyond these constraints to offer new and beneficial natural recreational prospects for county residents.

Key to this is a concerted effort on behalf of the Conservancy to package and claim ownership of the watershed. This positive association between the Conservancy and the watershed has many roles in realizing the natural and recreational potential of the area. First and foremost, it conveys the concept that a watershed is not discrete parts, but a connected whole. This allows the Conservancy to reach far beyond its own properties, and extend its influence, guidance, and vision with the entire watershed. Second, by integrating recreational opportunities throughout the watershed under a directed, purposeful identity, the Conservancy encourages a multiplier effect, increasing the benefits, visibility, and functionality of each of the watersheds constituent parts. Finally, this model lays the groundwork for similar projects throughout the County either under or outside of Conservancy. By providing a clear example of networked natural lands and open space, in the environmental fabric of a watershed, the Conservancy could influence similar efforts elsewhere.

In circumstances such as the Fishing Creek Watershed, there are many advantages for this approach over traditional methods. The first is the conservancy is freed focus on key properties in a network, rather than contiguous space. While Conservancy acquisition elsewhere in the County is driven largely by environmental opportunities, there are often considerations as to the viability and practicality of smaller properties disconnected from other areas. By moving the focus from the property to the watershed, small yet critical parcels contribute to part of the greater whole, and do not rely as heavily on individual feasibility. Watershed adoption also frees the Conservancy to take advantage of infrastructure outside of its own maintenance responsibilities. From roads to parks to historic architecture, these elements provide the means of recreation without the upkeep costs and personnel requirements. The watershed also provides a vehicle by which the Conservancy can advertise its purpose, and encourage participation in its larger goals. Integrating recreation in the watershed, through generating greater use of facilities, would also create a self-policing mentality, helping to cut back on detrimental activities that at present are not discovered until the damage is done.

This in mind, there are some considerations to take into account. Though the infrastructure outside of Conservancy properties need not be maintained, signage both delineating the watershed and providing information about the network would need to be maintained. The extent to which the network is implemented, and the degree to which vandalism and theft play a role, could vary considerably. Also, by connecting the various elements within the watershed, distributed parking options are also an important consideration. A central property, in this case the Conservancy land along Fishing Creek Road, would serve as a base of operations, though as such, facilities there would need to be expanded to accommodate the increased interest. By increasing recreation opportunities, the Conservancy would need to be careful to balance public access and management of environmentally sensitive areas. Increased activity can provide discouragement to reckless behavior, but overuse is still a concern. Finally, by extending the scope of the Conservancy throughout the watershed, there is a potential for disputes with local landowners, particularly when visitors make erroneous assumptions and trespass on private property. Even outside of the confines actual trespass, increased recreation within the watershed could generate opposition among some individuals who pride the area on the degree of privacy it affords them.

2. Key Elements

To create this level of ownership and integration, there are a number of key elements that would form the underpinnings of this recreational paradigm.

Key Element 1: Core Property

The core property would be central to providing a base of operations. This property would be key in describing the network that is the watershed, directing individuals to the various opportunities within the watershed, and finally, providing parking for visitors. Establishing the mission of the Conservancy in the watershed is at the core of this element, as it is the central node in the recreational network. Uses will be diffuse throughout the watershed, but parking will still be an important role of this site.

Specific Recommendations

- Develop signage for the core property, indicating the scope of the watershed, and the Conservancy's mission. Additionally, signage should inform visitors of the opportunities within watershed, and connections to and from these points of interest.
- A formal parking area should be established. This would prevent damage to the road from excessive shoulder use, and provide centrality for signage.
- A regular meeting time should be set up to discuss watershed issues, at least 6 times per year. This should be advertised at the central property.

Key Element 2: Stations and Boundaries

The stations of the watershed would provide interpretive panels throughout the watershed stressing various issues of importance within the watershed. These stations would be accessible via bicycle or automobile, and would focus on the interconnected nature of a watershed. In addition to environmental considerations, the panels would discuss the social and historical implications of the watershed, linking human and natural considerations. Additionally, signage would be placed at entry points into the watershed indicating the boundaries and the role of the Conservancy as steward of Fishing Creek.

Specific Recommendations

- Place "Now Entering/Now Leaving" signs on all major roads, and if possible/affordable, minor roads.
- Signage should be displayed in appropriate areas, but attention should be paid that they are dispersed as much as possible throughout the watershed.
- Consideration should be given for parking at the various stations. While a formal parking lot may not be necessary, sufficient shoulder space should at least be available for safe entry and exit of vehicles.
- Signage should be constructed in a manner to make theft and vandalism difficult. This should include paint resistant coatings and sturdy, damage resistant supports.
- Available options include, but are not limited to:
    - Agricultural Heritage
    - Aquatic Animals
    - Aquatic Insects
    - Aquatic Plants
    - Cultural Heritage
    - Geology
    - Fishery Management Programs
    - Headwaters
    - Native American Inhabitants
    - Ridge Lines
    - Riparian Corridors
    - Soils
    - Stream Restoration
    - Water as a Source of Power
    - Wildflowers

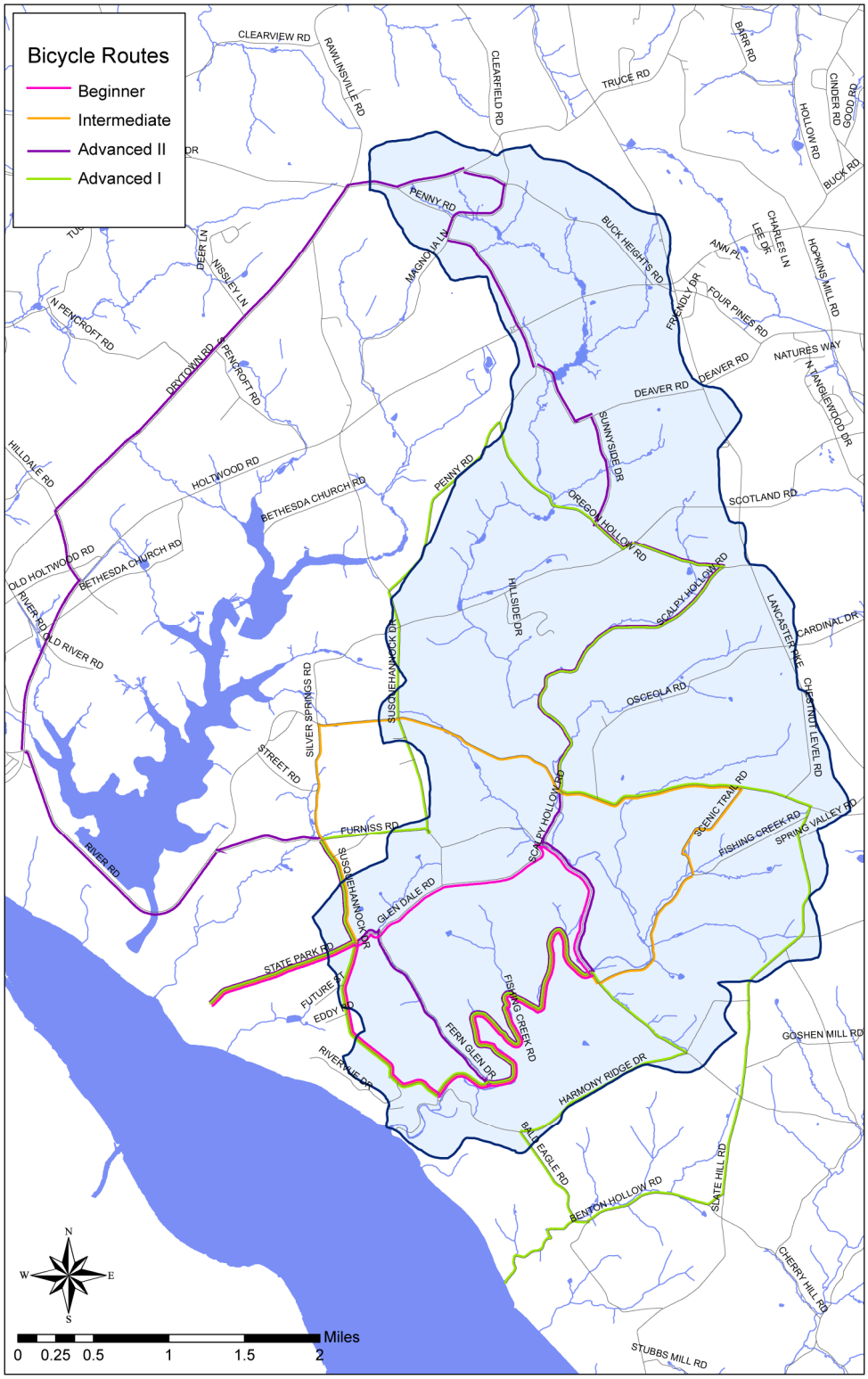
Key Element 3: Bike Network

A network of bike routes, each with its origin in the central property, and designed in a looping course, should be created. These routes would connect properties throughout the watershed, as well as the various educational stations. The network should contain routes of various lengths and levels of difficulty, each clearly marked at intersections, in much the same was as the County's heritage bike routes. Each path would take advantage of outside infrastructure, flexibility in re-routing, and increased visibility of the Conservancy's mission.

Specific Recommendations

- Provide for at least one beginner, intermediate and advanced bike route.
- At core property, provide maps of routes, including points of interest and options for rest and hydration.
- At significant points of interest such as local parks, seek cooperation in the acquisition of bike stands and locking locations to all use of these facilities while minimizing the opportunities for theft.
- Provide signage at all intersections, with each route color coded consistently throughout the watershed.
- Seek to use bike routes as an encouraged alternative to mountain biking throughout the watershed to decrease trail maintenance issues.

Figure VIII-6: Potential Bicycle Routes



Distances:

Beginner
(8.2 Miles)

Intermediate
(12.1 Miles)

Advance I
(23.5 Miles)

Advance II
(22.3 Miles)

Key Element 4: Hiking/Equestrian Trails Network

A hiking and equestrian trails network should be developed to connect various points of interest throughout the watershed. Where trails currently exist, they should be surveyed for future viability and current condition. Where the trails network is deficient, there should be exploration as to new trail placement. The trails should be marked clearly, with indications as to their difficulty noted. When applicable, maintenance should be provided to the trail.

Specific Recommendations

- When possible, redirect trails through pinch points or through areas of manageable, but intentional obstructions to discourage their use by ATVs and mountain bikes.
- Where possible, avoid those soil types that are at risk for severe or moderate soil erosion hazards (due to wetness, steep slopes and soil structure) for recreational trails.
- Take advantage of utility easements for new trail locations.
- Develop an inventory of trails within watershed, with scheduled inspection times.
- Provide maps at the core property showing the watershed's trail network.

Key Element 5: Creeking Trail

Creeking is a relatively new phenomenon combining kayaking with hiking. Generally, this involves small streams that are of sufficient depth to provide pure paddling, yet are of significant size to make wading impractical. Creeking takes advantage of stream right-of-ways to gain access to areas not generally accessible to the public. This interface between a creeker and a stream is much more intimate that conventional paddling and as such furthers the Conservancy's greater watershed goals.

Specific Recommendations

- Provide signage indicating the creeking path at designated put in and take out points.
- Provide for parking at both put-in and take-out points.
- Include a list of stream hazards such as strainers, deadfalls, submerged fences, and hydraulic currents at the put-in point.
- If possible, continue the creeking path to the Susquehanna River.
- Include signage about stream courtesy, particularly as it pertains to landowners and fishermen.
- Place a gauge at the put-in point, and indicate a low water level at which the stream should not be traveled.
- Periodically inspect the creeking trail for deadfalls and other potential hazards.

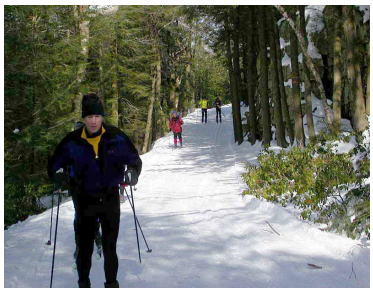
Key Element 6: Recreation Management

This element is broader than those previously, and encompasses encouraging future recreational uses while discouraging uses that are detrimental to the watershed. Like other components, these considerations will have their focus stemming from the core property.

Specific Recommendations

- Geographic Activities
  - Additional geocaching sites should be started within the watershed.
  - The Conservancy should place letterboxes throughout the watershed.
  - The Conservancy should host orienteering events throughout the year.

- Winter Activities
  - The Conservancy should encourage a variety of winter activities such as cross-country skiing and snowshoeing.



- Core-Property Sporting Activities
  - The Conservancy should encourage the Pennsylvania Fish and Boat Commission to classify Fishing Creek as special regulation waters allowing for the use of Catch and Release and the Delayed Harvest, Fly-fishing and Artificial Lures Only areas. This would enhance the use of the stream, bringing more conservation-minded anglers, as well as extending prime fishing longer into the year. This is contingent upon various water quality issues, many of which are addressed in previous chapters of the report. These chapters should be leveraged in this pursuit.

- Heritage hunting regulations would enhance the use of Conservancy properties both inside and outside of the watershed. These regulations would limit hunting to primitive weapons, such as bows, crossbows, atlatls, and flintlock rifles. Previously the Pennsylvania Game Commission has stated it would not be able to specifically enforce these restrictions; this however does not make them without merit. Especially with increased presence in the core property, the mere presence of watchful eyes should discourage violators.

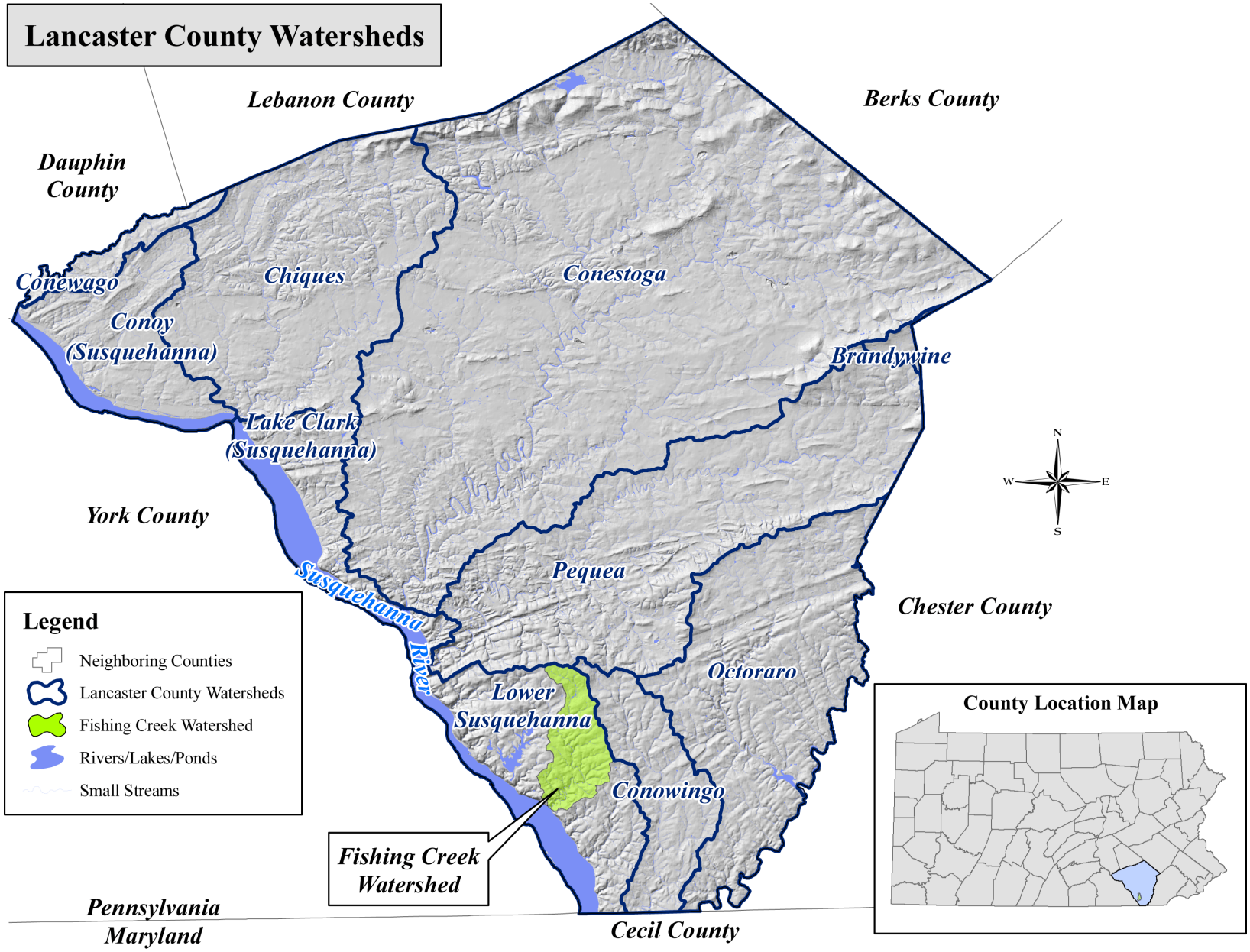
- Detrimental Uses
  - By their very nature, ATVs are designed to navigate a variety of impediments that would typically stop other vehicles. This creates specific difficulties in limiting their use of Conservancy land.
    - Primary attention should be focused on an active presence that discourages ATVs on Conservancy properties, with a self-policing concentration.
    - Provide numbers to call to report violators, and prosecute these violators to the full extent of the law.
    - When damage to Conservatory property occurs, when practicable, seek compensatory damages or community service in lieu of fines, with community service to be served on Conservatory properties.
  - Camping presents a unique challenge, as it occurs largely when the preserve is not occupied by visitors.
    - Encourage people to report camps being set up or taken down.
    - Fine fire, littering and alcohol violations to the full extent.
    - Work with local residents, law enforcement, and Conservancy members to set up periodic patrols during evenings, particularly on weekends.
    - When damage to Conservatory property occurs, when practicable, seek compensatory damages or community service in lieu of fines, with community service to be served on Conservatory properties.
    - Encourage law enforcement to ticket all vehicles parked on Conservancy properties during nighttime hours.

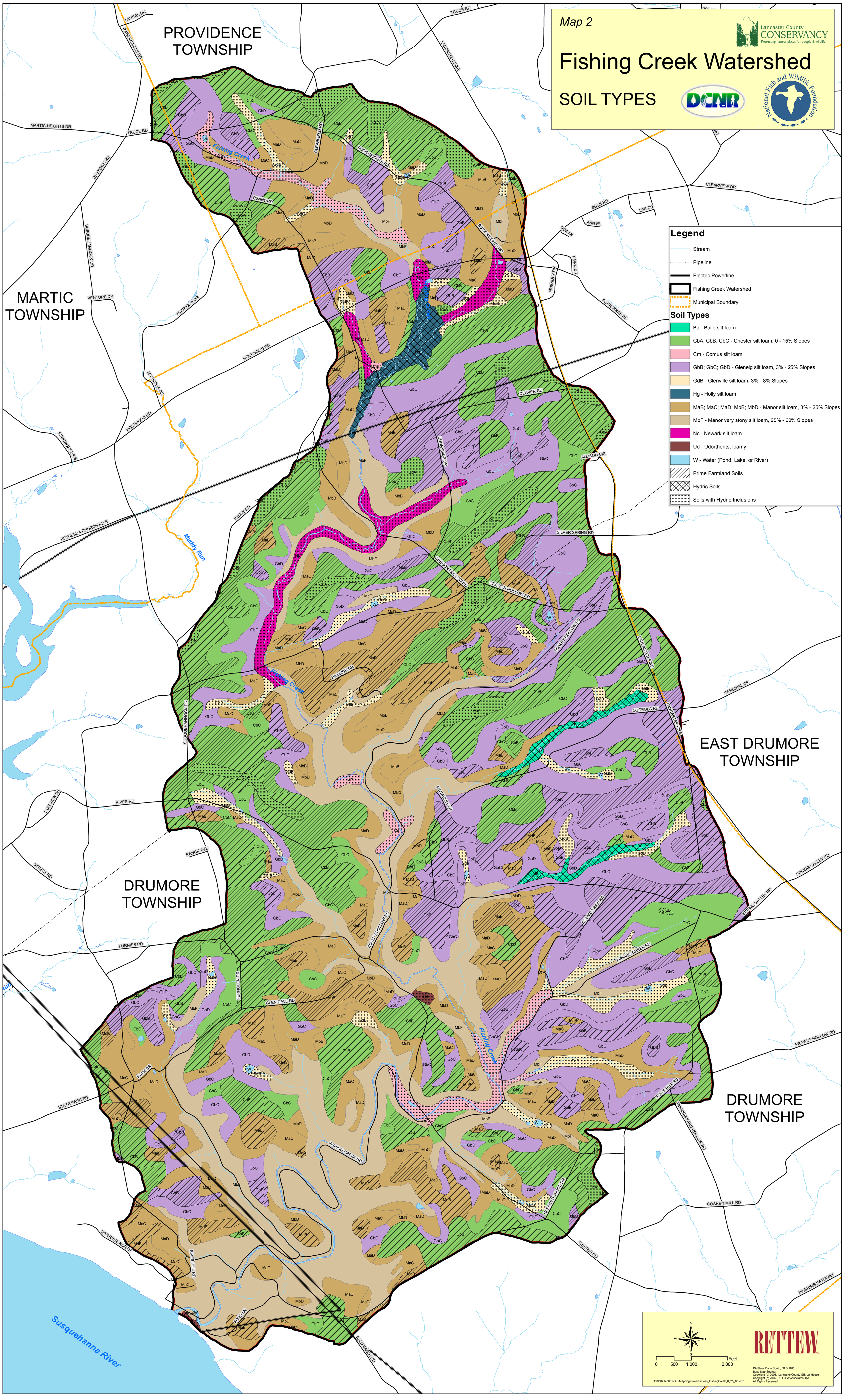
2. Implementation

For implementation, the first key step is developing a presence in the watershed. This will be best achieved by the boundary identification and signage. This will lay the groundwork for future efforts within the watershed. Next, it is critical that any necessary improvements are made to the core property, as once radial uses are established, this will only serve to exacerbate any existing deficiencies. The next step should include the bike routes and educational stations in concert with one another. Though they depend largely upon previous groundwork being laid, these steps provide the first unifying network that transitions the watershed into a truly integrated space. Other recreational considerations should be implemented as time, money and labor permits.

While these recommendations form a blueprint for the Conservancy, they are by no means meant to be confining. As new opportunities present themselves, and previously considered possibilities become liabilities, the Conservancy should adapt. As this model represents a new paradigm, there is also the potential for unforeseen complication. Should these complications endanger the Conservancy's larger mission throughout the County, they would need to be revised, and altered. Largely though, the biggest hurdle will be in dealing with the overabundance of opportunities in a watershed of so much potential.

Figure I-1
Fishing Creek Watershed Location Map




Map 2
Fishing Creek Watershed
SOIL TYPES
Lancaster County CONSERVANCY
Protecting natural places for people & wildlife
DCNR
National Fish and Wildlife Foundation
PROVIDENCE TOWNSHIP
MARTIC TOWNSHIP
EAST DRUMORE TOWNSHIP
DRUMORE TOWNSHIP
DRUMORE TOWNSHIP
Fishing Creek
Muddy Run
Susquehanna River
Legend
Stream
Pipeline
Electric Powerline
Fishing Creek Watershed
Municipal Boundary
Soil Types
Ba - Baile silt loam
CbA; CbB; CbC - Chester silt loam, 0 - 15% Slopes
Cm - Comus silt loam
GbB; GbC; GbD - Glenelg silt loam, 3% - 25% Slopes
GdB - Glenville silt loam, 3% - 8% Slopes
Hg - Holly silt loam
MaB; MaC; MaD; MbB; MbD - Manor silt loam, 3% - 25% Slopes
MbF - Manor very stony silt loam, 25% - 60% Slopes
Nc - Newark silt loam
Ud - Udorthents, loamy
W - Water (Pond, Lake, or River)
Prime Farmland Soils
Hydric Soils
Soils with Hydric Inclusions
0 500 1,000 2,000 Feet
RETTEW
PA State Plane South, NAD 1983
Base Map Source:
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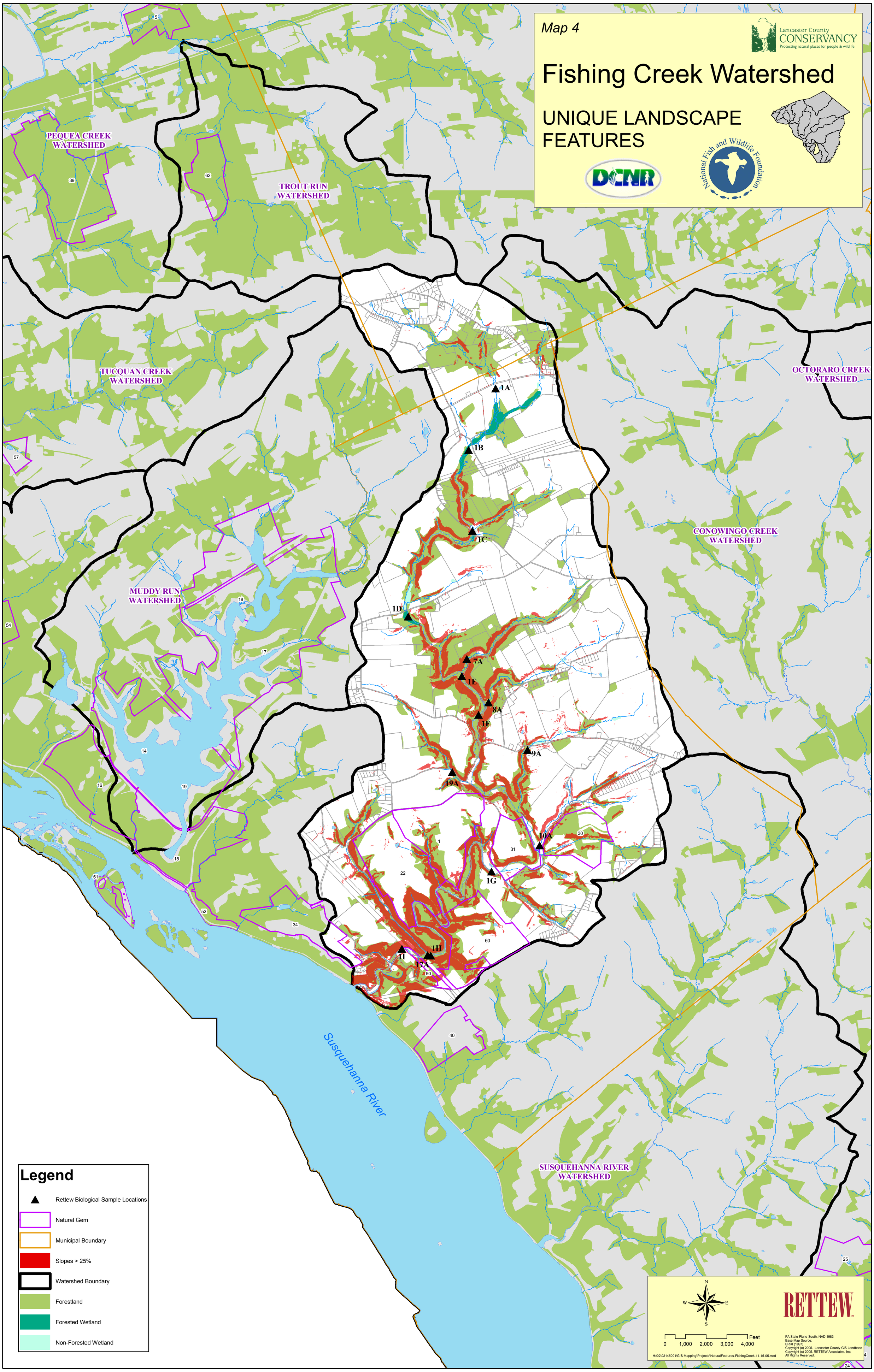
Map 4
Lancaster County CONSERVANCY
Protecting natural places for people & wildlife
Fishing Creek Watershed
UNIQUE LANDSCAPE FEATURES
DCNR
National Fish and Wildlife Foundation
PEQUEA CREEK WATERSHED
TROUT RUN WATERSHED
TUCQUAN CREEK WATERSHED
OCTORARO CREEK WATERSHED
CONOWINGO CREEK WATERSHED
MUDDY RUN WATERSHED
SUSQUEHANNA RIVER WATERSHED
Susquehanna River
1A
1B
1C
1D
7A
1E
8A
1F
9A
19A
10A
1G
1I
1H
17A
Legend
Rettew Biological Sample Locations
Natural Gem
Municipal Boundary
Slopes > 25%
Watershed Boundary
Forestland
Forested Wetland
Non-Forested Wetland
N
W
E
S
0
1,000
2,000
3,000
4,000
Feet
RETTEW
PA State Plane South, NAD 1983
Base Map Source:
ERRI (1997)
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Map 3

Lancaster County CONSERVANCY
Protecting natural places for people & wildlife

Fishing Creek Watershed

LAND COVER AND HABITAT COMMUNITY TYPES

DCNR

National Fish and Wildlife Foundation

PROVIDENCE TOWNSHIP

MARTIC TOWNSHIP

EAST DRUMORE TOWNSHIP

DRUMORE TOWNSHIP

DRUMORE TOWNSHIP

Fishing Creek

Muddy Run

Susquehanna River

LAUREL DR
RAWLINSVILLE RD
TRUCE RD
LANCASTER PIKE
MARTIC HEIGHTS DR
DRYTOWN RD
PENNY RD
BUCK HEIGHTS RD
CLEARFIELD RD
SUSQUEHANNOCK DR
CLEARVIEW DR
BUCK RD
LEE DR
ANN PL
DOE LN
FOUR PINES RD
FRIENDLY DR
FAWN DR
VENTURE DR
MAGNOLIA DR
HOLTWOOD RD
PENNY CT
DEAVER RD
PENCROFT DR S
SUNNYSIDE DR
ALLISON CIR
CENTER RD
BETHESDA CHURCH RD E
SILVER SPRING RD
OREGON HOLLOW RD
SCALPY HOLLOW RD
HILLSIDE DR
CARDINAL DR
OSCEOLA RD
RIVER RD
LAKEVIEW DR
MCCAULEY LN
CHESTNUT LEVEL RD
RANCK AVE
HARVEST VIEW LN
STREET RD
SPRING VALLEY RD
SCENIC TRAIL RD
FURNISS RD
FISHING CREEK RD
FERNGLEN DR
GLEN DALE RD
PRAWLS HOLLOW RD
PARK DR
STATE PARK RD
SLATE HILL RD
TANNING YARD HOLLOW RD
HARMONY RIDGE DR
GOSHEN MILL RD
RIVERVUE NORTH
RIVER HILL RD
RIVERVUE DR
PORT DEPOSIT RD
FORD LN
BALD EAGLE RD
PILGRIMS PATHWAY

Legend

- Stream
- Pipeline
- Electric Powerline
- Fishing Creek Watershed
- Municipal Boundary
- Agricultural Field (4572.90 Acres)
- Coniferous Forest (45.90 Acres)
  - Coniferous Plantation/Stand
  - Hemlock Forest
- Deciduous Forest (2143.02 Acres)
  - Dry Oak-Mixed Hardwood Forest
  - Red Oak-Mixed Hardwood Forest
  - Sycamore-Box Elder Floodplain
  - Tulip Tree-Beech-Maple Forest
- Emergent Wetlands (15.81 Acres)
  - Reed Canary Grass Marsh
  - Wet Meadow
- Farmstead/Barnyard (202.84 Acres)
- Forested Wetlands (38.94 Acres)
  - Bottomland Palustrine Forest Wetland
- Institutional (26.31 Acres)
- Mixed Forest (186.20 Acres)
  - Hemlock-Red Oak Mixed Forest
  - White Pine-Oak Mixed Forest
- Pasture (1127.13 Acres)
- Recreation (16.82 Acres)
- Residential (471.32 Acres)
- Stream, Pond (35.12 Acres)
- Successional Field/Shrubland (266.31 Acres)
- Urban (34.20 Acres)

N W E S

0 500 1,000 2,000 Feet

RETTEW

PA State Plane South, NAD 1983
Base Map Source:

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