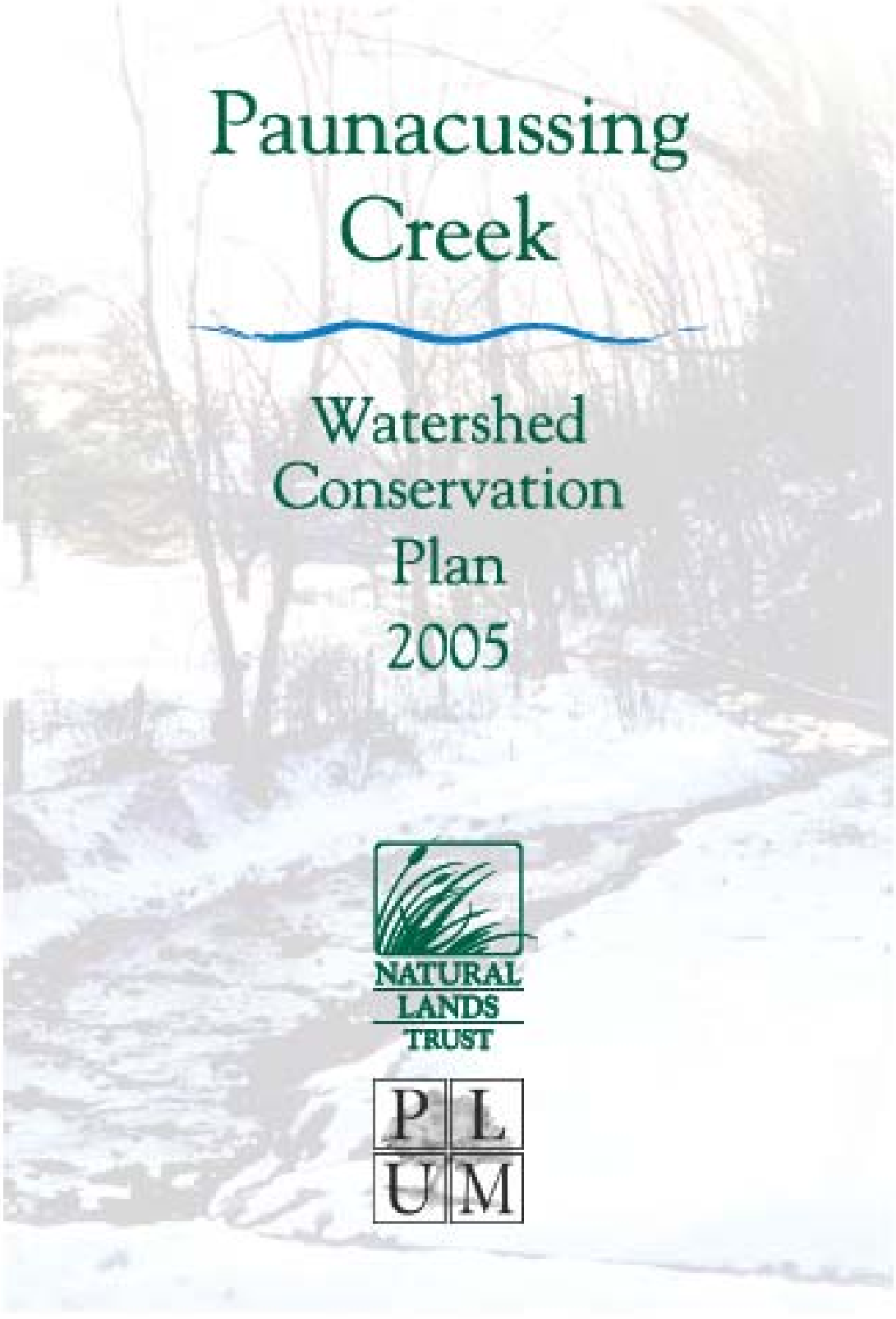

Paunacussing Creek

Watershed Conservation Plan 2005

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PLUM

Paunacussing Creek
Watershed Conservation Plan

Acknowledgements

The *Paunacussing Creek Watershed Conservation Plan* represents the shared vision of the Partnership for Land Use Management (PLUM) and its many allies, without whose help and guidance, this project would never have come to fruition. We thank the following organizations for their contributions to the development, and future implementation, of this Plan:

The Townships of Buckingham, Plumstead and Solebury & their EACs
The Paunacussing Watershed Association
Pennsylvania Department of Conservation and Natural Resources (DCNR)
Pennsylvania Department of Environmental Protection (DEP)
Natural Lands Trust
Delaware Riverkeeper Network
Delaware River Basin Commission
Biohabitats, Inc.
Bucks County Conservation District
Bucks County Audubon Society
Bucks County Natural Areas Program

Your comments on this Plan are welcome. Please address them to:

Natural Lands Trust
1031 Palmers Mill Road
Media, PA 19063
Phone: (610) 353-5587
Fax: (610) 353-0517
www.natlands.org

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FOREWORD

The Paunacussing Creek Watershed Conservation Plan (hereinafter known as "the Plan") is designed to serve as a guidebook for landowners, municipalities, conservation groups, and citizens interested in taking concrete steps to enhance the long-term health of the Paunacussing. Included in the Paunacussing Creek Watershed is the Hickory Run, a smaller, intermittent stream located just east of Ferry Road. A major portion of the Plan is devoted to an Action Plan listing general and specific management recommendations for municipalities, landowners and conservation groups to utilize in planning and funding watershed protection projects.

The Plan includes a summary of findings on existing natural features and physical, biological and chemical stream data gathered in several recent assessments, including the *Paunacussing Creek Non-point Source Pollution Assessment, Paunacussing Creek Landscape Conservation Plan,* and the *Paunacussing Watershed Stream Protection and Restoration Plan.*

Paunacussing Watershed Assessment. It catalogues current and projected land use and land ownership patterns affecting the area and assesses how local zoning ordinances and other municipal tools can be used to optimize the balance of open space and development. The input of municipal and county officials, landowners, and private citizens solicited through public workshops, meetings and interviews has also been summarized. The Plan provides a comprehensive geographic information system (GIS) database of computer map information available to local governments and organizations for environmental planning, conservation and restoration efforts in the watershed.

Funding for *The Paunacussing Creek Watershed Conservation Plan* was provided by a grant from the Pennsylvania Department of Conservation and Natural Resources (DCNR), Rivers Conservation Program. When DCNR approves the final Conservation Plan, the Paunacussing Creek will be submitted for inclusion on the "Pennsylvania Rivers Conservation Registry", providing the basis for DCNR matching grants to municipalities and environmental organizations interested in carrying out local protection and restoration projects listed in or supported by the Action Plan. These municipalities, or groups sponsored by them, will be eligible to apply annually to DCNR for grants to implement the recommendations in the report.

The project team partners are described as follows:

The Partnership for Land Use Management (PLUM) is a local, non-profit organization whose mission is to encourage sustainable growth and development that does not exceed the carrying capacity of the Delaware River Valley's natural environment. PLUM accomplishes this by providing local officials with expert technical research and support that will help them to make decisions about land development within the Paunacussing Creek Watershed.

Natural Lands Trust is a regional, non-profit land conservation organization working proactively to protect significant open lands in communities throughout the greater Philadelphia region. Since its founding in the 1950's, the Trust has helped protect over 100,000 acres of open space, through conservation planning, conservation easements, and a system of 45 nature preserves. The Trust's main preserve in Bucks County is the 108-acre Paunacussing Preserve on Holicong Road in Buckingham Township, situated at the headwaters of the Middle Branch of the Paunacussing Creek. The Paunacussing Preserve protects a combination of scenic productive farmland, a historic 18th-century farmstead, wildflower meadows and forested wetlands that characterize the headwaters landscape of the Paunacussing Creek Watershed. The Trust works with local municipalities to inventory and protect land, and holds conservation easements on over 1,000 acres of contiguous land in the Aquetong Valley Preserve in Solebury Township, approximately one mile south of the Paunacussing.

The communities of the Paunacussing Creek and Hickory Run watershed are fortunate to have retained their rural landscape, historic villages and high quality streams and aquifers that provide a healthy living environment for people, plants and animals. To avoid the fate of other watersheds that have been overcome by sprawl, the Paunacussing and Hickory Run watershed will require dedicated action and cooperation to implement many of the Action Plan recommendations. All of the valuable information, ideas and guidance contained in this Plan are only as good as the ability of local communities to implement them. Effective implementation requires the ongoing commitment of Buckingham, Solebury and Plumstead Townships, PLUM, the Paunacussing Watershed Association, Natural Lands Trust, and other conservation groups, and county and state agencies. In so doing, conservation professionals and volunteers in the Paunacussing area will be making a valuable *local* contribution to landscape conservation in central Bucks County, while also helping to maintain the viability of the lower Delaware River corridor.

Introduction

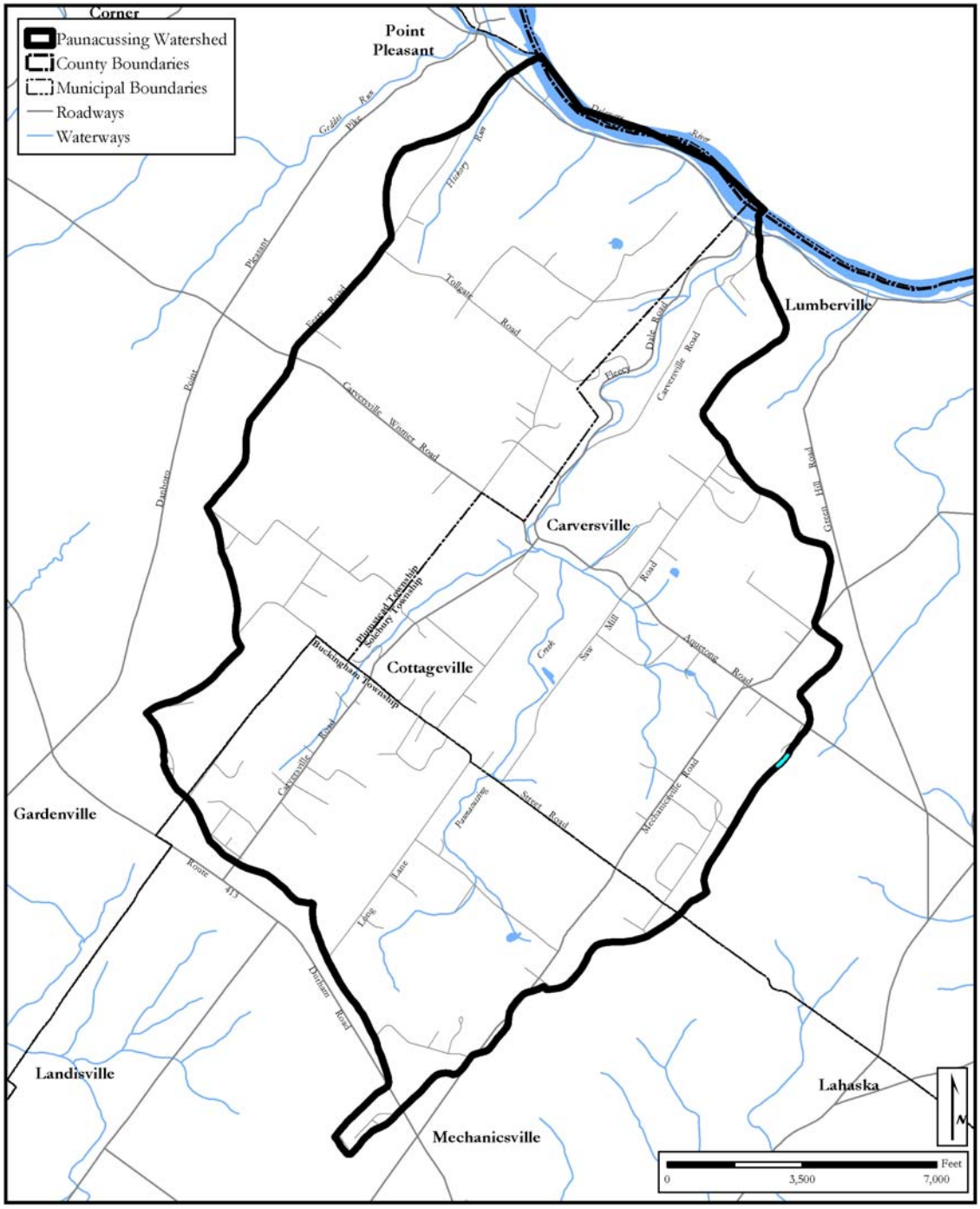
The Paunacussing Creek and Hickory Run watershed and adjoining stream valleys together represent an intact, culturally and ecologically diverse rural landscape of scenic farmland, forested stream valleys and historic villages that characterizes the rapidly growing Lower Delaware River Corridor.

The project study area for the Paunacussing Creek Watershed Conservation Plan is a 10.4-square mile (6,655 acre) landscape that includes all of the Paunacussing Creek and adjacent Hickory Run watersheds and several unnamed tributaries of the Delaware River in Bucks County (**Figure 1 – Location, Figure 2 – Aerial Photograph)**. The stream networks within this area benefit from extensive riparian forest buffers, with approximately 80% of all 11+ stream miles protected by full riparian forest buffers. The area is underlain by a groundwater aquifer contained in the underlying Stockton Formation shale bedrock. The largest blocks of forest-interior habitat (fairly rounded or square woodlands of 30 acres or greater) in this project area are situated on the plateaus and ravines closest to the Delaware River. The entire Paunacussing Creek watershed has been designated a "Priority 2" preservation site in the Bucks County Natural Areas Inventory.

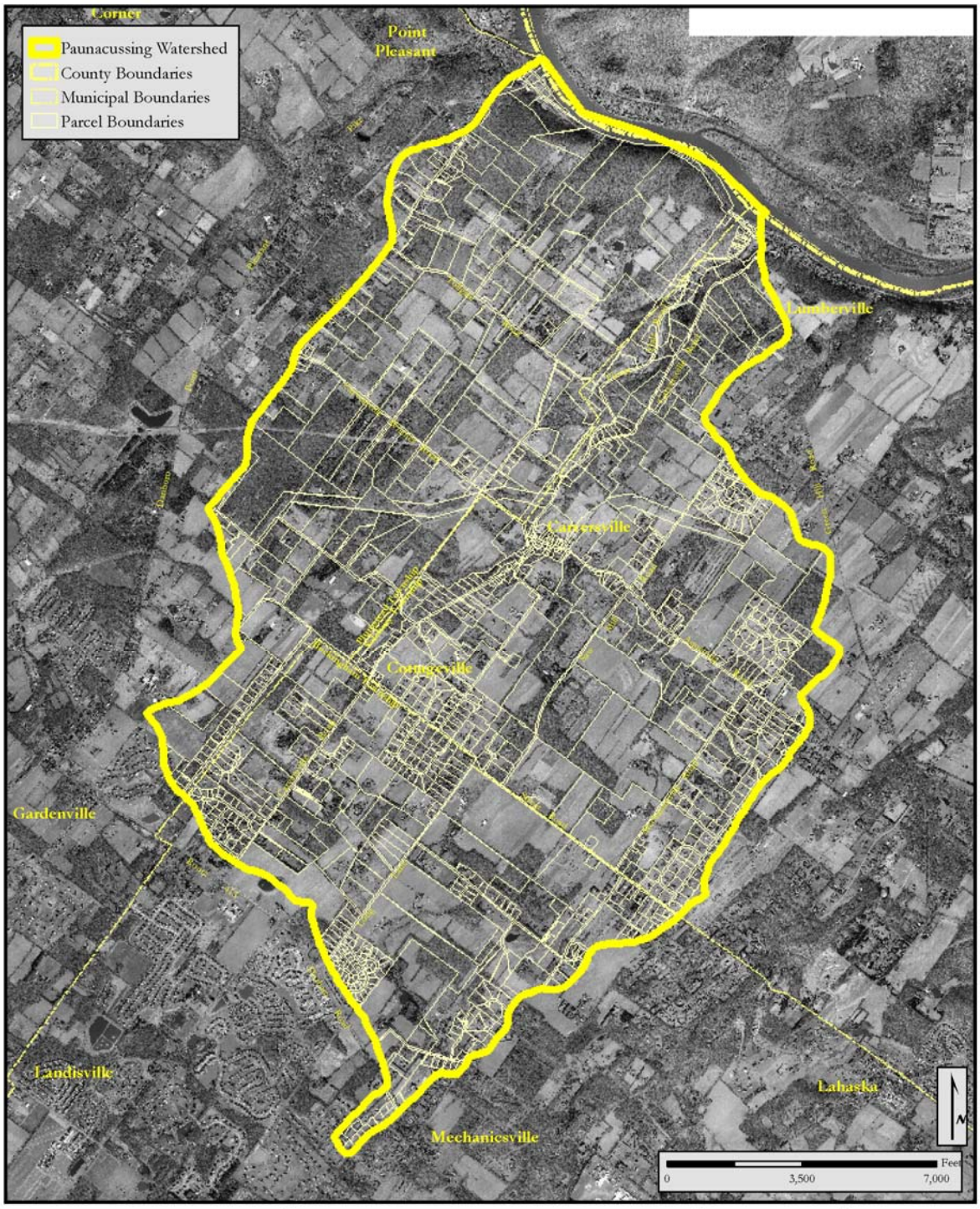
Three distinct landscape types define the Paunacussing/Hickory Run landscape:

1) *Headwater Plateaus(sp)*: the broad, fairly level landscape of historic farms, hedgerows and woodlots in the headwaters areas east of Route 413;
2) *Ravines*: the unusually dramatic forested ravines of oak, beech and hemlock, drained by High Quality, Cold Water Fisheries streams flowing past the historic villages of Carversville, Lumberville, Cottageville and Point Pleasant to their confluences with the Delaware River; and
3) *Delaware River Corridor*: with its broad river channel and prominent forested shale ridges or "palisades" perched high above the floodplain. The ecological and cultural integrity inherent in this landscape has also resulted in an extraordinary combination of unique native plant communities, rich wildlife habitat, and treasured cultural and historic structures and villages.

This unique combination of ecological and cultural factors, and the threat to the Paunacussing landscape posed by rapidly encroaching suburban development in central Bucks County has motivated the townships of Buckingham, Solebury and Plumstead to work aggressively toward permanent protection of key open space properties in the watershed, with significant voter-approved funding for acquisition of conservation



Paunacussing Creek Watershed Conservation Plan Bucks County, Pennsylvania	FIGURE 1 Location	Compiled by: DGR Date: 08/30/05 Data:	Partnership for Land Use Management in partnership with Natural Lands Trust



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 2
2000 Aerial Photograph

Compiled by: EGR Date: 03/30/05
Notes:
1. County boundaries, municipal boundaries, and aerial photograph, accessed through PASDA (www.pasda.psu.edu).
2. Parcels from Bucks County.
3. Aerial Photography dated 2000 from DVRPC.

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easements.[1]. Natural Lands Trust (NLT) includes this landscape in its list of priority conservation focus areas for southeastern Pennsylvania.

The watershed is mostly rural, with over 50% of the land devoted to agriculture and over 25% of it supporting woodlands. The headwaters of the Paunacussing rise in springs feeding three tributary streams flowing through the farm fields, woods, and scattered residential areas east of Route 413. The streams converge in the historic village of Carversville, where they form the main stem that continues flowing east for a mile along Fleecydale Road before reaching its confluence with the Delaware River at Lumberville. All of the people living in the watershed rely on local groundwater and use private wells and septic systems rather than public water or sewer. Because of its relatively undeveloped nature, the Paunacussing has achieved protected status as a state-designated High Quality – Cold Water Fishery stream. The Pennsylvania Department of Environmental Protection (DEP) categorizes the Paunacussing as part of State Water Plan Subbasin 02E, which includes the Delaware River and its tributaries from Tohickon Creek south to Neshaminy Creek.

The Paunacussing watershed and its streams, wetlands, groundwater and landscapes face serious threats from suburban development that is rapidly changing the land use pattern of the area. Indeed, all of central Bucks County in which the Paunacussing Creek is situated has experienced extremely high growth rates and intense development pressure. According to Census 2000, Plumstead Township ranked as the 7th fastest growing municipality in the Philadelphia region, with a population increase of 81% during the 1990s, while Buckingham Township ranked as the 9th fastest growing, with a 76% increase in population. Solebury Township experienced a 29% increase in population over the last 20 years, peaking in the 1990s. Population growth in these municipalities is expected to continue. Land conservation efforts are underway in the area, but the pressure to develop remaining open parcels continues.

As more land is converted to conventional suburban uses, the implications for a small watershed such as the Paunacussing are serious: water quality is typically degraded due to non-point source pollutants contained in runoff from paved areas, lawns, construction sites, and septic systems. Increased impervious surfaces combined with a growing number of private wells combine to take more water out of the hydrologic system faster than it can be recharged. New structures and lawns are designed and built in ways that fragment, degrade and destroy the native habitat because they clear woodlands, meadows and hedgerows. **One of the most important results of this Plan will be to provide clear, concise strategies for avoiding this destructive pattern that has degraded so many watersheds across southeastern Pennsylvania**.

[1] The Solebury Township Open Space Plan (2000) indicates that, between 1990 and 1998, the populations of Buckingham, Solebury, and Plumstead Townships together grew by 55.2%, from 21,277 to 33,765 individuals.

PROJECTS REFERENCED and SUMMARIZED IN THIS PLAN

Title: Paunacussing Creek Landscape Conservation Plan
Prepared by: Natural Lands Trust
Date: 2001
Purpose: To identify priority parcels in the watershed for protection to achieve long term goals for enhancing water quality and conservation of biodiversity.
To expand and prioritize its protection efforts throughout conservation focus area, NLT has prepared a Paunacussing Creek Watershed Landscape Conservation Plan (LCP).
This LCP provides a summary assessment of threats and stresses facing the area, with a series of strategies outlined to abate some or all of the threats and/or stresses. A detailed listing of Landscape Conservation Priorities was generated by using GIS, including parcel-specific identification of critical areas for short-term conservation and longer-term restoration. These properties are shown on the map "Habitat Conservation Networks with Critical Parcels". The majority of the undeveloped parcels over 10 acres in size with frontage along streams in the study area have been identified as priorities. Large contiguous properties with extensive woodlands are also listed as priorities, as are certain large contiguous farm properties.

Title: Paunacussing Creek Non-point Source Pollution Assessment
Prepared by: Partnership for Land Use Management, Natural Lands Trust, Biohabitats
Prepared for: Partnership for Land Use Management
Date: 2003
Purpose: To assess biological and chemical data for streams in the 3 branches and the main stem of the Paunacussing Creek, to determine potential land use and land management impacts, and recommend actions to protect and enhance stream water quality.
The *Paunacussing Creek Non-point Source(NPS) Pollution Assessment* (the Assessment) is the first effort to provide a comprehensive overview of the current water quality conditions of the Paunacussing Creek, and to determine current and future impacts posed by changing land use patterns in the watershed. It is also meant as a guide for local municipalities, which can use its findings to develop much-needed *multi-municipal, water-based, land use regulations* to guide development and conservation in a way that buffers streams and wetlands, maintains critical groundwater recharge, and guarantees that the Paunacussing Creek watershed will continue to provide clean, plentiful water for future generations. This study includes NPS pollution assessments conducted annually by the Paunacussing Watershed Association since the 1990s.

Title: Paunacussing Watershed Stream Protection and Restoration Plan
Prepared by: Biohabitats
Prepared for: Delaware Riverkeeper Network
Date: 2003
Purpose: To assess physical stream characteristics, rank problem areas, and prioritize restoration opportunities such as stream stabilization, riparian buffer establishment, and dam removal.
The *Paunacussing Watershed Stream Protection and Restoration Plan* is based on a stream walk that included a detailed characterization of physical stream conditions along each of the stream channels in the watershed. Criteria such as sediment load, degree of bank erosion, tree canopy and width of riparian forests were used to rank each stream segment in terms of its priority for revegetation and streambank restoration.

A CASE FOR PROTECTION OF THE PAUNACUSSING CREEK AND HICKORY RUN WATERSHED

The Paunacussing Creek, its tributaries and Hickory Run meander through the communities in and around the historic villages of Mechanicsville, Cottageville, Carversville, Lumberville, and Point Pleasant, connecting places and people, and weaving together a local story of ecology, agriculture, industry and changing land use. Hickory Run follows a similar path just east of Ferry Road in Plumstead Township en route to its confluence with the Delaware at Point Pleasant. The living history of these streams can be read in the deep rich woods along Fleecydale Road, the productive farms in the more level headwaters areas, the historic villages, and the expanding network of private and public lands protected permanently as open space. The stewardship ethic of local residents is evident in the well-maintained farmsteads, livable towns, and rich natural areas that define the landscape. There is a growing awareness among local residents, businesses, and municipalities that the quality and quantity of ground- and surface-water are integral to a healthy living environment. The voices and activities of such long-standing organizations as the Paunacussing Watershed Association (1970) and PLUM (1995) are further evidence of the intense interest in conservation in this area.

However, the last 300 years of land use along the Paunacussing Creek and Hickory Run have left a legacy of degradation among certain sections of streams, wetlands, and groundwater, which has compromised the quality and quantity of water, and the health of the local living environment. There are no known hazardous waste sites in the watershed, but vigilance is required to protect local aquifers and wells from this kind of pollution.

Numerous wetlands have been drained and filled to support agriculture or development; thus their vital natural functions as water purifiers, flood control devices, and habitat for flora and fauna have been lost. The stream quality has been degraded by many things:

- clearing trees along banks, floodplains and slopes
- unrestricted livestock access to the creek
- the construction of dams and ponds
- polluted runoff from roads, parking lots, lawns, crop fields and construction sites
- failing septic systems
- the unhealthy heating of streams that are exposed to full sunlight.

Such degradation is exacerbated by reduced baseflows resulting from increased stormwater runoff that causes the water to flow more quickly downstream to the

Delaware rather than seep in and regenerate the local aquifer. Pumping groundwater for wells also adds to the decreased baseflow. It is now difficult to locate breeding populations of native brook trout, an important indicator of stream health which were once common in the Paunacussing stream network.

All of the households in the watershed rely on local groundwater and use private wells and septic systems rather than public water or sewer. Heavy clay soils in the watershed provide poor drainage and tend to support perched water tables that create numerous wet areas. Sand mounds are required for on-site septic systems. Residents have experienced severe flash-flooding due to the topographic nature of the watershed: the flatter, perched water table areas at the west end of the watershed drain rapidly to creeks in steeper ravines that merge into the main stem at Carversville. Historic homes, roads and bridges are often in the path of floodwaters, and the intensity and frequency of floods can be expected to increase as the watershed continues to experience development. Recent flood events have led local residents to form the Carversville Safety Committee to deal with flooding problems in the village

The *Paunacussing Creek Watershed Conservation Plan* provides an overview of key natural and cultural elements as well as water quality and quantity concerns. The Plan also assesses major land use changes that have the potential to seriously alter the health of the watershed and the quality of life of its residents. Water is a vital resource, but it is not infinitely available and it is vulnerable to pollution. Many factors have critical influence on the future of the Paunacussing area as a desirable place to live:

- trends in the ownership of land
- the body of laws that govern land use
- the pattern and density of development
- demands for water supply, wastewater treatment and stormwater management, and the eternal natural cycles of flooding and drought.

Development over the next 20 years and the community's response to that development will decide the fate of the land and water resources that make up the watershed. The *Paunacussing Creek Watershed Conservation Plan* presents concrete recommendations on how the local community can influence the future health of the entire watershed. The series of Recommendations contained in the section entitled: Action Plan.

PRINCIPLES OF THE CONSERVATION PLAN

The Paunacussing Creek Watershed Conservation Plan is prepared with the guidance of the following principles: Throughout the document, more specific goals, objectives and recommendations developed from these primary principles are described:

- **General Awareness.** The Paunacussing Creek Watershed should come to be widely understood by those who live and work in the area as an interrelated natural system of land and water on which humans, plants and animals depend. Raising awareness among municipal officials about their role as watershed stewards is critically important. Such awareness includes the recognition that the issues affecting water quality and quantity in the Paunacussing also affect the ability of the watershed to support all forms of life.

- **Coordinated Action within the Watershed.** Through the coordinated actions of all parties – municipalities, agencies, landowners, citizens, institutions, businesses and private groups – the ecology and scenic beauty of the Paunacussing Creek Watershed should be preserved and, where possible, restored.

- **Coordinated Action with other Watersheds.** Those involved with the implementation of the Paunacussing Creek Watershed Conservation Plan should coordinate their work with other local watershed organizations, such as those working on the Tohickon Creek and Middle Delaware River, so that common issues are addressed in a coordinated fashion.

- **Central Role of Municipalities.** Municipalities should pursue the implementation of recommendations found in *The Paunacussing Creek Watershed Conservation Plan*, using matching funding sources such as the Pennsylvania Rivers Conservation Program, Growing Greener, and funding from private foundations. Multi-municipal water-based land use planning is an essential outcome of this watershed-based planning process.

Natural Features

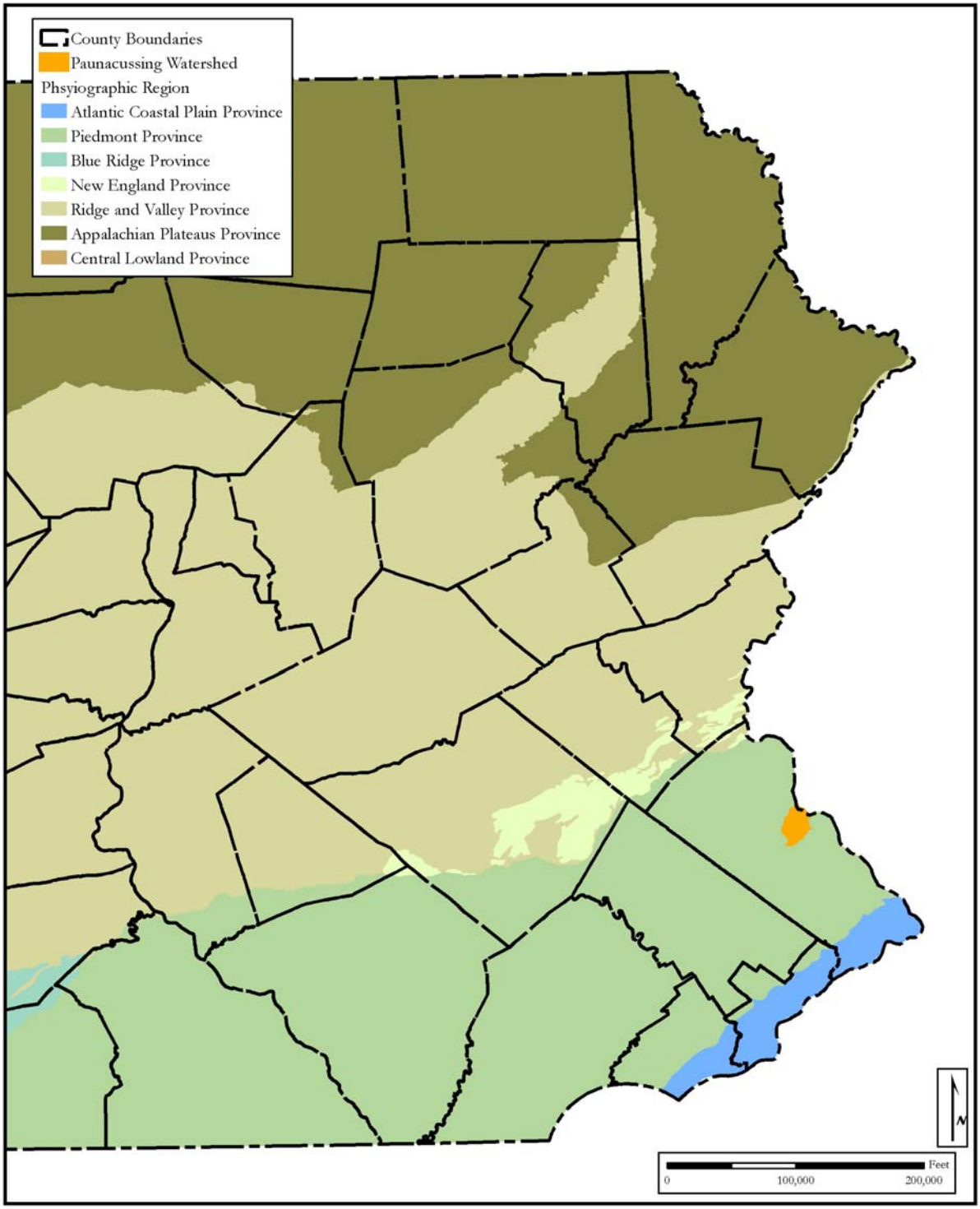
Physiographic Region

The Paunacussing landscape is situated in the lower portion of the 13,539 square mile Delaware River basin. The Delaware River flows for over 330 miles from Hancock, New York to the Delaware Bay estuary and it is the last major free-flowing river in the eastern United States. The streams of the lower Delaware River valley drain much of the southeastern Pennsylvania portion of the Northern Piedmont, a physiographic region extending from northern Virginia to southwestern Maine (The Nature Conservancy, 1996). The natural condition of this region is characterized by its gently rolling landscape of temperate deciduous forest underlain by crystalline and sedimentary bedrock and clay soils on the eastern foothills of the Appalachian Mountains reaching eastward to the Atlantic Coastal Plain. The Paunacussing Creek watershed is a fine representative example of the Northern Piedmont landscape within the Delaware River drainage.

The limits of the project study area are defined by watershed boundaries, roads and areas of contiguous woodland. The Delaware River corridor and state line between Pennsylvania and New Jersey defines the eastern boundary. The southern boundary is a combination of the contiguous woodlands of the lower Cuttalossa Creek valley and the southern boundary of the Paunacussing Creek watershed adjacent to the Aquetong Creek valley. The western boundary largely follows Route 413 (Durham Road) near the drainage divide of the Paunacussing Creek headwaters and adjacent to the Neshaminy Creek headwaters. Finally, the northern boundary follows the Point Pleasant Pike and Groveland Road. **(Figure 3 – Physiographic Region)**

Geology

The Paunacussing landscape is situated within the Newark Basin portion of the Triassic Lowland Province, a broad basin within the Northern Piedmont defined by its fairly young (150 million to 180 million year old) sedimentary shale bedrock geology – namely the Lockatong Formation and Stockton Formation. These sedimentary rocks can reach depths of up to 12,000 feet. The project study area also encompasses the eastern portion of a broad area of igneous (i.e. volcanic) diabase bedrock intrusions, perhaps the most dramatic landform within the Triassic Lowlands. The Stockton and Lockatong formations are



Paunacussing Creek
Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 3
Physiographic Region

Compiled by: DGK Date: 03/30/05
Notes:
- County boundaries, municipal boundaries, and aerial photographs accessed through PASDA (www.pasda.psu.edu).
- Physiographic Regions accessed through PASDA.

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generally reddish brown sandstones, also containing conglomerates, shale and mudstone. These shales are moderately resistant to erosion and weathering. Weathering parent material from these Triassic shales directly forms the reddish-brown soils that characterize the area. **(Figure 4 – Surface Geology)**

Lockatong Formation

Shales of the Lockatong Formation underlie the northern portion of the study area in Plumstead Township, including the Hickory Run area. Lockatong is composed of dark gray to black argillite with occasional zones of black shale. The aquifer in this bedrock has limited capacity, with private wells yielding in the range of 10 gallons per minute.[2]

Stockton Formation

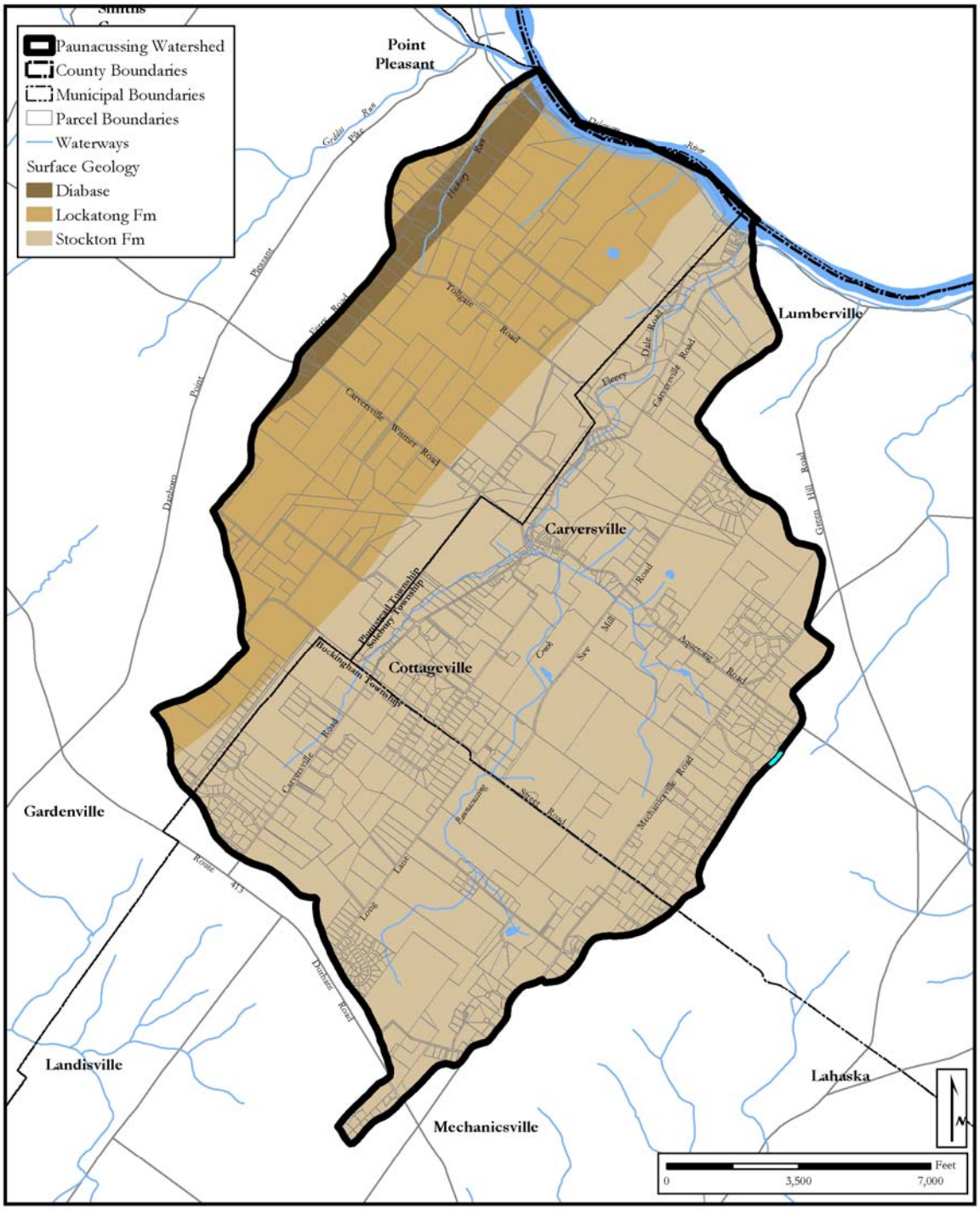
150- to 180-million-year-old shales of the Stockton Formation underlie the majority of the Paunacussing Creek and lower Cuttalossa Creek watersheds. The Stockton Formation is one of the oldest of the Triassic formations. It consists of interbedded arkosic sandstone, conglomerate, red shale and siltstone. This bedrock is especially porous and recharges groundwater efficiently. It has the highest average permeability of any aquifer in Bucks County, with wells yielding up to 500 gallons per minute. The rock outcrops along Fleecydale Road in the lower Paunacussing Creek provide a clear cross-section of the sedimentary nature of these shales. The steeply sloping topography and fairly rapid drop in elevation along the lower portions of streams in the Paunacussing study area indicates that certain sections of the Stockton geology are more susceptible to erosion.

Diabase

Diabase is a minor rock type underlying a portion of the project area, specifically Hickory Run. The prominent wooded ridges and steep slopes along Hickory Run can be attributed to the presence of diabase bedrock. Where diabase occurs as outcrops, it typically forms boulder-strewn ridges and hillsides with occasional boulder fields of "ringing rocks". While some of the boulders along the lower Hickory Run or Geddes Run may be diabase, the lack of larger outcroppings of these boulders in the Hickory Run area suggests that the diabase occurs as a narrow subsurface intrusion. Larger areas of prominent diabase outcrops can be found a short distance north and west of the Paunacussing area. This diabase formation was intruded into the 150- to 180-million-year-old Brunswick shale as molten lava some during that time period. This igneous bedrock heated the adjacent Brunswick shale to form a denser, crystalline, metamorphic rock type known as "hornfels", a rock type that is not mapped for the area but is likely to occur adjacent to diabase.

The igneous nature of diabase explains its physical characteristics as a dense, crystalline, erosion-resistant outcrops that weather to form large boulders, occasionally in broad

[2] Solebury Township Comprehensive Plan, Wells Larsen Appel, 1990. (NOTE: see updated Plan, 2002)



Paunacussing Creek
Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 4
Surface Geology

Compiled by: DGR Date: 03/30/05
Notes:
1. County boundaries, municipal boundaries, waterways, geology, reviewed Borough PASDA (www.pasda.psu.edu).
2. Parcels from Bucks County.
3. Surface Geology reviewed Borough PASDA.

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fields of "Ringing Rocks." Diabase, also known as "black granite" or "trap rock", has been used for headstones and support stones for large engineering projects, but was generally considered too dark to be used as building stone. While these boulders are not evident in the Paunacussing landscape, the quarry on Swagger Road above Geddes Run may have access to some of the subsurface diabase bedrock.

Planning Implications

The Stockton and Lockatong Formation shales tend to underlie landscapes that have fairly level topography and thick clay soils suitable for agriculture – the same general conditions that make land suitable for development. However, the erosion of these bedrock units over time by the streams as well as the Delaware River have shaped the more steeply dissected valleys and sharp ridges of the eastern half of the Paunacussing watershed, which is defined by steep slopes and thin, rocky soils. This topography presents natural limitations to agriculture, large-scale development, road construction, and even to the extensive use of septic systems and private wells.

Triassic shales are relatively good formations for groundwater storage and availability, yet tend to produce soils that are poor in terms of percolation for in-ground septic systems. The profusion of sand mounds in this area of Bucks County is testimony to the poor capacity of shale-based soils to handle septic effluent. The poor recharge capacity of these soils, combined with the relatively high water table at various times of year, causes great concern about the potential impact of septic effluent on the ground water supply upon which most residents rely. Future growth should be based on the carrying capacity of the aquifers in the geologic formations to supply clean, plentiful drinking water while also accommodating septic effluent and runoff from paved surfaces.

The diabase geology underlying the vicinity of Hickory Run is considered a poor source of groundwater, with most groundwater only available within the weathered zone to 30 feet deep, and median yields of 5 gallons per minute (gpm) reported (Cahill, 1994). Most of the underlying geology is too dense and the fractures and fissures too narrow to provide reliable well water on a large scale. Diabase geology also weathers to large boulders and thin soils, thus presenting limitations for construction and maintenance of in-ground septic systems.

Topography/Landforms

The topography of the Paunacussing Watershed can be described as a series of narrow ridges and valleys trending from the southwest to the northeast. The western upland areas are fairly level, with more rolling topography along stream headwaters areas, finally dropping sharply to ravines in the lower stream valleys and along the bluffs

above the Delaware River to the east. These sharp drops can be attributed to the varying erosion of the shale and sandstone geology. Much of the area averages 350 to 400 feet above sea level, but the steeply sloping areas along the lower stream valleys and just above the Delaware River drop sharply. The sense of ridges and valleys that define the terrain is borne out by local road and place names such as Green Hill Road, High Ridge Circle, Ridgeview Drive, Highmeadow Road, Rocky Ridge School, and Plumstead Hill.

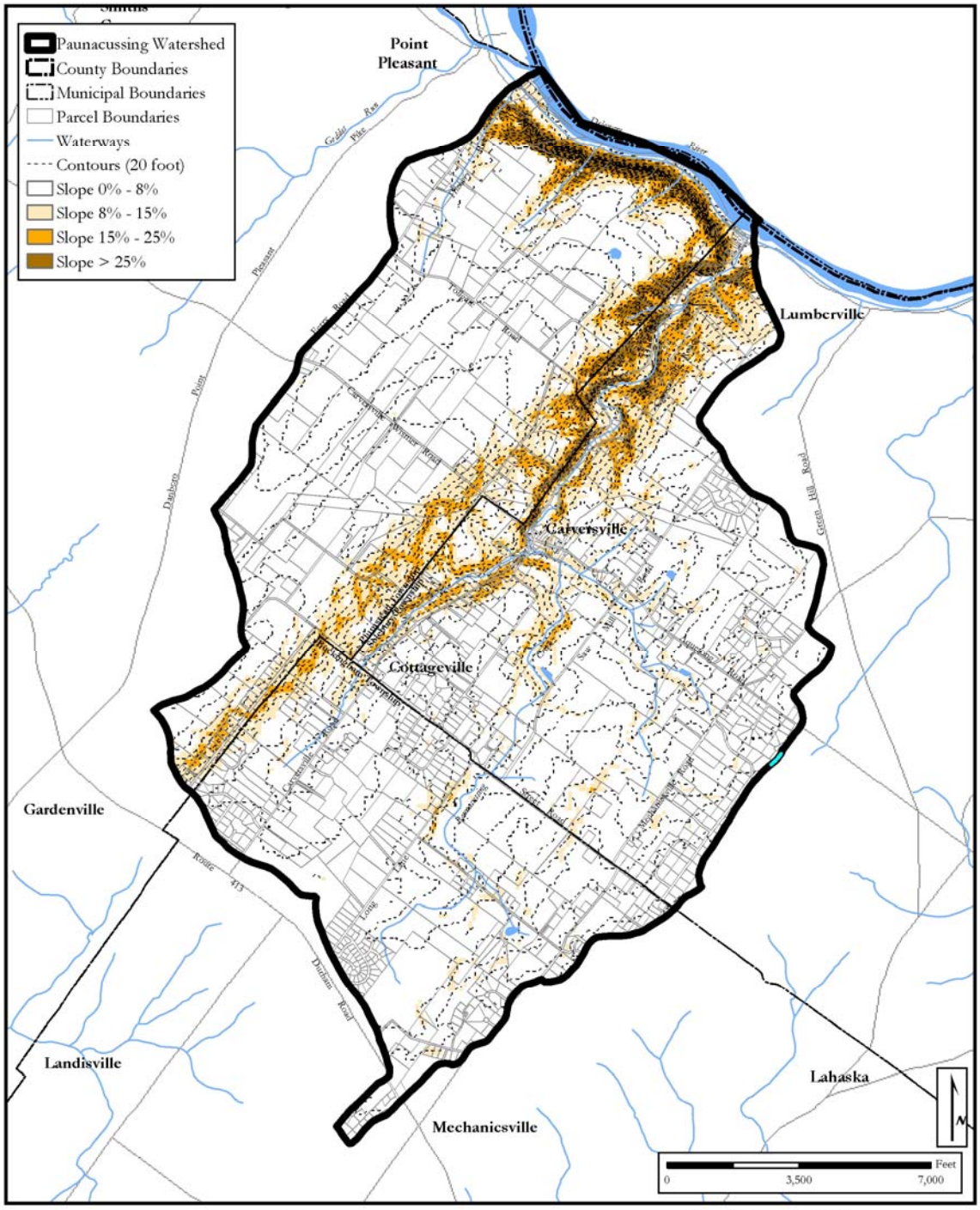
The highest points in the Paunacussing Watershed occur along Plumstead Hill, the ridge just north of Cottageville and Carversville, which separates the Paunacussing and Hickory Run drainages. Plumstead Hill reaches an elevation of 569 feet just east of Gardenville. The study area reaches its lowest point (approximately 90 feet above sea level) along the Delaware River floodplain just below Lumberville. The most dramatic example of the steep topography of the area,often in excess of a 25% grade, can be found along the Delaware River palisades, where the elevation drops precipitously 300 feet from the top of the palisade to the level of the Delaware riverbed over a relatively short distance of less than 1,000 feet. The floodplain of the Delaware River is narrow as it passes through the study area. **(Figure 5a – Topographic Features, Figure 5b – USGS Topographic Quadrangle)**

Planning Implications

The topography of the vast majority of the land in the Paunacussing Creek Watershed can be considered suitable for development, with at least 80% of the total land area supporting fairly level terrain with few constraints such as steep slopes, prominent ridges or floodplains. Areas closest to the lower stream valleys (east of Aquetong Road) tend to be more rolling and steep, with narrow roads and small bridges across streams. These qualities make it less favorable to large-scale residential development but may be attractive to custom builders seeking to place large single-family homes on large lots in this landscape.

The portions of the Paunacussing Watershed that are mapped as "steep slope" are situated within Solebury and Plumstead townships. Construction on slopes of 15-25% and 25% or greater is regulated in both townships. The Zoning Ordinance for Solebury Township (as amended through June 15, 1999 and currently being re-written in 2004/2005) designates a Steep Slope Conservation District that limits construction of buildings, roads, septic systems and stormwater management facilities on slopes greater than 20% by requiring a Conditional Use permit.[3]

[3] *Solebury Township Zoning Ordinance, as revised.*



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 5a

Topographic Features

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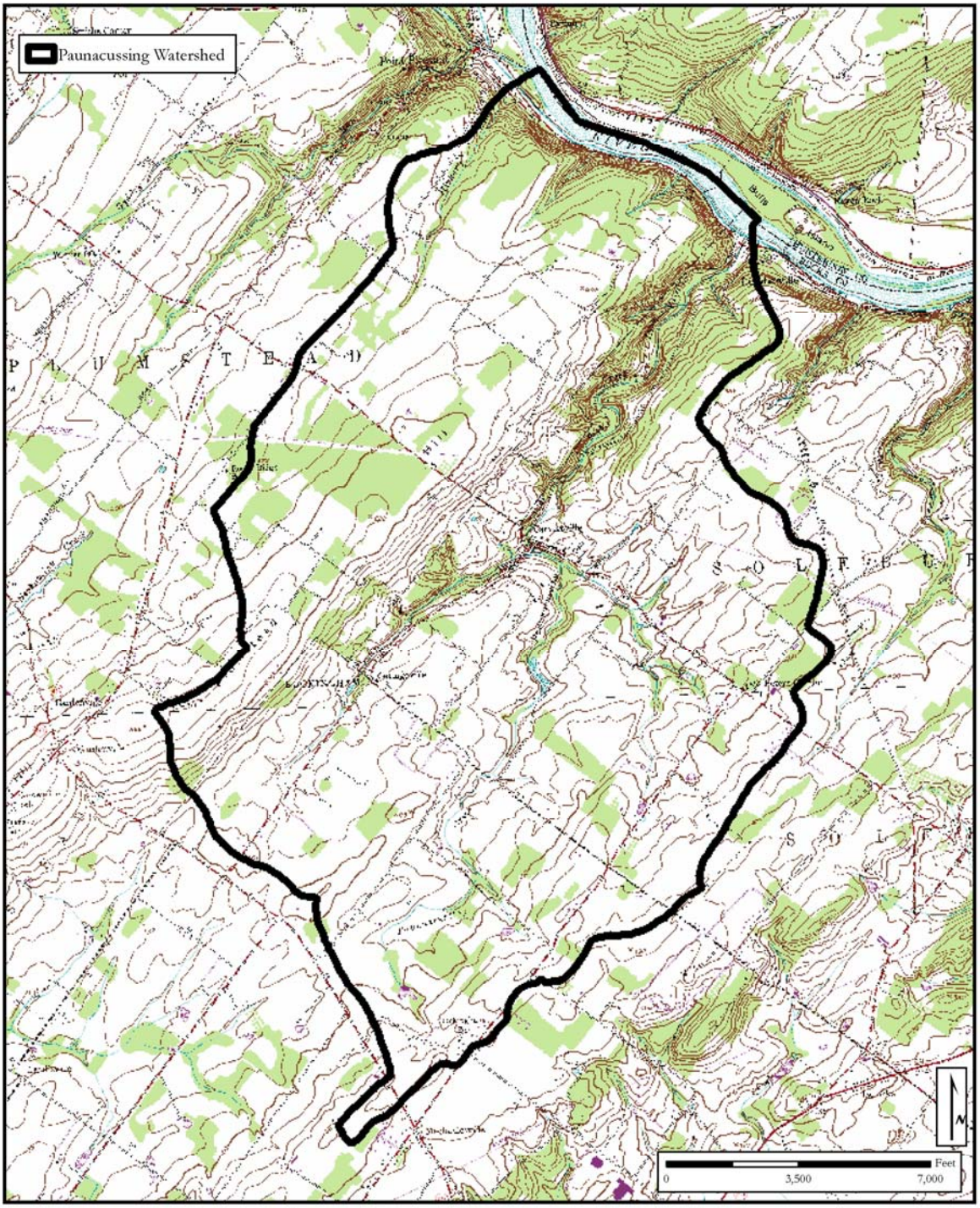

Paunacussing Creek
Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 5b

USGS Topographic Quadrangle

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Soils

Soils are perhaps the fundamental resource linking geology, topography, hydrology, vegetation and land use. They are formed over thousands of years by a combination of weathering bedrock and decomposing forest organic matter. The varying rates of permeability determine the balance of runoff and recharge throughout the watershed, and shape the natural pattern of vegetative communities. Agriculture has historically been focused on the deepest, most productive soils of the broad valleys, whereas the thin soils of the ridges have typically been managed for timber and recreational uses such as hunting and summer camps. Soils are also critical components of the water quality equation due to their varying capacities for filtering pollutants generated by human activities such as septic systems and fertilizer applications.

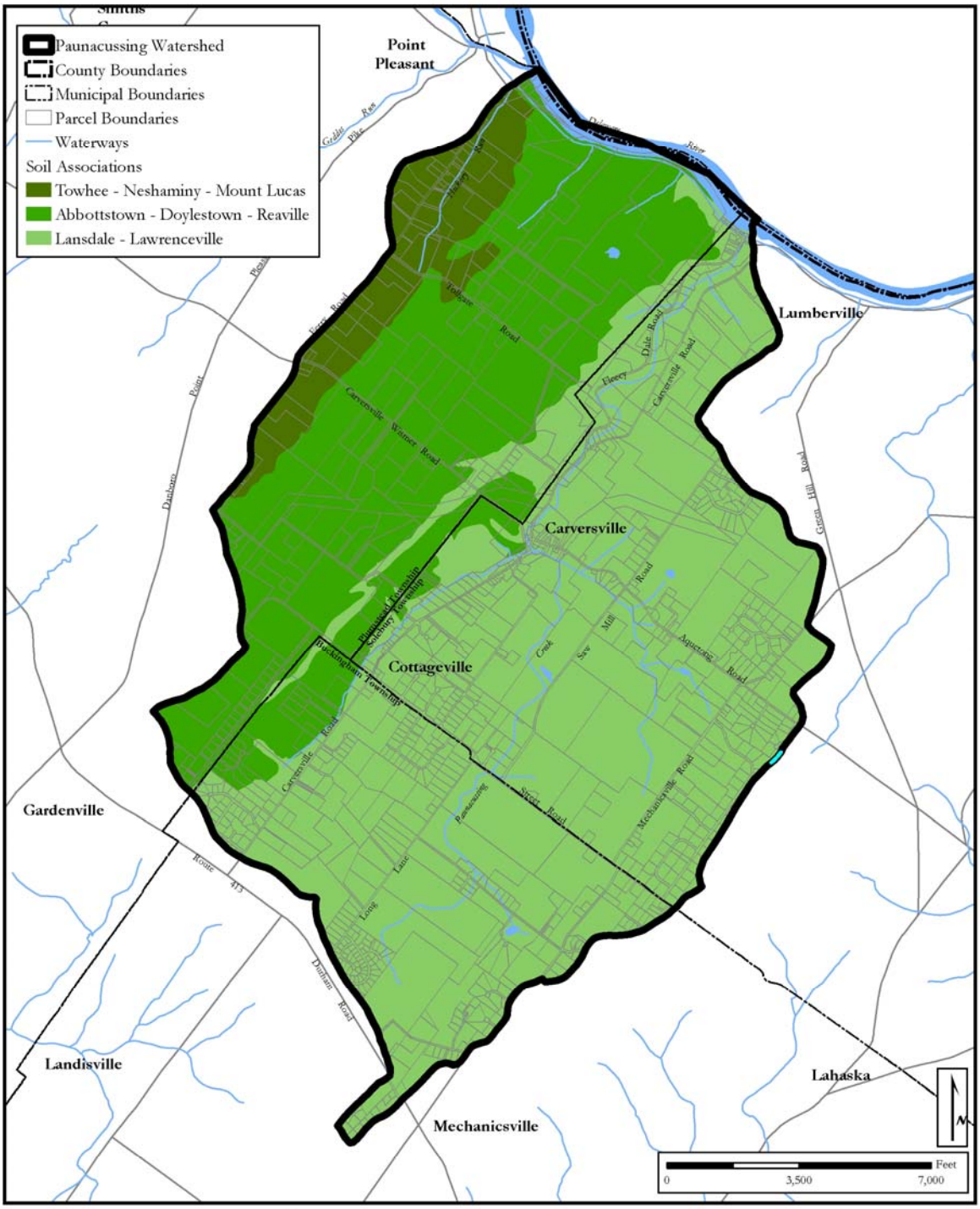
The red soils in the Paunacussing Watershed have formed over thousands of years from a combination of weathering shale and sandstone parent material and decomposing organic matter from deciduous forests. These are generally moderate- to poorly-drained soils of uplands, with shallow depth to bedrock. They occur in three main soil series: Lansdale-Lawrenceville; Abbottstown-Doylestown-Reaville; and Towhee-Neshaminy-Mount Lucas. **(Figure 6 – Soil Associations).** Many soils throughout the central and eastern parts of the watershed are rated by the United States Department of Agriculture as Statewide Important Agricultural Soils, with smaller pockets of Prime Agricultural Soils. Large properties containing these soils may be candidates for the Bucks County Agricultural Land Preservation Program **(Figure 7 – Agricultural Soils)**.

Lansdale—Lawrenceville

Soils of the *Lansdale—Lawrenceville Series* are nearly level to sloping, moderately well drained and well-drained soils on uplands, and typically overlay Stockton Formation shale and sandstone geology. These soils extend in a band east from the Doylestown area to the Delaware River at Solebury, largely covering the lower half of the Paunacussing Creek project area. A smaller percentage of Chalfont, Bowmansville and Doylestown soils area also included in this series. The main limitations of Lansdale-Lawrenceville soils are a seasonal high water table and restricted permeability. Soils within this series include:

Abbottstown—Doylestown—Reaville

Soils of the *Abbottstown—Doylestown—Reaville* Series are nearly level and gently sloping, moderately deep to deep, poorly drained to moderately well-drained soils on uplands, generally formed over loamy and silty shale and sandstone parent material of the Lockatong Formation. They extend in a wide band from the Montgomery County line eastward to the Delaware River at Plumstead, and include the majority of the soils in the north half of the Paunacussing Watershed. A smaller percentage of Reaville,



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 6
Soil Associations

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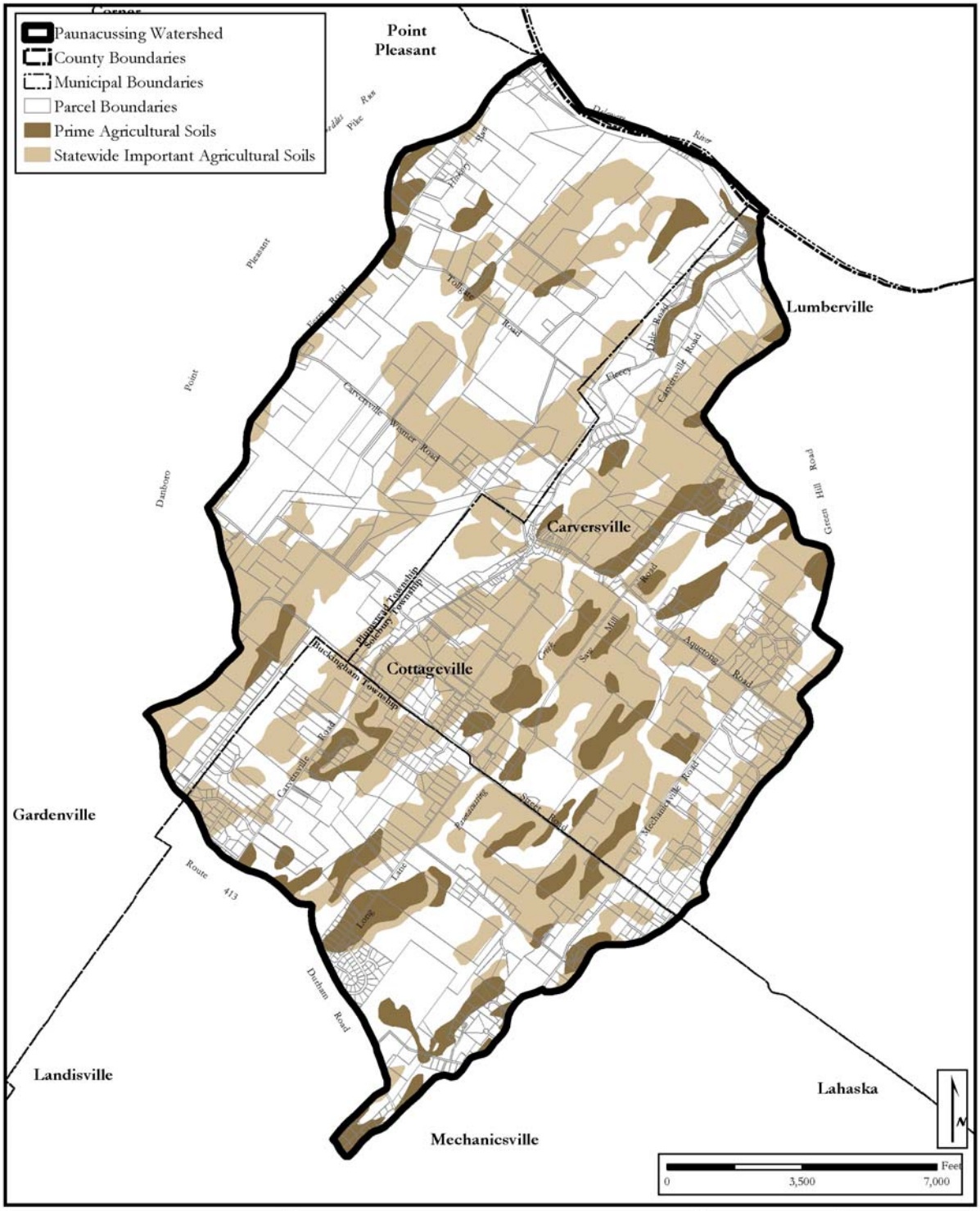

Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 7
Agricultural Soils

Compiled by: DCR Date: 03/30/05
Notes:
1. County boundaries, municipal boundaries, waterways, sourced through PASDA (www.pasda.psu.edu).
2. Parcels from Bucks County.
3. Soils from USDA NRCS.

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Readington, Bedington, Klinesville and Penn soils area also included in this series. High water table, restricted permeability, and depth to bedrock are the primary limitations of soils in this series.

Towhee-Neshaminy-Mount Lucas

Soils of the Towhee-Neshaminy-Mount Lucas Series typically occur over weathering diabase bedrock along hilltops, ridges and lower slopes, and can be found in the program area on the ridges and slopes along Hickory Run. They tend to be stony or have large boulders close to the surface, and are poorly drained, with a high water table often from fall through spring. As such, these soils have severe limitations for development.

Soil Association Type:	Geologic Origin	Topographic Position	Land Use Limitations	Distribution in Watershed
Lansdale-Lawrenceville				
Lansdale (LaA, LaB, LaC, LaD, LdD)	Shale and sandstone	Hills with broad, rounded summits and short, steep side slopes	Few limitations for agriculture. Moderate limitations for residential development include short, steep, eroded slopes and bedrock near the surface.	Overlying Stockton Formation bedrock, particularly along palisades over Delaware River south and east of Main Stem.
Lawrenceville (LgA, LgB)	Shale and Sandstone	Undulating and level uplands	Deep, moderately well-drained soils with seasonal high water table (1.5 to 3 ft. from surface). Development limitations include inoperative septic tanks, wet basements, and severe erosion after soil disturbance.	Overlying Stockton Formation south and east of Main Stem and North Branch.
Chalfont (CaA, CaB)	Sandstone and alluvial deposits.	Along tributary streams and headwater areas.	Hydric soils with high water table from .5 to 1.5 feet from surface in winter and spring. Moderate to severe limitations for development. Poor recharge.	Paralelling north, middle and south branch headwaters streams.
Bowmansville (Bo)	Alluvial deposits.	Major streams and rivers, some headwaters.	Formed from deposits of upstream sediments. Coincide with floodplain and are subject to flooding. High water table.	Floodplains of Hickory Run, Paunacussing and its tributaries.

Soil Association Type:	Geologic Origin	Topographic Position	Land Use Limitations	Distribution in Watershed
Abbottstown-Doylestown-Reaville				
Abbottstown (AbA, AbB) Doylestown (DoA, DoB)	Shale and sandstone	Base of slopes, on side slopes, and broad ridge tops.	Deep and poorly drained with limited permeability, compact subsoils with seasonally high water table. Prevents on-lot sewage disposal systems from operating efficiently, causes wet basements, & deterioration of paved surfaces.	Over Lockatong Formation, Plumstead Hill area upslope from north branch and north of Carversville, south of Hickory Run.
Reaville (ReA, ReB)	Shale and sandstone	Rolling uplands	Moderately deep, somewhat poorly drained with seasonal high water table.	Adjacent to Abbottstown soils on Plumstead Hill and near Carversville.
Readington (RdB)	Shale and sandstone.	Ridges and uplands.	Seasonal high water table (1.5 to 3 feet below surface), Prime Agricultural Soil, slow permeability, poor for septic.	Along Plumstead Hill above North Branch and Carversville.
Bedington (BeA, BeB, BeC)	Shale and sandstone	Ridges and uplands.	Same as above	Limited areas along Plumstead Hill.
Klinesville (KlA, KlC, KlD)	Shale and sandstone.	Uplands, gentle to very steep slopes.	Shallow, well drained upland soils.	Limited bands on Plumstead Hill and above Paunacussing Creek.
Penn-Klinesville (PlE, PlD)	Shale and sandstone.	Steep slopes.	Shallow soils, high erosion potential, shallow depth to bedrock. .	Plateaus and slopes above lower Main Stem and Delaware River.
Penn-Lansdale (PnA, PnB, PnC)	Shale and sandstone.	Uplands.	Shallow depth to bedrock.	Scattered in southern half of watershed.

Soil Association Type:	Geologic Origin	Topographic Position	Land Use Limitations	Distribution in Watershed
Towhee-Neshaminy-Mount Lucas				
Towhee	Diabase.	Moderately steep hills and low-lying areas between hills	Main limitations for land uses include slope, stoniness, seasonal high water table (0.5 feet from surface fall through spring) and restricted permeability.	Narrow band follows Ferry Road and Hickory Run. Over Lockatong bedrock.
Mount Lucas	Diabase.	Hilltops, ridges, lower slopes.	Slow permeability in subsoil. Hydric (water table 1 to 2.5 feet from surface). Large boulders, bedrock 5 to 10 feet from surface.	Ridge and slopes north of Hickory Run.

Planning Implications

The majority of the soils that constitute the landmass of the Paunacussing Watershed are characterized by poor drainage, high water table, shallow depth to bedrock, and rocky ridges and slopes. These qualities demonstrate that the gradual erosion of the underlying sandstone, shale and diabase geology, coupled with the close proximity to the lower Delaware River, have created a landscape where water and rock are common factors affecting the uses of the land and soil.

It is remarkable that, of the 16 main soil types that make up the Paunacussing Watershed, the USDA-NRCS Soil Survey for Bucks County rates all but 2 as having natural constraints to development, most frequently due to poor recharge qualities, high groundwater table, or shallow depth to bedrock. These include the most common soil types in the area, and they point to the fact that the area cannot handle significant increases in on-lot disposal of sewage effluent (with or without sand mounds) without seriously threatening the carrying capacity of the land to supply clean groundwater for the private wells used by most residents.

These limitations are serious enough to warrant careful consideration of the groundwater impacts of any proposed land development plan in the area. Where construction of new septic systems is permitted, protection of existing wells and ground water quality in the area should be guaranteed with accurate hydrologic documentation and escrow funds to cover the cost of replacing failed wells (see p. 67, Major Issue #5, Protection of the Local Aquifer, Recommendations and Background).

The attached GIS maps show areas of hydric and prime agricultural soils in the Paunacussing Watershed. These are the soils of most concern and interest for conservation planning, indicating preservation opportunities. While only a small

number of hydric soils has been recorded on the Hydrologic Features Map **(Figure 9)**, extensive prime agricultural soils of statewide-importance are shown in the Paunacussing Watershed.

Approximately 70 % of the project area has important agricultural soils, with the greatest amount falling into the Class 3 category of Agricultural Soils of Statewide Importance. Many of the farms that include these soils are eligible for agricultural preservation through the Pennsylvania's Agricultural Easement program, administered locally by Bucks County and, in some cases, with the assistance of municipal open space funding. These soils are shown on the Agricultural Soils Map (Map # 7). The critical mass area (several hundred acres) of contiguous Class 1, 2 or 3 soils that occurs at the headwaters of Paunacussing Creek and Hickory Run should be closely evaluated for agricultural preservation.

Hydrology

Surface Waters

The project area for the *Paunacussing Creek Landscape Conservation Plan* , prepared by NLT in 2001, included part or all of eight tributaries of the Delaware River and over 3 miles of frontage on the west bank of the Delaware River. More than 20 stream miles were included in the study area, in addition to the river frontage. The entire Hickory Run, Paunacussing Creek, and Copper Nose Run stream systems were included, and the lower portions of three main tributaries of the Delaware River (Tohickon Creek, Geddes Run and Cuttalossa Creek). Two unnamed First Order tributaries of the Delaware were also included. First Order streams are the smallest, unbranched, mapped tributaries in a watershed, flowing from a source or point of origin such as a spring. When two First Order streams converge, they form a Second Order stream, and so on.

These streams are generally characterized by the influence of natural conditions such as the underlying shale-based geology and the topography of level headwaters areas and steep ravines, combined with the long history of human influence: the initial forest clearing, agricultural use, construction of mills, dams and ponds, road and building construction, and modern development, conservation and restoration. The physical characteristics of the stream channel, the quality of the water (chemical, biological and physical), and the quantity of water during periods of average flow, draught and flooding are all influenced by the interaction of these natural and cultural forces.

As land in the watersheds continues to face increased pressure for subdivision and development, conservation and restoration of land along the streams are perhaps the most important steps that can be taken to counterbalance the impact of development. **Protection of local aquifers is also essential for sustaining streamflow and well water supplies (see p.66, Major Issue #5 – Protection of Local Aquifer).**

The Paunacussing Creek, at the heart of the study, drains a watershed of over 5,000 acres with approximately 11.6 miles of stream system; the main stem flows for nearly half of the stream's length from the Paunacussing Preserve to the Delaware River. The system includes three main headwaters branches draining the uplands in most of the western half of the watershed, converging at Carversville, where the main stem flows from there to the northeast through the steep ravine along Fleecydale Road en route to its confluence with the Delaware River at Lumberville. The Paunacussing is a Third Order stream, indicating that it drains a relatively small area with few major tributaries.

The headwaters streams of the Paunacussing are relatively shallow and narrow, with beds of alluvial silts, sediments, sands and gravels. As the streams enter the ravine in the vicinity of Carversville, the channels become wider and deeper, flowing past larger rocks, boulders and rock outcrops of the underlying shale. Severe erosion and cutting of stream banks below Carversville indicate the intense velocity and volume of runoff concentrating in the lower reaches of the stream during storm events. The land along the stream corridor below Carversville is mapped as floodplain, as are certain segments of the headwater tributaries, including most of the south branch along Mechanicsville Road and Aquetong Road.

The Paunacussing is a High-Quality, Cold-Water Fishery (HQ-CWF), as designated by the Pennsylvania Department of Environmental Protection (DEP), owing to the relatively undeveloped nature of the watershed and the amount of forested buffer along the stream network. However, at least 12 ponds have been identified, mostly on farm or residential properties along the three main headwaters tributaries. The total surface area of these ponds relative to the overall surface area of the stream network may be a contributing factor in warming the temperature of water in the Paunacussing. Warmer temperatures may have an affect on reducing the diversity or stream organisms and contribute to algae blooms. To optimize stream health and the cool water conditions required by many stream organisms (including the cold water trout), consideration should be give to the replacement of certain ponds with restored wetlands (including the pond at Natural Lands Trust's Paunacussing Preserve).

A stream geomorphology study has been prepared by the Delaware Riverkeeper Network through a grant from DEP. These efforts provide an excellent and detailed GIS database of land use and stream quality and quantity issues on the Paunacussing, and provide a roadmap for local organizations, landowners, and municipalities to work together toward watershed conservation and restoration.

Hickory Run

Hickory Run is a small First Order tributary that rises in the headwaters area north of Plumstead Hill and flows for just over 2 miles to the northeast along the south side of Ferry Road toward its confluence with the Delaware River at Point Pleasant. The stream is fairly narrow and shallow for most of its length, dropping into a steeper wooded

ravine after flowing past Tollgate Road. The watershed that drains to Hickory Run averages less than one mile in width, and comprises about 960 acres. The headwaters area includes some roads (Tollgate Road, McNeil Road) with roadside ditches that drain directly to the run, carrying with them road pollutants and sediment. The greatest concentration of hydric soils in the Paunacussing Watershed can be found along the Hickory Run headwaters, indicating that the stream is fed by numerous seeps, springs emerging from areas of seasonally high water table. The large forested tract between McNeil Road and Wismer Road is situated over these wet headwaters soils and provides an important natural filter, flood regulator and habitat for Hickory Run. Only two small ponds are situated along Hickory Run, both in the headwaters area along McNeal Road. These farm ponds may contribute slightly to thermal pollution (raising the water temperature through solar-heating) of the stream.

Planning Implications

The streams in the area are vulnerable to ongoing non-point source pollution impacts and erosion and flooding problems. On the quality side, pollutants such as road salt, hydrocarbons and sediments carried by runoff channels along the ditches of paved and dirt roads drain directly into these streams through culverts, swales and sheet flow. Runoff from farm fields and lawns in the watershed carries nutrients, pesticides and sediments directly to streams. Where a wooded strip of 50 feet or more buffers the stream, these pollutants are less likely to reach the stream as sheet flow is intercepted by natural vegetation and pollutant-laden sediments settle out and are filtered by plants and soils.

The acreage of land that is currently tilled or grazed for agriculture, or supports fields, thickets or woodlands is gradually shifting to residential lawns and impervious rooftops, driveways and roads. As this trend continues, the need for protected open space and innovative stormwater management approaches will become increasingly important to the health and viability of local streams. Two of the most important strategies to protect streams include the preservation and restoration of sizeable natural open space networks along streams, and the use of stormwater management systems that maximize filtration and recharge of stormwater runoff.

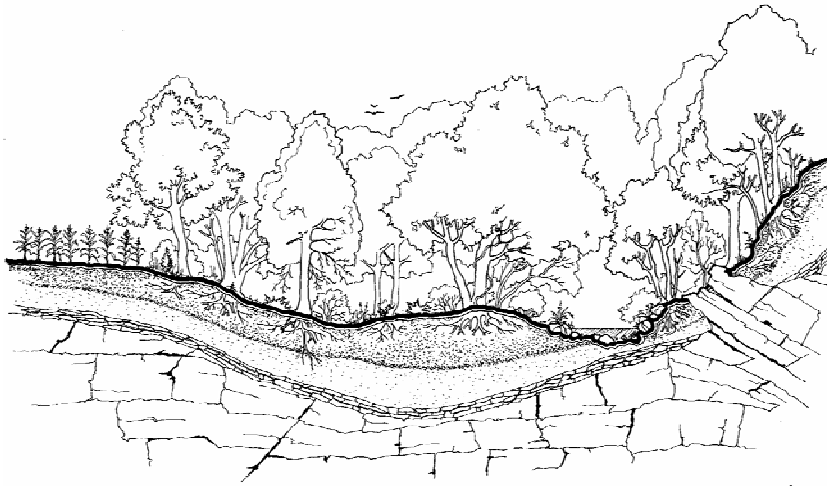
To maintain stream water quality and quantity in the Paunacussing area, stream-discharge of treated sewage effluent should be prohibited, as should export of groundwater (via wells) to sewage treatment systems discharging out of the local watersheds.

Riparian Buffers

Riparian buffers are defined in this Plan as wooded corridors paralleling streams and extending outward at least 100 feet from the tops of both banks of a stream. They provide numerous community benefits and are often the first line of defense for non-point source surface water quality concerns such as sediment, erosion, nutrients and other pollutants. The roots of trees, shrubs and herbaceous vegetation help to anchor streamside soils and reduce flooding. The leaves, twigs, branches and logs of trees provide food and habitat on which the entire food web of a healthy stream ecosystem is based, and tree canopies provide shade to maintain cooler water temperatures necessary for many native aquatic organisms, including native brook trout.

The Landscape Ecology section of this Plan presents a general assessment of riparian buffers in the study area, differentiating between "full" riparian buffers of at least 100 feet of woodland on each side of a stream, "partial" riparian buffers of less than 100 feet of woodland on each side of a stream, and "opportunities" for riparian buffers where no woodlands are present.

Areas with full riparian buffers are good candidates for voluntary protection agreements such as conservation easements. Partial buffers can be expanded with tree planting efforts and by fencing streams in areas where livestock graze, extending the width of existing riparian buffers to, ideally, at least 100-feet on either side of the stream. Many existing buffers are pressed by agricultural production into the narrowest possible strip. Missing buffers, areas where streams flow unprotected through fields or lawns, are "opportunities" for reforestation. The only exceptions to this recommendation apply in areas where native herbaceous wetlands (i.e. sedge marshes and wet meadows) provide important habitats for native plants and wildlife.



Riparian Forest Buffer Crossection. *Riparian forest buffers include a complex natural system of canopy and subcanopy trees, understory trees and shrubs, herbaceous plants, forest humus and soils, root systems and geologic formations that all serve as a living filter and support system for streams in the Crum Creek watershed.*

This Plan references the *Riparian Buffer Assessment of Southeastern Pennsylvania* (the Assessment) prepared by the Heritage Conservancy, one version of which includes a detailed analysis of riparian buffer coverage and gaps in the Paunacussing Creek and Hickory Run watersheds. The goal of the Assessment is "to promote non-point source (NPS) pollution prevention and mitigation." This study involved helicopter flights and video assessments of riparian corridors along streams throughout the region, and aerial photograph evaluation and field verification of riparian corridors throughout the watershed. **(Figure 8 -- Riparian Buffer Assessment)**

The results include documentation of 4 categories: "full" riparian forest buffers (at least 50 feet of woodland on each side of a stream);"partial" riparian forest buffers (less than 50 feet of woodland on one or both sides of a stream); streams "lacking buffer on one side"; and stream segments "lacking buffers on both sides", where riparian forest buffers are missing. This information is scheduled to be posted on the Internet at the Pennsylvania Spatial Data Access (PASDA) website.

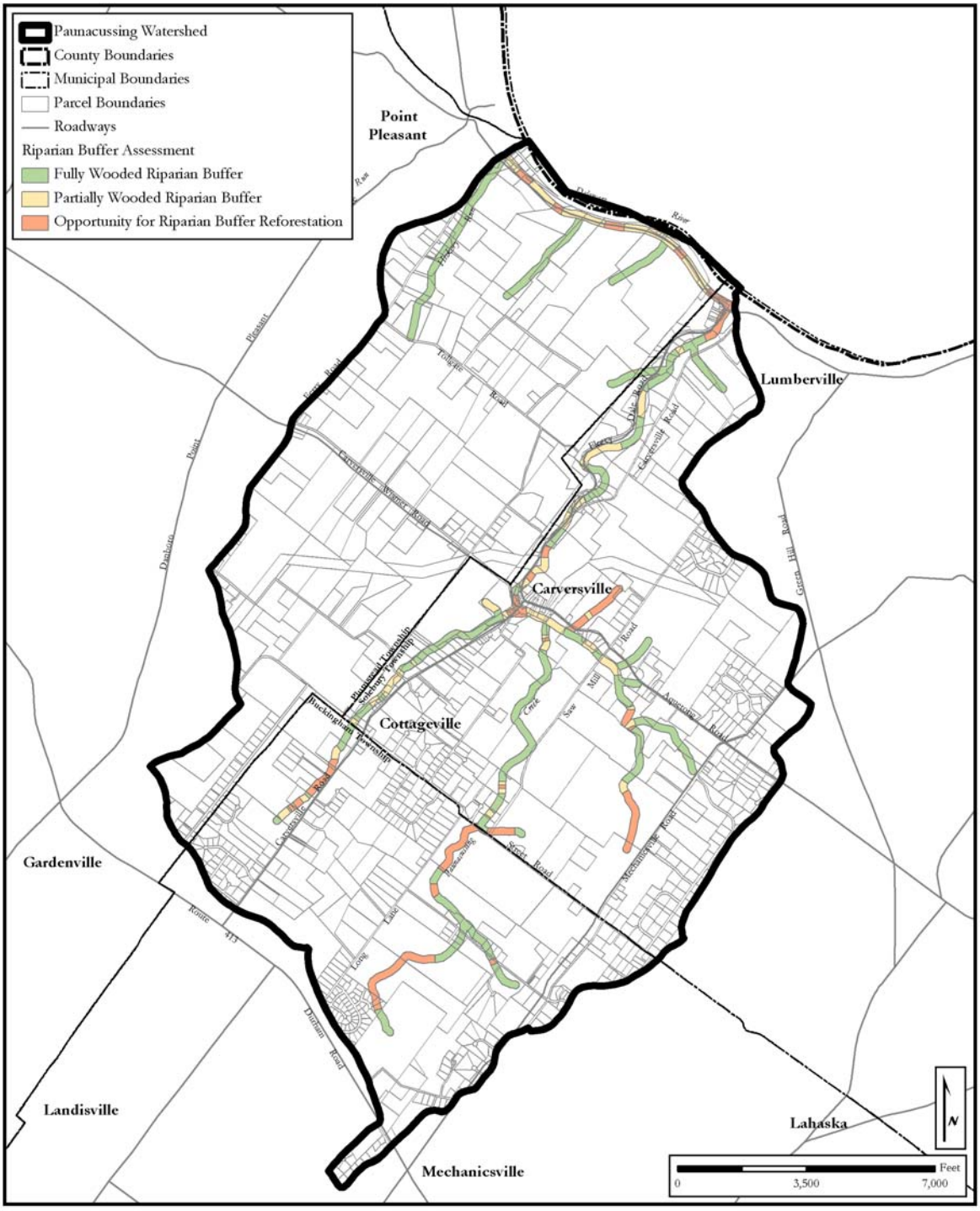
Numerous small streams in these watersheds were difficult to locate and therefore not covered in the Assessment, and some are not mapped because they are in culverts and storm sewers. The results of the Assessment and subsequent analysis provide important guidance for ongoing riparian buffer conservation and restoration activities in the Paunacussing watershed.

Planning Implications

Creative and innovative ways should be pursued to encourage landowners to provide proper riparian buffers and to remove grazing animals from surface waters by erecting stream bank fencing, or through reforestation, and conservation easement protection. There are many federal funding sources available through the USDA's Natural Resources and Conservation Service for stream-bank fencing and restoration plantings. **However, compensating landowners, particularly farmers, for the loss of income from installing or widening the buffers is usually a major issue. Local townships may want to consider financial incentives, such as property tax rebates, for landowners who are willing to install and maintain high quality riparian buffers on their property.** A program should be developed to achieve 80% steam bank fencing and riparian buffers along all surface water streams and wetlands within a set number of years, e.g. 10 years, and with the further aim of achieving 100% stream bank buffers within 20 years.

Flooding

The Paunacussing Creek watershed is naturally "flashy", i.e. prone to quickly rising flood waters due to its combination of dense geology, poorly drained soil types and sections of steep topography. These interrelated characteristics tend to concentrate water rather quickly during heavy storms at the confluence of the three main branches.



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 8

Riparian Buffer Assessment

Compiled by: RAM Date: 12/09/05

Notes:
1. County boundaries, municipal boundaries, waterways, watershed boundaries, and floodplains sourced through PASDA (www.pasda.psu.edu).
2. Parcels from Bucks County.
3. Riparian Buffer Assessment created by NLT using 100 foot buffer of waterways and the riparian buffer assessment from Heritage Conservancy.

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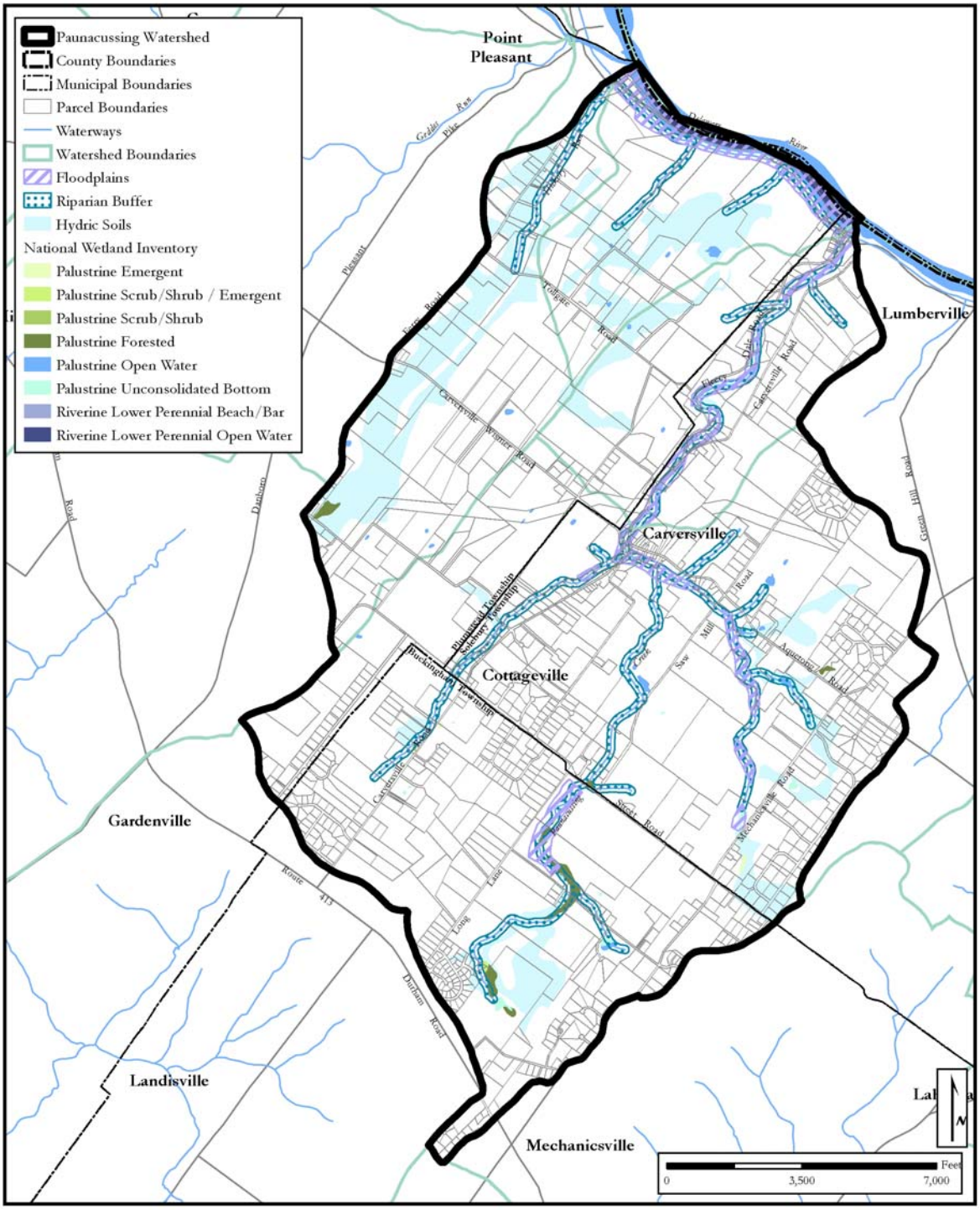
As the watershed is subject to increasing levels of development and impervious surface coverage, which contribute significant amounts of stormwater runoff to streams. Flooding is a serious and increasing problem in parts of the watershed -- property damage, severe erosion and stream degradation, and the safety of residents are among the top concerns, particularly the lower portion of the watershed from Carversville to Lumberville.

Floodplains are mapped on **Figure 9 – Hydrologic Features**. Stream corridors and floodplains are still relatively undeveloped in much of the watershed (with a mix of agriculture, woodland, and single family residential development along streams), allowing streams to spread out of their banks during high flows. As more residential development encroaches along streams and replaces woodlands and fields, the potential for flooding and flood related damage increases. Impervious surface coverage in the watershed is still well below 10%, which is relatively low compared to other parts of southeastern Pennsylvania. Coverage of 10 to 15% is considered by the Center for Watershed Protection to be a critical threshold for streams in terms of flood damage and degradation. The watershed is impacted by the typical flood problems associated with conventional stormwater management systems in suburban areas – basins throughout each subwatershed, collecting, concentrating, and discharging increased volumes of water directly to wetlands and streams over extended periods of time. *With proper planning in the Paunacussing Creek watershed, the cumulative flooding impacts of conventional stormwater management systems can be reduced and avoided as development continues.*

The Pennsylvania Floodplain Management Act of 1978 (Act 166), requires all municipalities in the state to adopt floodplain ordinances that meet minimum standards. Municipalities must comply with the Act in order for their citizens to be eligible for federal flood insurance and for the municipalities to continue to receive state funding. As flood problem areas have shown throughout the urbanizing portions of the Philadelphia region, minimum standards do not always keep people and property safe or allow streams to flow freely during floods. More progressive floodplain ordinances should be enacted to gradually shift toward fewer structures and road/driveway crossings in floodplains and re-greening of these areas.

Stormwater Management

Many conservation concerns arise from poor stormwater management. Surface water non-point pollution (particularly sedimentation), erosion and lack of groundwater recharge are the biggest concerns. *Although no site-specific analysis of stormwater conditions have been conducted for this report, some general guidelines can be recommended.* The particularly "flashy" nature of the Paunacussing and adjacent streams means that they tend to concentrate large volumes of stormwater runoff from broad areas into relatively narrow ravines, and that these areas tend to reach their peak flow very rapidly during



Paunacussing Creek
Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 9

Hydrologic Features

Compiled by: DGR Date: 03/30/05

Notes:

1. County boundaries, municipal boundaries, waterways, watershed boundaries, and floodplains sourced through PASDA (www.pasda.psu.edu).
2. NWI from DU Pods & Middle Towns.
3. Parcels from Bucks County.
4. Soils from USDA NRCS.

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storm events. The clearing of wooded slopes and headwater lands for agriculture surely exacerbated this condition and more recent increases in land development in the local watersheds has compounded the problem by creating impervious surfaces and lawns that discharge more runoff into streams than natural woodlands or meadows. The recent flood damage in the lower Paunacussing demonstrates how severe these problems can be.

Planning Implications

Excellent improvements in stormwater and impervious surface ordinances have been made in recent years and are being implemented around southeast Pennsylvania. Such ordinances in general apply to new development and strive to minimize land disturbance and impervious surface coverage, to maximize recharge of groundwater, and to promote biofiltration to remove pollutants from roads, lawn chemicals, etc.

Stormwater management ordinances should be consistent with approaches presented by PA DEP in *Pennsylvania Draft Stormwater Best Management Practices Manual* (December 2004). By and large, uncontrolled small storms (i.e. the "2-year storm" of 3.2 inches in 24 hours) cause most stormwater problems in the region, while modifying standard BMP's to account for the special considerations of the shale/sandstone topography would be useful.

Comprehensive ordinances should be consistent among the three townships having jurisdiction over the watersheds, and should provide:

- Performance standards
- Minimize soil grading and vegetation clearing
- Minimize impervious surface coverage
- Appropriate storm designs (e.g. detention of the 1 and 2-yr storms)
- Manage stormwater near its source, with decentralized systems in each micro-watershed on the site, rather than large systems concentrating stormwater on one or two areas of the site.
- Improvement in groundwater recharge, including:

  Retain first ¾ inch of rainfall on-site
  Preserve the same volume of infiltrated rainfall as in pre-development condition (based on annual rainfall). Meadow or woodland should be used as pre-development condition on all sites.
- Lists of recommended innovative Best Management Practices (BMPs) such as biofilters, rain gardens, stormwater wetlands, vegetated swales and berms, pervious paving, green roofs, subsurface recharge beds, etc.

- Also, the following are encouraged:

  Reassessment of stormwater management objectives by municipalities

  Assessment of existing stormwater systems and prioritization for retrofitting with up-to-date stormwater management facilities as they are redeveloped or as funds are available

  Requirements for the management of roof runoff

  Requirements for agricultural lands

Municipalities should have policies and ordinances that incorporate provisions to reward developers and homeowners (like relaxing some permitting requirements or shortening review cycles), for using low-impact site design principles.

Finally, tangible financial incentives are justified where voluntary measures will substantially reduce the costs that would otherwise be incurred by municipalities for water treatment, maintenance, repairs or improvements to publicly owned facilities. *This could include financial payments to local landowners and farmers - compensating them for crop revenue losses if they agree to set-aside 100-foot riparian buffers on each side of a stream, as well as hydric soils for riparian buffer and wetland restoration.*

Standards requiring state-of–the-art Best Management Practices in all new subdivisions should be included in the stormwater management ordinances for each municipality. These standards can be cross-referenced with the new (draft) Pennsylvania Stormwater Management manual (PA DEP, 2004).

At the same time, Stormwater Utilities (SWU) (a mechanism to fund stormwater facilities and services) are being implemented with greater frequency in the United States. Tax payments can be made to the municipality on the basis on some index of stormwater impact created by the property – such as total impervious area or contiguous impervious area. The revenues from these taxes should be used to fund watershed studies, GIS databases, direct subsidies to landowners who install BMPs, and where appropriate, upgrades to public works projects (e.g. tertiary treatment sewage treatment plants).

Overview of the Non-point Source Assessment (NPS) Process

The NPS Assessment (Paunacussing Creek Watershed Bucks County NPS Assessment), initiated by The Partnership for Land Use Management (PLUM) was funded by the Pennsylvania Department of Environmental Protection (DEP) "Growing Greener" program. The purpose of the project was to determine the primary NPS pollution sources of the Paunacussing, to create a G.I.S. (geographic information system) database

of NPS pollution information, to summarize the findings of the Assessment and to develop an NPS management program. The full Final Report is available through PLUM or the three townships. The procedure for accomplishing these tasks was to take a series of water samples from the Paunacussing Creek, and to analyze these samples for certain chemicals and other parameters that would indicate the health of the stream. Samples were collected at four stations located within the watershed: the Main Stem of the Paunacussing (Station 1 – private bridge midway down Fleecydale Road); the North Branch (Station 2 – McNeal Road just north of Carversville Road); the Middle Branch (Station 3 – Street Road just north of Sawmill Road),and; the South Branch (Station 4 - Sawmill Road just west of Aquetong Road). These stations will be used by PLUM for long-term volunteer stream monitoring to establish a continued record and monitor land use impacts to stream quality.

PLUM hired two consultants: Natural Lands Trust, Media, PA to assist with project management and preparation of this report, and Biohabitats, Inc., Timonium, MD, to design and initiate the stream sampling program, select the water testing lab and oversee its work, and compile and interpret the data. The water quality data in this report was produced from stream samples taken in automated Stormwater Samplers that were collected by PLUM volunteers and Natural Lands Trust staff, under the guidance of Biohabitats.

Parameter	***Possible Sources***
Fecal coliform bacteria	Septic systems/livestock/Canada Geese
Total suspended solids (TSS)	Soil erosion (construction/farming)/road runoff
Phosphates (PO4)	Septic systems/fertilizers (lawns and farms)
Ammonia (NH3)/Nitrate, Nitrite (NO3, NO4)	Septic systems/fertilizers/livestock/Canada geese
Metals (lead, cadmium, zinc)	Road & parking lot runoff/dumps/water lines

Table 1: NPS Pollution Parameters and Possible Sources

Summary of Findings

The current water quality condition of the Paunacussing Creek is worthy of its High Quality-Cold Water Fishery designation by PA DEP. The levels of pollutants detected in each of the four sampling stations generally reflect the qualities of a rural/suburban watershed with relatively low amounts of impervious surface coverage, fairly extensive forested areas and forested stream buffers, and no point-source discharges. The levels of nitrates and nitrites detected in the four sampling stations exceeded the EPA standards more frequently than any other parameter, indicating that runoff from agricultural fields, residential lawns, and/or leaking septic systems may be contributing sources for this pollutant.

The greatest concentration of non-point-source pollution detected in the initial baseline surveys was associated with the Middle Branch (Station 3). This subwatershed includes land areas that are predominantly agricultural (63%), with a mixture of cropland, hayfields, pasture and nurseries. Runoff from these areas is likely to be the greatest contributor of high nutrient loads (phosphorus and nitrates/nitrites), sediment (total suspended solids) and bacteria (fecal coliform). Two large ponds are also present at the headwaters of two Middle Branch tributaries, adding to warm water temperatures in the stream. Resident Canada goose populations in and around these ponds may contribute to nutrient and bacteria loads. The diversity of aquatic insects collected in this area was the lowest of the four stations, and the species found were those that are more tolerant of pollutants and warmer water conditions, rather than insects that thrive in clean, healthy, cooler waters. This change in the types of invertebrates found in the stream is another marker used to indicate a change in the health of the stream. The stream corridors throughout the watershed include good riparian forest buffer coverage, with trees and shrubs bordering both sides of the stream for much of its length. However, significant stretches of stream lack the full 75 feet of buffer on each side of the stream recommended as a minimum standard to provide shade, filter pollutants and provide sufficient food and cover in the stream. Several miles lack riparian forest buffers altogether, reducing food and habitat for aquatic life and exposing streams fully to the impacts of sunlight, erosion, sedimentation and pollution. Adjoining land uses along exposed, poorly buffered segments present the greatest threats to water quality.

The lowest readings of non-point source pollutants were generally associated with the Main Stem of the stream below Carversville (Station 1), which benefits from the dilution of the three main tributaries merging together, and from a relatively high concentration of forested cover. This area also hosted the greatest diversity of aquatic insects, and the largest number of species that thrive only in healthy, clean, coldwater streams, confirming the high quality of stream water and habitat in this area. The insects located here could not survive in more polluted, or warmer waters. These species, such as stonefly, caddisfly and mayfly nymphs are critical links in the food web that supports native fish species including brook trout. Because of their diet of leaf litter and other organic matter, these insects fill a vital niche as "decomposers" that maintain a balanced stream ecosystem.

Key Issues

In summary, the following Key Issues are highlighted by the data collected in this Assessment:

1) Loss and Degradation of Streamside Forested Areas and Wetlands – impacts of clearing, mowing, grazing, livestock, fertilizers, septic systems and stormwater runoff are confirmed by Total Suspended Solids, Nutrients, and Bacteria levels

2) Uncontrolled Stormwater Runoff -- Stream quality is negatively impacted by erosion, sedimentation and serious flooding associated with lack of effective stormwater management, and an increase in development of houses and roads near streams. Uncontrolled roadside runoff from ditches and culverts is a watershed-wide problem. Severe erosion impacts are evident along certain stretches of headwaters streams and Fleecydale Road. Heavy sedimentation is evident in the large deposits at the mouth of the Paunacussing on the Delaware River (confirmed by Total Suspended Solid levels and physical conditions in the *Stream Protection and Restoration Plan* prepared by Biohabitats and Delaware Riverkeeper)

3) Household Impacts – Residences in the watershed contribute to high fecal coliform bacteria levels and nutrient levels through failing septic systems and use of phosphate-based detergents. Large lawns contribute nutrients and other chemicals and utilize groundwater during draughts. Residences mowing along streams cause severe erosion and sedimentation in a number of locations.

4) Livestock in Streams and Wetlands – The presence of cattle and horses in streams and wetlands at several locations in the watershed is a problematic source of nutrients, sediment, and fecal coliform bacteria levels.

5) Canada Goose Populations – unnaturally high levels of fecal coliform bacteria and nutrients are evident in some locations downstream of ponds that attract large Canada goose populations.

It also should be noted that unnaturally warm water temperatures in the Paunacussing Creek are a contributing factor that exacerbates the impact of non-point source pollution on the health of aquatic life. Warm water temperatures in the watershed are most likely attributable to a combination of factors, including stream segments lacking shade from riparian forest buffers, ponds discharging warm surface water, and direct runoff from heated pavement or lawn areas.

Groundwater

The aquifers in the Paunacussing area vary widely in terms of yield – from some of the lowest yields in the region to some of the highest. All aquifers, regardless of yield, are vulnerable to overuse and contamination, particularly in areas of shallow depth to bedrock, high water table and poor recharge. The Lockatong formation and diabase geology that dominate the northern half of the study area are noted as having tight fractures and fissures, and associated soils with slow permeability, and yield limited well capacity, often 5 to 10 gallons per minute or less from private wells. Diabase is one of the poorest sources of water in the Triassic basin, with water usually occurring in the weathered zone averaging only up to 30 feet deep. The Stockton formation is much more productive, with yields of up to 500 gallons per minute noted in some wells. This

bedrock is especially porous and recharges groundwater efficiently. It has the highest average permeability of any aquifer in Bucks County.

Planning Implications

Sand mounds are common for new homes in the Paunacussing Watershed – even in relatively level headwaters areas. Where public water supply and wastewater treatment are not used, the nature of the shale and sandstone geology, moderate to poor permeability of soils, and the local reliance on private wells place limits on the development potential of the land. **However, the rate and scale of residential development proposed in recent years has increasingly disregarded such groundwater concerns.**

Most groundwater recharge in the area results from precipitation. A good five-feet of permeable soil overburden is recommended to cleanse most ordinary suspended and dissolved contaminants – i.e., there should be at least 5-feet of soil between the *bottom* of a septic system and the *top* of the water table. In order to provide reasonable assurances that septic leachate does not contaminate domestic water supply wells, densities should not exceed one residence in 3 to 3.5 acres. The use of spray irrigation of effluent is an important alternative to individual septic systems, particularly where vegetation and soils are used to take up nutrients.

In high water table areas, contaminants may not have a chance to be ameliorated by the soil before entering the water supply. Shallow wells in these areas are likely to become contaminated by septic effluent more easily than deep wells. Massive applications of liquid nitrogen fertilizer, including manure on agricultural lands, and the increasing number of lawns on which lawn care chemicals (pesticides and fertilizers) are applied may pose as much of a threat to groundwater quality as many common industrial solvents. These trends can be addressed by reducing the amount of lawn and by requiring plans with smaller lots and large open space areas maintained in woodland or meadow. Natural landscaping can be promoted by local municipalities and organizations as a "groundwater-friendly" alternative to existing lawns. This may require a change in local ordinances.

Ecology

Vegetative Communities

Plant communities do not generally occur at random across the landscape but rather form patterns based on environmental conditions. The division of plant communities into discrete communities is an artificial process but is conducted by simplifying the complexity of nature to convey the character of a site. There are no hard divisions between plant community types; boundaries dissolve slowly as rich mosaics of plant associations and community patches respond to changing environmental conditions, from dry to moist to wet, and by aspect, topography, depth of soil and elevation.

R*ed oak-mixed forest*. The most abundant forest type in the upland soils in the area can be described as a '*red oak-mixed forest*[4]', comprising the second-growth hardwoods that are, today, typical components of the Eastern Deciduous Forest that stretches throughout the east coast of the United States. This forest type occurs with other oaks (black oak, white oak) and red maple, hickories (shagbark, mockernut), sweet birch, white ash, and tulip poplar. Ten-to-fifteen-year old thickets of eastern red cedar and broomsedge dominate the early stage of woody succession in these areas, and dogwood is commonly found on the abandoned agricultural fields and hedgerows in the uplands of the Paunacussing area.

Bottomland oak-hardwood forest. This is the second most common forest type in the area, owing to perched water tables found throughout the watershed. Pin oak, red maple and shagbark hickory are commonly found in these areas.

Tuliptree-beech-maple forest is found on the mid- to lower- forested slopes in the study area: oaks, black gum, sugar maple, hickories, sweet birch and some eastern hemlock. Understory is typically dominated by viburnums, hornbeam, flowering dogwood, witch-hazel and hop-hornbeam, while the herbaceous layer is often rich (in the absence of deer browse) with species such as mayapple, bloodroot, rattlesnake fern, dutchman's breeches, wild leek and spring beauty.

Hemlock-rich hardwoods forest. Some north-facing slopes in the lower stream valleys support the *hemlock-rich hardwoods forest type*. Hardwood species may include tulip poplar, beech, northern red oak, red maple, sugar maple, sweet birch, yellow birch, white ash, basswood, and shagbark hickory. Shrubs such as bladdernut, rosebay rhododendron, witch-hazel and spicebush are commonly found, and a rich herbaceous

[4] As defined by Fike, 1999, 'Terrestrial & Palustrine Plant Communities of Pennsylvania': which is also a valid reference for typing plant communities in western New Jersey.

layer with maidenhair fern, trout-lily, Canada mayflower, wood anemone, wood geranium and numerous other species may be present where deer browse is not serious.

Dry oak-heath forest. The driest rock outcrops, ridges or steep slopes in the area may support *dry oak-heath forest*. Chestnut oak is the most common tree species in these areas, along with black oak, scarlet oak, and white oak. Sassafras, black gum, sweet birch, red maple, pitch pine and Virginia pine may also be present. The shrub layer often includes ericaceous species such as mountain laurel, black huckleberry, lowbush blueberry, maple-leaved viburnum and sweet fern. Herbaceous plant diversity is generally lower, with several sedges, trailing arbutus, wild sarsparilla and pink lady's slipper often present.

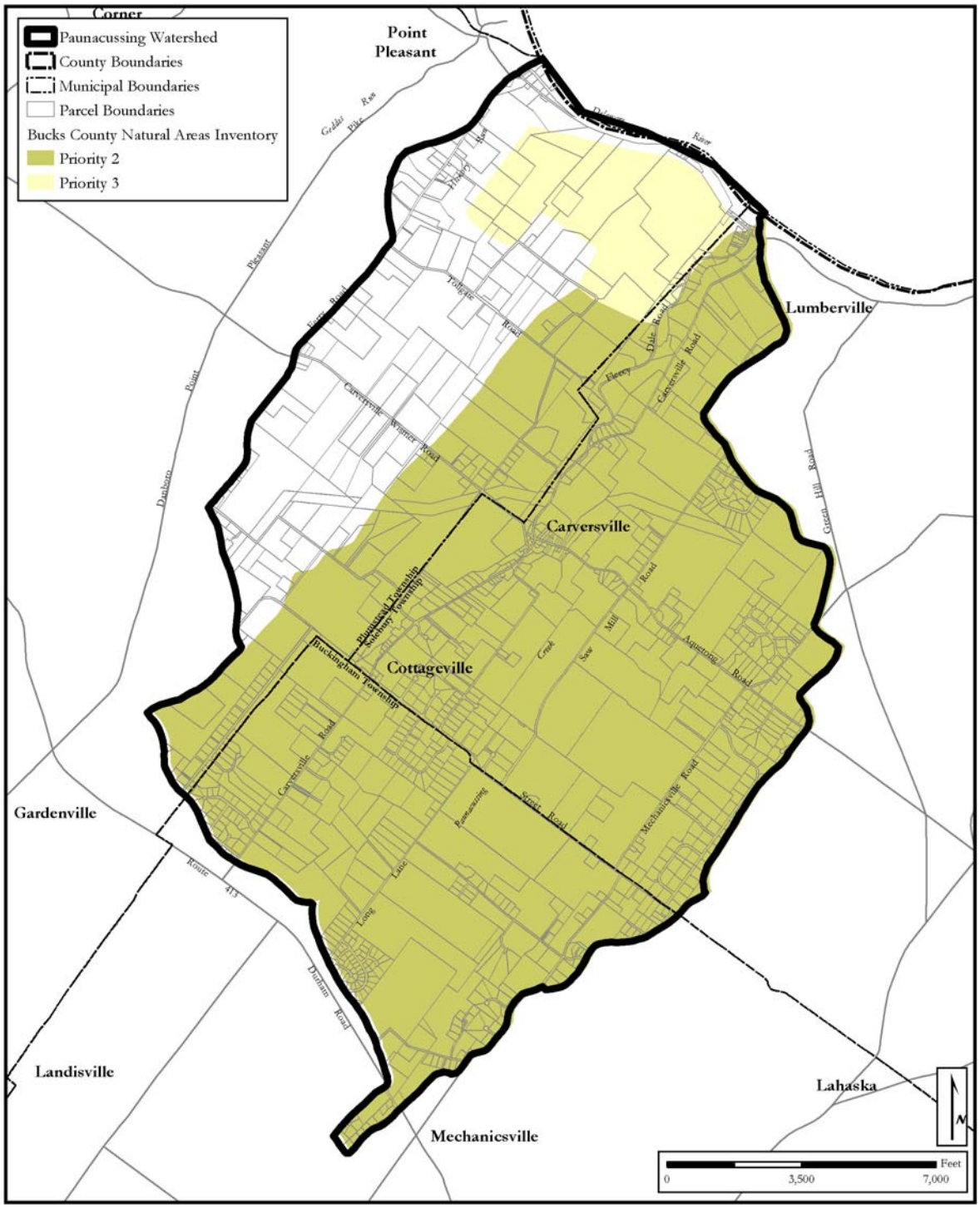
Sycamore-floodplain forest. The lower portions of the Paunacussing and Hickory Run, and the Delaware River floodplain contain some areas of sycamore - floodplain forest, which is dominated by species tolerant of flooding, such as sycamore, silver maple, red maple, and in some cases river birch.

Other species likely to be found in the area may include black walnut, black gum and sweet gum. Slope orientation and moisture will determine exact species distributions, with oaks typically dominating the drier, higher sites, particularly where the pH is reduced over thinner soils and higher levels of leaching.

The forests at the project site are suffering greatly from **deer browse** and, in some areas, invasive vines and shrubs are a problem. Deer browse threatens not only the diversity of shrubs and herbaceous plants in existing woodlands, but it limits future regeneration of canopy trees in ways that may greatly alter the character and function of future forest communities. No significant signs of infestations or diseases (like gypsy moth or beech blight) are evident at this time. Undoubtedly the forests have lost the American chestnut and elms that our grandfathers would have expected to see, but otherwise they are good quality representations of medium-aged common plant communities.

Bucks County Natural Areas Inventory

The Bucks County Natural Areas Inventory, 1999, prepared by the Morris Arboretum, includes the unusually broad designation of the entire Paunacussing Creek and Cuttalossa Creek watersheds as Priority 2 Sites, and a Priority 1 listing for the Tohickon Creek watershed at the northeast corner of the study area. These designations indicate the importance of the natural areas and streams in the Paunacussing area for biodiversity conservation. The study also includes Species of Special Concern (including state- and federally-listed rare, threatened, endangered) listed in the Pennsylvania Natural Diversity Index (PNDI). The Paunacussing program area supports one of the broadest designations of Natural Areas Inventory priority in all of Bucks County. **(Figure 10 – Natural Areas Inventory/PNDI)**



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 10

Natural Areas Inventory / PNDI

Partnership for Land Use Management
in partnership with
Natural Lands Trust

The Inventory describes the key natural features of the Paunacussing watershed as follows -- "an intact, small watershed with a fairly high diversity of habitats and plant and animal species. Headwaters areas are most vulnerable, as development along the Route 413 corridor pushes east bringing with it impervious surfaces, storm sewers, and other forces that retard ground water recharge and increase erosion and other non-point source pollution. Immediate efforts are needed to protect the smallest tributary streams and ground water recharge areas of the upper watershed in order to assure the future health of downstream portions of the watershed. Steep slopes should remain forested to prevent erosion and siltation that inevitably follow deforestation." (Rhoads and Block, 1999)

The inventory notes the dramatic cliffs formed by outcrops of Stockton shale geology along Fleecy Dale Road facing south and west, the diversity of habitats they provide, and the presence of a locally unusual tree species, post oak (*Quercus stellata*). The lower part of the Paunacussing valley is noted for its diverse forest types, including hemlock-rich hardwoods on north-facing slopes, early- and mid- successional deciduous forests dominated by tulip tree. Spring(s) are also noted in this area. The confluence with the Delaware River provides a rich assortment of plants and habitats along the alluvial bars and islands, including sand cherry (*Prunus pumila*), an endangered species in Pennsylvania.

At least 8 plant communities are identified in the Inventory, including forest types such as: dry oak-heath; red oak-mixed hardwood; tuliptree-beech-maple; rich hemlock – mesic hardwood; sycamore-river birch-box elder floodplain; and floodplain communities such as river beach bar community; river birch-sycamore-floodplain scrub; water willow-smartweed riverbed community.

Deer browse in the area is rated from moderate to severe – impacting shrub and forest diversity in most woodlands. The relatively high diversity of bird species (86 recorded, 13 rare breeders, 2 species of special concern) was noted in the Inventory as an important indicator of healthy natural areas.

Planning Implications

The ecological importance of local natural areas, particularly woodlands and riparian corridors, raises obvious concerns about clearing of these habitats for development. For critical properties that cannot be saved through conservation protection, municipal ordinances are an important line of defense to guide development away from the most sensitive environmental features. Plumstead, Buckingham and Solebury each have progressive zoning and subdivision and land development ordinances, but it is important to review these periodically to be sure that they are truly doing the job of reducing fragmentation and destruction of woodlands and riparian corridors. The plan

review process is also an important opportunity to guarantee that a plan is based on ecologically-sensitive design before it is approved.

Rare plants identified in the Natural Areas Inventory may represent a small sample of the overall presence of rare plant species in the Paunacussing area, due to the obvious difficulty of accessing every natural area with qualified botanists. It is easier to protect rare plant species and plant communities than rare wildlife, since they do not move (in a short time-frame). Due to the efforts of caring local conservationists, several sites containing rare plant species have already been preserved in the project area. **It is recommended that all rare plant sites in the project area be proactively protected through land preservation efforts as a matter of priority, where possible. Priority should be given to preserving the higher-ranked sites first. Monitoring should be carried out periodically to assess invasive exotic plant species impacts at these special sites and appropriate management actions taken as necessary.**

Timber management is a concern for some landowners and for the community in the Paunacussing area. The USDA-Forest Service sponsors a Forest Legacy Program that endorses sustainable forestry, promoting selective cutting with good environmental best management practices**. Selective harvesting can occur without causing too much harm to forest and aquatic systems; however, local controls need to ensure that over-harvesting and clear-cuts are avoided, especially within riparian zones, hydric soils and on the steepest slopes, which have the soils most prone to erosion.**

At the end of the last ice age (Pleistocene), the area forests probably consisted primarily of spruce, pine, birch and alder, which gave way to chestnut-oak forests as the climate warmed. Indians likely burned the forest periodically, while subsequently Euro colonials cleared and plowed many forests and introduced new species, both intentionally (e.g. Norway maples) and unintentionally (e.g. chestnut blight). While chestnut, elm and hemlock have declined locally due to disease, and oaks, beech and hickories are now probably *underrepresented* due to high-grade lumbering, ash, maple, sycamore and tulip poplar are probably more common than they once were in the landscape.

Any future restoration activities involving forests and/or riparian buffers should consider *emphasizing* the underrepresented native species to reinstate biological balance. This will also ensure that appropriate seed-sources are reintroduced to the region, which will in turn provide for long-term viability and balance of the common plant communities.

A final note about *local provenance* is applicable at this point: Efforts should be made to ensure that, where possible, any plants used for restoration should be obtained from local growers. Much discussion in the ecological and native plant communities in recent years has promoted the concept of purchasing plants grown within, ideally,

less than 50 miles of the planting site – and certainly no more than 100 miles. This helps to maintain a healthy gene pool among native plants adapted to the local growing conditions.

Local municipalities may consider implementing a natural landscaping ordinance that promotes the use of native plant species for all new plantings, and as alternatives to lawn; *requiring* institutional and corporate landowners to comply with *local provenance* requirements, while *encouraging* (perhaps through property-tax incentives) local residential landowners to adhere to *local provenance* guidelines.

Invasive Exotic Plant Species

In disturbed areas, such as successional old fields or clear-cut forests, especially south-facing slopes, a slate of invasive exotic plants may be evident, intermixed with ruderal (i.e. opportunistic) natives such as cherry, red cedar, dogwood, crab apple, maple and tulip poplar. Invasive exotic plant species of particular concern in the area typically include, but are not limited to:

Herbaceous plants/grasses -- garlic mustard, lesser celandine, dame's rocket, purple loosestrife; Japanese knotweed; stilt grass; miscanthus grass; pennisetum grass; reed canary grass; Many areas of the forest floor are dominated by lush-looking but highly invasive Japanese stiltgrass, which outcompetes most forest wildflowers and ferns;

Vines -- Japanese honeysuckle; Japanese hops; Asiatic bittersweet; akebia vine; porcelain-berry vine; mile-a-minute vine;

Shrubs -- European barberry, winged euonymus (a.k.a., burning bush); Japanese barberry; tartarian and amur honeysuckles; buckthorn; privet; Russian and autumn olive;

Trees -- Norway & sycamore maples; ailanthus;

This list represents only some of the most infamous species. More extensive lists are available[5], which also consider potentially harmful species that are still being evaluated locally for detrimental impacts.

At the same time, there is also a general overabundance of native ruderal species that prefer 'edge' or disturbed environments in the region. Human impacts in the past few centuries have created many more of these habitat types than there were in pre-colonial times through fragmentation. This imbalance can be addressed through public

[5] Pennsylvania Department of Conservation and Natural Resources has recently published [4/00] an excellent pamphlet called 'Invasive Plants in Pennsylvania' [#8100-pa-dcnr3077]explaining this problem and listing plant species in the region which are considered current threats.

awareness and discouraging over-abundant, aggressive native species in favor of underrepresented native species. For example, fox grape is an over-abundant native species in the area that thrives in disturbed edge habitat conditions. Although it provides good wildlife food, its extent should be monitored carefully. If it becomes overabundant, it should be carefully controlled - but not necessarily eradicated. If there are local concerns about loss of wildlife food sources, encouraging natural regeneration or planting native shrubs that produce high-lipid berries and nuts (e.g. viburnums, hazel) – is a good alternative.

Planning Implications

Invasive exotic plant species spread typically by bird droppings (for berry-or seed reproducing species) or wind. Since humans introduced most invasives, either by accident or purposefully, their distribution is typically highest around urban areas, with concentric rings of decreasing density moving into the countryside. In this area, if the seed-source for many of these species is not yet evident – they will probably be arriving soon.

With the invasion of aggressive non-native species, many native plant populations can be severely impacted. Highly disturbed forests can lose their naturally high biodiversity in the face of these alien invasions – and surprisingly quickly. The added pressures of deer browse, soil erosion from urban runoff, and acid rain deposition combine to tip the balance further in favor of hearty exotic plants.

It is recommended that local conservation groups undertake annual monitoring of the natural habitats throughout the Paunacussing area, particularly those that are conservation areas or that house rare plant species. At the first signs of invasion by exotics, volunteers should be solicited to manually remove the invasive plants, paying particular attention to removing all roots and seed-heads to avoid resprouting or new germination. If necessary, a skilled, qualified and certified professional can be hired to spot-spray herbicide (typically in the late summer with Roundup,) to control patches of invasive exotic plants that don't respond to manual removal. A public education campaign should be initiated to inform local landowners of the issue and concerns. The Natural Lands Trust Paunacussing Preserve provides an important case study for demonstrating techniques for managing invasive exotic vegetation.

As a compliment to the "native plant species, local-provenance ordinance" proposed above (under the Vegetation Communities section), local governments should also consider implementing an Invasive Exotic Plant ordinance to ensure that future plantings do not use known invasive species. Again, institutions and corporations could be *required* to adhere to the guidelines, while residential landowners might be *encouraged*, perhaps through property tax rebate incentives, to follow the

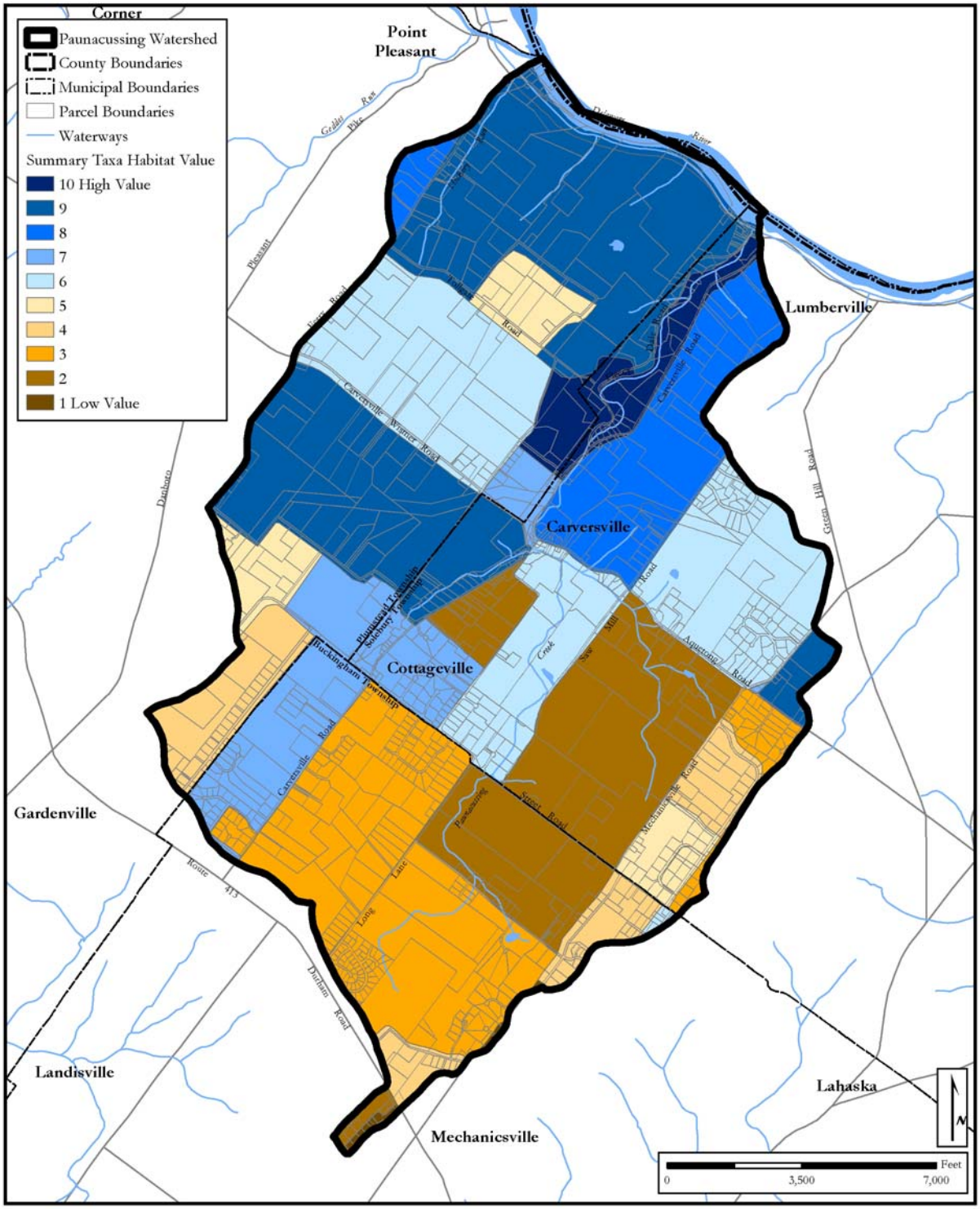
recommendations. Numerous counties and municipalities in southeast Pennsylvania have such ordinances that could serve as models.

Wildlife Communities

The Paunacussing watershed supports a relatively high diversity of native wildlife species. A number of wildlife species are present that are not commonly found in the more heavily agricultural or developed landscapes of southeast Pennsylvania, primarily because of the relative lack of forest fragmentation and habitat disturbance in the lower stream valleys along the Delaware River. Mammal species such as **mink,** forest-nesting birds including **scarlet tanager and pileated woodpecker** and amphibians such as **gray-backed salamander** are all indicative of the ecological integrity of the Paunacussing area.

The distinction between wildlife species that are *habitat specialists* and those that are *habitat generalists* is important to consider in prioritizing natural areas for protection. Habitat *specialists* depend on specific habitat types (e.g. grasslands, forest-interior, cold-water streams), whereas habitat *generalists* are more adaptable to a variety of human-influenced environments. Habitat generalists such as gray squirrels, white-tailed deer and blue jays are more often likely to be commonly found in the suburban landscapes of residential areas, woodland edges and woodlots, and small fields that are becoming more ubiquitous throughout the region. Habitat specialists such as bald eagles, wood frogs and luna moths rely on larger, undisturbed blocks of interconnected natural areas – the very kind of networks that are being replaced by suburban landscapes favoring habitat generalists.

This Plan includes a Summary Taxa Habitat Value map **(Figure 11)** that demonstrates the suitability of the habitat networks for supporting biodiversity for each of the major taxa groups: plants; aquatic species (invertebrates and vertebrates); birds; mammals; herpetofauna (reptiles and amphibians); and invertebrates (terrestrial). The map provides a comprehensive overview of the Paunacussing area that rates blocks of land based on their potential for supporting biodiversity. This map reveals that the blocks of land containing the broadest networks of forest, wetland and stream habitat are those with the greatest potential habitat value for biodiversity conservation. The corridors along the lower Paunacussing Creek the Delaware River, and the headwaters of Hickory Run are all rated as the *Most Important* tracts of land for supporting biodiversity spread across the greatest number of taxa groups. This assessment was prepared by Natural Lands Trust using its GIS-based mapping and analysis tool known as Smart Conservation.



Paunacussing Creek Watershed Conservation Plan Bucks County, Pennsylvania	FIGURE 11 Summary Taxa Habitat Value	Compiled by: DGR Date: 03/30/05 Notes: 1. County boundaries, municipal boundaries, waterways, watershed boundaries, and floodplains sourced through PASDA (www.pasda.psu.edu). 2. Parcels from Bucks County. 3. Summary Taxa Habitat Value developed using Stream Conservation methodology.	Partnership for Land Use Management in partnership with Natural Lands Trust

Aquatic Species (fish, invertebrates)
The aquatic ecosystem of the Paunacussing Watershed provides food and habitat conditions suitable for a rich diversity of aquatic life. These include **an array of benthic macroinvertebrates (insects and larvae found in stream beds) such as caddisfly nymphs, stonefly nymphs, and mayfly nymphs. Freshwater mussels, snails and crayfish** also fall into this category. These species form the base of the food web in stream ecosystems, and are important indicators of stream health or degradation. **The diversity of aquatic life includes fish such as dace, darters, minnows, suckers, brown trout and native brook trout. River species such as shad, bass and perch also fall into this category.**

The best habitats for supporting these aquatic species are streams, ponds and wetlands, but also associated forest areas that provide filtration and recharge benefits to maintain the critically important quality and quantity of water on which aquatic organisms depend. Freshwater stream ecosystems evolved in a forested condition, and their richness and viability are inherently connected to the presence of healthy streamside and upland woodland networks. Residential and agricultural land areas are less important for these species.

Bird Species
The Bucks County Audubon Society maintains annual records of bird counts for winter and breeding periods. The lists document 82 breeding species of birds in the Paunacussing watershed including 10 rare breeders and 4 species of special concern in Bucks County. The total number of overwintering, migratory and breeding bird species utilizing the area may be close to double that amount. The habitats of the Delaware River attract numerous species of ducks, loons, herons, wading birds, gulls, bald eagles and osprey that are not commonly found in other parts of the county. The large woodlands and wooded riparian corridors attract habitat specialists such as woodland warblers, woodpeckers, owls and small hawks and wood ducks. Even shrubbier successional old field habitats attract less-common edge species such as American woodcock, yellow-breasted chat, and indigo bunting.

These woodland/stream/wetland/river habitat networks are critical for supporting bird species diversity in the Paunacussing area. Lower density residential areas are rated as having moderate value, but agricultural lands and more intensive residential developments rate as Least Important for most bird species, owing to the lack of food and cover opportunities for many of the habitat specialists that make up the list for the area.

Herpetofauna (Reptiles and Amphibians)
The same habitat networks that support aquatic and bird species diversity are also critical for the reptiles and amphibians. Amphibians such as frogs (at least 7 species), toads and salamanders (at least 5 species) are perfect examples of habitat specialists,

often reproducing in small vernal pools and shallow wetlands during the spring breeding season, then dispersing to streamside and upland woodlands and wet meadow areas. Reptiles including turtles (at least 5 species) and snakes (6 species) are also found more commonly in natural areas rather than residential or agricultural landscapes. The stream, pond, wetland and river habitats are Most Important for these species, with the majority of woodlands in the area ranking as moderately important. Agricultural and residential landscapes are less important habitats for reptiles and amphibians.

Invertebrates (Terrestrial)

Invertebrates are perhaps the most diverse yet least understood and appreciated of the wildlife taxa groups. The myriad number of ants, beetles, worms, and larvae that live in the forest leaf litter and upper soil layers in the region are the "decomposers" that play a crucial role in maintaining healthy ecosystems and stream quality. The more charismatic butterflies, moths, dragonflies, damselflies, and the less popular bees, wasps, flies and mosquitos play crucial roles as pollinators and/or decomposers, and are often *plant specific* in their habitat requirements, in addition to being habitat specific. These species are most dependent on forested habitats for their survival, due to the combination of high plant diversity and accumulation of organic matter they provide. Agricultural and residential landscapes are less beneficial.

Mammals

The Paunacussing Watershed may support as many as 50 species of mammals. Some of these are more common *habitat generalists* or woodland edge species found in many backyards. Species such as white-tailed deer, gray squirrel, groundhog, white-footed mouse, raccoon, opossum, moles, shrews, and eastern cottontail rabbit fall into this category. The potential list of less common and more *habitat specific* species in the area includes several types of weasels (including mink), foxes (red and potentially gray), up to 10 species of bats, eastern coyote and red squirrel. Several larger mammal species that are indicators of large, healthy habitat networks may pass through the area, or could be attracted in the future. These include bobcat, black bear, beaver and river otter. The important woodland/stream/wetland/river networks are ranked as Most Important for mammals, but agricultural and residential landscapes have secondary value for mammals. The buffering and linking value of farmland adjoining woodlands is certainly an important factor in maintaining the diversity of mammals in the Paunacussing area.

Planning Implications

Habitat destruction, fragmentation and disturbance are the primary causes of loss of flora and fauna diversity. However, studies show that the introduction or invasion of exotic species now has the second largest impact in reducing species diversity. Locally,

gypsy moth invasions are a good example of invasive exotic wildlife, but there are many others, the newest of which are the Asian longhorn beetle and Asian and European earthworms. No sustainable solutions to these new invasives have yet been developed.[6]

Some wildlife species are bouncing back, such as white-tailed deer, wild turkey and red fox, while others continue to decline. Typically invertebrates, amphibians and reptiles continue to be disproportionately impacted by our modern world, while other vertebrates, and mammals in particular, seem better able to adapt. Species of all taxon groups that have difficulty adapting to disturbance, or those that *require* specific disturbance regimes or that are area-sensitive and affected by habitat fragmentation, continue to decline in the region. Many bird species – neotropical migrants and grassland species in particular, are showing marked population declines on the east-coast. Many amphibians and reptiles suffer as wetlands, vernal pools and other surface waters are 'improved' for higher-value land use or compromised by pollution. While water habitats may be essential for breeding, there is a growing realization that many of these species also need an undisturbed upland habitat buffer adjacent to their breeding habitats for foraging and hibernation in non-breeding season.

It is very difficult to obtain accurate wildlife survey information, and even when we do obtain it, it is always over-representative of charismatic megafauna and under-representative of the lower orders of faunal life forms.

Unlike flora, it is difficult to know where wildlife is located at any given time since it moves around over both the short and long term. Seasonal migrations are particularly difficult to provide for in conservation planning, especially when the migrations are of large geographic extent, particularly international. Neotropical migratory birds are perhaps the best example of this scale. The Delaware River corridor and its adjacent woodlands are critical stopover points for migratory birds along the Atlantic Flyway, the major migratory corridor for birds in eastern North America. Within the study area, species such as mink may utilize the forested banks of the Delaware River corridor and adjoining streams. *Successful land preservation efforts to support viable wildlife therefore needs to focus more on providing a suitable regional habitat network, rather than just focusing on site-specific parcels where species have been seen and are presumed to reside. Local land use ordinances must also consider the importance of wildlife habitats in guiding development. In addition, more detailed surveys of local fauna are needed to better assess the health or crises facing wildlife communities in the area.*

[6] Contact Natural Lands Trust for more information on this developing issue.

Landscape Ecology

The Paunacussing Watershed includes ecologically-significant networks of habitat interspersed through the broader areas of farmland and residential development. These networks of both remnant and regenerating woodlands, wetlands, streams, ponds and successional areas (i.e. meadows, old fields and thickets) are the main sources of habitat for the native vegetation and wildlife that constitute the natural biodiversity of the area. As of the year 2001, approximately 40 % of the Paunacussing Watershed can be considered as habitat networks.

Conservation and restoration activists focusing in the Paunacussing can work to sustain and enhance several important characteristics of these habitat networks:

1) relatively large habitats representing the full diversity of habitat types that are typical of the region;
2) habitats that are linked by undeveloped corridors such as streams, hedgerows, utility lines, and other open space linkages;
3) habitats that feature plant or animal species or unique habitats listed in the Pennsylvania Natural Diversity Inventory or the Natural Areas Inventory for Bucks County.
4) include higher quality habitats that retain their ecological integrity and are not seriously degraded by disturbances such as exotic invasive vegetation, intensive logging, erosion, sedimentation, soil compaction, grazing, dumping, etc.
5) habitats with existing open space buffers and potential for expansion through active restoration or natural succession.

This Plan evaluates the interconnections between habitat networks in the Paunacussing landscape and identifies those networks which best meet these characteristics as "Habitat Conservation Networks" which are mapped as the highest priority areas for conservation. In addition, areas of open space that are contiguous with these Habitat Conservation Networks are identified as having Habitat Restoration Potential or Habitat Management Potential. Finally, the Landscape Conservation Priorities section further evaluates these Habitat Conservation Networks and areas of Habitat Restoration or Management Potential in terms of their pattern of ownership and prioritizes specific parcels for conservation and restoration.

Habitat Conservation Networks

Four Habitat Conservation Networks are identified in the Paunacussing Watershed. These include:

1) Hickory Run;
2) Upper Paunacussing Creek;
3) Lower Paunacussing Creek;
4) Delaware River Corridor;

These areas are identified by large blocks of contiguous woodland and extensive riparian corridors with some amount of wooded riparian buffer.

Forest Interior Habitat

The forest blocks along lower Geddes Run, the headwaters of Hickory Run, lower Hickory Run, and Paunacussing Creek are among the largest, most viable habitats in the area. Each is over 200 acres in size and is fairly rounded or square in shape, indicating good representation of forest-interior habitat. Forest-interior conditions are critical for sustaining diverse forest-nesting bird populations, and providing cool, moist soil conditions for a rich variety of forest wildflowers. In addition, these blocks benefit from extensive frontage on streams in the area (thousands of feet in most cases). This interface between woodlands and streams is critical to the health of the stream ecosystem and quality and quantity of stream water. It also provides upland areas for species such as salamanders and frogs to disperse following spring breeding along streams and vernal pools.

Riparian Forest Habitat

The riparian forest buffers that extend beyond these woodlands provide critical linkages that allow wildlife to move from one habitat patch to another, thus forming the habitat network. This is particularly true of Hickory Run and the Paunacussing Creek. **The extent of riparian buffer frontage was measured to determine which stream networks provided the greatest amount of linkage, and to identify where gaps existed that could be candidates for reforestation**.

As shown in the Riparian Buffer Assessment map **(Figure 8)** The greatest amount of full riparian forest habitat (at least 100 feet of woodlands on each side of the stream) can be found along Hickory Run (95% coverage) and the two unnamed tributaries of the Delaware River (95% coverage). **The Paunacussing Creek proved to have the lowest amount of coverage, with only about 60% coverage in the three main headwaters tributaries and roughly 80% coverage of the main stem below Carversville.** The largest gaps in the Paunacussing were the upper reaches of all three tributaries -- the north branch along Carversville Road, the middle branch southeast of Long Lane, and

the south branch along east of Mechanicsville Road. Each of these areas was only about 50% covered by full riparian buffers, pointing to important opportunities for restoration of these streams.

Habitat Restoration or Habitat Management Potential

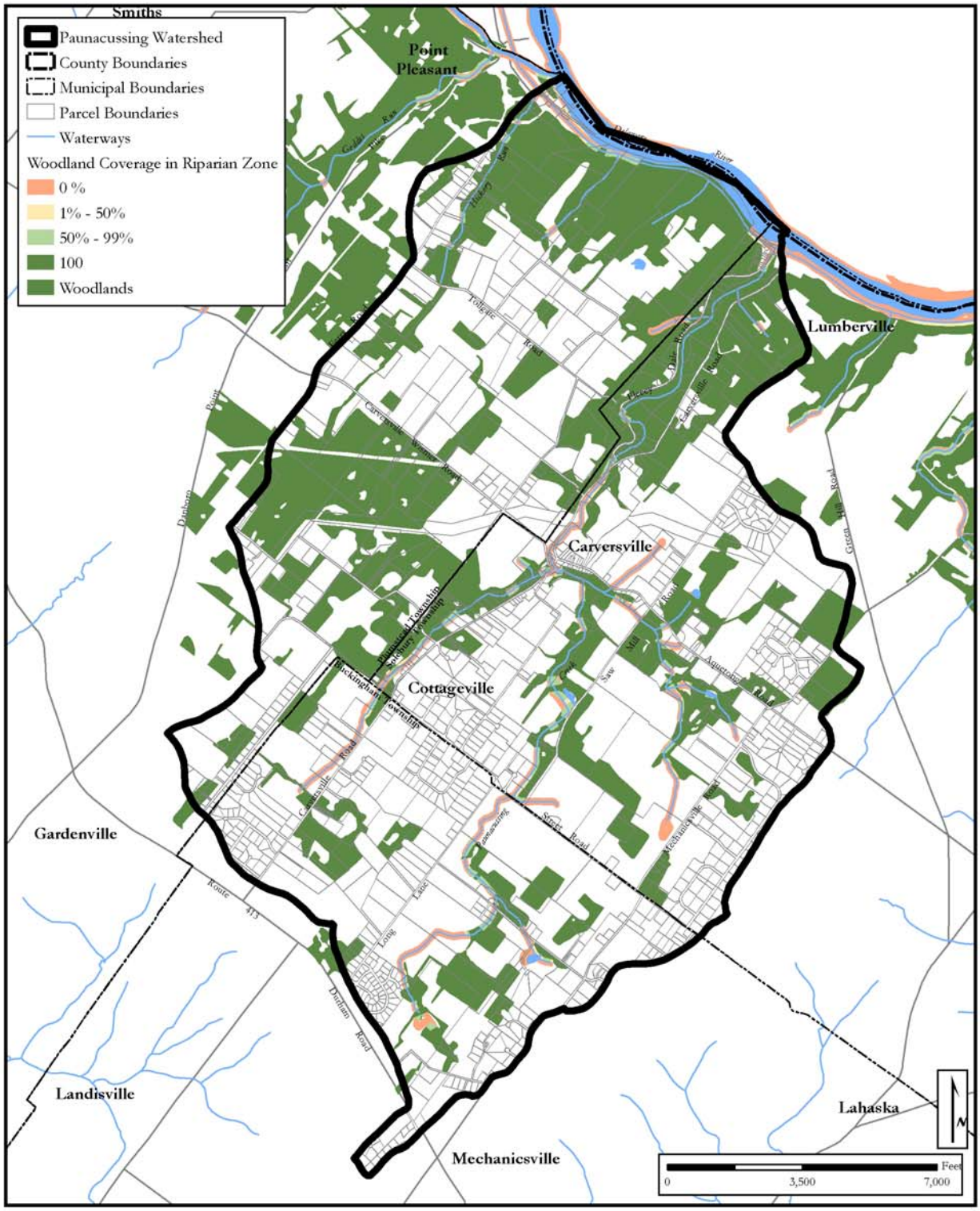
Habitat restoration is a process of human actions to reverse past damage or degradation of natural areas caused by or influenced by human land use or land management actions. Examples of restoration include: stabilization and reforestation of streambanks and riparian corridors that were cleared for farming; replacement of ponds with emergent wetlands; and reforestation of fields on steep slopes adjacent to existing woodlands.

Habitat management approaches involve management of residential, agricultural or natural landscapes in a manner that promotes the diversity of native plants and wildlife. This may include conversion of a large lawn area to a meadow of native grasses and wildflowers, removal of exotic invasive vines smothering a woodland edge, or designing and maintaining stormwater management facilities to utilize native wetland vegetation in berms, swales and recharge beds.

The most clearly delineated areas for habitat restoration or management are shown on the **Habitat Conservation Networks Map (Figure 12)** as riparian zones with 0% woodland coverage. These areas are ideally suited for riparian buffer reforestation. Other areas suitable for reforestation include obvious gaps or clearings in major woodlands, and steep slopes. Farm fields on hydric soils may be ideal candidates for wetland restoration projects.

Planning Implications

The maintenance of identified **Habitat Conservation Networks** is an important approach to protecting the water quality and biological diversity of the Paunacussing Watershed. Private and public approaches will be needed to maintain a network of high quality habitats that represent the full diversity of types typical of the region.
Land trusts, local conservation groups and municipal open space committees are putting together the foundation of such networks by working with landowners to acquire nature preserves and conservation easements on critical parcels within Habitat Conservation Networks. As a second priority, landowners may also volunteer to restore and manage natural areas within Habitat Conservation Networks. Habitat management agreements with utility companies can promote restoration of greenways along utility corridors.



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 12

Habitat Conservation Network

Compiled by: DCR Date: 03/30/05

Notes:
1. County boundaries, municipal boundaries, waterways, watershed boundaries, and floodplains were digitized through PASDA (www.pasda.psu.edu).
2. Parcels from Bucks County.
3. Riparian Buffer Assessment carried out by MLT using 100-foot buffer of waterways and the riparian buffers assessment from Heritage Conservancy.
4. Woodlands digitized by MLT from aerial photographs.

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Municipal ordinances can also guide conservation efforts. Natural landscaping ordinances can replace weed laws to encourage management of meadows and other habitats as replacements for lawn. Open space regulations can be used to ensure that new subdivisions protect critical aspects of Habitat Conservation Networks. Management requirements for these regulations can focus on habitat restoration or maintenance to mitigate the impact of the development on the local environment.

Cultural and Historic Resources

The cultural and historic significance of the Paunacussing program area is exemplified by its unusual concentration of National Register Historic Districts. The three main population centers in the study area, the 18th-century villages of Carversville, Lumberville and Point Pleasant (partially in the study area), are each Pennsylvania-listed Historic Districts and are on the National Register of Historic Places. In addition, the Delaware and Lehigh Canal that transects the eastern limit of the program area is designated as both a National Heritage Corridor and a State Heritage Park. The Twin Silo and McNeil Road area, including a bridge over the creek, has been determined eligible for listing on the National Register of Historic Places by the PA Historic and Museum Commission (PHMC).

The Paunacussing Watershed includes other locally-significant historic hamlets such as Gardenville and Cottageville, and numerous 18th and 19th century houses and farm structures that provide a living history of the local landscape. The *Solebury Township Comprehensive Plan* (2002) includes detailed mapping of over 60 such structures as *historic sites* that exist outside of the designated Historic districts.

The scenic landscapes of the Paunacussing Watershed are a resource of great importance to local residents and municipalities and help to secure the local economy of the area as a destination for travelers. Local artists of the New Hope School, a tradition of Pennsylvania Impressionism, have immortalized these landscapes in numerous early 20th-century paintings. The *Solebury Township Open Space Plan* (2000) identifies at least two significant views of the Paunacussing valley from vista points located near Carversville, and designates the lower Paunacussing as a Scenic Stream Valley.

The national significance of these scenic qualities has been recognized in the *Lower Delaware River National Wild and Scenic Rivers Management Plan Area*, designated by the US Congress in November 2000, which includes the majority of the Paunacussing program area. The Paunacussing Creek corridor in Solebury and the Delaware River corridor in Solebury and Plumstead Townships are designated "recreational" segments of the 67.3 mile Lower Delaware River addition to the National Wild and Scenic Rivers System. **The designation does not prevent development, but it does provide a significant barrier to large projects requiring federal funding or permits such as large dams or highways.** It also enhances federal funding potential for conservation-oriented projects consistent with the Management Plan for the Lower Delaware.

Planning Implications

The *Paunacussing Creek Watershed Conservation Plan* is primarily focused on protection of water quality and quantity, natural areas, and open space along riparian corridors within the watershed; however it includes structures and landscapes that are an important part of the historic and cultural heritage of Solebury, Plumstead and Buckingham Townships as well. Protection of the broad number of historic structures and settings, and scenic viewscapes is of paramount importance in the Paunacussing area.

Three of the main tools for preservation of historic structures and settings are:

- the use of façade easements,
- Historic Architectural Review Boards (HARBS), and
- ownership by historic groups or local governments.

In addition, protection of scenic viewscapes and historic settings can be achieved with the use of land acuisition or easement acquisition. Some of the most important examples of these resources are identified as **Landscape Conservation Priorities** in Natural Lands Trust's *Paunacussing Landscape Conservation Plan*.

Recreational Opportunities

The Paunacussing Creek Watershed provides a range of non-invasive recreational opportunities, such as walking, hiking, cycling , fishing, birdwatching and hunting (during appropriate seasons), however, the amount of publicly-accessible land is relatively minimal. Many of these activities are on private lands (by landowners or those with landowner permission) or along public roads. The Delaware and Lehigh Canal which passes along the entire length of the Paunacussing watershed interface with the Delaware River, is the most significant and accessible area for many of these recreational opportunities. Quiet back roads within the watershed serve as de facto "trails" used by hikers, bikers, and dogwalkers.

National Register Status	Type	Name	Address	Municipality	Date(s)
Listed	District	Bridge in Solebury Twp.	Carversville Road (L.R. 09066)	Solebury	1854
Listed	District	Carversville Historic District	Off PA Route 32	Solebury	1820 - 1860
Listed	District	Lumberville Historic District	River Road (PA Route 32)	Solebury	1700 - 1930
Listed	District	Point Pleasant Historic District	River Road and Point Pleasant Pike	Plumstead	(18th – 19th century)
Listed	District	Mechanicsville Village Historic District	Route 413 (Durham Road) and Mechanicsville Road	Buckingham	1700 - 1900

National Register of Historic Places – Listings within the Paunacussing Creek and Hickory Run Watersheds.
Source: Pennsylvania Historical and Museum Commission website, ARCH database: www.arch.state.pa.us

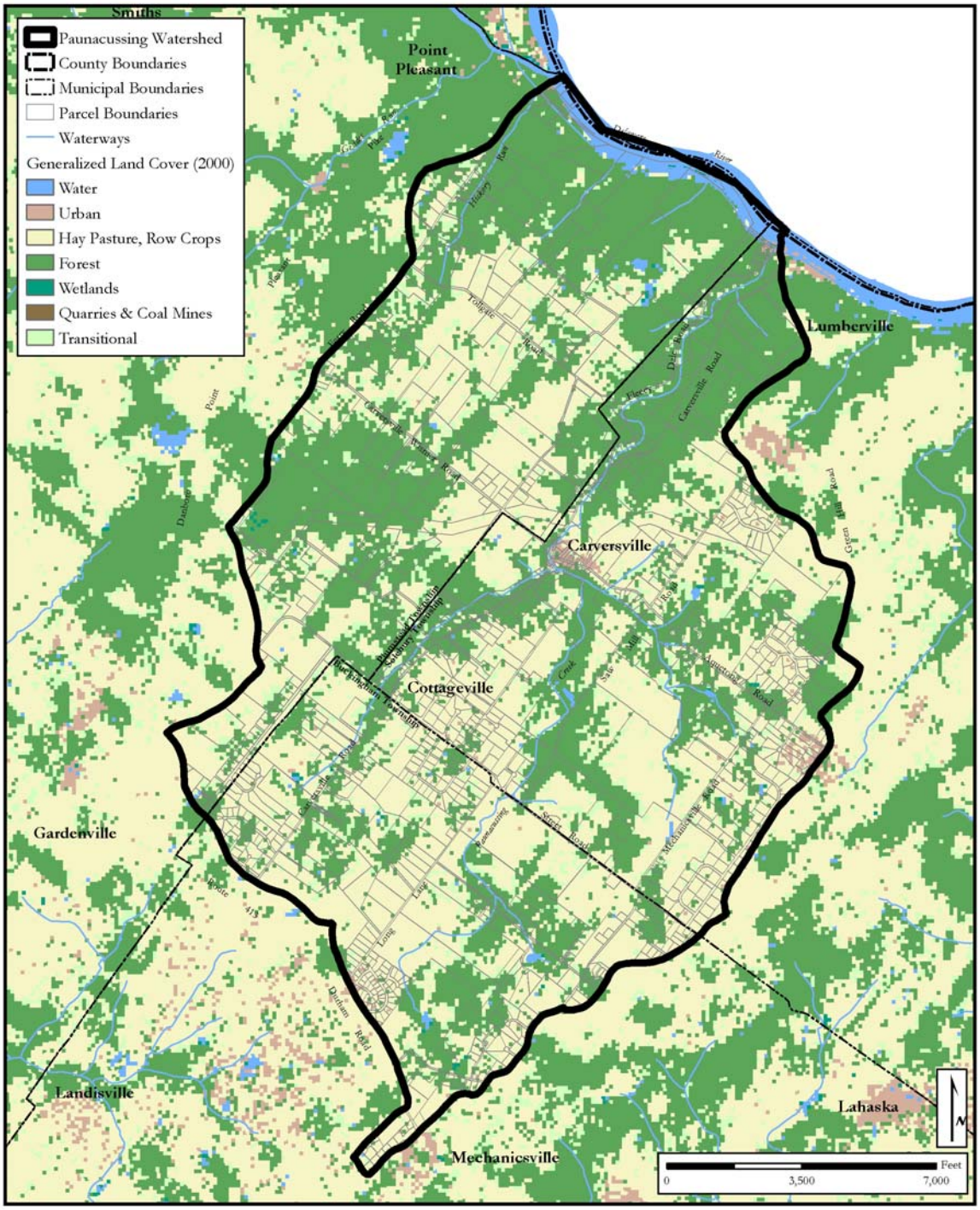
Land Use Patterns and Trends

The **land use pattern** in the headwaters, ravines, and river corridor landscapes of the Paunacussing area is closely linked to the ownership pattern, the natural constraints of the land, demographic trends, local land use regulations in Buckingham, Solebury and Plumstead, and the central Bucks County real estate market. The area can generally be described as a historic, semi-rural landscape that retains a fabric of small farms in agricultural uplands, steep wooded valleys with 18th century mill villages, and the historic canal villages, bluffs and floodplains of the Delaware River corridor. Suburban residential development of varying densities is the newest land use pattern, encroaching on all of these landscape types near the Route 413 corridor, Street Road and Mechanicsville Road. **(Figure 13 – Land Cover 2000)**

The headwaters portions of the Paunacussing and Hickory Run watershed along Route 413, Carversville Road, Mechanicsville Road and Aquetong Road include a mixture of older dairy farms, and new residential development ranging from small-lot subdivisions to custom homes on larger lots. The Route 413 corridor in particular has generated more intensive residential development including smaller lots (Buckingham View) and larger lots (Carversville Estates), and associated services, including the new Midway Volunteer Fire Company, and the new Cold Spring Elementary School (just west of the study area). Street Road includes one large and several smaller subdivisions. The Mechanicsville Road corridor east of the historic village of Mechanicsville includes at least 6 small-scale cul-de-sac subdivisions with 10 lots or less. This pattern may be a local trend with farms selling 10 to 15 acres at a time to local builders.

Several core areas of contiguous farmland are located in the study area, including along Twin Silo Road in Plumstead Township, Long Lane and Sawmill Road in Buckingham and Solebury Township, and Mechanicsville Road and Greenhill Road in Solebury Township. Maximuck's farm market on Long Lane and Street Road stands out as a bastion of the rural lifestyle that has defined this landscape for so many generations. A patchwork of smaller farm fields in the headwaters areas have been abandoned in the last 10 to 20 years and have grown up as thickets of eastern redcedar, red maple, flowering dogwood and other successional shrubs and young trees.

Land use along the Hickory Run is typical of Plumstead Township, with scattered small farms, maturing woodlands, and an increasing number of single-family residences on individual lots and small-scale subdivisions. There are no quarries within the study area. The nearest quarry is along Point Pleasant Pike within the Tochickon Creek watershed north of Hickory Run.



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 13

Land Cover (2000)

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There are no modern industrial or commercial land uses present in the study area, other than small businesses. No large-scale recreational uses (i.e. golf courses, large ball fields) or community facilities are present. Public utilities are limited to two public utility corridors that pass west-to-east across the study area: a PECO Energy overhead transmission line and a Duke Energy gas pipeline. These manmade corridors are maintained as cleared areas of 100 to 150 feet in width, and cross Hickory Run, Paunacussing Creek, and fragment several woodlands. A third utility line cut extends from the Point Pleasant Pumping station, paralleling the north side of Hickory Run, and reaching a building in the Delaware River floodplain on the south end of Point Pleasant. This controversial system sends water from the Delaware to the Bradshaw Reservoir and the East Branch of the Perkiomen Creek in Montgomery County, where it is used to supplement cooling water for PECO's Limerick Nuclear Generating Station on the Schuylkill River.

The pattern of development appears to be moving eastward toward the Delaware River, which has experienced a recent increase in larger lot (3 to 10 acre) development with custom homes. The central portion of the Paunacussing corridor forms a more dramatic, rolling landscape of fields and woods with steeper ravines, narrow winding roads and cliffs formed by pronounced outcrops of Stockton bedrock. The valley both upstream and downstream from Carversville includes a mix of smaller historic farms with hedgerows, hayfields and woodlots and newer custom homes on larger lots. The stream corridor below Carversville is mostly wooded, with stands of hemlock on north-facing slopes and steep valley walls. This topography appears to have served as a natural constraint against over development, particularly when combined with the potential for the area to attract conservation-minded landowners. **However, current and future zoning and subdivision and land development ordinances may not completely restrict development in these sensitive zones.**

Roads

Roads, the presence or absence of which is closely tied to local topography, have historically had a major influence on the nature and density of development in the Paunacussing Creek watershed. This influence continues today, with Route 413 and Route 32 (River Road) forming the busiest routes at the western and eastern boundaries of the watershed, respectively.

Route 413 follows the ridge along the relatively level areas formed by the sandstones of the Stockton Formation, providing a direct link to the more populated Langhorne/Levittown area to the south and with Route 202 in the Doylestown area, and with Route 611 and Easton to the north. River Road provides a more meandering connection to the south with population centers around Yardley/Trenton, where it connects with I-95 leading to Philadelphia. Development along River Road is naturally constrained by the steep topography and the Delaware River floodplain, however, the village of Lumberville is not subject to historic preservation standards such as a Historic

Architectural Review Board (HARB) Development along Route 413 is a greater possibility, with commercial and institutional uses beginning to concentrate along this corridor between Mechanicsville and Gardenville. However, there is no commercial or industrial zoning along the Plumstead portion of this corridor, and public sewers are limited to individual subdivisions.

Although the watershed is crossed with smaller local roads, most of these do not directly link population centers and destinations and therefore do not present a major threat as catalysts for large-scale development. Aquetong Road and Street Road are considered Minor Collector roads crossing the watershed, and do provide direct routes from the fast-growing New Hope area to the south.

Protected Open Space

Several hundred acres of land in the Paunacussing Creek watershed have been protected from development through voluntary agreements or acquisitions. In addition to the Delaware Canal (PA DCNR), the Paunacussing Preserve (NLT), over a dozen parcels have been protected by conservation easements voluntarily donated or sold by landowners to land trusts, municipalities, and county programs. Plumstead acquired 87 acres of a former dairy farm along Twin Silo Road. Solebury, Plumstead and Buckingham Townships are actively pursuing open space acquisitions in the watershed, often with the assistance of groups such as the Heritage Conservancy, Brandywine Conservancy and Natural Lands Trust, and also the Bucks County Agricultural Land Preservation program. One of the unique areas within the watershed is the Paunacussing Preserve, owned by Natural Lands Trust, on Holicong Road in Buckingham Township. This 108-acre site protects the Middle Branch headwaters.

Growth Projections

While the vast majority of the 54 municipalities in Bucks County had their peak growth periods in the 1970s and 1980s, the three municipalities in the Paunacussing program area peaked in the 1990s. According to Census 2000, Plumstead and Buckingham both made the Census Bureau's top-ten list of fastest growing municipalities in the Philadelphia region, based on percentage change in population between 1990 and 2000. Plumstead Township ranked as the 7th fastest growing municipality in the region, growing by 81% over the last decade, while Buckingham ranked as the 9th fastest growing, with a 76% increase. In the 20 year period from 1980 to 2000, Plumstead was the 4th fastest growing municipality in Bucks County, with a population increase of over 121%. Solebury's growth rate is somewhat more modest, with a 29% increase in population over the same time period, yet it still reached its peak in the 1990s.

What these statistics mean for future growth in these municipalities is clear – the wave of growth in southern Bucks County is moving northward, and the central Bucks County municipalities in the areas surrounding Doylestown and New Hope are experiencing, and will continue to experience, rates of growth that are unparalleled in their history. While much of this growth has taken place to the

west, closer to the Route 611 corridor, these trends place obvious pressure on all parcels within the Paunacussing landscape that have the potential to be developed, and point to the urgency of implementing the recommendations in this Watershed Conservation Plan.

Planning Implications

The current land use pattern and growth trends are interrelated. The traditional pattern of farms, woodlands, and historic villages is still present, and can be maintained even as the area continues to grow, provided that conservation and planning approaches are utilized, as recommended in this plan. The majority of critical open space parcels can be preserved with donations of land and conservation easements, open space funding to purchase land and conservation easements, and possibly transfer of development rights (TDR) to areas that are better suited for more intensive development.

Ownership Patterns –

Largest Parcels (100 to 180 acres; 75 to 100 acres)

The largest parcels are 100 to 180 acres in size. Approximately 7 properties in the Paunacussing study area are in this category, with most being close to 100 acres. 13 properties are between 75 and 100 acres. Almost all of these large parcels are located on the upland soils of the Paunacussing Watershed; most support large agricultural fields. The majority are found on the east side of the Route 413 corridor and the north side of Mechanicsville Road in the Paunacussing and Cuttalossa Creek headwaters, with smaller concentrations north of Geddes Run and on the palisades north of Lumberville. The **Large Parcels Map (Figure #14)** shows this pattern clearly in dark green.

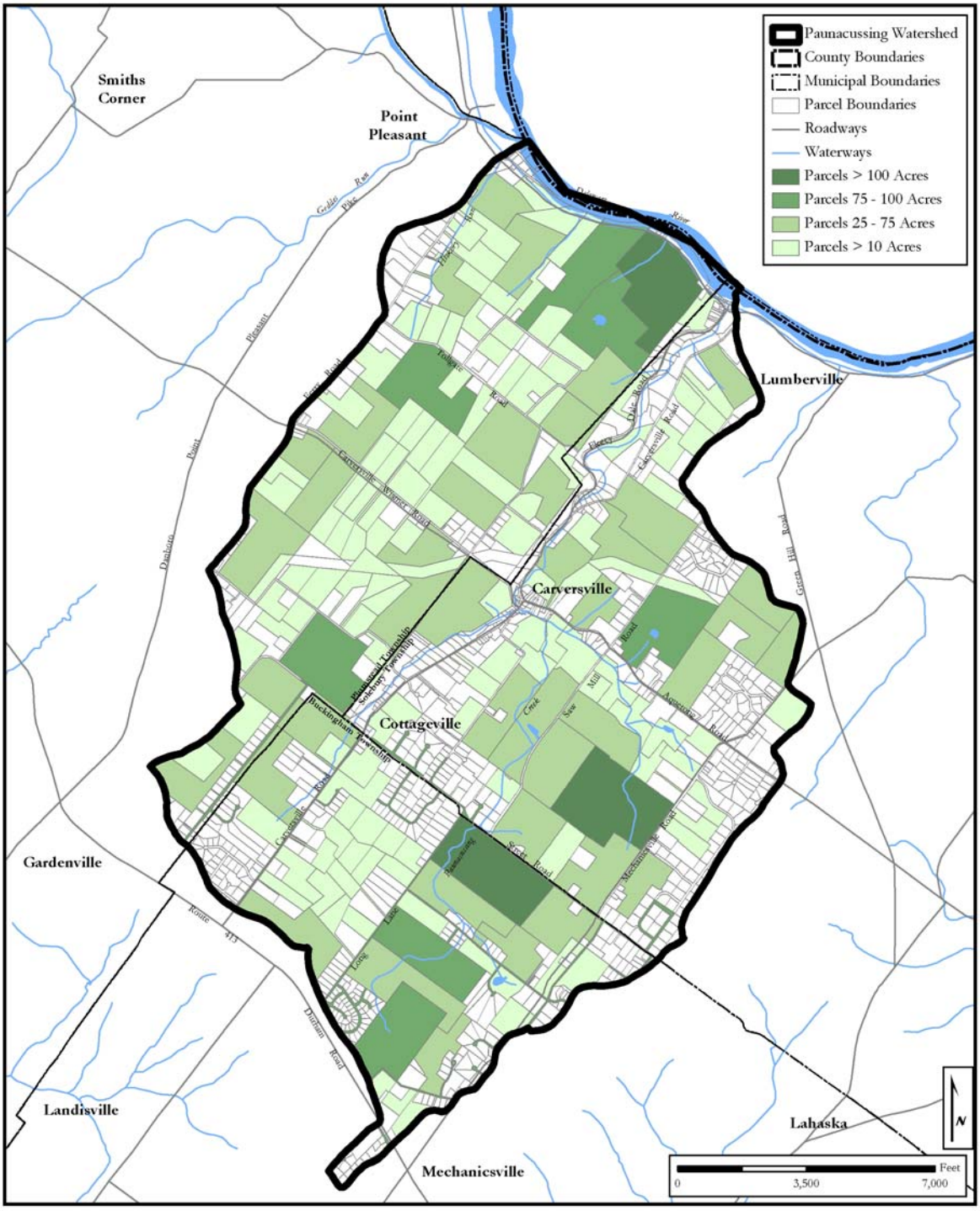
Most of these large parcels lack significant woodlands, wetlands or stream corridors; their value is generally attributable to their sheer size as open, scenic agricultural lands with groundwater recharge benefits. Where they are contiguous, their conservation importance is even greater. Entire *scenic landscapes* (such as exists along Sawmill Road) also could be protected when protecting properties of this size.

Second-Tier Parcels (25 to 75 acres)

The next level of parcel sizes are those in the 25 to 75 acre range. Roughly 65 properties are within this range; they are also shown in dark green on the **Large Parcels Map**. They are scattered throughout the area but are often contiguous with other parcels of the same size or those in the **Largest Parcels** category. They often include significant woodlands, steep slopes, hydric soils and riparian corridors.

Third-Tier Parcels (10 to 25 acres)

The next level of open space parcels fall in the 10 to 25 acre range (How many?). These are shown in light green on the **Large Parcels Map**, and are scattered widely throughout



Paunacussing Creek Watershed Conservation Plan
Bucks County, Pennsylvania

FIGURE 14
Large Parcels

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the Paunacussing area, often in contiguous blocks. The largest concentrations of these open space parcels are in Plumstead Township, along Ferry Road, Tollgate Road, and Wismer Road.

Small Individual Parcels and Subdivisions

The Paunacussing Watershed is fortunate to not yet have experienced many large-scale subdivisions. Historically, the 5 villages have supported much of the population in well-designed homes on small lots. In the mid- to late 20th century, individual road-front lots were sold off for custom homes, particularly along Ferry Road, Point Pleasant Pike, and Ridge View Road. In the 1970s, 80s and 90s, at least 9 subdivisions with more than 10 lots each have been constructed in the area, with several others proposed. The largest of these are located along Route 413 and Mechanicsville Road. The majority of the subdivisions (at least 11) are smaller cul-de-sacs with 10 lots or less. An increasing number of large-lot subdivision (3 to 5 acres or more per lot) are being developed in the area.

ACTION PLAN

FOR THE
PAUNACUSSING CREEK
WATERSHED CONSERVATION PLAN

The Action Plan that follows is organized according to the Major Issues that affect the conservation of the Paunacussing Watershed. Each section begins with Goals specific to the Paunacussing Creek, followed by Management Recommendations. Following certain Recommendations are Background Sections that explain the rationale for the Recommendations.

The identification of Major Issues, Goals and Management Recommendations in the Paunacussing Creek watershed is based input from public meetings, meetings with municipal officials, and from research and analysis of data from a variety of sources.

The issues that affect stream, wetland and aquifer protection tend to overlap, thus their separation into these discrete Major Issues may seem at times artificial. Often a Recommended Implementation Action for one issue is also contained in a Goal Statement for another. The most important objectives, for example a commitment to preserving and enhancing riparian buffers, are those that address most of the issues simultaneously. Rather than repeating similar information, the recommendations are placed under what seem to be the most fitting issue.

MAJOR ISSUE #1

GUIDE LAND DEVELOPMENT

GOALS

The overall pattern and intensity of land uses in communities throughout the Paunacussing Creek watershed should be planned in a manner that:

- *Permanently protects critical environmental features such as streams, wetlands, floodplains, riparian woodlands, major forest blocks and steep slopes from clearing, excavation and development.*

- *Retains the traditional pattern of development in the area, with homes and businesses on smaller lots in or near existing hamlets, villages and towns and crossroads (where major roads and utilities already exist), and rural lots and large properties in areas dominated by farmland and woodlands.*

- *Provides flexible standards for developers to design more compact communities adjoining substantial areas of protected open space.*

- *Explicitly recognizes the value of regional planning among neighboring municipalities.*

MANAGEMENT RECOMMENDATIONS

1. Flexible zoning and subdivision ordinances should be adopted by municipalities. Enacting "*Conservation Design*" ordinances can strongly encourage a shift from conventional residential development on 1 or 2 acre lots to more *open space-oriented development* with residences on lots of less than 1 acre in size and substantial areas of protected open space encompassing sensitive natural features and historic resources and also otherwise "buildable" land. "*Traditional Neighborhood Design*" ordinances should be enacted to shift Highway Commercial development away from wide extended strips along major roads and toward existing "nodes" at crossroads and existing developed areas. Model ordinances from county planning commissions or nonprofits and enacted by other communities to achieve these goals should be provided to municipalities for consideration.

2. Municipalities should review and consider establishing Transfer of Development Rights (TDR) programs. This strategy includes identifying important "sending zones" (such as prime farmland and large forests) where important land areas should be protected and "receiving zones" (such as village extension areas or existing "nodes" of development) where higher densities of residential or mixed-use development can be accommodated in a creative and environmentally-sensitive manner. Model ordinances enacted by other communities to achieve this goal should be provided to municipalities for consideration. This approach is also compatible with strategies such as Agricultural Land Preservation, Effective Agricultural Zoning, Village Extension Overlay Zones and Joint Municipal Comprehensive Planning.

3. Municipalities should review and consider adopting Village Extension Overlay ordinances. These can be useful in areas where important farmlands or woodlands adjoin existing villages or hamlets, and would allow development densities to be shifted from the majority of a tract of land to the portion closest to the existing village or hamlet, while requiring the new development to be planned and designed for compatibility with the existing community. This approach is also compatible with strategies such as Agricultural Land Preservation, Effective Agricultural Zoning and Transfer of Development Rights.

4. Increase enrollment of Paunacussing properties in County and State land preservation programs for agricultural lands and natural areas. This effort can be made by a coalition of municipalities, county agencies and conservation groups.

5. Municipalities should consider the use of Effective Agricultural Zoning in areas where farming is a primary use of land. This type of ordinance can be used in conjunction with Transfer of Development Right programs, Village Extension Overlay zones and Agricultural Land Preservation programs to create zoning districts that promote the viability of agricultural operations on minimum lot sizes of 25 acres or greater.

6. Neighboring municipalities should consider working together to adopt Joint-Municipal Comprehensive Plans, as allowed under the Pennsylvania Municipalities Planning Code. Since the scale and rate of development that is occurring in central Bucks County affects entire landscapes and subwatersheds, a coordinated, regional approach to land use planning among neighboring municipalities allows for more realistic growth management and resource protection than the conventional mosaic of small, fragmented plans. Regional comprehensive planning is being conducted in the watershed and should be considered in municipal land use planning. These efforts include the Quakertown Area Regional Planning Commission, and several communities in Berks County.

7. Municipalities should consider the use of environmental impact fees and requirements for environmental impact mitigation for major energy generation facilities and quarries.

8. Enhance the livability of the hamlets of Mechanicsville, Gardenville, Cottageville as village extension areas for appropriate, village style development. Enhance the livability of the villages of Carversville, and Lumberville through the use of stormwater management strategies.

9. Ensure that municipalities throughout the watershed adopt the full range of environmental protection ordinances, including those dealing with wetlands, floodplains, riparian buffers, steep slopes and grading. Most of these regulatory approaches are described in under the relevant section of this plan. Steep slope ordinances should be adopted by municipalities to protect steep slopes and limit development in these areas. Steep slopes are naturally constrained in that they often have shallow depth to bedrock and highly erodible soils. Construction on steep slopes generally require excessive amounts of grading that alters natural hydrology and generates accelerated erosion and sedimentation in areas adjacent to streams.

Implementation Action Summary:
Issue #1: Guide Land Development

Specific Tasks Involved	***Potential Participating Parties***
1) Flexible Zoning and Subdivision Ordinances should adopted by municipalities.	*Municipalities, County Planning, Conservation. Organizations, DCNR (Growing Greener)*
2) Municipalities should review and consider establishing Transfer of Development Rights (TDR) programs.	*Municipalities, County Planning, Conservation Organizations*
3) Municipalities should review and consider adopting Village Extension Overlay ordinances.	*Municipalities, County Planning, Conservation Organizations*
4) Increase enrollment of Paunacussing farms in County and State Agricultural Land Preservation programs.	*A coalition of Municipalities, County Agencies and Conservation Organizations*
5) Municipalities should consider the use of Effective Agricultural Zoning in areas where farming is a primary use of land.	*Municipalities, County Planning, Conservation Organizations*
6) Neighboring municipalities should consider working together to adopt Joint-Municipal Comprehensive Plans.	*Same as above*
7) Municipalities should consider the use of environmental impact fees and requirements for environmental impact mitigation for major energy generation facilities and quarries.	*Same as above*
8) Enhance the livability of the hamlets and villages.	*Municipalities, County Planning*
9) Steep slope ordinances should be adopted by municipalities to protect steep slopes and limit development in these areas.	*Same as above*

BACKGROUND FOR MAJOR ISSUE #1

Land development is perhaps the single most critical issue facing the Paunacussing Creek watershed. Of all the issues affecting watersheds in the rapidly growing region of southeast

Pennsylvania, suburban sprawl typically has the most far-reaching effects on the quality and quantity of both ground and surface water resources. This fact, combined with the significant growth projections facing the communities of the Paunacussing, place the land development issue at the top of the list for watershed conservation planning.

Poorly planned growth and overdevelopment in other watersheds in the region are directly linked to a broad array of serious, often interrelated watershed impacts. These include:

Water Quantity Impacts

- *Severe flash flooding due to increased runoff from impervious surfaces and poor stormwater management practices*
- *Depletion of aquifers and resulting well failures due to increased runoff, reduced ground water recharge, and increased reliance on ground water for public and private water supply wells (occasionally discharging to streams via sewage treatment plants).*
- *Unnaturally low stream flows during droughts due to increased runoff, depletion of aquifers and loss of wetlands*

Water Quality Impacts

- *Groundwater contamination due to failed septic systems and pollutants found in runoff*
- *Stream contamination due to increased discharges from industrial plants, municipal and package sewage treatment plants, and non-point sources such as stormwater runoff washing pollutants from roads, parking lots, and lawns.*

Water Quality *and* Quantity Impacts

- *Loss of critical wetland habitats and associated flood control, water filtration and stream baseflow functions*
- *Erosion, sedimentation and channelization of streams due to increased runoff and loss of natural stream and wetland vegetation*
- *Loss of aquatic biodiversity of plants and organisms and associated water filtration functions*

Land consumption is one of the greatest impacts of sprawl – we are wasting valuable farmland and natural areas by converting it to suburban environments. While the population of the Philadelphia region has remained relatively constant over the last 30 years, the acreage of land consumed to accommodate that population and related services and businesses has increased dramatically. The costs associated with excessive land consumption extend beyond the loss of important open space to include the community costs of maintaining unnecessarily large infrastructure and utility systems.

Conservation Design

One of the most effective approaches communities in southeastern Pennsylvania are using to deal with these sprawl-related watershed impacts is to change the *pattern and*

intensity of land development through flexible, open space-oriented zoning and subdivision ordinances. The municipal zoning district codes described above often include provisions for concentrating development in part of a property, and leaving the remainder in a form of open space, either public park land, common open space owned by a Homeowners' Association, or in some cases privately owned. Conservation subdivision (often referred to as cluster development) has been permitted as an option in modern zoning codes for several decades because smaller lots generally require less roadway and utility lines to service the homes, meaning less municipal maintenance, and the provide a public amenity and environmental protection in the preserved open space.

To protect municipal government and taxpaying residents from the public costs of poorly conceived designs, cluster ordinances lay out a number of standards that the developments must meet. They generally include:

- either on-lot wells with a certain percentage permitted within the open space, community wells in the open space, or public water
- either on-lot septic systems with a certain percentage permitted within the open
- space, community systems in the open space, or public sewer.
- A minimum percentage of open space, often at least 50% including buildable land
- above and beyond constrained land (i.e. floodplains and steep slopes).
- Some provision for active recreation (i.e. ballfields) or passive recreation (walking
- trails) within the open space.
- A mechanism to establish the maximum density of units to be built on the site.
- Modest density bonuses to encourage use of the Conservation Design option, and to
- encourage optimum size and layout of open space.

Traditional Neighborhood Design

One of the most important national trends in planning has been a rediscovery of the value of traditional neighborhoods, such as those that exist in the historic villages and hamlets of the Paunacussing Valley. As an alternative to the isolated, land consumptive, automobile-dependent pattern of suburban development, many communities are promoting new neighborhoods with features such as sidewalks, front porches, small front yards, village greens, and corner stores to create a sense of community and a sense of place. This pattern of development can be encouraged in developments adjoining existing villages and hamlets.

MAJOR ISSUE #2

RIPARIAN FOREST BUFFER PROTECTION AND RESTORATION

GOAL

*Protection, restoration and management of a full riparian buffer extending 75 to 100 feet from each stream bank of streams throughout the **entire** Paunacussing Creek watershed. Where this width cannot be achieved, a sliding scale of buffer widths should be considered. The majority of these buffers should consist of native floodplain forest vegetation, however, existing herbaceous wetland vegetation, meadow, and shrub vegetation should be considered as alternatives where forest buffers are not feasible. In addition, historic settings should be respected.*

MANAGEMENT RECOMMENDATIONS

1. Establish an Paunacussing Riparian Buffer Initiative. Protection, restoration and management of riparian forest buffers and, in some cases, vegetative buffers, should be established as the goal of a watershed-wide program such as an *Paunacussing Riparian Buffer Initiative*. The initiative should be sponsored by a coalition of local watershed and conservation organizations and should promote this goal by encouraging the adoption of riparian buffer ordinances by municipalities. The Initiative should utilize the *Paunacussing Watershed Stream Protection and Restoration Plan* prepared by the Delaware Riverkeeper Network and Biohabitats as a basis for planning ongoing projects, and should involve local volunteers in conducting a more detailed assessment of riparian corridor priorities. In addition, funding assistance should be encouraged and provided for private, institutional and government landowners to voluntarily protect and restore these areas on their lands through easements, fencing, and reforestation.

2. Municipalities throughout the watershed should consider adoption of a Riparian Buffer Ordinance as an overlay district with consistent standards. This ordinance would require anyone submitting a land development plan application or a building permit application to demonstrate that a full riparian buffer zone of 75 to 100 feet on either side of a stream or wetland has been protected as a condition of approval (as recommended by the USDA Forest Service and the Stroud Water Research Center). When larger-scale residential,

industrial or commercial developments are proposed, reforestation of unforested riparian buffer zones should be required as a mitigating measure and stormwater Best Management Practice to offset the impact of the development on streams running through or adjacent to the site. A sliding scale of alternative buffer widths (15-25 feet, 25-50 feet, 50-75 feet, based on stream size) should be provided where applicants can demonstrate that 75 feet or greater is not feasible. Riparian buffer ordinances can be freestanding, to apply to specific areas of degradation along streams. The Bucks County Planning Commission has developed a model ordinance. Additional models are available through the Pennsylvania Stream ReLeaf manual prepared by DEP.

3. Provide Riparian Forest Buffer protection/restoration funding assistance to landowners. Landowners should be encouraged to consider implementing voluntary riparian buffer projects including streambank fencing, reforestation, and conservation easements. Riparian buffer projects have been instituted on a number of farms and properties in Bucks County watersheds by the Delaware Riverkeeper Network. Such projects should also follow the 75-100 foot standard for each side of the stream, but should allow for a sliding scale of reduced buffer widths where the full amount cannot be achieved. Local townships may want to consider financial incentives, such as property tax rebates, for landowners who are willing to install and maintain high quality riparian buffers on their property.

4) Develop riparian habitat restoration and interpretive projects at locations throughout the watershed.

a) Establish riparian restoration and natural landscaping demonstration projects at parks with stream frontage in Buckingham, Solebury and Plumstead Townships, NLT's Paunacussing Preserve and other suitable sites in the watershed. These projects are key locations for promoting riparian buffer awareness through demonstration projects developed at public education facilities. These projects should be developed as part of an overall Restoration and Management Plan for each site.

b) Additional riparian habitat restoration and interpretive projects should be continued in conjunction with the Delaware Riverkeeper assessment.

c) Protect land along the main stem of Paunacussing Creek adjacent to Fleecydale Road between Carversville and Lumberville.

d) Restore buffers, remove invasive vegetation, develop trails and provide signage and educational programs in public open space.

e) Restore streambanks along the non-forested sections of the North Branch, Middle Branch and South Branch of Paunacussing Creek.

f) Conduct educational outreach programs on riparian buffers for streamside landowners.

Implementation Action Summary:
Issue #2: Protection/Restoration of Riparian Forest Buffers

Specific Tasks Involved	***Potential Participating Parties***
1) Establish an Paunacussing Riparian Forest Buffer Initiative	*Coalition of Conservation Organizations, County Agencies, Municipalities*
2) Municipalities throughout the watershed should consider adoption of a Riparian Buffer Ordinance	*Coalition of Conservation Organizations, Municipalities, County Planning*
3) Provide Riparian Forest Buffer protection/restoration funding assistance to landowners.	*Coalition of Conservation Organizations, Landowners, Funding Agencies*
4) Develop riparian habitat restoration and interpretive facilities throughout the watershed	*Conservation Organizations, County Parks, Municipalities, Landowners, Conservation Districts*
a) Establish riparian restoration and natural landscaping projects at township parks with stream frontage.	
b) Protect land along the main stem of Paunacussing Creek adjacent to Fleecydale Road.	*Solebury Township, PLUM, Delaware Riverkeeper Network, Paunacussing Watershed Association.*
c) Restore buffers, remove invasives vegetation, develop trails and provide signage and educational programs in public open space.	*Townships, Conservation Organizations*
d) Restore streambanks along the North, Middle and South Branches of Paunacussing Creek.	*Townships, Conservation Organizations*
e) Conduct educational outreach programs on riparian buffers with streamside landowners.	*Townships, Conservation Organizations*

BACKGROUND FOR MAJOR ISSUE #2

The riparian forest, or the woodland that lines the banks and corridors along streams, has been shown to be critical to the continued stability and health of waterways (US Forest Service, *Riparian Forest Buffers*, 1991). Most streams in the northern Piedmont region evolved within a naturally forested cover, including those of the Paunacussing watershed. With the human alteration of land over the last 300 years, many streams

have been taken out of these natural settings and instead flow through miles of agricultural fields, lawn grasses and even paved areas. *Protection and restoration of riparian forest buffers is perhaps the single most important strategy that can be used to maintain the health of streams in the Paunacussing Creek watershed.*

Riparian forest buffers are natural sponges that have been shown to absorb and bind much of the sediments, nutrients and some of the pollutants in runoff before they reach the waterway. The shade provided by the trees and shrubs maintain lower water temperatures and their leaves and twigs are the primary source of food for the aquatic food web. They slow the speed of stormwater, reducing erosion of the small swales and gullies that feed the stream. Research by the Stroud Water Research Center on the White Clay Creek in Chester County has shown that forests along streams also support cooler, wider streams (Sweeney 1992). The US Forest Service publication cited above, and the 1995 paper by the Montgomery County Planning Commission titled "*Riparian Corridor, the Benefits of Protection*," are both excellent brief descriptions of the many benefits of riparian forests.

An increasing number of funding sources are available for riparian buffer protection and restoration. Different programs are set up to fund different riparian project types, including streambank fencing, streambank restoration, agricultural properties, easement acquisitions, stormwater management projects. A partial list of funding sources includes the USDA Conservation Reserve Program, Act 319 Clean Streams grants, Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, PA Department of Environmental Protection (Growing Greener), certain county programs, Ducks Unlimited and Trout Unlimited, and certain private foundations. Local or regional conservation groups such as the Paunacussing Watershed Association, PLUM, Heritage Conservancy, Natural Lands Trust, Delaware Riverkeeper Network and County agencies can all be considered as partners that are active in riparian corridor protection and restoration.

Plumstead Township has a Resource Protection District that prohibits grading, altering, piping of creeks and wetlands.

MAJOR ISSUE #3

CONSERVATION OF MAJOR WOODLANDS

GOAL

Large, contiguous blocks of "deep woods" (or forest-interior habitat) should be identified and targeted as a top priority for conservation, in order to limit the impact from clearing and development.

MANAGEMENT RECOMMENDATIONS

1) Establish a Paunacussing Woodland Conservation and Restoration Initiative
Organizational partnerships should be established with the goal of encouraging reforestation. The maintenance of a permanent, contiguous forest throughout the watershed should be emphasized. Expansion of existing forest networks should be encouraged so that the overall forest area will increase in size, shape, connectivity and health.

2) Identify the largest blocks of contiguous forest in the watershed for conservation.
Work to make the connections between the blocks if they do not already connect. On the Habitat Conservation Network map, **(Figure 12)** the blocks of forest appear to be fairly well connected. These include the extensive woodlands, along the main stem between Carversville and Lumberville and the wooded palisades above the Delaware River, (identified as a high priority for conservation in numerous plans prepared by county and municipal agencies and conservation organizations), and other large wooded tracts such as those along Wismer Road east of Ferry Road. Continued fragmentation of the existing forest will undermine both plant and animal diversity in the watershed.

3) Utilize the full range of conservation options for parcels containing key woodlands. Tailor one or more options to each specific situation, such as: donation of land or conservation easements, bargain sale of land or conservation easements, purchase of land or conservation easements, and limited development with conservation of key wooded open space. The Pennsylvania Forest Stewardship Program and the Forest Legacy Program should be pursued where appropriate through the Pennsylvania Bureau of Forestry.

4) Promote the adoption of municipal woodland conservation ordinances.The language of such an ordinance should state that all woodlands that currently exist in the watershed are important, and that any activity that would disturb the forest would require or trigger a newly adopted "overly ordinance" or "overlay easement," which will require Best Management Practices for woodland management.

5) Develop a Paunacussing Biodiversity Management Plan with a strategy to restore and maintain native species and reduce exotic invasive plants.

Implementation Action Summary:
Issue #3: Conservation of Major Woodlands

Specific Tasks Involved	***Potential Participating Parties***
1) Establish a Paunacussing Woodland Conservation and Restoration Initiative.	*Partnerships of State, County, Local Governments, Conservation Organizations, landowners*
2) Identify the largest blocks of contiguous forest in the watershed for conservation.	*Same as above*
3) Utilize the full range of conservation options for parcels containing key woodlands.	*Same as above*
4) Adopt a woodland conservation ordinance, including an overlay ordinance.	*Municipalities, Conservation Organizations*
5) Develop a Paunacussing Biodiversity Management Plan	*PLUM, NLT, municipal EAC's*

BACKGROUND FOR MAJOR ISSUE #3

Forest fragmentation and destruction due to urbanization and conversion to other uses is a great threat to the biological diversity of northern Piedmont forests, including the Paunacussing Watershed.

The forests of the Paunacussing watershed are among the largest, most unfragmented networks of "deep woods" or forest-interior habitat in central Bucks County. They are concentrated along the ravines and palisades closest to the Delaware River, and along major ridges and slopes. The variety of "Sites of Statewide Significance" and "Sites of Local Significance" identified in the *Natural Areas Inventory of Bucks County, Pennsylvania*, 1999 includes a number of ecologically important woodlands in the watershed. In addition, the entire Paunacussing Creek watershed is identified as a Priority 2 Site in the *Natural Areas Inventory of Bucks County, Pennsylvania*,, , in part due to the quality of its woodlands. The *Bucks County Open Space Plan*, 1996, identified wooded slopes and rock outcrops along Fleecydale Road as a "Significant Natural Area" of special emphasis

for biodiversity conservation, and recommended that it be preserved. The *Paunacussing Creek Landscape Conservation Plan* (Natural Lands Trust, 2001) focuses on the importance of conservation and restoration of this area as a regionally-significant network of forested patches and stream corridors.

Solebury, Buckingham and Plumstead Townships, Natural Lands Trust, Bucks County, DCNR, local citizens groups and private foundations and organizations have already contributed to the conservation of many significant wooded parcels in the Paunacussing Creek watershed, with several critical acquisition projects pending on wooded tracts.

PLUM, a local citizens group with members in Plumstead, Solebury and Buckingham Townships, is actively involved in preservation of the Paunacussing Creek watershed. Preservation of the watershed has been the primary goal of the Paunacussing Watershed Association for an even longer period of time. The PWA was formed in 1972 to protect the water, animal, and vegetal resources of the Paunacussing Creek Watershed.

MAJOR ISSUE #4

PROTECTION AND RESTORATION OF WETLANDS

GOALS

- *Permanently protect existing wetlands throughout the Paunacussing Creek watershed from excavation, filling and clearing of native vegetation.*

- *Provide adequate open space buffers between all wetlands and adjacent land uses and structures to minimize non-point source pollution and alteration of natural hydrology.*

- *Restore previously drained, filled or cleared wetlands wherever possible.*

MANAGEMENT RECOMMENDATIONS

1) Identify and characterize all existing wetlands within the Watershed. This can be achieved with aerial photo interpretation, Soil Survey and National Wetland Inventory (NWI) mapping, field verification, and in some cases wetland delineation. Characterization should be based on general wetland types including forested, shrub, emergent, wet meadows and other wet habitats such as vernal ponds. Data should be compiled and regularly updated on the *Paunacussing GIS Database.* Funding sources to carry out this recommendation should be identified and made readily available to organizations that wish to pursue it.

2) Establish a Wetland Conservation Initiative in the watershed. Partnerships should be formed among interested organizations, with the goal of permanent wetland protection throughout the watershed, including vernal ponds along wooded streams and wetlands.

3) Establish a Wetland Restoration Initiative in the watershed. Identify degraded or destroyed wetlands (those altered by draining [tiling, ditching], excavation or filling) that potentially could be reestablished as wetlands. Programs such as the

PA DEP Wetland Mitigation Banking program can provide funding for such projects.

4) Protect and restore those wetlands listed as "high priority sites" in ***Natural Areas Inventory of Bucks County, Pennsylvania*, 1999.** These sites are described in the Vegetation and Wildlife section of this Plan. The drainage areas that supply water to these wetlands should also be targeted for conservation.

5) Adopt wetland protection ordinances in municipalities throughout the watershed.

6) Utilize the full range of conservation options for parcels containing important wetlands. Educate landowners and tailor one or more conservation options to each specific situation, such as: donation of land or conservation easements, bargain sale of land or conservation easements, purchase of land or conservation easements, and limited development with protection of key wetlands and buffers.

7) A *wetland assessment service* should be considered. Perhaps this could be initiated by the Paunacussing Watershed Association. This service should provide professional wetland delineation expertise to local groups, landowners or municipalities. It could provide additional detail for watershed-wide wetland inventory mapping, and allow additional evidence as a "second opinion" for wetland delineations presented as part of a land development project.

Implementation Action Summary:
Issue #4: Protection/Restoration of Wetlands

Specific Tasks Involved	***Potential Participating Parties***
1) Identify and characterize all existing wetlands within the Watershed	*Partnerships of State, County, Local Governments, Conservation Organizations, landowners*
2) Establish a Wetland Conservation Initiative in the watershed	*Same as above*
3) Establish a Wetland Restoration Initiative in the watershed.	*Same as above*
4 Protect and restore those wetlands listed as "high priority sites" in *Natural Areas Inventory of Bucks County, Pennsylvania*, 1999.	*Same as above*
5) Adopt wetland protection ordinances in municipalities throughout the watershed	*Same as above*
6) Utilize the full range of conservation options for parcels containing important wetlands. 7) A *wetland assessment service* should be considered.	

MAJOR ISSUE #5

Protection, Conservation and Prudent Use of the Local Aquifer

GOALS

- *To protect the Paunacussing Watershed water supply by maximizing groundwater recharge of the local aquifer, and monitoring the "water budget", a scientific, GIS-based assessment of water use based on future growth projections.*
- *To base land use regulations and conservation actions on the water budget.*

MANAGEMENT RECOMMENDATIONS

1. **Enact Multi-municipal Water-based Land Use Regulations to guide development of the Paunacussing Watershed**. To guarantee watershed health, the density and location of development in the Paunacussing Creek watershed must be managed in a way that maximizes stream and wetland protection and promotes natural recharge of groundwater. Because the watershed traverses three townships, multi-municipal cooperation is critical. These regulations can be implemented by the individual townships, but should contain similar wording and similar objectives.

2. **Several Water-based Land Use Regulations targeting specific problems should be considered.** Some of these are listed below and discussed further in the following section entitled BACKGROUND ON MAJOR ISSUE #5.
    - ***a.*** *Innovative Stormwater Management Ordinance and Retrofits*
    - ***b.*** *Riparian Forest and Wetland Buffer Ordinances*
    - ***c.*** *Groundwater Recharge Protection Area Ordinance – Critical*
    - ***d.*** *Wellhead Protection Ordinance*
    - ***e.*** *Open Space Management Standards*
    - ***f.*** *Natural Landscaping Ordinance*
    - **g.** *Septic Maintenance Programs*

3. **Initiate public education programs** targeting individual homeowners to help them understand the importance of preserving their local watershed.

BACKGROUND ON MAJOR ISSUE #5

All critical lands within the watershed cannot be preserved. A more reasonable course of action is to utilize municipal ordinances to guide conservation, restoration and management of habitat areas. Developers will be required to focus on habitat restoration and techniques to mitigate the impact of development.

2a) Innovative Stormwater Management Ordinance and Retrofits – Uncontrolled stormwater runoff has a serious impact on stream quality, flood hazard and depletion of groundwater. To comply with the new **National Pollution Discharge Elimination System (NPDES), Phase II** (administered by PA DEP) municipalities in the Watershed will have to upgrade existing stormwater management ordinances to address the critical issue of groundwater recharge and to improve the quality of runoff water. The ordinance should stipulate that stormwater must be infiltrated back into the soil in the Watershed and runoff that discharges to streams must be filtered before reaching the stream. Stormwater should not be directed away from the Watershed. These ordinances should contain the following requirements:

1) minimize disturbance of existing soil and vegetation;
2) reduce impervious cover (rooftops and paved areas) and protect significant open space areas;
3) manage stormwater where it is generated, in small, decentralized systems rather than large, concentrated systems; and
4) use "Best Management Practices" (BMP's) including roof gardens, recharge beds, pervious paving, biofiltration or recharge gardens, grassed swales, level-spreader berms, and constructed wetlands.
5) Existing developed areas and roadways lacking stormwater management controls are priorities to "retrofit" existing basins, culverts, and drainage swales with BMP's.

2b) Riparian Forest and Wetland Buffer Ordinance – Natural wooded buffers and healthy wetlands along streams constitute a "last line of defense" to offset the impact of development throughout the Paunacussing Creek watershed. All three townships in the watershed should require protection and restoration of on-site riparian forest buffers and wetlands as mitigation measures for each new subdivision. The impact that the "built environment" (new roads, buildings, grading and infrastructure) has on the health of the watershed can be mitigated by protecting the "green infrastructure" by requiring:

1) the establishment of common open space areas (rather than individual lots) around existing wetlands and riparian buffers,
2) the removal of invasive plant species and
3) the planting of native floodplain forest or wetland vegetation in disturbed areas.

These riparian forest and wetland buffers should then be permanently protected with conservation easements held by a land trust and/or municipality. Such ordinances should come into effect **with any change of ownership**. They should be packaged as part of a broader multi-municipal *Riparian Buffer Restoration Initiative* to address problems associated with livestock, crop fields and lawns by providing streambank fencing, tree planting, establishing meadows, and proposing conservation easements.

2c) Groundwater Recharge Protection Area Ordinance –Every household, business and institution in the Paunacussing Creek watershed depends on private wells that draw groundwater from underlying aquifers. Despite this dependency on the underlying aquifer, there are no measures in place to guarantee that future development will not alter the land in a way that reduces groundwater recharge. This groundwater also provides the baseflow to streams and wetlands. To promote sustainable water supplies and avoid reliance on public water from outside the watershed ("interbasin transfer"), the three townships in the watershed should prepare a hydrogeologic analysis to determine the most productive groundwater recharge areas. Additionally, the townships should update their Subdivision and Land Development Ordinances to create a *Groundwater Recharge Protection Area* **overlay district** to reduce or eliminate the clearing of vegetation, grading of soil, or placing of impervious surfaces on those areas. Such a *Groundwater Recharge Protection Area* **overlay district** can be implemented at a future date when hydrogeologic analysis data becomes available.

2d) Wellhead Protection Ordinance – If community wells are constructed within the watershed to provide water supply for multiple dwellings, measures should restrict development in and around the "drawdown zone" of those wells to reduce the potential for contamination. The three townships can adopt standards to require development constraints within a certain radius of each community well, based on an analysis of the drawdown zone.

2e) Open Space Management Standards – Developments constructed under open space ordinances contain substantial amounts of protected open space that may be contiguous with broader open space networks (such as crop fields, pasture or woodland). After development is completed, such open space may be altered to include lawns, formally landscaped areas, ball fields, trails, stormwater management areas, or restoration areas. New developments frequently remove or disturb natural habitat and impact streams and wetlands. It is important to mitigate these impacts. Require developers to submit **Open Space Management Plans** that emphasize management and restoration of natural areas such as wildflower meadows, reforestation areas, woodlands, wetland restoration areas and riparian forest buffers. Future owners should be held responsible for

ensuring that the **Open Space Management Plan** is adhered to as the "green infrastructure." It should be noted that fecal coliform bacteria and excessive nitrogen associated with Canada goose populations can be reduced by maintaining naturally landscaped meadows and woodlands instead of lawns around ponds.

2f) Natural Landscaping Ordinance –Lawns are among the most serious contributors of non-point source pollutants to streams, particularly when they are established adjacent to streams and wetlands. Because of the amount of acreage in the Paunacussing watershed devoted to lawn is increasing, the importance of natural landscaping alternatives to lawn cannot be overestimated. However, natural landscaping may be illegal in municipalities where weed laws (prohibiting neglected lawns) are adopted to protect neighborhood aesthetics and property values. Municipalities in the watershed should adopt **Natural Landscaping Ordinances** that acknowledge homeowners' rights to natural landscapes and encourage the establishment of natural gardens, wildflower meadows, reforestation areas and wetlands. These ordinances can be written in such a manner to still protect homeowners from nuisances associated with neglected properties or invasive plant species. Two good sources for additional information are: The Wild Ones natural landscaping organization (www.for-wild.org), and more locally, Bowman's Wildflower Preserve.

2g) Septic Maintenance Programs –Fecal coliform bacteria was detected in the Paunacussing Creek watershed during the NPS Pollution Assessment. It is clear that septic system maintenance is a problem that must be addressed. The local soils are known to have relatively poor percolation qualities and often cannot handle septic effluent without artificial sand mounds. Older homes (pre-1960's) may still utilize poorly functioning cesspools. Part of the reason that the problem persists is that the cost of upgrading or replacing failed septic systems is significant and is therefore a politically sensitive issue. However, the problem will worsen as an increasing number of homes with septic systems and wells are constructed in the watershed. Municipalities should consider requiring homeowners to submit regular test results of their septic systems (every 2 or 3 years). Systems that fail can be scheduled for required upgrading or replacement. Funding assistance such as low-interest loans, grants or tax abatements would make this requirement less onerous.

Public Education Initiatives

Two prime examples of public education would be yield almost immediate results are: 1) the importance of stream bank planting to reduce flood damage and 2) how the use of phosphates (dish washer detergent) degrades the quality of water in their own back yards. Such basic, but invaluable information, can turn those homeowners into important allies. Education programs that target local farms are also imperative. Very

simple, relatively inexpensive changes such as planting of stream buffers and using organic instead of inorganic (chemical) fertilizers can reap huge benefits for the watershed.

MAJOR ISSUE #6
Stream and Groundwater Monitoring

GOALS

- *To have available consistent, reliable data on the quality of the stream water and the ground water of the Paunacussing Watershed.*
- *To be able to identify any degradation to the stream or ground water as early as possible, so that remedial action can be taken.*

MANAGEMENT RECOMMENDATIONS

1. The Stream Sampling Program conducted for the NPS Pollution Assessment study should be refined and continued. Stream sampling for water quality has been conducted by the Paunacussing Watershed Association twice a year since 1990. It is recommended that the two groups (PWA and PLUM) combine forces to continue joint sampling of the stream. A consistent record of the stream's health can be established over time by utilizing the same sampling locations and parameters. PA DEP's Citizen's Volunteer Monitoring Program provides excellent guidance for establishing this type of program.
2. Expanding the Stream Sampling Program effort to include monitoring of individual wells for water quality and levels will provide a better understanding of the connection between groundwater and streams in the watershed. Biological assessment could be expanded to include sampling of fish species present in the watershed (generally done by electro-shocking) and surveys of amphibians (frogs, salamanders) and reptiles (turtles, snakes).

BACKGROUND ON MAJOR ISSUE #6

Local residents and communities will be able to guide the growth and restoration in the Paunacussing Creek watershed as their own knowledge about the stream increases. The teamwork involved in this kind of volunteerism makes a watershed-wide project seem less intimidating. Such restoration efforts should improve water quality and aquatic habitats.

MAJOR ISSUE #7

LANDSCAPE CONSERVATION PRIORITIES

GOALS

- *Identify and prioritize those properties that are most critical to preserving the overall health and well-being of the Paunacussing Watershed, including Hickory Run.*
- *Develop a strategy that each township can use to conserve the identified properties.*

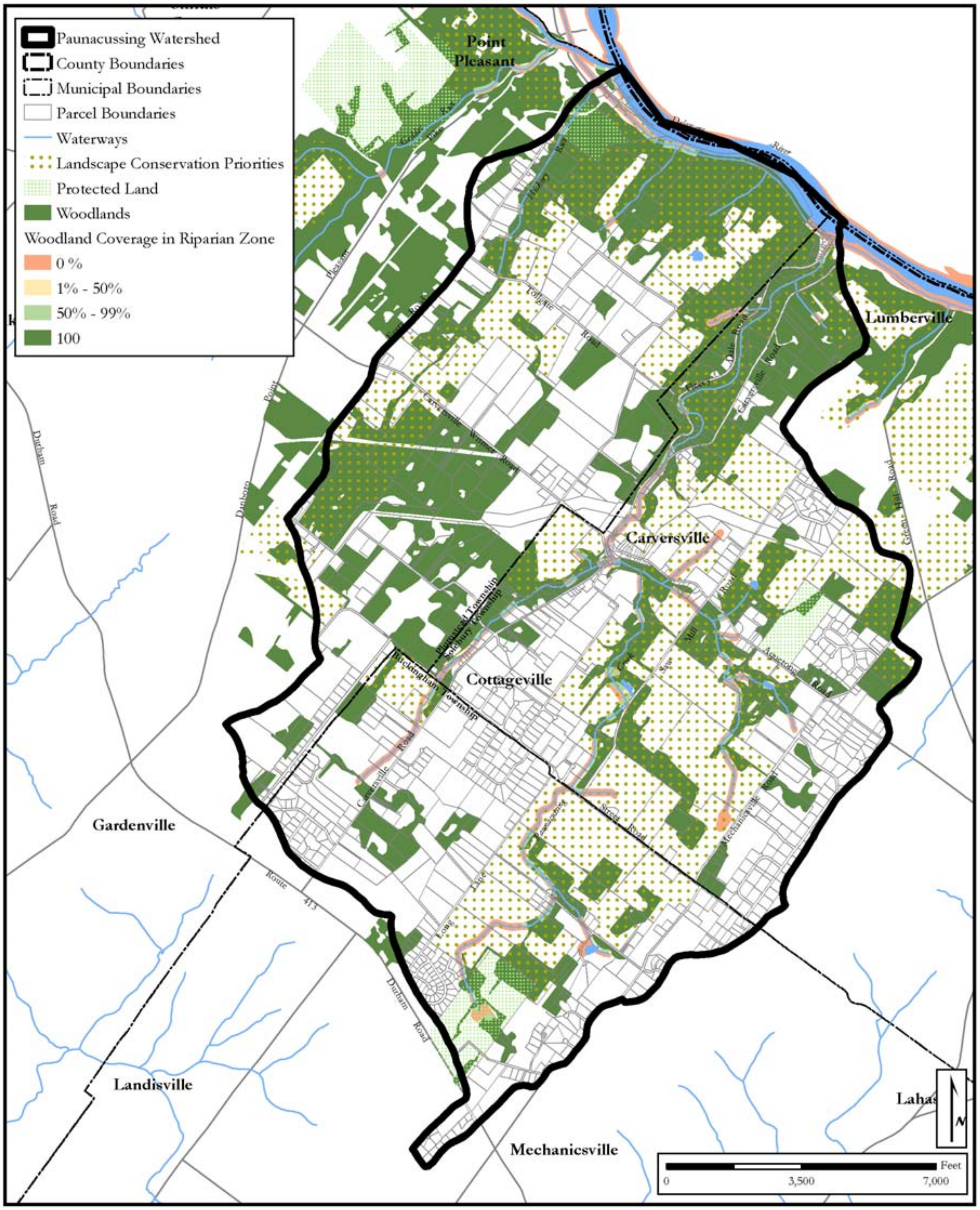
MANAGEMENT RECOMMENDATIONS

1. Large parcels that include major woodland areas or large blocks of contiguous open space acreage adjoining stream corridors should be targeted for conservation.
2. Given the conservation importance of the Paunacussing area, all parcels over 10 acres in size may be considered as priorities providing significant conservation benefit.
3. As the Landscape Conservation Priorities properties are identified, the relevant township will be provided with a list of properties that are located in their township, with a description of the important features and potential conservation status of individual properties where possible

BACKGROUND ON MAJOR ISSUE #7

Sixty-eight properties have been identified as priorities for conservation in the Paunacussing Watershed, including Hickory Run. These are shown in a general manner on **Figure 15**: **Habitat Conservation Network with Critical Parcels**. These properties were identified by detailed GIS analysis, with an aim of protecting large parcels that are interconnected along stream corridors or the Delaware River. The majority of these properties are 10 acres or greater, and have at least some stream frontage or close proximity to streams.

The Landscape Conservation Priorities are listed below organized by municipality and watershed. Description of important features and potential conservation status are indicated where possible. **These parcels are not listed in order of priority**. Some properties are listed as a series of contiguous parcels under single ownership. Others are listed as proposed for subdivision, with potential protection of key resources. Lands that are already protected are listed as such. Given the conservation importance of the



Paunacussing Creek Watershed Conservation Plan Bucks County, Pennsylvania	FIGURE 15 Habitat Conservation Network with Critical Parcels	Compiled by: DCR Notes: 1. [illegible] 2. Parcels from Bucks County 3. Riparian Buffer Assessment [illegible] by NLT [illegible] 4. Woodlands digitized by NLT from aerial photograph. 5. Landscape Conservation Priorities determined by NLT.	Partnership for Land Use Management in partnership with Natural Lands Trust

Paunacussing area, all parcels over 10 acres in size may be considered as priorities providing significant conservation benefit. The three townships of Buckingham, Plumstead and Solebury are actively working to preserve the landscape of the Paunacussing Watershed by partnering with county agencies and non-profit land trusts.

Plumstead Township

More than two dozen parcels are identified as Landscape Conservation Priorities within the Plumstead Township portion of the study area, including land along the Hickory Run on the ridge overlooking the Delaware River. The east end of the some Hickory Run property includes extensive areas of steep slope, forming part of the palisades over the Delaware River below Point Pleasant. This area is primarily underlain by hydric soils and contains part of the broader forested headwaters wetland, which is the largest block of woodland in the Hickory Run. One large property is mostly fields underlain by relatively small areas of agricultural soils of Statewide Importance and hydric soils.

One very large parcel in the Paunacussing Watershed contains over 220 acres, including 4 parcels in single ownership. While the top portion is agricultural, the property includes extensive wooded slopes above the Paunacussing Creek and the Delaware River, both of which flow just down the slope from this property. This property, with its dramatic wooded slopes, forms an important scenic backdrop for the historic village of Lumberville, as well as for the historic homes along Fleecydale Road, which abuts the Paunacussing Creek. An intensive logging plan has been proposed for this important natural area, thus bringing into start relief the great importance of aggressively pursuing the conservations of large properties within the Watershed.

Hickory Run

Sixteen properties totaling over 560 acres were listed as Priorities for conservation along Hickory Run between River Road, Ferry Road and Wismer Road. These properties range in size from 10 to 81 acres, and average roughly 33 acres in size. A number of properties have extensive wooded stream frontage of 1,000 feet or greater. They include wooded, sloping land along Hickory Run, broad areas of hydric soils with numerous seeps, springs and wetlands, and part of the wooded palisades over the Delaware River below Point Pleasant, and level agricultural fields. The rights-of-way for the water line from Point Pleasant and the Duke Energy gas pipeline cross through the area, including crossings under Hickory Run. One of the largest parcels, a 73.59 acre farm with extensive frontage long the headwaters of Hickory Run along Tollgate Road, has been proposed for subdivision.

Unnamed Tributaries of Delaware River

181 acres of land are identified as Priorities along the two unnamed tributaries between Hickory Run and the Paunacussing Creek. These range in size from 15 acres to 88 acres, and include the wooded slopes, ravines and palisades above the Delaware River, extensive stream frontage, and some canal and river frontage.

Paunacussing Creek
Large property including agricultural lands along Tollgate Road and extensive wooded slopes above the Paunacussing Creek and the Delaware River. This property also forms an important scenic backdrop for the historic village of Lumberville.

Buckingham Township

Eight properties in Buckingham Township totaling over 430 acres are identified as Landscape Conservation Priorities in the Paunacussing Creek watershed. These range in size from 11 to over 100 acres. The Solebury Township Open Space Plan of 2000 describes the importance of linking open space networks along the Paunacussing Creek by protecting the 6 high priority preservation targets in Buckingham Township with those key target lands in Solebury Township. Natural Lands Trust's Paunacussing Preserve forms an anchor on which to build conservation efforts in this area. Key resources include agricultural fields and prime agricultural soils, scenic views, wooded headwaters areas with hydric soils, wetlands and forested stream frontage,

Solebury Township

23 properties in the Paunacussing watershed are identified as Landscape Conservation Priorities within Solebury Township, ranging from 10 to over 200 acres, and totaling over 1,400 acres. Two of the properties are already protected, and a number are in negotiation for conservation easements. The parcels range from Street Road to the Delaware River, and Mechanicsville Road to Fleecydale Road. Utility lines such as the PECO Energy transmission line and the Duke Energy gas pipeline cross the area and the stream below Carversville. Included are important resources such as:

- scenic road frontage and viewsheds,
- working farms and prime agricultural soils
- historic structures and landscapes
- hydric soils
- ponds
- extensive stream frontage (some over 2,000 feet) including First Order tributaries
- extensive woodlands along main stem and above Delaware River
- floodplains
- old fields, thickets, hedgerows and meadows

Community Stewardship and Ongoing Watershed Studies

Community stewardship is key to carrying out the recommendations for conservation of lands listed as Landscape Conservation Priorities in the Paunacussing Watershed. The

designation of “Critical Conservation Areas” and “Critical Restoration Areas” is meaningful only if it engages the residents of the Paunacussing Watershed and inspires them to initiate such voluntary actions as conservation easements or restoration of riparian forest buffers. To generate interest among residents, landowners, and conservation groups, education programs are essential. Several brochures and Study Executive Summaries are available that can be used to initiate such education programs, (e.g. executive summaries of the LCP, and the NPS assessment) In-house workshops at the NLT Paunacussing Preserve Conservation Resource Center, as well as mobile workshops throughout the watershed, will also be useful to generate volunteer interest in preserving the Watershed. Case studies from other watersheds can be featured. NLT, PLUM, PWA, Delaware Riverkeeper Network, and other organizations can cooperate on such essential projects as stream bank restoration, wildflower meadow plantings, and many of the other recommendations on this PLAN.

APPENDIX A – Public Participation Program

A series of informational public meetings were held to introduce the *Paunacussing Creek Watershed Conservation Plan* and solicit comments from residents, businesses, organizations and government agencies. Kickoff meetings were held in 2003 at each of the 3 municipal buildings, and at a historic barn in the village of Carversville. A Draft Plan meeting was held in 2005 at the historic barn in Carversville. Advertising the meetings included press releases in local papers, flyers, e-mails and phone calls distributed to key stakeholders in the watershed. Sample flyers are included in this appendix. Comments from all meetings have been summarized and incorporated in this Plan, particularly in the Main Issues and the Action Plan sections.

The final plan will be presented at public meetings in each of the three municipalities, and public comments will be kept on file at the Partnership for Land Use Management and Natural Lands Trust.

Partnership for Land Use Management (PLUM)
Carversville, PA

Phone: 215-297-5953
Email: susan.plotkin@verizon.net

Contact: Susan Plotkin
Date: February 25, 2005

For Immediate Release

Paunacussing Creek Watershed Conservation Plan to Address Water Quality and Stormwater Issues

Public Meeting and Discussion Forum reviews Draft Plan

The **Partnership for Land Use Management (PLUM)**, in conjunction with **Natural Lands Trust**, will be holding a **Public Meeting** to discuss the draft ***Paunacussing Creek Watershed Conservation Plan***. The study, funded by the Pennsylvania Department of Conservation and Natural Resources (DCNR) and other sources, will spotlight the 8-square-mile Paunacussing Creek watershed and adjacent Hickory Run, from its source near Route 413, its North, Middle and South branches meeting at Carversville, to its main stem along Fleecydale Road to its confluence with the Delaware River at Lumberville.

This study comes at an important time, as the Paunacussing Creek is experiencing increasing development and associated threats to water quality and exacerbated flooding. The study will provide Geographic Information System (GIS) computer maps and a database for the entire Crum Creek watershed for use by local communities. The focus of the analysis will be on water quality and quantity, critical natural resources, greenways, stream corridors, as well as recreation, historical, and cultural areas. Particular emphasis will be placed on assessing the impact of land development trends on the streams, wetlands, groundwater and public water supply reservoirs that make up the Paunacussing Creek watershed.

Community residents are encouraged to attend this meeting to review the Draft Plan and offer their ideas and concerns about key issues affecting the health of the watershed. This meeting is an important opportunity for public input, including recommended projects and strategies to be included in the Action Plan section of the report. When completed later this spring, the recommendations in the Action Plan will be eligible for future funding through state Growing Greener grants, and will guide future funding for specific projects in local communities.

WHEN: Saturday, March 5, 2005 4:00pm

WHERE: Guthrie's Barn, 3694 Aquetong Rd.
Carversville, PA 18913

~Light Refreshments will be served~

Public Meeting and Discussion

On the

Paunacussing Creek Watershed Conservation Plan

The **Partnership for Land Use Management (PLUM)**, and **Natural Lands Trust (NLT)**, will hold a Public Meeting to discuss the **Draft *Paunacussing Creek Watershed Conservation Plan,*** funded by the Pennsylvania Department of Conservation and Natural Resources (DCNR)**.** All interested parties are encouraged to attend, to share ideas and provide feedback.

WHEN: Saturday, March 5, 2005 4:00 pm

WHERE: Guthrie's Barn, 3694 Aquetong Rd.

Carversville, PA 18913

Copies of the Draft Plan will be available for review and comment.
Light refreshments will be served.

If you have specific ideas for projects that address water quality or quantity issues in the Paunacussing watershed, these might be included in the Plan and could be eligible for state funding. Find out more at the gathering, and feel free to bring a friend!

For directions or other questions, contact Susan Plotkin of PLUM at 215-297-5953

APPENDIX B – Sources/References

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APPENDIX C -- Sample Municipal Resolution in Support of the Paunacussing Creek Conservation Plan

The following sample resolution should be considered for adoption by municipalities upon completion of the Paunacussing Creek Watershed Conservation Plan.

WHEREAS, *the Board of Supervisors recognizes the importance of conservation and improvement of the Paunacussing Creek and its tributaries and Hickory Run to the continued quality of life in _____ Township; and*

WHEREAS, *Resolution _____, passed on _____, 200_ stated _____ Township's support and endorsement for the efforts of the Partnership for Land Use Management (PLUM) and Natural Lands Trust (NLT) to secure funding for a "Paunacussing Creek Watershed Conservation Plan" from the Commonwealth of Pennsylvania's Rivers Conservation Program, the Philadelphia Foundation, the William Penn Foundation, and other sources; and*

WHEREAS, *the grant and matching funds were received by PLUM and the Conservation Plan has been completed; and*

WHEREAS, *the Conservation Plan contains a number of conservation recommendations suitable for utilization in _____ Township, and throughout the entire Paunacussing Creek and Hickory Run watersheds; and*

WHEREAS, *the Conservation Plan has been reviewed and found acceptable by the Board of Supervisors;*

NOW, THEREFORE, *the Board of Supervisors of _____ Township do hereby endorse the Paunacussing Creek Watershed Conservation Plan, and will endeavor to take appropriate action to implement its recommendations.*

Resolved this _____th day of _____, 200_.