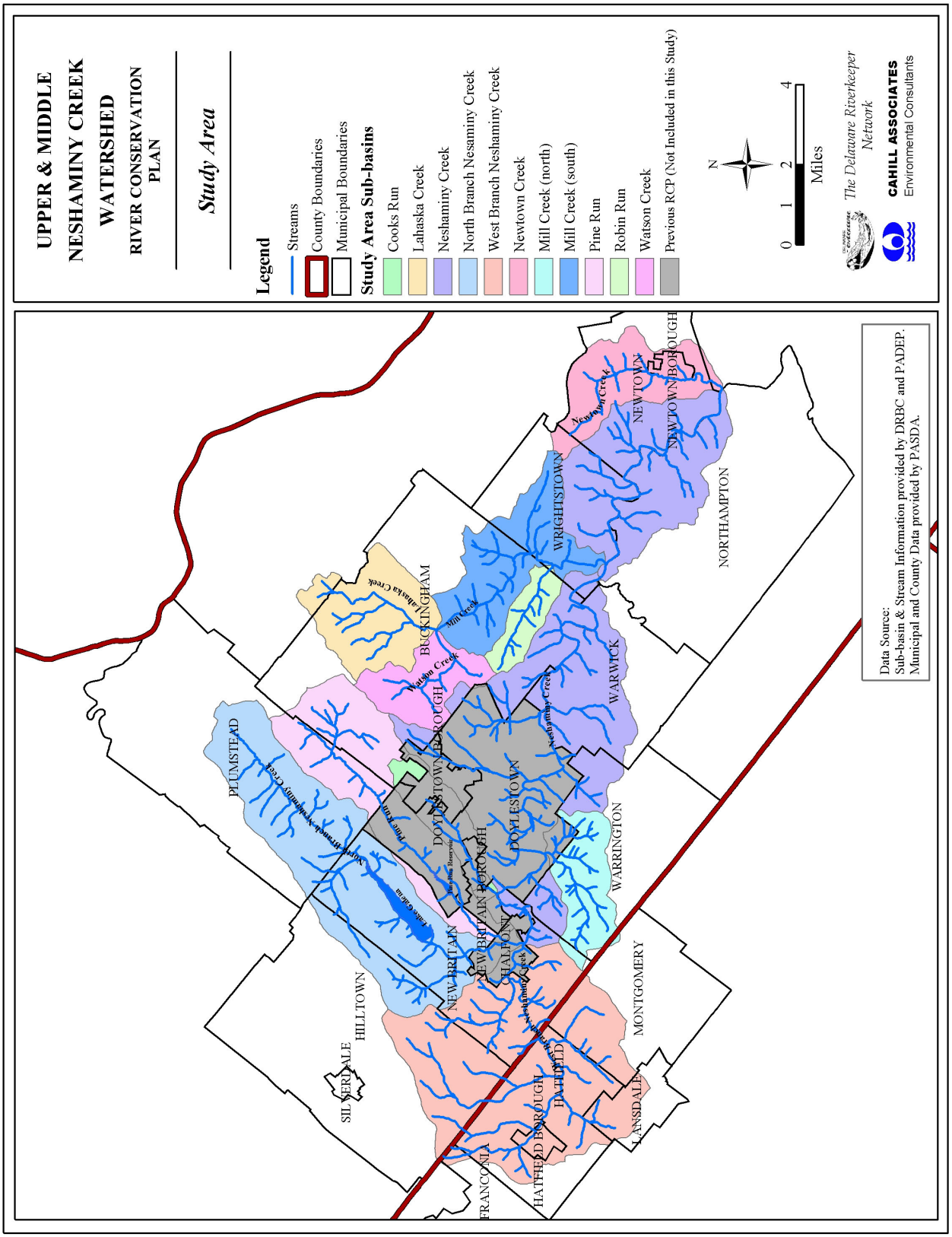
Executive Summary

EXECUTIVE SUMMARY

The Upper and Middle Neshaminy Creek of southeastern Pennsylvania (See Figure of Study Area) has played an important role in the history of the Delaware Valley. The watershed has served as a source of both ground and surface water supply, as well as the recipient of wastewater effluent from many thousands of residents in Bucks and Montgomery Counties. In fact, during dry periods, the entire stream flow is comprised of effluent. At the other extreme, the small communities that historically nestled along the banks of the stream have long been subject to flooding impacts. As the region has experienced a migration from the urban center of Philadelphia to the surrounding once-rural counties, the changing landscape and increasing demands for water have further stressed these water resources, resulting in a stream that is flooded more often with the ever-increasing runoff from new impervious surfaces, and depleted during dry periods because the groundwater has not been recharged by this "lost" rainfall. Efforts have been made in the past to mitigate this water excess or deficit by the building of dams throughout the watershed. These structures have reduced the extreme rate of flood flow immediately downstream of a given structure, but the increase in runoff volume continues to overwhelm the natural channels. Each new land development project has further contributed to this increased runoff volume, in spite of the thousands of detention basins constructed over the past twenty-five years.

Despite the many challenges that exist in this watershed, the Upper and Middle Neshaminy still provides a valuable water resource to its communities. There are many important natural, cultural and recreational areas that remain as a testament to the history of community stewardship in the watershed. However, it must be recognized that in order to protect these existing resources for future generations to enjoy, careful planning is necessary that will allow social and economic growth without destroying the very qualities that attract so many people to the watershed.

It is hoped that this Plan will serve as a map of the land and water resources that comprise this unique watershed, guiding the residents in efforts to protect and sustain these resources. Each citizen can begin by implementing recommended projects in the Plan—such as developing trails that bring people closer to the Creek; retrofitting existing conventional detention basins so that they infiltrate stormwater; and modifying existing residential and commercial lawn areas with native trees and shrubs as a demonstration of conservation landscaping. Residents may decide to work on a historic resource protection plan to help preserve and appreciate local historic and prehistoric cultural features, explaining how their community is bound up with the life of the Neshaminy Creek. Local planning commissions may recommend revisions to municipal ordinances that allow for more effective flood control, through better stormwater management and land conservation practices. It is also hoped that this Plan will lay the groundwork for the support needed from the Department of Conservation and Natural Resources, as well as other sources, in order to accomplish these goals.



Upper and Middle Neshaminy Watershed River Conservation Plan
Study Area

RCP GOALS and ACTIONS

RCP Goals

A thoughtful appraisal of the watershed of today shows much stress, but also offers many signs of concern and hope for renewal, as the stakeholders, old and new, recognize the value of the resource at risk. It is the intent of this RCP to focus this interest and identify a number of potential measures that will begin to restore and hopefully sustain the stream system into the future, even as growth and change occurs. This Plan begins with a set of Goals that express the collective will of the community, as follows:

A. Sustain and Restore the Quantity and Quality of Streams and Groundwater

(1) Maintain stream baseflows – Don't let the streams go dry.
(2) Restore a healthy water balance.
(3) Reduce and prevent ground and surface water contamination by point and nonpoint source pollution.
(4) Protect the quantity and quality of existing and future wells.
(5) Reduce impacts of quarrying on groundwater and surface water.

B. Maintain and Improve Healthy Streams

(1) Restore/protect aquatic communities, habitats, and stream channels.
(2) Restore/protect natural floodplain and riparian corridors.
(3) Restore/protect intermittent channels as flow pathways.

C. Protect and Restore Wetlands and Related Vegetative and Hydrologic Systems

(1) Restoration of riparian vegetation, especially wetlands, is a key measure
(2) Upland vegetation restoration is also important, especially woodlands protection

D. Improve Stormwater Management Practices

(1) Manage stormwater runoff volume.
(2) Increase infiltration of stormwater from new and existing development.
(3) Manage for water quality in all stormwater planning.

E. Improve Wastewater Management

(1) Reduce pollution from on-lot sewer systems.
(2) Reduce/prevent wastewater discharges to lake systems.
(3) Reduce pollution from public sewage treatment systems.
(4) Promote environmentally responsible wastewater treatment approaches.

F. Protect and Maintain Natural and Recreational Resources

(1) Protect wildlife and flora of the watershed.
(2) Protect endangered and protected species of flora and fauna.
(3) Restore and improve natural recreation and fishing areas.
(4) Canoeing, stream access, and greenways.
(5) Restore, maintain, and/or increase trout stocking.

G. Protect and Maintain Cultural, Historical, and Scenic Resources

(1) Enhance protection and awareness of Native American, historic, and scenic sites.
(2) Restore, improve, and encourage ecotourism.
(3) Enhance the link between community businesses and the Neshaminy Creek.

H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

(1) Promote integration of RCP and its goals and actions with Municipal comprehensive plans and ordinances.
(2) Promote sustainable land practices – runoff quantity and quality, erosion control, groundwater protection, chemical and fertilizer use.
(3) Promote watershed based zoning and land use planning.
(4) Promote re-use of existing sites and infrastructure.

I. Educate Municipal Officials, Community Groups, and the Public

(1) Promote inter-municipal cooperation in planning.
(2) Promote review of development plans by the township's EAC.
(3) Create EAC's in all municipalities.
(3) Promote educational programs for municipal engineers and park and recreation personnel.
(5) Promote educational programs for homeowners.

RCP Actions

As good as these Goals may be, they must be translated into specific actions, which can be summarized as follows:

Implement River Conservation Plan Projects - The various projects identified in the River Conservation Plan should be developed in greater detail and implemented with support funding through DCNR. **Supports all of the above Goals**

Change the Way We Develop the Landscape - It is possible to develop the landscape and protect land and water resources at the same time. All municipalities should consider the adoption of a second Ordinance relating to Land Development that includes better protection of water resources by more sensitive land development techniques. Issues considered in this Ordinance include earthwork limitations, tree protection, steep slope limits, use of on-site systems, drainage and grading, fertilization/ chemical maintenance and site protection.

Goals Supported:

A. Protect and Maintain Natural and Recreational Resources
G. Protect and Maintain Cultural, Historical, and Scenic Resources
H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

Revise All Municipal Comprehensive Plans to Include the Upper and Middle Neshaminy RCP - The Neshaminy Watershed is comprised of many municipalities. Protecting the watershed can only happen when the municipalities work and plan together. Each municipality should consider revision of their Comprehensive Plan to include this Watershed Plan and Goals. Where specific environmentally sensitive areas exist within a given municipality, they can be included in the Official Map.

Goals Supported:

F. Protect and Maintain Natural and Recreational Resources

H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

Establish a Groundwater Protection Zone – While much of the drinking water is served by public water supplies, there are many areas that rely on both community and private wells. In these cases municipalities should establish a Groundwater Protection Zone to protect the water supply quality and quantity.

Goals Supported:

A. Sustain and Restore the Quantity and Quality of Streams and Groundwater

F. Protect and Maintain Natural and Recreational Resources

H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

Remove/Protect Structures in the Floodplain and Restore the Natural Floodplain - Each municipality should evaluate local flooding conditions and determine if existing structures can be relocated outside of the current flood plain or floodproofed. Floodplain restoration could include the daylighting of buried streams where feasible.

Goals Supported:

B. Maintain and Improve Healthy Streams

Provide Riparian Buffer Zones Along Streams - Riparian buffer zones keep development back from the edges of a stream by a set distance. This allows vegetation along the stream to slow down and reduce runoff, reducing downstream flooding, and allows the vegetation to remove pollutants. Trees and vegetation provide shade, reducing stream temperatures and making the stream healthier for fish. It is recommended that each municipality consider the creation of a Riparian Buffer Zone along all perennial streams within their boundaries.

Goals Supported:

B. Maintain and Improve Healthy Streams

Manage Stormwater Differently - Impervious surfaces create more runoff because rainfall can no longer infiltrate into the soil and groundwater. Detention basins slow the **rate** of runoff, but still send a much greater **volume** of runoff (and pollutants) downstream. All municipalities should consider the adoption of new guidance for stormwater management that requires, where possible, the use of systems that recharge the groundwater, and that prevents new development from increasing the volume of runoff discharged downstream. A Model Stormwater Management Ordinance is included in the River Conservation Plan for municipal consideration. The Ordinance covers related issues, such as floodplain protection, nonpoint source pollution, protection of wetlands, soil erosion, riparian buffer zones, and aquifer recharge protection.

Goals Supported:
A. Sustain and Restore the Quantity and Quality of Streams and Groundwater
D. Improve Stormwater Management Practices
H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

Maintain and Improve (Retrofit) Existing Stormwater Structures - Existing stormwater detention basins can be identified within each municipality to determine maintenance needs, as well as the potential for retrofitting for quality and quantity improvements. Maintenance of existing infrastructure is a critical issue.
Goals Supported:
D. Improve Stormwater Management Practices

Maintain and Improve Existing/Future Wastewater Facilities and On-site Septic Systems – Wastewater treatment, when not managed properly, can have detrimental water quality & quantity effects to both surface and groundwater resources. Maintain or improve existing facilities, especially older on-site septic systems that may not be functioning properly, to prevent groundwater or surface water contamination. For new or re-development projects, investigate the use of innovative wastewater treatment technologies where feasible.
Goals Supported:
A. Sustain and Restore the Quantity and Quality of Streams and Groundwater
E. Improve Wastewater Management

Monitor Water Quality - The changes in aquatic habitat and water quality during wet and dry periods should be monitored for use in tracking the success of land management measures in the future.
Goals Supported:
A. Sustain and Restore the Quantity and Quality of Streams and Groundwater

Control Fertilizers and Sediments Draining to Lakes and Reservoirs - In lake drainage areas, local community associations and/or municipalities can evaluate land fertilization and erosion control practices within the local drainage area and recommend changes or restrictions that reduce sediment and related nutrient runoff to lakes.
Goals Supported:
I. Educate Municipal Officials, Community Groups, and the Public

Purchase Undeveloped Land as Protected Open Space – There are many opportunities within the watershed to purchase undeveloped parcels to be preserved as open space. These areas could be utilized for recreation, environmental education, scenic and natural areas, or simply preserved land. These areas could also serve to link existing natural or recreation areas for a variety of uses.
Goals Supported:
C. Protect and Restore Wetlands and Related Vegetative and Hydrologic Systems
F. Protect and Maintain Natural and Recreational Resources
G. Protect and Maintain Cultural, Historical, and Scenic Resources

Improve Existing Recreation Areas and Create Stream Access Areas – Many outdoor enthusiasts and fisherman use areas, particularly in and around streams, that are not designated recreation or access areas. This often causes trampling of vegetation and unwanted disposal of garbage. Creating managed access areas that provide trails, trash disposal, and fishing and boat access should decrease damage to natural areas and increase awareness of the problems associated with using non-designated areas.

Goals Supported:

F. Protect and Maintain Natural and Recreational Resources

G. Protect and Maintain Cultural, Historical, and Scenic Resources

Educate, Educate, Educate! Simple steps such as not mowing to the edge of streams and in detention basins can make a significant difference in reducing nonpoint source pollution. Municipal Public Works and Recreation Department personnel, as well as the public, should be educated in sustainable landscaping practices. The Watershed Plan will only work if the residents of the Neshaminy Watershed understand the how and why, and what it means to them.

Goals Supported:

I. Educate Municipal Officials, Community Groups, and the Public

RCP Implementation

The member communities have identified some 97 specific projects that implement these RCP actions, and they are presented in detail below. All seek to put into action the Goals established for the restoration of the watershed, and it is hoped that many will be implemented by continuing support from the PADCNR or possibly with funding by the individual municipalities or the counties. Some of the general recommendations are not dependent on additional financial support but rather on a fundamental change in our practices of living, especially in how we develop the land. Here new Ordinances will play the critical role, but we must make an investment in adopting these regulations. Other actions must include paying more attention to our water resources, monitoring the health and physical condition of all streams and assuring that our groundwater receives equal attention. None of our Goals will be easily achieved, nor will the Action Plan be implemented within a few short years. However, if we have the collective will to restore and sustain the Neshaminy Creek, it will continue to provide a vital part of our environment for the future.

The recommended projects have been grouped into the following categories based on project type.

Recreation & Trails
Conservation & Restoration
Stormwater Best Management Practices
Regulatory & Management Programs
Planning & Research
Education & Community Programs

The projects, submitted by various organizations, municipalities, businesses, and concerned citizens, are the first step in implementing a new watershed planning approach. This new approach looks to the goals and actions set forth in this RCP as a guide to protecting and improving the priceless resources in the Upper and Middle Neshaminy Watershed.

Upper and Middle Neshaminy River Conservation Plan
Recommended Projects

Recreation & Trails Projects

1. **Dark Hollow Bridge Restoration -** Remove existing old vehicular bridge and rebuild foot-bridge in a way that protects Neshaminy Creek, Dark Hollow (Warwick and BCA).
2. **Canoe Access Areas** – Create canoe access areas where portage is required and additional put-ins and take-outs along the creek (NAABC, Watershed Stakeholders).
3. **Seven Mile Nature Trail** – Trail encircling Lake Galena, Peace Valley Park, New Britain Twp. - Include interpretive signs for environmental education. (Peace Valley Nature Center)
4. **YMCA Trail System -** Environmentally Friendly Trail System surrounding Central Bucks Family YMCA in Doylestown Township. Includes new playground with interpretive signage and environmental education components. (YMCA)
5. **Big Meadow Park Enhancement -** Enhance Big Meadow Park on Stoney Ford Road in Holland for passive recreation and a nature study area along the Neshaminy Creek (Northampton).
6. **Northampton Township Trail Development** – Trail along the Neshaminy Creek from Big Meadow Park on Stoney Ford Road through the following properties: Bryan's Farm and Bryan's Island on Rt. 232 and two parcels north of Bryan's Farm along the Neshaminy. Need to develop Master Plan (Northampton).
7. **Montgomery Township Trail Plan** – Implementation of plan included in Montgomery Twp. Open Space Plan that links Horsham Township through Windlestrae Park in Montgomery Township connecting to the Route 202 Bypass Trail. The trail will be enhanced and connected by building a pedestrian bridge across the Neshaminy at Windlestrae Park (Montgomery).
8. **Warrington Trail Expansion** – Enhance and expand the trail that will be built as a part of the Route 202 Expressway through existing Township open space on Upper Stump Road between Pickertown and Bristol Roads (Warrington).
9. **Warrington Stream Trail System** – Develop a trail system through the stream valley that flows through the school district property that contains the Mill Creek Elementary School and the future Central Bucks High School (Warrington).
10. **Wrightstown Trail Project** – Develop a trail system along Mill Creek linking to an existing open space preserve and other trail systems (Wrightstown).
11. **Warwick Trail Program** – Implement goals and projects from the Warwick Township Natural and Historical Trails Program (Warwick).
12. **Hardiaken Creek Trail** – Riparian buffer, walking/recreational trail with possible connection to Plumstead North Branch Trail and Seven Mile Trail. Trail system located in over 168 acres of township preserved land in which additional park uses will be developed (New Britain).
13. **Railroad Creek Recreation Enhancement** – Enhance 60+ acre site leased from the county to be used for a natural preserve and walking trail. Provide pedestrian views and access via the Walters Road trail (New Britain).
14. **PennDOT Wetlands Trail** – Create a walking/recreational trail through PennDOT Wetlands between Schoolhouse Road and SR 152, Limekiln Pike/Main St. Wetlands are adjacent to the West Branch and incorporate other efforts by neighboring townships (New Britain).

Conservation & Restoration

1. **Parcel Protection** - Permanent protection of parcels along the Forks of the Neshaminy and riparian areas and their adjacent lands. 425 acres planned to be purchased for conservation by Heritage Conservancy (Watershed Stakeholders).
2. **Windlestrae Park Restoration** - Montgomery Township Watershed Restoration Project to maintain and preserve Windlestrae Park (Montgomery).
3. **Stream bank Restorations –** Restore stream areas with erosion and degradation (BCA & Watershed Stakeholders).
4. **Restore Riparian Buffers** – Restore buffers and stream bank vegetation and protect existing systems. Assist and encourage private landowners to restore riparian buffers on their property (Plumstead, Hilltown, Wrightstown, NWA & Watershed Stakeholders).
5. **Cook's Run Rehabilitation** - Rehabilitation of Cook's Run through Doylestown Borough, Doylestown Twp, and New Britain Twp. Project includes stream bank stabilization, water quality upgrades, and a 1-mile trail. (BCCD & municipalities).
6. **Plumstead Twp. Greenway** - Implementation of the recommendations proposed in the Plumstead Township Greenway and Trail Linkage Feasibility Study (Plumstead).
7. **Northampton Stream Bank Stabilization** - Project in Northampton Township for stream bank stabilization. The township and partners are currently evaluating stream locations for restoration (BCCD & Northampton).
8. **Stream Bank Restoration/Riparian Buffer Creation** - Paunnacussing Creek along Indian Spring Road & Watson's Creek near None Such Farms & Lindquist Farm (Buckingham).
9. **Hatfield Stream Assessment Implementation Projects** – Implementation of Stream Restoration and Riparian Buffer Restoration Projects listed in the Hatfield Township & Hatfield Borough Visual Stream Assessment Priority List for the West Branch Neshaminy Creek, N. Hatfield Creek, Unionville Creek, Lansdale Creek, and Colmar Creek (Hatfield Township & Hatfield Borough).
10. **Open Space Acquisition, Neshaminy Watershed** - Fund Municipalities for Open Space Acquisition (Wrightstown, New Britain, NWA & Watershed Stakeholders).
11. **Riparian Corridor Greenways** – Protect existing greenways and create new greenways where possible (Wrightstown & Watershed Stakeholders).
12. **Headwater Stream Restoration & Protection** – Restoration of impaired first and second order streams and protection of non-impaired headwaters (Hilltown & Watershed Stakeholders).
13. **Wildlife Restoration** - Restoration of existing wildlife habitat throughout the watershed (NWA).
14. **Reforestation of Open Space** – Hilltown Township
15. **Stream Clean-Up** - Removal of trash, debris and downed trees from stream corridors, specifically the east side of the Neshaminy Creek between Newtown-Richboro Road and Buck Road (Newtown).
16. **Exotic Invasive Plant Removal** – Removal of invasive plant species, particularly in the riparian corridor (PVC).
17. **Buckingham Township Land Preservation** – Preserve agricultural and other open space parcels for permanent protection to curb suburban sprawl and protect rural character of the township (BCA).

18. **Wrightstown Township Riparian Restoration** – Enhance the riparian buffer along Anchor Run a tributary to the Neshaminy which traverses Wrightstown's Open Space Preserve (Wrightstown).
19. **Wrightstown Environmental Education Area Development** – Provide an area for environmental education in the Township Open Space Preserve that would include "demonstration projects" showing stream protection methods such as vegetated buffers and agricultural practices that promote conservation of soils and adjacent water bodies (Wrightstown).
20. **Plumstead Land Preservation** – Preservation of a large land parcel on Ridgeview Drive and Durham Road. The Parcel contains valuable ecological resources including wetlands, vernal pools, forest, and a successional field. The area is also adjacent to 40 acres of Township open space (Plumstead).
21. **Stream and Habitat Restoration at Plumstead Open Space Preserve** – Begin a program to repair and restore a headwater stream with a focus on water quality and habitat enhancement. The stream has been severely degraded by stormwater runoff from a nearby development. Stream restoration will include sediment removal and streambank stabilization (Plumstead).
22. **Forest Ecology Study and Enhancement, Plumstead Open Space Preserve** – Remove current basin levee along the Forest Border with the Fox Hunt development. Inventory tree species, assess deer grazing damage, remove invasives, plant understory trees for succession, and plant additional edge trees (Plumstead).
23. **Meadow & Wetland Restoration at Plumstead Open Space Preserve** – Re-vegetate meadow and wetland areas with native species to enhance biodiversity and habitat value. Include education interpretation areas such as bird and wildlife watching areas and a raised boardwalk in the wetlands. Construct a raised boardwalk ending in an observation deck adjacent to the Pine Run and link it to an existing parking area (Plumstead).
24. **Newtown Township Land Preservation** – Purchase 134 acres of open space (Melsky Tract) in Newtown and Upper Makefield Townships for preservation. The large parcel contains valuable wetlands (Newtown).
25. **Stewart, Nicholas Property Preservation Corridor** – Preserve corridor along the West Branch and incorporate a trail and wetlands preservation (New Britain).
26. **Pine Run Creek Trail and Preservation** – Obtain land for easement along Pine Run from Keller/Iron Hill to the juction with the North Branch for development of nature trail along the creek (New Britain).

Stormwater Best Management Practices

1. **Pennswood Village Retirement Community**: Design and Construction of a Multi-functioning Riparian Corridor for the Management of Stormwater Quality and a landscaping plan using native plants for a new development project (PVC).
2. **Stormwater Management Wetlands** - A Well Developed Plan to Restore and Create Wetlands for Stormwater Management (Buckingham).
3. **Detention Basin Retrofits** - Retrofit Existing Detention Basins to Infiltrate Stormwater for the purposes of reduced flooding, increased groundwater recharge, water quality, reduce stream bank erosion (Warwick, Plumstead & Buckingham Townships).

4. **Sewage Recycling Project** – Model project to demonstrate how sewage recycling works on a single lot basis (HLA and New Britain).
5. **Durham Ridge Stormwater Retrofit Project** - Implementation of Phase II to include "daylighting" of storm drain pipes through a created wetland, fish stocking in vegetated retention pond, building of nature trails, establishing a community outreach program (educational video/ kiosk, site tours) (Plumstead & PRWI).
6. **Open Space Enhancement** - Utilize open space areas for aquifer recharge through retrofitting and through preservation/enhancement of existing functions such as forest communities (Hilltown).
7. **Cattle Crossing** - Fence and Cattle Crossing along Streams (HLA).
8. **Flood Prevention and Control Project, Shrine/Pine Run Community** - Address current flooding with multiple solutions including infiltration basins, porous pavement for parking lots, and re-engineering of stormwater infrastructure in order to reduce volume and velocity of runoff and to protect streambanks and water quality in cooperation with PennDOT and neighboring municipalities (New Britain).
9. **Native Plantings and Infiltration Project** — Expand existing detention basin, providing infiltration enhancement and native plantings to reduce erosion and runoff (DH).
10. **Northampton Municipal Park and Community Center Basin Analysis** - Conduct an environmental engineering analysis of the detention basins to assess how to protect the environmentally sensitive grounds at these 2 municipal properties (Northampton).
11. **Catch Basin Stenciling** – Boroughs, town centers, and commercial areas to stencil catch basins with pictures or phrases to discourage dumping. Eg. "DO NOT DUMP, GOES TO STREAM" (Buckingham & Watershed Stakeholders).
12. **Fox Hunt Detention Basin Retrofit** – Retrofit a very large detention basin for infiltration to reduce stormwater volume impacting a nearby headwater stream and to increase infiltration feeding the adjacent high value forest (Plumstead).
13. **Railroad Creek Stormwater Improvements** – Enhance stormwater management by installing infiltration structures that capture and infiltrate runoff from the Twin Maples basin (New Britain).
14. **Detention Basin Investigation** – Investigate the mitigating effects of naturalized drainage basins on stormwater releases into receiving streams, investigate the effect of basin naturalization on biodiversity in and around the naturalized area, and educate residents regarding the benefits of naturalized basins and BMPs (Montgomery).
15. **Warwick Township Stormwater Management Assessment** – Assess the functionality, maintenance, and management of existing stormwater structures in Warwick Township (Warwick).

Regulatory & Management Programs

1. **Archeological/Historic Protection Program** - Require developers to conduct archeological/ historic and prehistoric surveys before starting new development projects in probable areas (NAABC, Watershed Stakeholders).
2. **Ordinance Revisions** - Municipal Revisions to Stormwater and Erosion Control Ordinances to encourage Groundwater Recharge, Reduction in Nonpoint Source Pollution and flood reduction using non-structural approaches (NWA, Wrightstown, Watershed Stakeholders).

3. **Update Stormwater Regulations** - Municipal Stormwater regulations to prevent stormwater runoff and to recharge groundwater and streams (BCA & NWA).
4. **Riparian Buffer Regulations** - Require a riparian buffer in municipal regulations (NWA).
5. **Sewage Management District** - Create management district for subsurface sewage disposal systems to assess problems, educate owners as to maintenance, and set up community fund for repairs. Investigate alternatives for areas where individual lot systems are not functioning or feasible (HLA, NWA & New Britain).
6. **Stream Monitoring Program** – Program involving volunteers and students (PVC).
7. **Goose Control Program** (HLA)
8. **Municipal Assistance Program** - Assist municipalities in revising planning and subdivision ordinances to encourage minimum disturbance techniques for development projects (Watershed Stakeholders, NWA, Wrightstown).
9. **Stormwater Structure Assessment Program** - Program for the assessment of all existing and proposed stormwater management facilities in the watershed to help municipalities better program and organize observation, repair, and maintenance functions for stormwater facilities that may be creating hazardous conditions in the watershed (BCPC).
10. **Native Habitat Creation Program** - Programs that encourage the inclusion of new habitat within stormwater and erosion control facilities (NWA).
11. **Open Space Management Program** – A management program that promotes water quality improvement and wildlife habitat preservation in the Pine Run Sub-watershed (PRWI).
12. **Ordinance Revisions 2** – Consider Zoning as a tool for Riparian Protection and TMDL and BMP enforcement to enhance water quality in impaired streams (Buckingham, Watershed Stakeholders).
13. **Watershed HOTLINE** - Phone number to report threats to the Neshaminy Creek (PVC).
14. **Deer Population Management Program** (PVC)
15. **Nonpoint Source Sediment Control Program** (Buckingham, Wrightstown)

Planning & Research

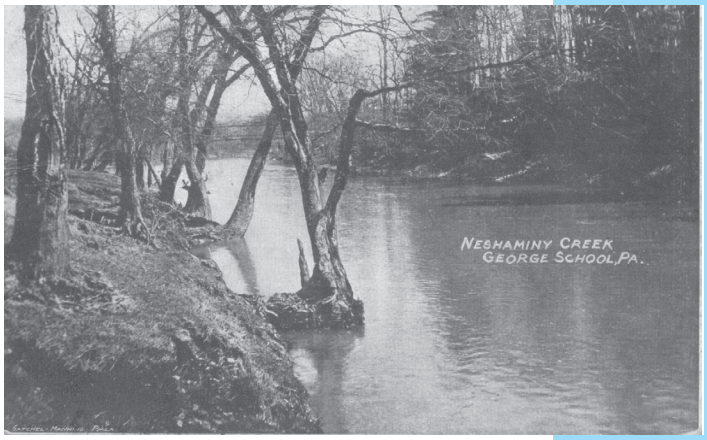
1. **Hydrogeology Study** - Technical Study of hydrogeology of region to assess sustainable water use (Wrightstown & Watershed Stakeholders).
2. **Watershed Protection Plan** – Plan throughout the Upper and Middle Neshaminy Watershed focused on Stormwater Management and Water Quality (Watershed Stakeholders).
3. **Stormwater Infrastructure Survey** - Survey of stormwater inlets within Buckingham Township to determine upgrade needs and recharge potential (Buckingham).
4. **Geology Mapping** - Mapping of karst limestone belt within Buckingham Township (Buckingham).
5. **Riparian Program** – Program for riparian buffer protection and reestablishment, could include Planning, Assessment or a Research Study (Watershed Stakeholders, NWA).
6. **Water Quality Studies** – Attempt to accurately determine the causes/sources of stream pollution so that mitigation programs can be designed and implemented (BCA).
7. **Water Redemption Project** - An analysis and plan of action for how to manage water resources related to quarrying activities in Hilltown Twp (Hilltown).
8. **Mill Creek Water Quality Study**- Water Quality study for Mill Creek in Wrightstown Township (Wrightstown).

9. **Warwick Township Environmental Assessment** – Complete a study to assess the health of Warwick Township Water Resources and other Environmental Resources. Study should include assessment of existing and potential stormwater BMP's, water and sewage treatment, land preservation, and stewardship. Problems and Solutions should be implemented (Watershed Stakeholders).
10. **Dark Hollow Stream Assessment** – Complete a study of the Neshaminy Creek and its tributaries in the Dark Hollow Area of Warwick Township. Study should focus on local stormwater impacts from uphill developments, water quality, and stream morphology (Watershed Stakeholders).
11. **New Britain Twp**. **Sewage Treatment Assessment** - Assess the functionality of aging on-site septic systems in New Britain Twp., especially those systems in the Lake Galena drainage area. Study should aid in developing solutions to failed septic systems impacting the water quality of Lake Galena. May include development of alternative wastewater technologies to replace failed systems (Watershed Stakeholders).

Education & Community Programs

1. **Water Resource Education for Community** (PVC, Wrightstown).
2. **Landscape Education** - Distribute "25 Ways" brochure and other educational brochures widely as part of a homeowner/neighborhood education program to encourage landscape practices for homeowners that don't rely upon pesticides, herbicides and excessive fertilization (PVC & NWA).
3. **Stream Monitoring Program** - Development of a volunteer stream-monitoring program with an associated curriculum to involve local schools (Buckingham).
4. **Mosquito Prevention Program** – Program to educate the community about mosquito prevention through habitat education of residents (PVC).
5. **Stream Dumping Prevention Program** - Public Education Program that discourage illegal dumping along and into streams and waterways (Watershed Stakeholders, NWA).
6. **Hatfield Stream Assessment Implementation** - Implementation of the Community Education Programs listed in the Hatfield Township & Hatfield Borough Visual Stream Assessment Priority List for the West Branch Neshaminy Creek, N. Hatfield Creek, Unionville Creek, Lansdale Creek, and Colmar Creek (Hatfield Twp. & Hatfield Borough).
7. **Motorized Recreational Vehicle Prevention Program** - Education and Enforcement Programs that deal with illegal and destructive use of ATV's and other motorized vehicles in and adjacent to waterways, wetlands and stream buffers (Watershed Stakeholders, NWA).
8. **Municipal Maintenance Training** - Training Programs for municipal public works departments that focus upon reducing or finding alternative to deicing material use for snow and ice control and minimizing the use of pesticide, herbicide and fertilizers in the maintenance of municipal facilities. The program should address mowing practices near streams and in stormwater management structures (Watershed Stakeholders, NWA).
9. **Outdoor Classrooms** - Educational Program for school children that utilizes watershed resources as outdoor classrooms to develop a first hand familiarity and respect for natural surroundings and to focus on the benefits of protecting natural resources (NWA & PVC).

10. **Homeowner Education** - Education of residents who live adjacent to/near streams about restoration and protection/enhancement of naturally vegetated riparian buffers to decrease mowing and eliminate turf and non-native plants along waterways and ponds (Plumstead, Hatfield Township, Hatfield Borough, Wrightstown & NWA)
11. **Northampton Municipal Park Education Area** - Provide an area for environmental education at park located on Hatboro and New Rds., including a boardwalk. Master Site Plan for this park identifies a wetlands and aquatic education area in the northern portion of the Park surrounding the main drainage area, including existing wetlands and vegetative buffer (Northampton).
12. **Educational Program for On-site Septic Systems** – Educate septic system owners to encourage proper maintenance and management of existing septic systems. Could be a video on the cable channel, meetings, or written materials (Wrightstown).
13. **Educational Video on Watershed Problems** – Educate public on landscape practices and other means of preserving streams and lakes (Watershed Stakeholders).
14. **Education for Township Engineers and Developers** – Educate personnel to encourage sustainable design practices and the use of BMP's for stormwater management. Create a BMP manual specifically geared for these professionals (Watershed Stakeholders).
15. **Alternative On-site Sewage System Education** – Wrightstown Township would like to initiate an education program for residents in alternative onsite sewage disposal system (ie. Drip systems as opposed to sand mounds), (Wrightstown).
16. **Neighborhood Watershed Stewardship Program** – Educate the public and landowners about minimizing lawn fertilization and practicing watershed stewardship (Plumstead).



1. INTRODUCTION & BACKGROUND

I've watched beside thy waters
In all thy varied moods;
I've sought remote recesses
Where seldom one intrudes;
I've caught thy pictured visions,
Thy beauties as they flee;
I've listened to thy harmonies,
O, dear Neshaminy!

Verse One from *Neshaminy*
by M.R.K. Darlington (1896)
Great-Aunt of Mary Ellen Noble,
Associate Director, DRN

Photo Postcard provided by Richard Albert, DRN

1. INTRODUCTION AND BACKGROUND

A. The River Conservation Plan Framework

The Delaware Riverkeeper Network and its technical consultants, Cahill Associates, have prepared this River Conservation Plan (RCP) for the Upper and Middle Neshaminy Creek under a grant provided by the Community Conservation Partnerships Program, Rivers Conservation Program, under the administration of the Pennsylvania Department of Conservation and Natural Resources (PADCNR), Bureau of Recreation and Conservation. The Neshaminy Creek RCP builds on a variety of previous studies of Neshaminy Creek and its tributaries.

PADCNR has several purposes in mind for all river conservation plans:

- To foster development of locally initiated river conservation plans which restore, maintain or enhance the river resources throughout the Commonwealth;

- To provide financial and technical assistance for local river conservation planning activities;

- To establish a Pennsylvania Rivers Conservation Registry to recognize rivers or river segments which have an approved river conservation plan; and

- To encourage state and local organizations to take actions that are consistent with local river conservation plans.

Generally, River Conservation Plans are intended to inventory significant river resources, identify potential threats to these resources, and recommend restoration, maintenance, or enhancement options in the form of a set of management strategies, all based on a vision of the watershed's future. To the extent possible, River Conservation Plans also are encouraged to identify *specific projects* that are eligible for funding from any grant source that supports watershed activities. Once watersheds or river corridors studied within Rivers Conservation Plans are placed on the Pennsylvania Rivers Conservation Registry, implementation activities identified within the watersheds or river corridors become eligible for funding under The Pennsylvania Rivers Conservation Program.

PADCNR has established a four step planning process to guide this planning, which is being followed for this Neshaminy Creek Watershed planning, which includes:

- Step 1 Determine public interest
- Step 2 Collect and analyze resource data
- Step 3 Prepare draft plan
- Step 4 Prepare final plan

In order to accomplish these River Conservation Plan goals in general - and especially in the case for the highly diverse Neshaminy Creek Watershed, public participation and involvement is criti-

cal. Because there are many different municipalities in this watershed (14) and because these municipalities play such an important role in so many elements of watershed life and decision-making, municipal involvement and cooperation early on has been recognized as essential to the success of this Neshaminy Creek Watershed RCP. First, the Plan consultants needed input from the municipalities to identify the key natural, historic, and recreational features and facilities within each municipality, as well as to provide land use and land use management information. Identification of watershed issues and problems has relied heavily on municipal input, as has the process of establishing watershed goals and undertaking the visioning that is so important for this Plan. Ultimately, identification of general types of restoration and conservation projects, as well as specific project listings, is also very much influenced by municipal participation, though not exclusively.

The public participation process developed for this Neshaminy Creek Watershed Plan has included a series of public meetings (evening) strategically located within the Watershed, as well as municipal meetings for municipal staff and officials. A short video was produced and distributed to all study area municipalities to generate awareness and interest in the plan. It also helped to establish a Municipal Steering Committee that met throughout the planning process to continually foster municipal involvement in the plan. Special watershed flyers have been prepared and distributed for display in each municipal building as well as in public libraries and other community buildings to help engender Plan interest and momentum. Building on the resources (and relationships) of an already well-established watershed organization, the Delaware Riverkeeper Network's website has been used to promote the RCP process. DRN has also utilized the media to promote the planning process by advertising public meetings in local newspapers. The Watershed Study Advisory Committee (Municipal and Non-Municipal; see discussion below) has been formed, including municipal representatives as well as a special list of priority watershed professionals, and has been especially instrumental in the difficult work of defining watershed projects and prioritization of watershed projects.

All of these efforts notwithstanding, all participants fully acknowledge that so much remains to be done. The hope is that this RCP, reinforced by continuing efforts of the DRN as well as the Municipalities and watershed stakeholders, will serve as the impetus for truly meaningful watershed conservation.

B. The Upper and Middle Neshaminy Creek Watershed Study Area

The Upper and Middle Neshaminy Creek is an especially ambitious River Conservation Plan, given the Watershed's complexity and increasingly high degree of urbanization. The greater Neshaminy Creek is located within southeastern Pennsylvania and flows into the Delaware River, just north of the City of Philadelphia (Figure 1-1). However, this RCP is limited to the Upper and Middle Neshaminy Creek which flows from the east central edge of Montgomery County through central and southern Bucks County to the confluence of Neshaminy and Newtown Creeks on the border of Newtown and Northampton Townships (Figure 1-2). The watershed lies entirely in the rolling hills of the Piedmont region of Southeastern Pennsylvania. The Upper and Middle Neshaminy Creek Watershed includes more than 131.5 square miles and includes portions of

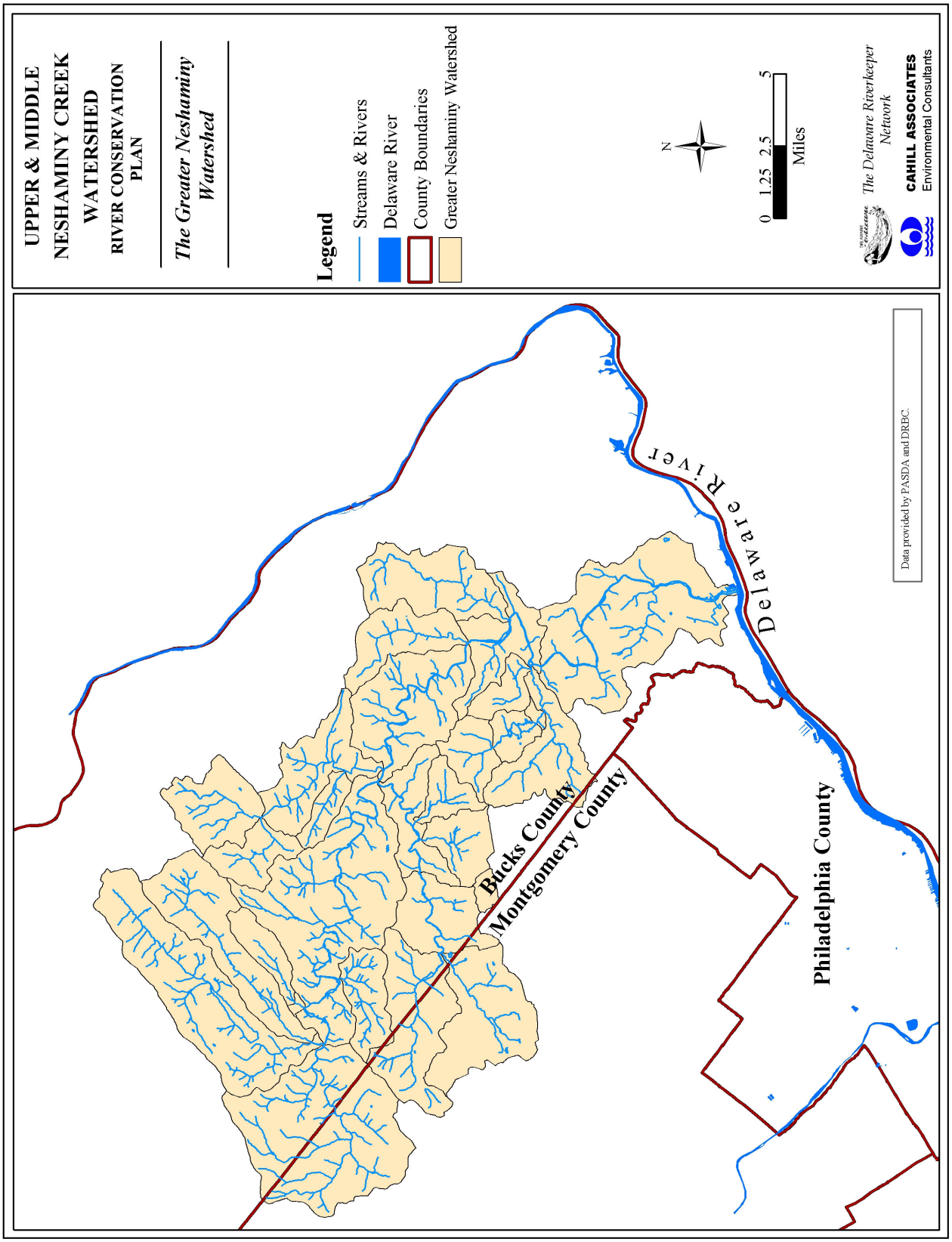


Figure 1-1. The Greater Neshaminy Creek Watershed

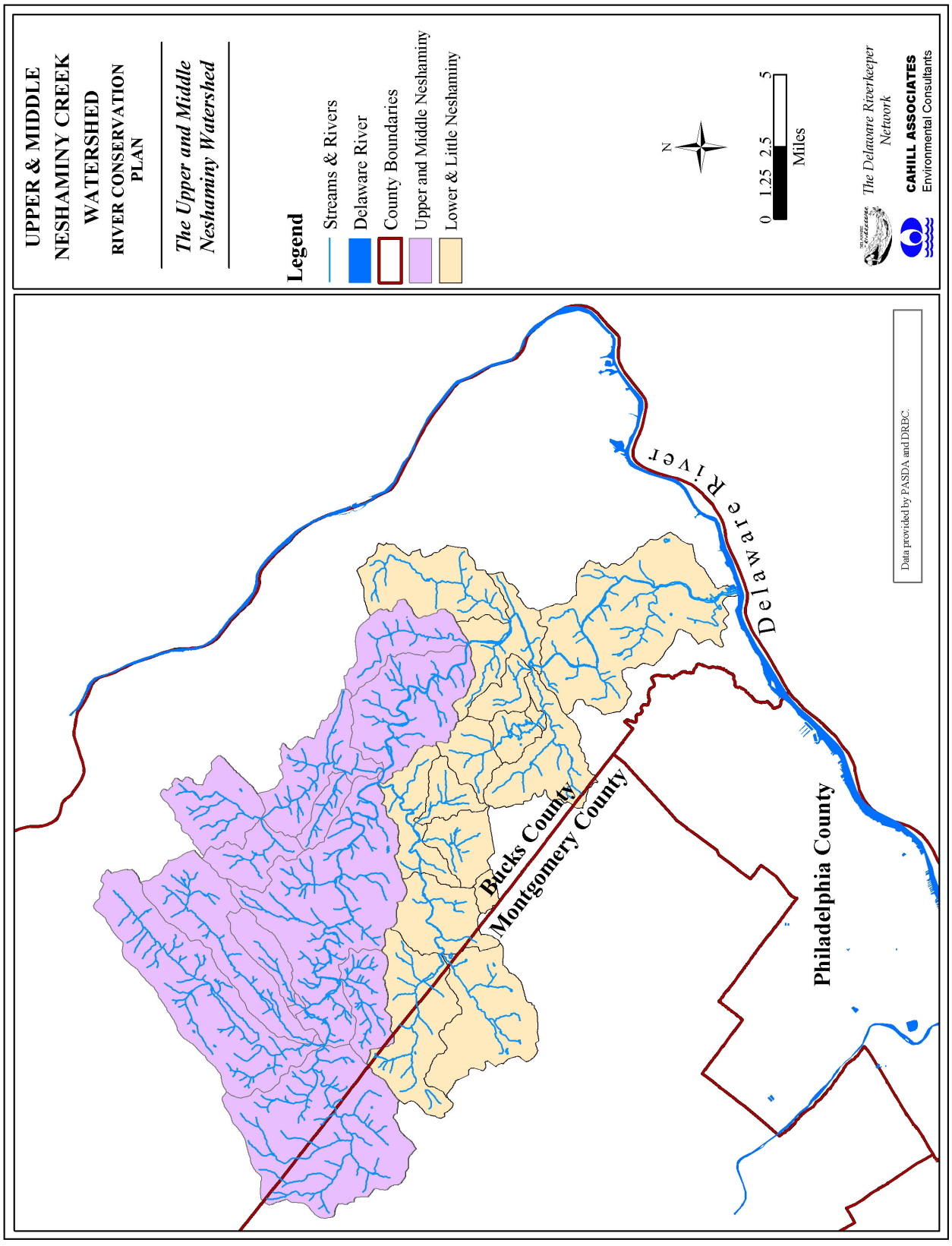


Figure 1-2. Upper and Middle Neshaminy Creek Watershed.

Bucks and Montgomery Counties, with all or parts of 14 municipalities. Several municipalities centrally located in the watershed (Doylestown Township and Borough, Chalfont Borough, and New Britain Borough) are not formally included in the study area because a previous RCP has been prepared for this portion of the watershed (Figure 1-3). Most of the watershed is located within Bucks County. Major tributaries of the Upper and Middle Neshaminy Creek include the West and North Branch of Neshaminy Creek, Pine Run, Cooks Run, Mill Creek, Lahaska Creek, Robin Run, Watson Creek, and Newtown Creek, all of which flow into the Main Stem Neshaminy Creek.

Historically, the watershed has developed out from settlements close to the Delaware River and Philadelphia with the primary land use and purpose of settlement being farming. Since the time of William Penn and prior, the watershed was transformed from forest to agricultural land including the development of small villages and boroughs as town centers. More recently, in the last several decades, the watershed has undergone another transformation from agricultural land to suburban development, with most suburban development originating in close proximity to major transportation corridors. Some portions of the watershed, such as Hatfield and Lansdale in Montgomery County and Doylestown Borough in Bucks County, represent older development where there is an urban village atmosphere. This older development tends to be very dense; most of it pre-dates any sort of stormwater management and other site development regulations. At the other extreme are the areas of the Neshaminy Creek Watershed where the transformation from farmland to suburban residential and commercial areas is much more recent and where development continues to compete for a rapidly dwindling supply of developable land. However, this newer development tends to benefit from somewhat improved stormwater management and other site development regulations. The Upper and Middle Neshaminy Watershed is home to a population of 212,000 people (2000 census), for an average density of nearly 2.5 persons per acre. This represents over a 30% increase in population from 1990, illustrating the rapid growth this watershed has seen in the last decade. Its many businesses and economic enterprises provide numerous jobs, ranging from robust high tech office parks to many older industries.

Urbanization of this watershed with the resulting changes to the natural landscape has taken its toll, especially upon water resources. These changes have often substantially altered the natural characteristics and flow patterns of streams. Both direct human intervention as well as natural forces associated with surging flows from increased stormwater runoff have straightened once slowly meandering streams, scouring streambeds, and eroding stream banks, making it difficult for aquatic life to continue, let alone thrive. For instance, in the Pine Run Watershed, the banks of once small headwater streams have been significantly eroded by increased runoff, causing banks to be undercut by 6 feet or more in some areas. These same streams are found to have zero baseflow in the dry summer months, disturbing the natural balance of aquatic life. Furthermore, with increased encroachment onto the natural floodplain by development, flooding has worsened, extending to adjacent homes and properties not previously subject to flooding. In multiple cases, watershed development, particularly in the floodplains, has exposed homes and businesses to more frequent flooding.

As we know, the human relationship with watersheds has not always been a healthy one. Land development—progress—has often meant filling in of wetlands. Wetlands act as natural filters,

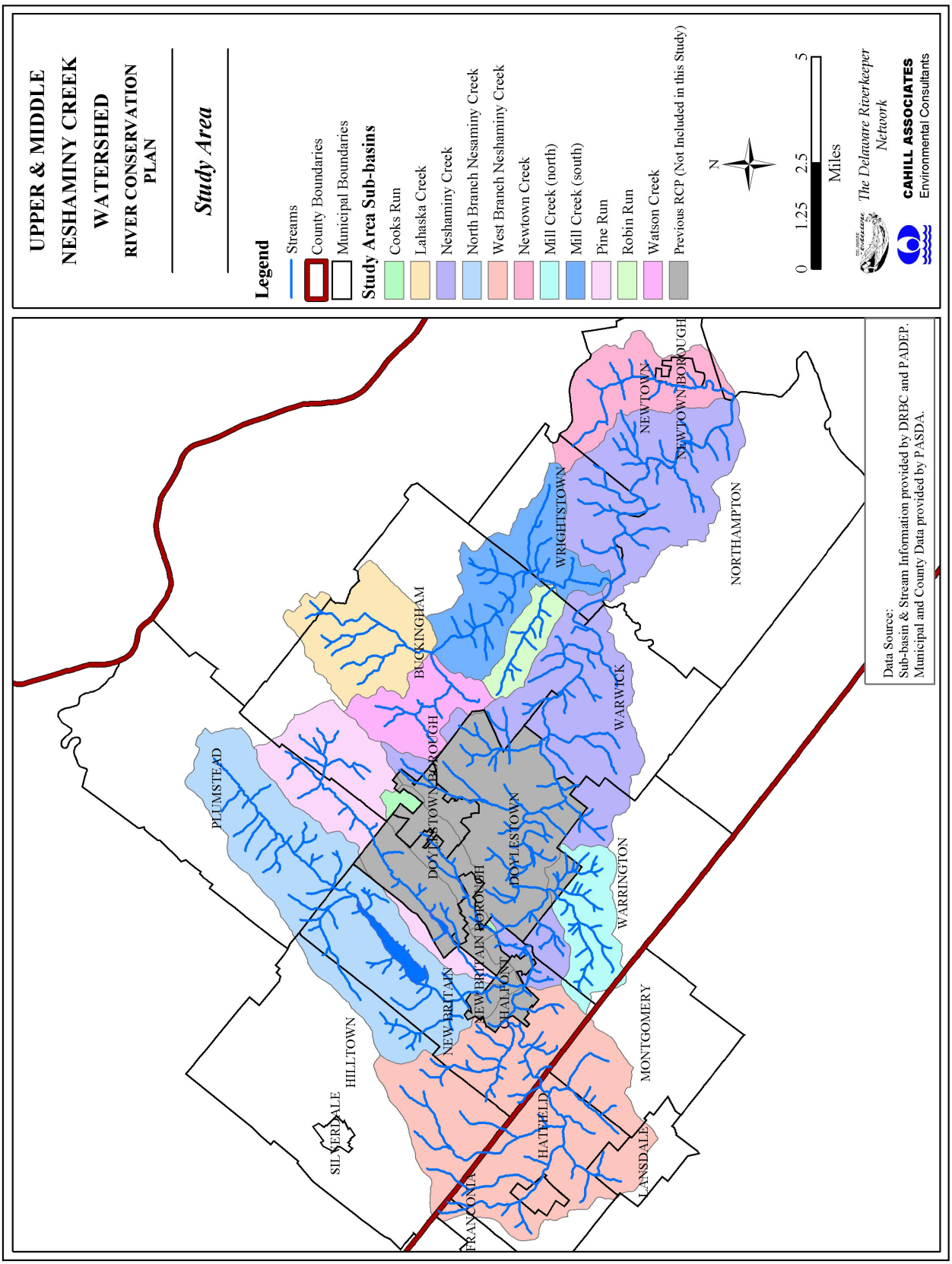


Figure 1-3. Upper and Middle Neshaminy Creek Watershed RCP Study Area.

cleaning stormwater runoff and protecting our streams, and further act to mitigate flooding. The streams' natural floodplains, the land adjoining the streams, were paved in many places, destroying their natural buffers. Businesses and homes were built, and sewers were constructed in the stream corridors to drain away wastewater.

Until recently, the impact of these changes to the land and streams—to watersheds—has not been fully understood. Sediment from land disturbed by development upstream has been transported by stormwater runoff into the stream system. Urbanization increases the volume and velocity of stormwater runoff, so that contaminants deposited in the streets and on paved areas, such as oil, gasoline, metals, and other substances are washed away and then deposited in the stream system. We are only beginning to address the problems caused by shortsighted land use and development practices.

In fact, as much as this is a watershed of commonalities, this is a watershed of contrasts. It is a watershed of many personalities, often divergent in nature. It is densely populated in parts of Montgomery County and Central Bucks at the County Seat of Doylestown, while other areas such as Hilltown and Buckingham Townships retain the rural qualities of a once primarily agricultural landscape, although development pressures are a constant threat. In short, unity of watershed planning comes to be a most challenging goal, where the goals and objectives of the stakeholders in one portion of the watershed can be widely different from the goals and objectives of stakeholders in another part. In densely populated areas, the goals may be to provide additional recreation or to retrofit existing areas to restore past mistakes, while in more rural areas of the watershed focus may be placed on protecting the resources from destruction or alteration. As a consequence, Neshaminy Creek RCP preparers have realized early on that the inventorying and analysis of the Upper and Middle Neshaminy Creek Watershed must respect these many distinctions—as well as acknowledge the commonalities and watershed linkages where they exist—in order for the Plan to be properly focused, accurate, and ultimately successful. Therefore, although the Plan would be too cumbersome to discuss data from each of the 14 municipalities on an individual basis, from time to time groupings have been developed which highlight these important watershed distinctions.

C. The Delaware Riverkeeper Network (DRN) and the Study Advisory Committee

The Delaware Riverkeeper Network (DRN) is a nonprofit, membership organization that has worked since 1988 to protect and restore the Delaware River and its tributary watersheds through advocacy, enforcement, and citizen action. An affiliate of the American Littoral Society, a national conservation group, DRN works throughout the Delaware's entire 13,539 square mile watershed which includes portions of NY, NJ, PA and DE. Their programs include a watershed wide advocacy program; taking a stance on regional and local issues that threaten water quality; an environmental law clinic dedicated to enforcing environmental laws within the watershed; a tributary task force initiative designed to organize and strengthen local communities working to protect local streams; a stream restoration program dedicated to helping communities restore degraded and

eroding stream and waterway systems and riparian corridors; a volunteer monitoring program with sites throughout the watershed; pollution hotlines.

DRN is committed to preparing a River Conservation Plan for the Upper and Middle Neshaminy Creek that provides a vision for the restoration and protection of the Upper and Middle Neshaminy Creek Watershed, one that considers all residents and interest groups, all neighborhoods, and all municipalities. As such this plan must be actualized through the cooperative efforts of the many diverse stakeholders in this Neshaminy Creek Watershed. In a watershed where resources are so often rigorously competed for, this cooperative vision is no simple matter.

A steering committee was formed in September 2000 to guide the River Conservation Plan development. Good representation from various interests resulted in an active and interested committee that took on its responsibilities enthusiastically and carried its energy through to the completion of the Draft Plan. The committee formed the foundation of the Plan by setting goals, and then actions, and finally reviewing suggested projects for inclusion in the Plan. The work of the steering committee has been of great benefit to the watershed's residents and to furthering the objective of protecting and enhancing the Neshaminy Creek.

The Steering Committee members are as follows:
Michael Coia, Wrightstown Township Resident
Jeff Featherstone, Delaware River Basin Commission
Ed Fell, President, Native American Alliance of Bucks County
John Fowler, Wrightstown Twp. Planning Board
Bernice Graeter-Reardon, Warminster Twp. Historic Commission
Phil Margolis, President, Neshaminy Valley Natural Foods
Rich Myers, President, Neshaminy Watershed Association
Betty Snyder, Hilltown Twp. Supervisor
Ray Stepnoski, Buckingham Twp. Supervisor

Advisors to the Steering Committee:
Terry Bentley, Bucks County Planning Commission
Jane Magne, Wrightstown Twp. Supervisor and Financial Officer

Special services donated by:
Dickson Sorenson, video direction
Lower Bucks Cable Television, video production

A Municipal Committee also formed and met to help formulate the goals and actions for the Plan. They also reviewed the suggested projects for inclusion in the Plan prior to preparation of the Draft Plan. The committee's memberships were fluid and changed with personnel/responsibilities at the municipal level. There was good representation from the municipalities with 80% attendance of the 14 municipalities at critical meetings.

Watershed Municipalities:

Buckingham Township	Newtown Borough
Hatfield Borough	Newtown Township
Hatfield Township	Northampton Township
Hilltown Township	Plumstead Township
Lansdale Borough	Warrington Township
Montgomery Township	Warwick Township
New Britain Township	Wrightstown Township

D. Important Planning in the Watershed

In addition to this River Conservation Plan, several other very important planning and management processes are ongoing in the Neshaminy Creek Watershed. Given the seriousness of the watershed challenges, it is of paramount importance that these major efforts be effectively coordinated and that they work together successfully.

The following interrelated activities makes the Upper and Middle Neshaminy an especially good candidate for productive partnering:

- **State List of Impaired Streams, 303d List, TMDLs:** Many sections of the Upper and Middle Neshaminy have been listed on the State's list of "impaired streams," as a result of PADEP's statewide assessment of streams (PADEP has conducted and continues to conduct an assessment of all water bodies in the State as required by the Clean Water Act); "impairment" means that the waterway is not achieving its State-designated stream standards. Several tributaries to the main stem Neshaminy Creek have been listed on the State's 303(d) List, including headwater streams such as the West Branch in Montgomery and Bucks Counties as well as the North Branch, Pine Run and Robin Run in Bucks County. The CWA requires the development of Total Maximum Daily Loads (TMDLs) to be developed for both point (wastewater treatment plants) and nonpoint pollutant sources for these impaired waters which are listed on this "303d List." A TMDL is currently being developed for this watershed. Because all of the Main Stem Neshaminy Creek as well as several other headwater sections have been designated as "impaired" by the State, clearly water quality problems exist. Although the Neshaminy has some significant point sources of pollution (e.g., wastewater treatment plants), water quality improvement efforts must also focus heavily on nonpoint sources and their equitable allocation in order to meet CWA water quality standards in the Watershed.

- **NPDES Phase II:** The National Pollution Discharge Elimination System Phase II stormwater plan and permit requirements for Municipal Separate Storm Sewer Systems will affect all of the municipalities in the watershed. All municipalities over a certain population and/or with a certain threshold population density must be permitted under the requirements of this new program; in order to obtain these permits, detailed Phase II plans will have to be prepared and submitted by each affected municipality. These permit re-

quirements are being phased in under the administration of both PADEP and the US Environmental Protection Agency.

- **River Conservation Plan:** And of course DRN is developing the River Conservation Plan. This plan is an important means of creating new partnerships within the watershed, particularly in creating inter-municipal cooperation and planning. The public, including but not limited to community groups, schools, hospitals, and environmental organizations, have been involved in the planning and development of this plan to every extent possible. All of the recommendations that are proposed in this plan are a direct result of contributions made by municipal government and the public. The continued support of both the local government bodies and the public is integral to the plan's success. One of the most important goals of this plan is to use it as a tool to implement change in the way we do business regarding our natural resources. Fostering community partnerships is an essential component to making this RCP and its recommendations a success.

Act 167 Stormwater Management Plan

The Bucks County Planning Commission (BCPC), in cooperation with the Bucks County Conservation District, prepared an Act 167 Stormwater Management Plan for the Neshaminy Creek in 1992, funded in part through a PADEP grant. The preparation of this watershed-level study involved a complex planning process, with detailed inventorying and complex hydrologic modeling. The 167 Plan identifies stormwater problems and includes development of new regulatory requirements which watershed municipalities are asked to adopt. It should be noted that Act 167 plans are designed to address future stormwater impacts from new development, not correct problems resulting from existing development. The Act 167 plan for the Neshaminy included model ordinances and detailed design information for many very effective stormwater BMP's. Unfortunately, most of the new development that has occurred in the watershed since the plan's approval has not incorporated the recommended BMP's. In fact, the most common stormwater management structure constructed in the watershed is the detention basin, which provides little water quality control and no stormwater volume control. The implementation of the Act 167 Stormwater Management Plan recommendations have had limited success in the Neshaminy thus far.

Currently, the Bucks County Planning Commission is in the process of updating the Neshaminy Act 167 plan. This is again an opportunity to advance the use of innovative stormwater management technologies that more efficiently control both stormwater volume and quality. Given the current state of the watershed and the number of Neshaminy tributaries listed on the state 303d list, it is imperative that any new development incorporate the recommendations discussed in the Act 167 plan.

Neshaminy Creek Watershed Work Plan Number 5

Watershed issues for many watershed stakeholders have been focused on a history of severe flooding which has occurred in selected portions of the Watershed, particularly in the lower portions of the watershed (Lower Bucks County). As a result of the flooding problems faced in this watershed, in 1967 Congress approved a plan through the PL-566 program to construct flood

control dams on the Neshaminy Creek. Since the approval, eight flood control dams have been constructed and construction of two remaining dams was put on hold in 1989. Due to severe flooding that occurred in the watershed in 1996, a Neshaminy Creek Steering Committee and Technical Team was formed to study additional flood control strategies for the watershed. The technical team began a five-year study to develop an updated watershed plan for the Middle and Lower Neshaminy Creek from Route 611 down to the Delaware River. Four alternative flood control programs were chosen for further study and public scrutiny (no action, nonstructural solutions, a dry dam in Dark Hollow Park, and a combination of a dry dam and nonstructural). The nonstructural alternative was proven to provide the greatest level of flood damage protection to the most people in the most cost-effective manner.

E. A Brief History of Watershed Problems and Issues

As a substantially developed watershed where development continues to increase at a tremendous rate, the Upper and Middle Neshaminy Creek Watershed suffers from a variety of water resource and general environmental problems. The significant change in the natural landscape with the tremendous addition of impervious cover undoubtedly has produced dramatic changes in the overall hydrology of the watershed, if patterns existing in pre-colonial times were to be compared with the current day. First, stormwater runoff has increased such that serious flooding occurs in many different parts of the watershed and the watershed contributes to flooding in the lower Neshaminy Watershed. This increased runoff means at the same time that far less water infiltrates naturally into the ground to replenish the groundwater, resulting in significant declines in stream baseflow. This "lost-recharge" also contributes to water quantity problems for the majority of residences and businesses in the watershed reliant on wells for water supply. Stream flow quickly "flashes" into out of bank flooding during rains and then quickly sinks to a trickle after the rain stops. The flood flows erode stream banks, scour away the natural pools and riffles so critical to the aquatic biota, and ultimately change the whole nature of the stream or its geomorphology in today's terms.

Flooding problems are widely prevalent in the Neshaminy Watershed. In the last several years, flood problems have been demonstrated vividly in the Lower Neshaminy when floodwaters from Hurricane Floyd reached the 100-year flood level at the USGS gauge at Langhorne, PA. While much of the significant flooding has occurred in the Lower Neshaminy Basin, many areas in the Upper and Middle Neshaminy have suffered from serious flood problems, particularly in areas where development has occurred in the floodplain. Land uses historically have encroached into the floodplain (many uses built before floodplain regulations). Still, floodplain encroachment continues even today as developers search out vacant parcels even with serious environmental constraints. Many municipalities maintain minimum floodplain regulations which allow substantial disturbance of sensitive floodplain zones, provided that new uses are floodproofed. This flood-plain development causes an increase in the velocity of floodwaters while reducing floodwater storage area, thereby rendering structures located in the floodplain more vulnerable to serious damage.

To help combat flooding, many flood control dams were constructed in the watershed as part of a state funded program to help reduce flooding in the Neshaminy. However, as a result of a five

year study to evaluate flood control methods, this approach (dam building) has been abandoned in favor of non-structural solutions such as the removal of structures and fill from the floodplain. In fact, the Bucks County Commissioners recently approved the first purchase of flood prone property along the Neshaminy through a $15 million program funded by the county and the U.S. Department of Agriculture. In spite of the flood control measures enacted in the watershed, flooding remains a serious issue and likely will involve a multi-faceted approach to remedy.

On the water quality side, substantial point and nonpoint source pollutant loads, including sediment, are washed into the streams and impoundments during and after rain events; this pollution combines with virtually constant (dry weather and wet weather) effluent from wastewater treatment plants located throughout the watershed. Nonpoint loadings combine with various other hazardous waste site discharges, private wastewater treatment plant discharges, and miscellaneous sources such as a proliferating Canadian goose population to make overall water quality significantly degraded.

Another serious problem in the watershed has been the direct impact of development on the stream system itself, from extensive channelizing and relocation of the stream to outright total piping, enclosure, and burial. Burial of the stream may solve one problem (though even this is questionable), but many more problems have been created! While the watershed does not suffer from extensive stream burial as is seen in more urban watersheds, there are areas in Newtown and Lansdale Boroughs where small headwater streams are substantially buried. Although the stream burial in Lansdale and Newtown is more indicative of extensive stream burials (i.e. Large sections of stream are completely piped and buried), smaller stream burial occurs all the time in the watershed in areas where development (road crossings, parking lots, residential and commercial development) encroaches on the stream channel. Indeed, as the result of this environmentally shortsighted and ineffective practice, many flooding problems have been exacerbated. Natural floodplains are entirely eliminated where stream burial occurs and floodwaters are conveyed more quickly through the stream conveyance pipes. Furthermore, culverts and other conveyance structures often back up floodwaters, contributing to flooding conditions where these structures are located. Water quality problems have worsened as well.

Addition problems occur within the stream, for example bridge abutments and old dam structures interfere with the free flow of the stream. Dumping has occurred and continues in many locations. Riparian buffers have been removed. Streambanks are often heavily eroded by increased runoff. Aquatic habitat has been seriously impacted by increased sediment and decreased baseflow. In short, the Neshaminy Creek has been substantially impacted by human action.

In many ways, the dilemma of the Upper and Middle Neshaminy Creek Watershed mirrors the dilemma facing so much of Pennsylvania and other developed areas throughout the country. The end result becomes one of inefficient decay of older communities and rapid-fire destruction in zones of sprawling new development, all of it auguring watershed disaster as the “islands” of Penn’s Woods in watershed headwaters quickly vanish. The goal of this RCP is to reverse some of these trends and restore watershed values, realizing that because of an abundance of existing resources it is not too late in the Upper and Middle Neshaminy.

When all the world seems wrong
And the ways of life seem vain,
I seek in thy companionship
To live with thee again.
The world all round thy margin
Is held embraced by thee,
An true are thy reflections,
O, dear Neshaminy!

Verse Two from *Neshaminy*
by M.R.K. Darlington (1896)

2. POPULATION & LAND USE

Postcard provided by Richard Albert, DRN

2. POPULATION & LAND USE

A. Population Profile

Population in the Watershed

The Neshaminy Creek Watershed in total is a highly developed watershed. Although the lower portions of the Neshaminy not included in this RCP are more heavily developed, the Upper and Middle portions of the watershed as defined here are still rather heavily developed, with the upper portions of course being somewhat more rural. In terms of municipal counts, the older boroughs have declined in population in recent years (Newtown Borough's decline being by far the largest at nearly 10 percent, 1990 to 2000), whereas the less developed surrounding townships are all growing, though at somewhat different rates (Warwick Township's growth rate of 102.4 percent being the greatest, more than a doubling in a decade). Table 2-1 provides both 1990 and 2000 Census counts for total population, indicating that the total population for the watershed (again, here defined as including the total of the municipalities comprising the watershed; no attempt was made to exclude non-watershed portion population) increased from 154,048 to 200,362, 1990 to 2000 (note also that this table excludes the several municipalities treated in the first Neshaminy Creek RCP, Doylestown Township and Chalfont, Doylestown, and New Britain Boroughs). In short, these data indicate both that a large number of people currently reside in the watershed (200,000 is an overestimate, though if the Neshaminy Creek RCP population were to be included and the non-watershed portions excluded, the 200,000 estimate might be a reasonably close estimate), as well as the fact that the watershed is clearly rapidly growing. In addition to Warwick Township, Plumstead, Montgomery, and Buckingham Townships are also very rapidly growing as well, nearly doubling in size between 1990 and 2000.

Table 2-1 also provides population projections, developed by the Delaware Valley Regional Planning Commission (DVRPC) for their Year 2025 planning program. These projections are the "official" projections used regionally for transportation and other official planning purposes and have been adopted by DVRPC as well as by Montgomery County. Projections indicate a continued large increase in total watershed population growth, with an increase to 266,500 persons by 2025, a 33.0 percent increase during the period. This growth rate is larger than that projected for either Bucks or Montgomery Counties as a whole during this period, illustrating again the special economic vibrancy of the central Bucks and central Montgomery Counties context. Especially large absolute and percentage increases are projected in both Warrington and Warwick Townships, with large increases also projected for Plumstead, Newtown, Buckingham, and Montgomery Townships. The boroughs continue their modest decline.

Table 2-2 translates absolute population into population densities, important in overall watershed planning for a variety of water quality and water quantity reasons. Clearly, the boroughs are grouped by themselves with greatest density (Lansdale at 5,411 persons per sq mi being the highest). On the other hand, the lowest density townships include Wrightstown, Plumstead, Hilltown, and Buckingham Townships at around 500 persons per sq mi or less. Montgomery, Hatfield, Newtown and Northampton Townships have intermediate densities (1,500 persons per sq mi or higher) with Warrington and Warwick not far behind.

Table 2-1. Census Population Statistics for the Watershed Municipalities (U.S. Census Bureau and Delaware Valley Regional Planning Commission, 2000)

Neshaminy Watershed Municipalities	1990 Population	2000 Population	% Change, 1990-2000	2025 Projection	% Change, 2000-2025
Buckingham Twp.	9,364	16,442	75.59%	22,870	39.10%
Hatfield Boro.	2,650	2,605	-1.70%	2,510	-3.65%
Hatfield Twp.	15,357	16,712	8.82%	19,320	15.61%
Hilltown Twp.	10,582	12,102	14.36%	16,820	38.99%
Lansdale Boro.	16,362	16,071	-1.78%	15,490	-3.62%
Montgomery Twp.	12,179	22,025	80.84%	28,210	28.08%
New Britain Twp.	9,099	10,698	17.57%	16,640	55.54%
Newtown Boro.	2,565	2,312	-9.86%	2,160	-6.57%
Newtown Twp.	13,685	18,206	33.04%	24,070	32.21%
Northampton Twp.	35,406	39,384	11.24%	44,670	13.42%
Plumstead Twp.	6,289	11,409	81.41%	17,500	53.39%
Warrington Twp.	12,169	17,580	44.47%	29,790	69.45%
Warwick Twp.	5,915	11,977	102.49%	22,210	85.44%
Wrightstown Twp.	2,426	2,839	17.02%	4,240	49.35%
TOTALS	154,048	200,362	30.06%	266,500	466.73%

Table 2-2. Population Density in Watershed Municipalities (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	Persons per Square Mile*
Buckingham Twp.	500.21
Hatfield Boro.	4,070.31
Hatfield Twp.	1,674.55
Hilltown Twp.	448.06
Lansdale Boro.	5,411.11
Montgomery Twp.	2,070.02
New Britain Twp.	701.05
Newtown Boro.	4,203.64
Newtown Twp.	1,570.84
Northampton Twp.	1,507.23
Plumstead Twp.	418.37
Warrington Twp.	1,275.76
Warwick Twp.	1,087.83
Wrightstown Twp.	288.22

A note should be quickly added here that density itself is not necessarily a negative concept in terms of overall planning and watershed management. Far from it! In this watershed where low-density sprawling growth is consuming so many valuable watershed resources, concentrations of density whether in existing boroughs or surrounding townships, depending on environmental constraints, are to be advocated. However, because higher density development has typically not

been undertaken in an environmentally sensitive manner and in a manner, which protects watershed values in this and other watersheds, density has historically come at a high environmental cost and taken on negative watershed connotations. At the same time, it is clear that, if these environmental impacts were to be effectively mitigated and if watershed values were to be restored, much of the dense development existing in watershed's boroughs with their mixture of uses bears stark resemblance to the new urbanist/neo-traditional patterns which are being touted as "cutting-edge" by planners elsewhere, where rural watersheds are sprawling out with low density development at alarming rates. It remains a cruel irony that the dense development patterns of Newtown and Hatfield are being forsaken in the Neshaminy even as large areas of relatively pristine watershed only a few miles away are being rapidly consumed.

Age Characteristics in the Watershed

Table 2-3 provides information relating to age, with two categories, "17 and under" and "over 65," highlighted, using 2000 US Census data. These two categories are especially relevant in terms of this Neshaminy Creek Watershed River Conservation Plan, especially in terms of addressing special recreational needs and opportunities. Though absolute numbers are of interest, of particular interest are the percentage calculations and where these percentages depart significantly from the County averages, especially in the municipalities with the larger base populations. Obviously, an especially large number of youth translates into particular recreational needs and demands. At the same time, especially large numbers of the elderly in the "over 65" age group also implies particular types of recreational needs and demands. Additionally, large groups of the elderly also can translate into special socioeconomic constraints such as larger portions of the population on fixed incomes and with special financial limitations.

Table 2-3. Age Characteristics of the Neshaminy Creek Watershed (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	Age 0-17	(% of Total)	Age Over 65	(% of total)
Buckingham Twp.	4,648	28.3%	2,194	13.3%
Hatfield Boro.	604	23.2%	304	11.7%
Hatfield Twp.	4,199	25.1%	1,862	11.1%
Hilltown Twp.	3,290	27.2%	1,460	12.1%
Lansdale Boro.	3,566	22.2%	2,505	15.6%
Montgomery Twp.	6,254	28.4%	2,497	11.3%
New Britain Twp.	2,931	27.4%	1,273	11.9%
Newtown Boro.	505	21.8%	371	16.0%
Newtown Twp.	5,260	28.9%	1,501	8.2%
Northampton Twp.	11,107	28.2%	3,929	10.0%
Plumstead Twp.	3,526	30.9%	746	6.5%
Warrington Twp.	5,120	29.1%	1,502	8.5%
Warwick Twp.	3,961	33.1%	698	5.8%
Wrightstown Twp.	793	27.9%	280	9.9%
TOTALS	55,764	27.8%	21,122	10.5%

In terms of youth, Table 2-3 indicates that the more rural townships not surprisingly have an especially large proportion of young people. Although the watershed as a whole has a high 27.8 percent of its total population in the 0-17 category, many of the individual townships like Plumstead and Warrington (with many close behind) have even higher populations of youth with youth-related recreational needs. The boroughs tend to have significantly reduced populations of this youth category; however, they have conversely larger populations in the Over 65 category, with Lansdale and Newtown Boroughs at about 16 percent in contrast to Plumstead's 6.5 percent. Overall, when contrasted with Bucks and Montgomery Counties and their age breakdowns, the watershed is generally "younger" with greater numbers of children (0-17) and fewer residents in the Over 65 category.

Income Characteristics

Table 2-4 provides data on median household income, based on the 2000 US Census. Although the nature of the data preclude an averaging in order to calculate a watershed-wide total or median, it is quite clear that the watershed is above average in terms of income. Keeping in mind that both Bucks and Montgomery Counties are two of the wealthiest counties in Pennsylvania and certainly in the region, the watershed is obviously well off, relatively speaking. Although Hatfield and Lansdale boroughs are actually below the medians for the respective counties, Newtown Borough and the other townships are above and oftentimes very far above the respective county medians, with Wrightstown and both Northampton and Buckingham being about 70 percent higher than the already very high county medians.

Table 2-4. Income Characteristics of the Neshaminy Creek Watershed (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	2000 Median Household Income
Buckingham Twp.	$82,376
Hatfield Boro.	$45,975
Hatfield Twp.	$57,247
Hilltown Twp.	$63,178
Lansdale Boro.	$46,232
Montgomery Twp.	$78,953
New Britain Twp.	$71,194
Newtown Boro.	$63,571
Newtown Twp.	$80,532
Northampton Twp.	$82,655
Plumstead Twp.	$70,332
Warrington Twp.	$63,364
Warwick Twp.	$81,711
Wrightstown Twp.	$82,875
County Data	
Bucks County	$59,727
Chester County	$65,295
Delaware County	$50,092
Montgomery County	$60,829
Philadelphia County	$30,746

Employment

Although historically the watershed has probably been known most as a series of bedroom communities where most residents commute to employment outside of the watershed, this condition has changed significantly in recent years, as employment centers have mushroomed within and near watershed boundaries. Office parks now abound and are on the rise. Furthermore, the quality of these jobs is ever expanding and improving, as reflected in the various economic indicators reported in this RCP. Incomes are rising rapidly. Table 2-5 provides a detailed listing of employment characteristics for watershed residents, again summarizing for total municipalities. Looking at the Employment Sector totals column, the largest single category is "Executive, Administrative, Managerial" at 17.4 percent with "Professional Specialty Occupations" bringing up a close second (17.0 percent). In sum, nearly 35 percent of the total workforce is classified as upper level "white collar"(because some of the other categories such as "Technical, Sales, Administrative Support" also likely includes some "white collar" employment, this percentage could actually be larger). Municipalities with especially large "white collar" concentrations appear to be Northampton and Newtown Townships, with major concentrations in Montgomery, Buckingham, Hatfield, New Britain, Warrington, and Warwick. Though the watershed is not without its economic problems, these data indicate that the watershed enjoys substantial prosperity and wealth.

B. Housing Profile

Housing Units in the Watershed

Table 2-6 summarizes housing unit data for the watershed, indicating a substantial increase from 56,835 units in 1990 to 73,252 units in 2000 (increase of 28.9 percent; again, counting the total municipalities). Housing data show even more pronounced trends in the boroughs versus the surrounding townships, with all the boroughs declining (Lansdale declining by a large 15.2 percent). Conversely, the townships ranged from Warwick's remarkable 104.4 percent increase to the very large increase of Plumstead and Buckingham (78.8 and 78.5 percent respectively) to New Britain's 66.9 percent increase. In sum, although clearly a proportion of these housing units would be located outside of the watershed boundaries per se, this watershed is tremendously active in terms of new land development, especially residential new land development. Although both Bucks County and Montgomery County are considered to be strong growers amongst Pennsylvania counties, the statistics for the watershed in total and more so for the highest municipal growers indicate that much more development activity occurred in the watershed than elsewhere in either Bucks or Montgomery Counties. Clearly, this watershed is a focus of growth and development.

In terms of owner occupancy, Table 2-6 indicates a very high level of owner occupancy in most of the municipalities in the watershed. Traditionally, owner occupancy has been viewed as a positive factor in terms of overall community development and generally has been associated with economic vitality and vibrancy. As to be expected the three boroughs have significantly lower owner occupancy rates, although even these rates are high. In many of the townships, such as Warwick (95.5 percent) and Montgomery (94.2 percent), the owner occupancy rates are extremely high.

Table 2-7 provides more detailed information relating to new housing building permits issued, further documenting the increases recorded in the US Census. Again, very large increases are

Table 2-5. Employment in Watershed Municipalities
(U.S. Census Bureau, 1990)

Employment Sector:	Buckingham Twp	Hatfield Boro	Hatfield Twp	Hilltown Twp	Lansdale Boro	Montgomery Twp	New Britain Twp	Newtown Boro	Newtown Twp	Northampton Twp	Plumstead Twp	Warrington Twp	Warwick Twp	Wrightstown Twp	TOTALS
Executive, administrative, and managerial occupations (000-042)	1,144	120	1,083	705	1,030	1,402	869	209	1,961	3,740	480	1,090	629	219	14,681
Professional specialty occupations (043-202)	1,081	167	1,246	693	1,066	1,201	963	386	1,759	3,384	504	977	570	283	14,280
Technical, sales, and administrative support occupations (203-402):															
Technicians and related support occupations (203-242)	191	44	400	243	469	334	248	63	389	781	106	291	178	31	3,768
Sales occupations (243-302)	676	191	1,250	488	999	1,031	794	171	1,385	3,250	373	854	447	152	12,061
Administrative support occupations, including clerical (303-402)	611	276	1,482	1,069	1,524	1,223	789	137	1,116	3,395	493	1,256	431	186	13,988
Service occupations (403-472):															
Private household occupations (403-412)	34	9	5	22	23	0	8	5	8	51	12	10	0	1	188
Protective service occupations (413-432)	26	18	83	58	73	26	28	12	32	110	0	61	39	11	577
Service occupations, except protective and household (433-472)	353	115	638	478	850	383	407	122	410	1,283	223	546	165	109	6,082
Farming, forestry, and fishing occupations (473-502)	111	14	72	64	53	40	26	9	8	211	60	80	25	14	787
Precision production, craft, and repair occupations (503-702)	408	288	1,045	890	1,278	590	546	101	439	1,537	478	813	424	169	9,006
Operators, fabricators, and laborers (703-902):															
Machine operators, assemblers, and inspectors (703-802)	98	194	771	437	1,003	333	126	26	105	336	164	259	79	44	3,975
Transportation and material moving occupations (803-863)	96	52	231	206	341	135	158	27	141	294	200	176	90	61	2,208
Handlers, equipment cleaners, helpers, and laborers (864-902)	103	102	357	330	456	121	94	43	135	429	88	204	29	32	2,523
TOTALS	4,932	1,590	8,663	5,683	9,165	6,819	5,056	1,311	7,888	18,801	3,181	6,617	3,106	1,312	84,124

Table 2-6 Housing Data in the Neshaminy Creek Watershed Municipalities (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	1990 Housing Units	2000 Housing Units	1990-2000 Unit Change	% Owner Occupied (2000)
Buckingham Twp.	3,283	5,861	2,578	92.3%
Hatfield Boro.	1,172	1,139	-33	46.8%
Hatfield Twp.	6,087	6,592	505	64.5%
Hilltown Twp.	3,659	4,370	711	83.9%
Lansdale Boro.	7,009	6,893	-116	57.5%
Montgomery Twp.	4,825	8,053	3,228	94.2%
New Britain Twp.	3,284	3,969	685	90.6%
Newtown Boro.	1,104	936	-168	66.2%
Newtown Twp.	5,329	6,848	1,519	86.7%
Northampton Twp.	11,486	13,138	1,652	93.1%
Plumstead Twp.	2,295	4,103	1,808	89.3%
Warrington Twp.	4,458	6,314	1,856	80.5%
Warwick Twp.	1,981	4,050	2,069	95.5%
Wrightstown Twp.	863	986	123	88.3%
TOTALS	56,835	73,252	16,417	n/a

recorded for Montgomery and Buckingham Townships, with Plumstead, Warrington, Northampton, and Warwick not far behind. The watershed increase of 17,300 units in this ten-year period is quite large and appears to be relatively evenly distributed year-by-year, although there are fluctuations in rate of development during the decade. Another trend that is shown in Table 2-7 is the type of housing units that are being constructed. In this watershed, most of the residential development is composed of single unit structures, a trend that is indicative of suburban sprawl. Of course, in addition to this residential development there must be added non-residential development, which in many cases could be quite significant. Masses of retail and

Table 2-7. Housing Units in the Neshaminy Creek Watershed Municipalities (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	Housing Units Authorized by Residential Building Permits										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	TOTAL
Buckingham Twp.	88	156	212	266	382	399	401	331	271	198	**2,704**
Hatfield Boro.	4	1	2	2	2	1	2	5	3	8	**30**
Hatfield Twp.	56	80	105	70	31	55	85	29	36	81	**628**
Hilltown Twp.	57	67	90	47	50	74	81	90	81	54	**691**
Lansdale Boro.	4	1	0	0	2	1	1	38	3	36	**86**
Montgomery Twp.	470	409	388	466	482	372	131	94	130	183	**3,125**
New Britain Twp.	52	71	111	125	103	82	34	16	5	61	**660**
Newtown Boro.	0	0	0	0	2	5	0	0	1	0	**8**
Newtown Twp.	316	201	226	129	155	66	100	128	113	129	**1,563**
Northampton Twp.	150	237	216	196	201	145	142	125	171	218	**1,801**
Plumstead Twp.	20	38	108	238	409	299	169	206	179	344	**2,010**
Warrington Twp.	117	241	187	252	93	60	46	237	274	498	**2,005**
Warwick Twp.	35	65	119	191	177	327	195	248	271	203	**1,831**
Wrightstown Twp.	7	11	8	11	13	26	20	23	21	18	**158**
TOTALS	1,376	1,578	1,772	1,993	2,102	1,912	1,407	1,570	1,559	2,031	17,300

blue: at least 95%of the housing units built in this year were single-unit structures

*red: **all** housing units built in this year were single-unit structures*

other non-residential development have occurred along the major roadways, which cross the watershed.

Housing Values in the Watershed

Median values of housing units for watershed municipalities are given in Table 2-8, based on 1990 and 2000 US Census. This housing value data mimics the trends apparent in median household income, though the trends are even more pronounced. In this case, two of three boroughs have median housing values which are somewhat below those for their respective counties, Lansdale being by far the lowest at $122,400. Newtown Borough, on the other hand, had a value which was dramatically higher than the Bucks County median, notwithstanding its decline in population and total housing unit count and even depressed income level (i.e., there appears to be a disconnect between Newtown Borough's housing values and income levels). Housing values in townships can be remarkably high, with Buckingham's median of $266,500 being the highest and literally 61 percent higher than the Bucks County median value (already high in terms of the region). Wrightstown and Plumstead were also quite high, at $251,700 and $222,900 respectively.

Total Assessed Valuation and Municipal Millage Rates in the Watershed

Table 2-8 reflects median housing value data and further reinforces the trends apparent in housing. Obviously, a municipality's total assessed valuation is a very good measure of its fiscal health and overall economic health. In a state such as Pennsylvania where so much of the taxing authority and revenue potential is linked to the real estate tax and the real estate tax base, total assessed valuation is particularly important, especially where projects that require local revenues are concerned.

Both the assessment data and tax millage data reflect two rather different systems in Bucks and Montgomery Counties. Due to reassessment and the fact that assessed values have been brought much closer to fair market value in Montgomery County, assessed values for total municipalities are vastly larger than those listed for Bucks County. Conversely, the total assessed values for municipalities such as Buckingham are a small fraction of the actual fair market value. In terms of taxation, the assessed valuation is multiplied times the millage rates, both for the municipality as well as for the school district (usually a much larger tax bill). The discrepancies between Bucks and Montgomery Counties' systems are balanced with the millage rates, where total millage rates are vastly smaller for Montgomery County municipalities, being applied to much larger base assessed values. The point is that it all balances out in terms of net tax bills for individual owners (i.e., owners of $500,000 houses in Bucks County are probably not paying that much more or less in taxes than owners of comparable houses in Montgomery County). The bottom line is that there is substantial assessed valuation in this watershed, resulting from both the significant residential and commercial development in the watershed.

Table 2-8. Housing Value Watershed Municipalities (U.S. Census Bureau, 2000)

Neshaminy Watershed Municipalities	1990 Median Housing Value	2000 Median Housing Value
Buckingham Twp.	$235,600	$266,500
Hatfield Boro.	$121,200	$133,400
Hatfield Twp.	$146,700	$156,800
Hilltown Twp.	$155,300	$170,600
Lansdale Boro.	$114,900	$122,400
Montgomery Twp.	$172,700	$188,400
New Britain Twp.	$169,400	$182,600
Newtown Boro.	$183,300	$232,800
Newtown Twp.	$168,500	$188,200
Northampton Twp.	$195,500	$219,100
Plumstead Twp.	$179,800	$222,900
Warrington Twp.	$167,600	$199,900
Warwick Twp.	$180,700	$203,400
Wrightstown Twp.	$193,800	$251,700
County Data		
Bucks County		$163,200
Chester County		$182,500
Delaware County		$128,800
Montogomery County		$160,700
Philadelphia County		$59,700

C. Land Use and Transportation

Historical Development Trends

As discussed in the Cultural Resources section of this Plan, development trends in the Neshaminy Creek Watershed have radiated both outward, east to west, from the City of Philadelphia as well as upward, south to north, from the Delaware River and upstream.

The watershed has a rich history, some of which has been preserved and remains with us today. Some of the earliest settlements in the United States occurred in the watershed. As these early colonial settlements matured, more developments followed, especially along the trails and the roadways that emerged. With the Colonial Period came the emergence of the watershed as an agricultural center. Large Quaker farms sprung up around the countryside. As the area prospered and developed even more, more people moved into the watershed, more businesses emerged as well. Crossroads villages grew into towns. As all of southeastern Pennsylvania became a growing center of commerce in the fledgling nation, the economic effects radiated outward and rural settlements felt the stimulus.

For good or for bad, the watershed "came into its own" with the advent of post-World War II sprawl. Sprawl can be defined as a regional pattern of development that is characterized by low density, non-contiguous expansion, consumption of outer suburban agricultural lands and environmentally sensitive areas, travel dominance by motor vehicles, small developers operating independently of each other, and a lack of integrated land use planning (due to a fragmented system of local governments with varying fiscal capacities) (Burchell, et al, 1998). Some municipalities like Newtown and Warrington and Montgomery Townships experienced these waves of residential

development starting in the 1960's, increasing in the '70's, and coming full force in the '80's and '90's. Initially, the bulk of the development was residential, many of these communities being classic "bedroom suburban" in nature. However, in the last 20 years, this wave of development has very definitely included non-residential land uses, including impressive office parks to retail shopping centers to other services and a myriad of commercial uses. To that end the watershed and its overall economy is less linked to the City of Philadelphia and other older economic centers and is increasingly related to the commerce occurring both within the watershed itself as well as in adjacent suburban areas which have proliferated as well.

Transportation Facilities

Figures 2-1 and 2-2 show Major Roads and Railroads. In both cases, these transportation facilities are not recent (with some literally harkening back to Indian paths winding up and down stream valleys) and have played historically significant roles in the development of the watershed. Perhaps most curiously, there are no expressways or major new arterials bisecting the watershed. In fact the only major US route, US 202, remains a two-lane highly congested road for much of its length, with the exception of a superhighway bypass around Doylestown Borough, although the planned construction of a "202 Expressway" continues to be underway after a long and arduous planning process, now delayed by a variety of court challenges (the consensus is that this project will be moving ahead in the near future). Although all sorts of special impact mitigations have been committed as a part of this project planning, construction of this new highway can be expected to affect the watershed in a variety of ways, increasing development pressures as accessibility is dramatically increased. As a matter of fact, some would argue that some of the development, which has already occurred in the watershed, has anticipated the completion of this new highway.

Although there are no expressways in the watershed, there are a series of major state arterials routes, PA 309 (Bethlehem Pike), PA 611 (Easton Road), PA 263 (York Road), as well as secondary state arterials such as PA 132, PA 232, PA 332, and PA 413, which carry heavy traffic flows and commuter traffic. In fact, the watershed is almost totally auto-dependent. And although many of these major highways are in fact historical transportation routes, they have now been widened and generally expanded. PA 611 between Doylestown and the Willow Grove Exit of the Pennsylvania turnpike (out of the watershed) is an excellent case in point, where a series of large-scale commercial and residential development and re-developments projects in the last 10 years has made this a major development focus for the entire southeastern Pennsylvania region.

This reliance on motor vehicles for transportation is a symptom of suburban sprawl. As development and population spreads into formerly rural areas the need for new or larger roads increases. The development of transportation networks directly impacts streams as bridges and culverts are often constructed, impeding flow, particularly during flood events. Furthermore, roads impact water quality as pollutant-laden runoff from roadways is often directly conveyed to stream systems in the watershed. This increase in road networks contributes to the fragmentation of natural areas and open space, as well. The breaking up of contiguous tracts of open space (wildlife corridors) by road networks decreases the ability of species to travel within their home ranges and contributes to a loss of habitat and species diversity.

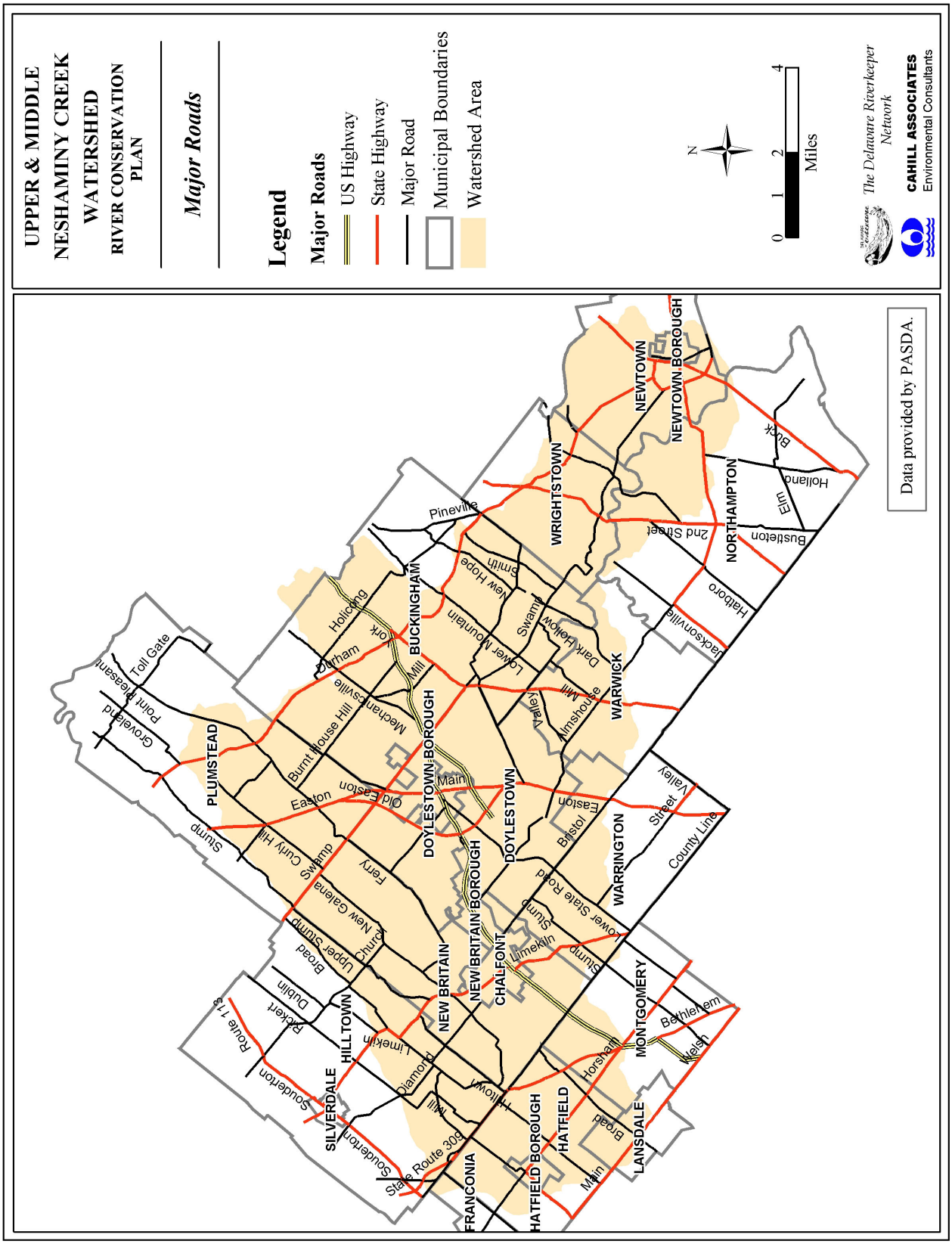


Figure 2-1. Major Highways and roads in the Watershed

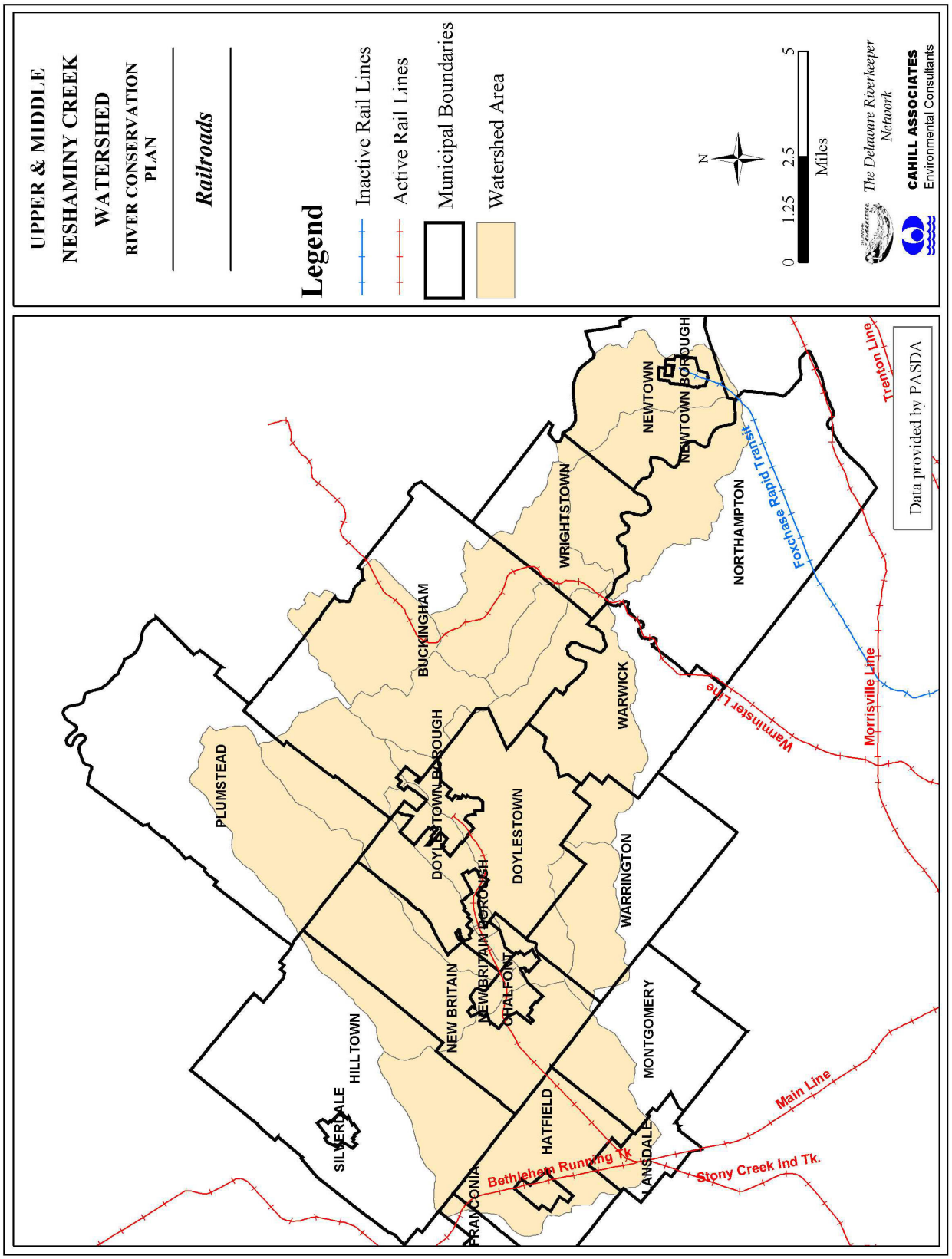


Figure 2-2. Railroads in the Watershed

Although motor vehicle transportation dominates in this watershed, railroads exist, both passenger and freight. There are actually three SEPTA commuter lines which serve the watershed, all of them linking to the City of Philadelphia and beyond. The main line is the Doylestown Line (R5), which starts at Doylestown and then moves southwestward through Montgomery County. The Warminster R2 line does not extend far enough North to enter the watershed, though some may drive to the Warminster Station for commuting purposes. However, there are more commuter lines to the south. The third rail line in the watershed is the Newtown-Fox Chase Line, which was deactivated in the late 1970's. Unfortunately, the real significance of these commuter rail lines has probably diminished over recent years, giving way to the primacy of the automobile.

Existing Land Use Patterns

Existing land use data has been developed by the Delaware Valley Regional Planning Commission, using a variety of categories as explained below and is presented in Figure 2-3 and 2-4. The categorization has been based on interpretation of 1995 air photos. DVRPC uses standard land use categories, though some amplification is useful here. For example, Low Density Residential includes all single-family detached dwelling units, even on small lots (in some parts of the watershed that density could increase to 4 to 6 units per acre). Medium Density Residential includes single-family attached, rowhouses, and mobile homes. High Density Residential includes multi-family apartments. Community Service includes hospitals, government buildings, churches, schools, and cemeteries. Transportation includes parking lots in this analysis; however, streets in residential subdivisions are categorized as Residential. Utility includes power generation, transmission lines, and all types of transmission towers, water and wastewater treatment, and landfills. Recreation includes parks, playgrounds, amusement parks, resorts and camps, golf course, and public assembly areas (i.e, both public and private facilities). Forested/Wooded includes those areas with a continuous tree canopy or solid tree cover, natural lands, marshes, and swamps; Wooded does not include hedgerows or wooded areas related to residences or other uses, to the extent that that can be interpreted. Vacant includes land that is not Forested, not Agriculture, and not categorized as any other use. Because parcel boundaries were not used to classify uses in this process, clearly some error has been introduced in the classification. For example, it is likely that some Forested areas are in fact included in parcels which are active developed land uses and therefore should be understood as part of these uses. A variety of other similar "confusions" may exist. However, the overall picture presented by this data is an accurate one and certainly appropriate for this River Conservation Plan. Obviously there has been development, in some cases considerable development, since 1995. Also, it is important to point out that these land use statistics comprise the entire watershed study area including Doylestown and Chalfont and New Britain Boroughs (these municipalities are not officially within the study area of this RCP).

Land use for the Neshaminy Creek Watershed is given in Figure 2-3 and Table 2-9 using the land use categories as developed by the DVRPC. Patterns for the entire watershed suggest a surprisingly broad distribution of developed land uses throughout the watershed, from "bottom" to "top." Looking at Figure 2-3, there are substantial distributions of Low Density Residential and Agriculture shown throughout the watershed. Scattered areas of Forested also appear to be distributed throughout the watershed, though in some cases following stream valleys. A cluster of more urbanized land uses exists at the most downstream portion of the watershed (Newtown area), including both Commercial and higher density residential uses. Development intensity then

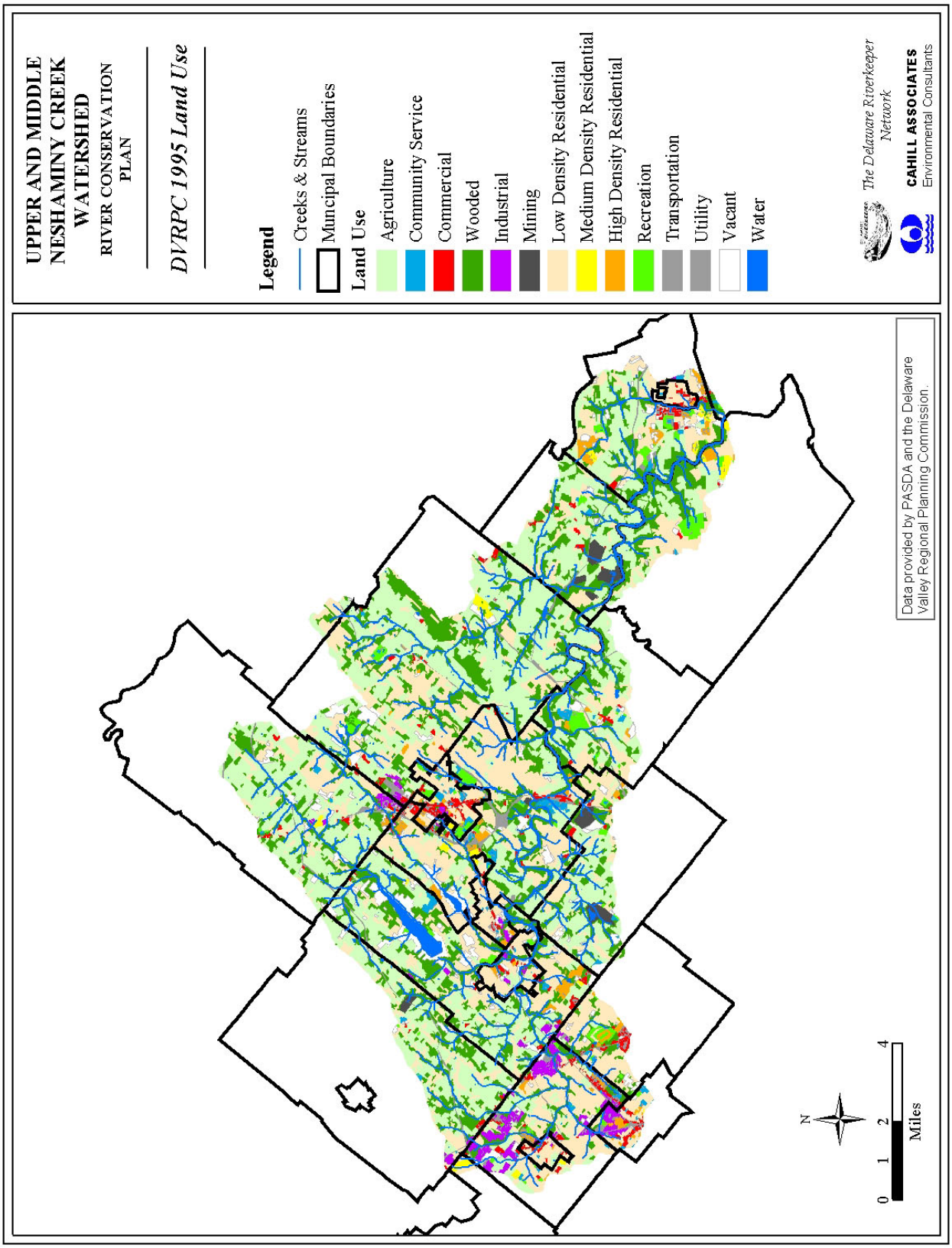


Figure 2-3. DVRPC 1995 Land Use in the Neshaminy Creek Watershed

Table 2-9. DVRPC 1995 Land Use in the Neshaminy Creek Watershed

LAND USE CATEGORY	ACRES	PERCENTAGE
Agriculture	28,290	33.9%
Community Service	850	1.0%
Commercial	1,689	2.0%
Wooded	17,899	21.5%
Industrial	1,300	1.6%
Mining	628	0.8%
Low Density Residential	23,003	27.6%
Medium Density Residential	576	0.7%
High Density Residential	1,188	1.4%
Recreation	1,345	1.6%
Transportation	1,491	1.8%
Utility	743	0.9%
Vacant	3,506	4.2%
Water	900	1.1%
Total	83,408	100.0%

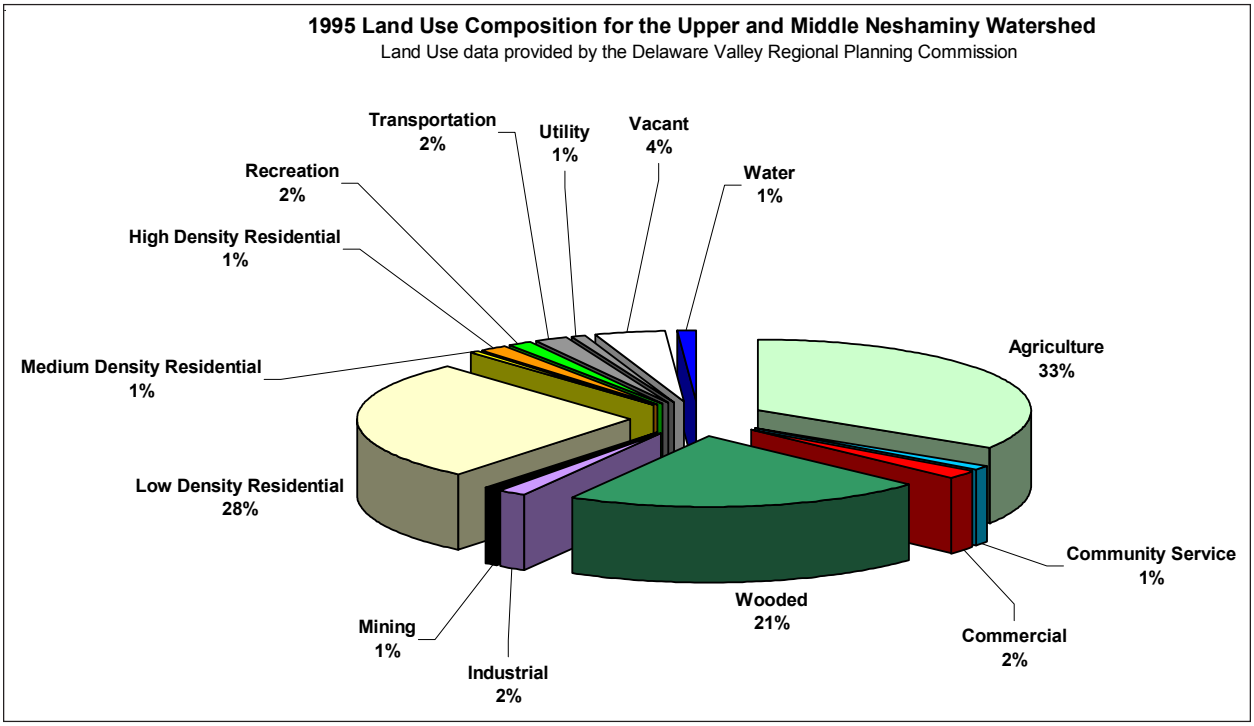


Figure 2-4. Land Use Composition in the Neshaminy Creek Watershed

appears actually to decrease, moving upstream, until the center portion of the watershed is reached. In terms of land use, there really has evolved an arc of land use intensity, revolving around the US 202 corridor, from the most western headwaters areas in Montgomery County eastward to the Doylestown development centroid. Radiating from this US 202 corridor are more rural areas in Hilltown and in Plumstead.

Table 2-9 data indicate that a surprising 33.9 percent of the watershed was Agricultural; even assuming that a considerable proportion of this total has been developed by now, this percentage

is high. Residential is the next largest land use (total of 29.7 percent), with the vast bulk being Low Density and very modest quantities of Medium Density and High Density. Forested area was rated at 21.5 percent which has undoubtedly also declined (in other words, given the likelihood that virtually the entirety of the watershed was Forested at some point many years ago in its pre-disturbance condition, the watershed has only about one-fifth of its natural forest remaining). There are very small percentages of remaining developed land uses, such as Recreation, Commercial, Transportation, Community Services, Industrial, and Utilities. Although there is not a considerable quantity of Industrial land use in the watershed, it is very much focused along the US 202 corridor and PA 309 corridor areas. The land use category itself does not distinguish by type of industry, but likely the bulk of this activity is light industrial in nature, often taking the form of high tech office parks in many cases.

Table 2-10 disaggregates the land use data by the 11 watershed sub-basins. Perhaps most interesting here are the land use categories which can be grouped as "undeveloped," although such a categorization can be misleading. Clearly "undeveloped" land is important in a watershed with such well-documented development pressure. At the top of the list of "undeveloped" is Agriculture (which is of course is very much a land use though at the same time, as we know, very much subject to development pressures). Although some farms may be protected through the county and state purchase of development rights program, the bulk of this acreage is not protected and vulnerable. Certainly large quantities of Agriculture remain, especially in the Neshaminy Mainstem itself, as well as the North and West Branches (there is substantial acreage elsewhere as well), notwithstanding the fact that a lot of development already has occurred. Similarly, large areas of Forested land appear in the Mainstem and North and West Branches. In the Vacant category itself, the largest concentrations occur in the Mainstem, Pine Run and North and West Branches. In summary, land use data indicate that 59.5% of the watershed is comprised of developable land, so that there remains the potential for significant watershed impacts resulting from much more land development. At the same time, there remains the potential for much more conservation-related action to occur.

Table 2-10. Land Use Statistics by Sub-basin

Land Use Category	Area by Sub-basin (Acres)											
	Cooks Run	Lahaska Creek	Main Stem Neshaminy	Newtown Creek	North Branch	Mill Creek (North)	Pine Run	Robin Run	Mill Creek (South)	Watson Creek	West Branch	*Total*
Agriculture	192	2023	7450	1111	5474	2787	2127	720	1477	920	4010	28290
Community Service	77	31	345	60	31	3	93	1	26	-	182	850
Commercial	237	39	332	153	117	65	109	-	38	31	569	1689
Wooded	155	1122	6252	735	2768	1499	1139	296	615	641	2676	17899
Industrial	44	-	33	12	43	-	145	-	-	-	1023	1300
Mining	4	-	345	-	62	91	-	-	126	-	-	628
Low Density Residential	712	1075	7294	1174	1855	703	2611	358	653	1034	5533	23003
Medium Density Residential	138	-	128	62	38	82	3	-	-	-	127	576
High Density Residential	92	6	298	193	34	-	135	-	26	7	397	1188
Recreation	107	53	686	94	83	-	61	-	26	-	236	1345
Transportation	200	28	373	129	22	12	235	1	8	22	462	1491
Utility	7	24	204	47	194	40	2	64	-	-	162	743
Vacant	78	30	664	217	1046	58	784	-	94	65	470	3506
Water	4	20	312	19	353	15	74	12	29	6	56	900
Total	2047	4452	24714	4007	12121	5353	7518	1451	3118	2726	15901	83408

Impervious Coverage

Table 2-11 translates land use data into impervious coverage, an especially important factor when understanding overall watershed health and more specific water quality and water quantity issues. Using generalized factors (percent impervious by land use) of imperviousness based on land use analysis elsewhere, this application indicates a total of 10,371 acres (12.5%) in the watershed have been made impervious (use of these impervious cover factors obviously overstates in some cases, understates on others; the factors are designed to provide an accurate averaged condition). From the impervious and pervious land area, the annual runoff volume can be estimated by applying runoff coefficients, based on the expected average land cover by land use type, and annual precipitation (assumed 45" in this region). Because of the way in which stormwater had been managed (or mismanaged) in the vast bulk of the watershed for the vast bulk of this impervious cover, this imperviousness has translated into increased stormwater discharge of 14,650,529,793 gallons per year (539,552 ac-in), which in turn translates into a reduction in infiltration of 14,650,529,793 gallons with a related reduction in groundwater recharge of 4,529,577,307 gallons (166,816 ac-in).

The watershed condition is actually more impacted than even the imperviousness statistics indicate, given the fact that development has not only created building roofs and parking areas as impervious cover, but has also created vast areas of highly compacted soil in an artificial landscape of turf and other species. This substantially altered pervious area, though not classified as impervious, nevertheless has been significantly reduced in its ability to absorb and infiltrate precipitation, as would occur in a naturally forested area or meadow. Consequently, the loss of water is actually much larger than the numbers indicate above (Center for Watershed Protection, 1998).

Table 2-11. Land Use translated into Impervious Coverage for the Neshaminy Creek Watershed

Existing Conditions								
Land Use Category	**Area (acres)**	**Percent Impervious**	**Percent Pervious**	**Impervious Area (ac)**	**Pervious Area (ac)**	**Impervious Runoff Coefficient**	**Pervious Runoff Coefficient**	**Estimated Annual Runoff Volume (ac-in)***
Agriculture	28,290	5%	95%	1,415	26,876	0.95	0.15	241,881
Community Service	850	50%	50%	425	425	0.95	0.15	21,037
Commercial	1,689	80%	20%	1,351	338	0.95	0.15	60,047
Wooded	17,899	1%	99%	179	17,720	0.95	0.10	87,390
Industrial	1,300	70%	30%	910	390	0.95	0.15	41,522
Mining	628	40%	60%	251	377	0.95	0.15	13,273
Low Density Residential	23,003	15%	85%	3,450	19,552	0.95	0.20	323,476
Medium Density Residential	576	25%	75%	144	432	0.95	0.23	10,631
High Density Residential	1,188	30%	70%	356	832	0.95	0.28	25,716
Recreation	1,345	3%	97%	40	1,305	0.95	0.15	10,531
Transportation	1,491	60%	40%	895	597	0.95	0.15	42,280
Utility	743	5%	95%	37	706	0.95	0.15	6,356
Vacant	3,506	1%	99%	35	3,471	0.95	0.15	24,928
Water	900	98%	2%	900	-	-	-	-
Total	83,408	-	-	10,389	73,019	-	-	909,068
Pre-existing Conditions								
Natural Wooded Condition	83,408	0.01	0.99	834	82,574	0.95	0.10	407,241
						Increase in Runoff/Decrease in Infiltration		501,827
						Lost Recharge*		166,816

*Value is a function of area, the runoff coefficient and annual rainfall (assumed average is 45").

**Lost recharge is based on the reduction of infiltration and loss due to evapotranspiration.

Special Land Uses

The watershed includes some very special recreational facilities as discussed in Section 6, as well as historic and cultural resources (e.g., Our Lady of Czestochowa National Shrine). Another significant use, though technically within the Doylestown Township excluded portion of the watershed is Delaware Valley College of Agriculture and Science, a four-year liberal arts college which has been growing and expanding in recent years; the college has moved from a more technical orientation to a more fully-grounded liberal arts curriculum, although the institution continues with specialties which focus on land resources, earth sciences, and other watershed-related studies which could be of tremendous benefit to overall conservation efforts in the future.

Public and Private Ownership

As discussed in Section 6, there are many different public land holdings distributed throughout the watershed, with the bulk of these parcels being in recreational use of one type or another. In terms of land use patterns, significant uses include the large Tyler State Park in the lower portion of the watershed (Northampton, Wrightstown, Newtown, Buckingham, Doylestown and Middletown Townships), with the adjacent uses of the Bucks County Community College, Northampton Valley County Club, and Northampton Tennis and Fitness Club, and Council Rock Intermediate School and High School. This constellation of recreational, open space, and institutional uses creates a major node of public or quasi-public area in the watershed. Literally 9.2 miles of stream and riparian zone are included in this massing of approximately 2,186 acres.

Similarly, farther upstream is Bucks County's very large 1,500-acre Peace Valley Park with the multi-purpose Lake Galena (also nearby Pine Run Reservoir) in New Britain Township. This facility comprises a large portion of the Township and is a keystone use in the central portion of the watershed as well. The County's Dark Hollow Park in Warwick, Buckingham and Doylestown, with over 650 acres and 7.8 miles of controlled riparian stream buffer, reinforces the open space and recreational facilities provided by Peace Valley.

There are a limited number of private conservation holdings in the watershed, such as conservation easements, held by the Heritage Conservancy and other conservation and land trust organizations.

D. Land Management and Planning in the Watershed: Public and Private

Public Land Management: Comprehensive Planning, Functional Planning, Zoning, Subdivision/Land Development Regulations

Land is managed publicly most directly through municipal zoning ordinances as well as other municipal ordinances and plans. All watershed municipalities have zoning ordinances, although some of these ordinances are somewhat outdated. All municipalities also have subdivision/land development regulations, which are to work in conjunction with the zoning ordinance. Most watershed municipalities also have individual open space, recreation, and environmental resources (OSRER) plans, in response to the open space programs, which have been created in both Bucks and Montgomery Counties in recent years

Trying to document comprehensive planning and land use planning in two different counties and 14 different municipalities is no simple matter. To begin with, it must be recognized that comprehensive planning and land use planning is most directly accomplished on the local municipal level in Pennsylvania. In a watershed with 14 municipalities, the challenge of developing a unifying watershed-wide "vision" becomes extremely difficult, notwithstanding the fact that there is also planning occurring on the countywide and regionwide levels (i.e., Bucks County, Montgomery County, and the Delaware Valley Regional Planning Commission). To complicate matters, municipal jurisdictions rarely conform to natural boundaries, such as watersheds, so that plans often emerge looking like patchwork quilts. Because each municipality also has its own zoning ordinance, providing for a full array of land uses to satisfy the Pennsylvania Constitution, the end result can be disordered.

Overall, the majority of the comprehensive plans, as well as the majority of zoning ordinances and land development regulations, is substantially deficient in terms of promoting many of the goals of this RCP. First and foremost, most municipalities in the watershed fail to recognize the multiple values of the stream system, the floodplains, riparian zones, and related wetlands which link to many watershed neighborhoods. Most municipalities acknowledge floodplains and wetlands (although even this basic level of understanding is sometimes not present), but the vast majority have simply not brought to the table the understanding of watershed systems, why they are important, and how they connect—one way or the other—to those upstream and downstream. This lack of appreciation for watershed values is further reflected in the accompanying regulations, both zoning and subdivision/land development ordinances. That is the bad news. The good news is that through the municipal planning process, and through the development of the comprehensive plan and the implementation of zoning ordinances and related land development regulations, each municipality has the power to attack watershed problems. Each municipality has the ability to cooperate to make watershed opportunities a reality.

We should also add here that many municipalities are moving forward, and are working to develop innovative plans with better regulations and overall management programs. Unfortunately, this tends to be most true of the municipalities which have experienced the greatest growth and development pressures and where impacts have been greatest to date. To some extent, the municipalities where resources are more plentiful and less impacted, and where the problems are

fewer, may not have elevated their awareness to this same extent. In any case, the watershed vision embodied in the RCP goals must be communicated to all fourteen municipalities.

The Special Role of Environmental Advisory Councils

This RCP directs considerable attention to the municipal level of government. Many RCP recommendations in Section 7 involve, either directly or indirectly, municipal government actions, either by the elected governing body or the planning commission, or some other arm of municipal government. These additional RCP recommended actions and initiatives come at a time when many municipalities are already overwhelmed by mounting responsibilities, with municipal officials searching for ways to shorten lists, rather than add to them.

An answer can be the municipal environmental advisory council or EAC. In 1973 the State passed Act 148 which allows a municipality or group of municipalities to establish EACs by ordinance. EACs are intended to advise the elected officials, the municipal planning commission, and other relevant boards on matters relating to natural resources and their conservation, protection, management, promotion, and use. Unfortunately only a few municipalities in the watershed have used this useful tool to date. Creation of EACs could be very useful in spearheading the municipal-level recommendations being made in this RCP. Activities typically include development of natural resource inventories, park and recreation system improvements, and development plan reviews, in addition to a variety of special studies and reports. A challenging agenda for any EAC, new or old, would be to undertake to implement the multiple recommendations being directed toward municipalities in this RCP!

The Pennsylvania Environmental Council (215-563-0250) has established the EAC Network, which will explain how to get started, how to organize EAC efforts, and ultimately how to start to take the critical steps toward RCP implementation.

Private Land Management and Private Land Stewardship for Watershed Conservation

In addition to the conventional public acquisition and purchase of lands for overall conservation and recreation purposes, lands may be set aside through private mechanisms, including outright donation, donation of conservation easement, partial donation (bargain sales), and other mechanisms other than the straightforward fee simple transfer of title (i.e., outright purchase). Unfortunately, very little land in the Neshaminy Creek Watershed has been privately set aside for conservation. Typically, a private land trust organization such as the Heritage Conservancy or Natural Lands Trust manages these “conservation interests” in some manner, although local municipal land trusts can be created; if there has been a donation involved with possible Federal tax credit/benefit being provided to the donor, the land trust organization typically is required to inspect whatever has been donated to make sure that the public interest is being maintained (note that public interest does not equate to public access, according to the law; typically donated conservation easements do not include rights of public access).

There are a variety of mechanisms or techniques, which can be applied creatively to accomplish watershed conservation objectives privately, without public or municipal outlay of funds or without municipal regulatory action of some sort. These mechanisms include, but are not limited to:

Conservation Easements: A conservation easement transfers certain rights for use of a property, such as the right to develop and subdivide the property, while allowing the original property owner to retain ownership and occupancy of the property. A conservation easement may be donated or purchased, though usually are donated in exchange for Federal tax forgiveness (possibly also reduced local real estate taxes) as well as for an overall conservation intent.

Bargain Sales: A conventional fee simple transfer of a property though accomplished at significant reduction of fair market value, as determined by a fair and equitable appraisal process. Owners bargain-selling to a government may enjoy some direct financial reward from the purchase, but may also enjoy a Federally recognized donation which can be used to offset the unpleasant taxes often linked to hugely appreciated properties (i.e., not only are the capital gains from the transaction substantially reduced, but the donation further offsets the taxes due).

Limited Development: Property owners intentionally reduce a development program well below the maximum zoned density allowed by the respective zoning ordinance, in order to maximize conservation values at the property. Ironically, rather than lower values, this limited development approach has come to be viewed as extremely beneficial and desirable from the market's perspective (i.e., by purchasers), with values and prices inflating tremendously in many cases elsewhere in the region. Some experts would argue that there may be more money to be made from limited development, than from conventional development! For example, property values have been shown to increase when natural features such as wetlands and waterways with riparian buffers are preserved. Also, the presence of trees increases property values. Research by the University of Guelph, Ontario found that people were willing to pay up to 15% more for homes with trees. (Rappaport and Wolfe, 1998; Center for Watershed Protection, 1998; DNREC and Brandywine Conservancy, 1997, Garden Design, 2000)

Open Space/Conservation Development: Also called clustering, a conventionally gridded subdivision plan with large lots is allowed to be tightly concentrated on considerably smaller lots, thereby allowing large portions of the site to remain undeveloped, undisturbed. If the cluster is properly and thoroughly developed, this open space area will be deed restricted or could be conveyed in some manner to a local conservation organization or the municipality itself, depending upon the context. PADCNR's Growing Greener program further advocates the strategic linking of these zones of open space, development by development, so that greenways are created. Because this open space being protected clearly should include, though not be limited to, sensitive zones such as floodplains, riparian areas, and wetlands, ideally a greenway eventually is created which protects the stream system. The important objective in clustering is to make sure that open spaces being provided are meaningful and not simply isolated and residual pockets of land where environmental functions have been substantially impacted and depleted and that the developed area employs best management practices to provide environmental and watershed protection.

Estate Planning: In many instances, property owners have held properties for many years and are severely impacted by federal and state taxes through the estate taxation process. Poor estate planning often results in heirs having to sell off the family farm or subdivide it, all of which is unnecessary. The sheer act of proper and effective estate planning, utilizing some of the

tools described above, can produce results, which are financially more beneficial to the heirs and achieve many conservation objectives.

There are many properties remaining in the watershed where some/all of the above mentioned mechanisms could be useful.

E. Critical Areas in the Watershed

Until recent years, most people were less aware of and less concerned about chemical wastes and how these chemicals affect public health and the environment. On properties where such chemical production and handling practices occurred, the result unfortunately has too often come to be a legacy of abandoned hazardous waste sites, such as abandoned warehouses, landfills and underground storage tanks. The US Environmental Protection Agency (USEPA) directs many federally funded programs that inventory, evaluate, and mitigate the adverse effects of these hazardous waste sites. Of most importance for the Neshaminy Creek Watershed is the "Superfund" program, technically including both the **National Priorities List** (NPL), and the **Toxic Release Inventory** (TRI) program.

Superfund Program
Citizen concern over the extent of unregulated hazardous waste sites prompted Congress to establish the Superfund Program in 1980; this program is intended to locate, investigate, and remediate (i.e., clean up) the worst inactive hazardous waste sites nationwide. The USEPA administers the Superfund program in cooperation with individual states and tribal governments. Once a site is discovered and USEPA is notified, the site is entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Database, which contains information on hazardous waste sites, site inspections, preliminary assessments, and remediation of hazardous waste sites. A limited-scope, Preliminary Assessment is performed on every CERCLIS site to determine the nature of the threat to human health and the environment. If the threat is deemed to be serious, a Site Inspection is performed to determine what hazardous substances are present at a site and what substances have been/are being released into the environment. Information from the Preliminary Assessment and/or Site Inspection is used to calculate a Hazard Ranking System score. The HRS system is the main mechanism USEPA uses to list sites on the NPL. Sites with an HRS score of 28.50 or greater are eligible for listing on the NPL.

Table 2-12 provides the Superfund sites that are listed in the Neshaminy Creek Watershed (Figure 2-5) at present. The sites are distributed around the watershed. Furthermore, there are considerably more sites on the CERCLIS List, which are not shown here. Obviously, this array constitutes a significant land use issue in the watershed, although given the extent of existing development in the watershed; the presence of a considerable number of problems is not surprising.

Toxic Release Inventory
Currently over 600 chemicals nationally have been determined to be toxic, and certain industries must report to USEPA if they use or handle these chemicals. Two federal statutes, Section 313 of the Emergency Planning and Community Right-To-Know Act and Section 6607 of the Pollution Prevention Act, mandate that a publicly accessible toxic chemical database be developed and

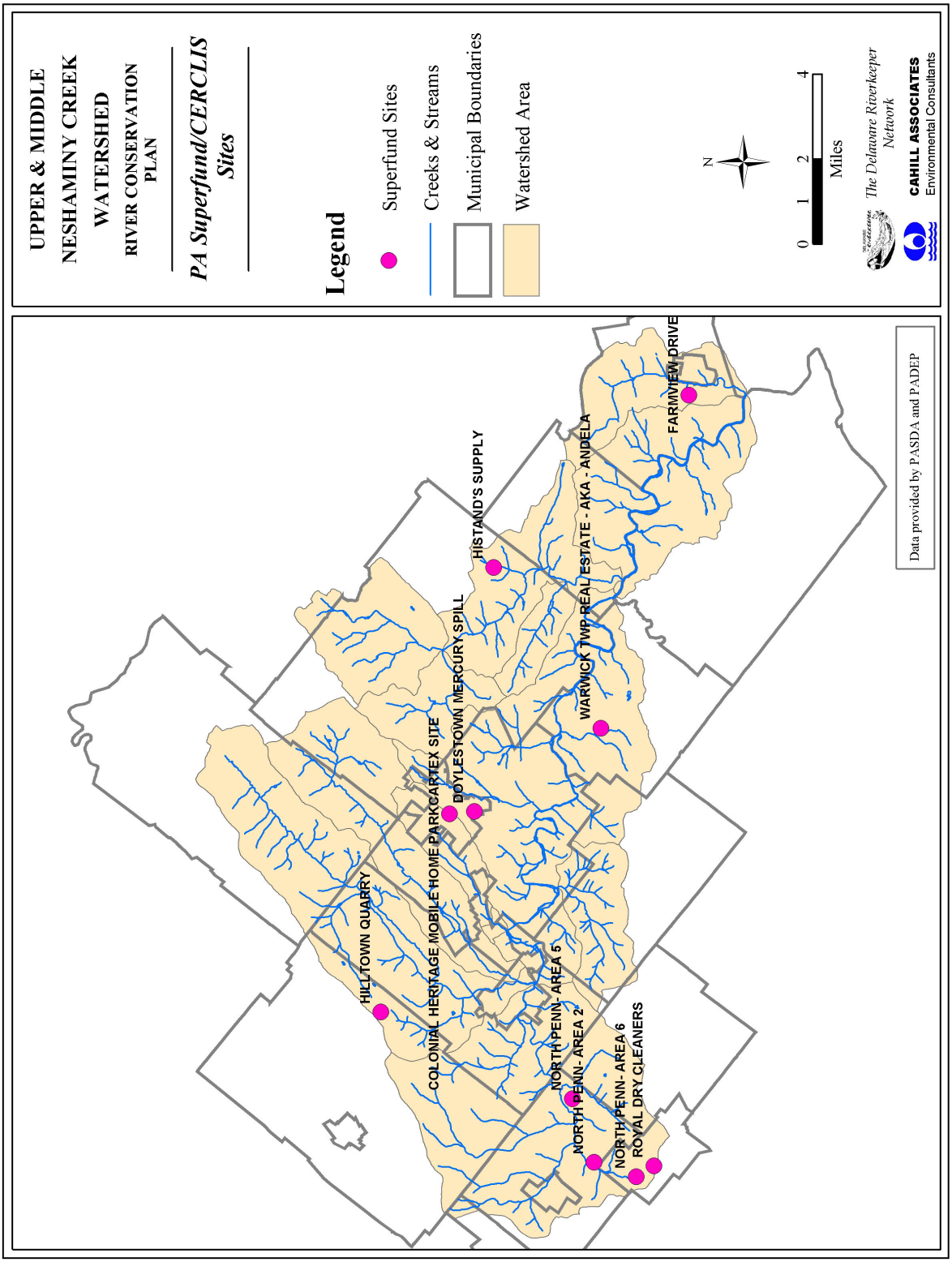


Figure 2-5. Superfund/CERCLIS Sites in the Neshaminy Watershed

maintained by USEPA. This database, the Toxic Release Inventory (TRI), maintains information concerning waste management activities and the release of toxic chemicals by facilities that manufacture, process, or otherwise use them (Figure 2-6 and Table 2-13). Manufacturer facilities are required to report the locations and quantities of chemicals to both state and local governments. Seventeen TRI facilities are located in the Upper and Middle Neshaminy Creek Watershed and are well distributed throughout the study area (EPA, TRI Query Form, www.epa.gov/enviro/html/tris/tris_query.html).

Table 2-12. Superfund/CERCLIS Sites in the Neshaminy Watershed

EPA Site No.	Site Address	Site Name	Sub-basin
PA0000767046	Broad St. & Veterans Ln.	Cartex Site	Cooks Run
PA0001897255	Route 202 West	Colonial Heritage Mobile Home Park	Cooks Run
PA0000585901	960 Creek Rd.	Warwick Twp Real Estate/Andela	Neshaminy Creek
PASFN0305511	400 S. Main St.	Doylestown Mercury Spill	Neshaminy Creek
PA0001483304	2033 Farmview Dr.	Farmview Drive	Newtown Creek
PAD980538847	Hilltown Pk.	Hilltown Quarry	North Branch Neshaminy Creek
PAD069027027	3979 Smith Rd.	Histand's Supply	Mill Creek (North)
PAD987279817	Main St.	Royal Dry Cleaners	West Branch Neshaminy Creek
PAD980926976	W. 3rd St.	North Penn Area 6	West Branch Neshaminy Creek
PAD980692693	Maple Dr.	North Penn Area 5	West Branch Neshaminy Creek
PAD002342475	1 Spring Ave.	North Penn Area 2	West Branch Neshaminy Creek

Table 2-13. TRI Sites in the Neshaminy Watershed

Facility ID	Facility Name	City	Sub-basin
PAD147325146	Triboro Electric Corp.	Doylestown	Cooks Run
PAD002371987	Penn Eng. & Mfg. Corp.	Danboro	North Branch Neshaminy Creek
PAD987359478	Aquarium Pharmaceuticals	Chalfont	North Branch Neshaminy Creek
PAD000437558	Penn Color Inc.	Doylestown	Pine Run
PA0000898957	Penn Color Inc.	Hatfield	West Branch Neshaminy Creek
PAD002277978	Crystal Inc.	Lansdale	West Branch Neshaminy Creek
PAD002265593	Paramount Packaging Corp.	Chalfont	West Branch Neshaminy Creek
PAD002341113	Rex Heat Treat of PA Inc.	Lansdale	West Branch Neshaminy Creek
PAD002348381	Gasboy Intl. Inc.	Lansdale	West Branch Neshaminy Creek
PAD009224981	American Electronic	Lansdale	West Branch Neshaminy Creek
PAD054718937	ARTCO Corp.	Hatfield	West Branch Neshaminy Creek
PAD049623937	American Electronic Lab. Inc.	Montgomeryville	West Branch Neshaminy Creek
PAD981039118	Webcraft Mail Sys. Inc.	Chalfont	West Branch Neshaminy Creek
PAD980692933	John Evans' Sons Inc.	Lansdale	West Branch Neshaminy Creek
PAD987325594	Fendt Finding Co. Inc.	Hatfield	West Branch Neshaminy Creek
PAD002347003	Daltile Corp.	Lansdale	West Branch Neshaminy Creek
PAD987359569	IPC Pyro-Tech Ind. Inc.	Hatfield	West Branch Neshaminy Creek

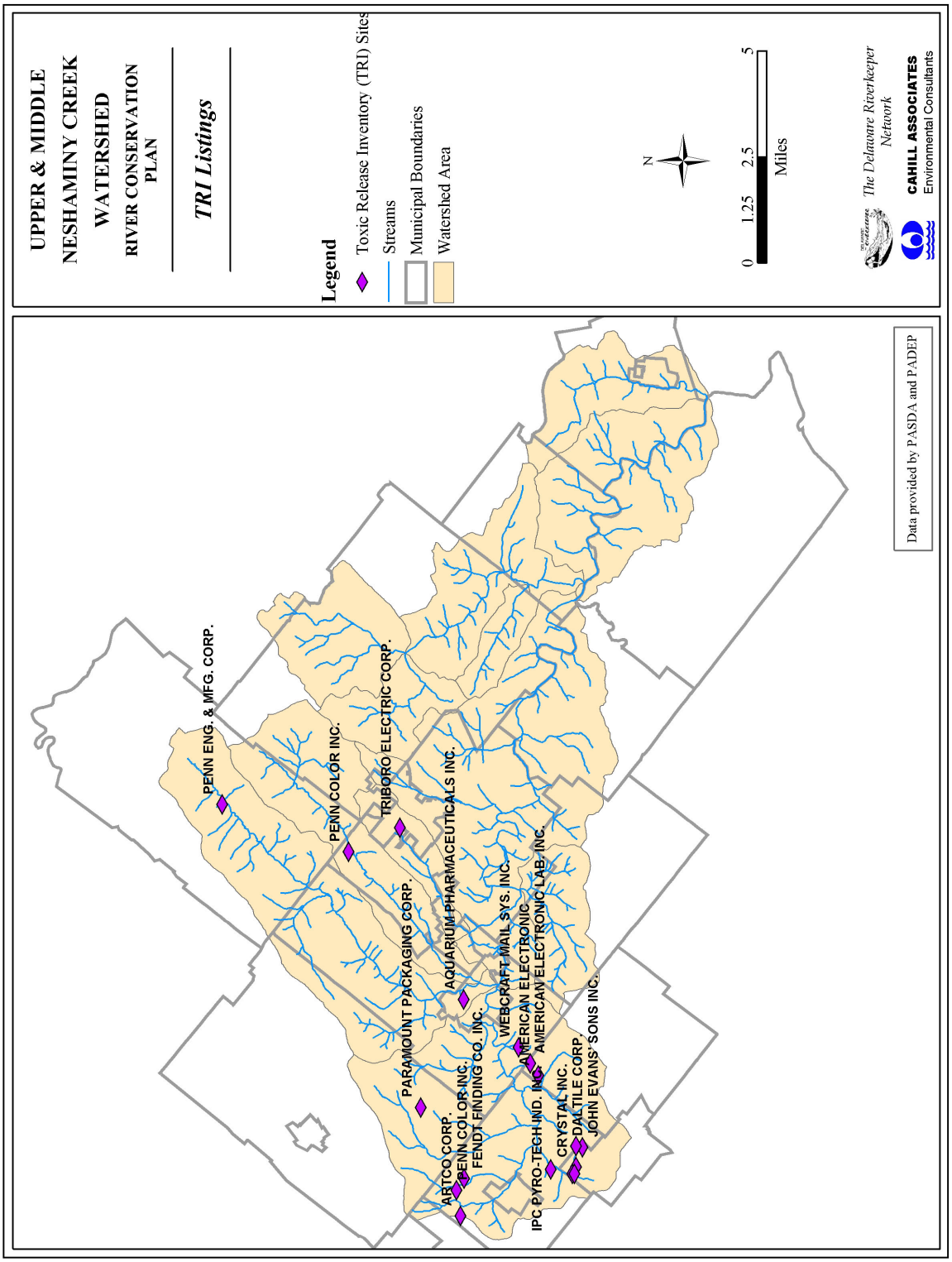


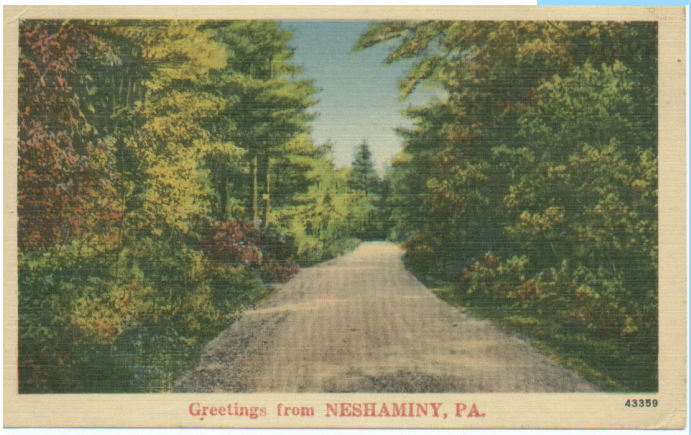
Figure 2-6. TRI Sites in the Neshaminy Watershed

Quarries, Abandoned Mines, and Landfills

PADEP has developed a comprehensive environmental compliance online information reporting system to provide public access to facility information (http://www.dep.state.pa.us/efacts/). For those interested in documenting all PADEP permitted activities and compliance information for facilities in their neighborhood, the PADEP **eFACTS** system is a user-friendly source of public information, searchable by geographic location. Both eFACTS and DEP officials were consulted in order to inventory the quarry, mining, and landfill resources of the watershed.

There are various locations of active quarries and mining operations in the watershed. According to DVRPC land use files, there are 627 acres of quarries and mines in the study area. There are also some quarry/mining sites that are no longer in operation. An economically beneficial alternative for a closed quarry is conversion to a "reclamation" site whereby certain nontoxic substances are buried in the available quarry excavation. This activity – if unregulated – can obviously lead to dangerous and harmful effects on groundwater if the quarry intersects or is close to the water table. PADEP Bureau of Waste Management permits and inspects only those "cleanfills" that are potential threats to water resources.

It is important to downstream residents and the entire watershed community that permitted waste management activities are regularly inspected. According to the PA DEP there are no landfills in the Upper and Middle Neshaminy, although two landfills do exist in the Lower Neshaminy, both in Falls Township. Unfortunately, it is not uncommon for illegal dumping to occur. Illegal dumpers, both small and large from the dumper of crankcase oil to the larger dumper of commercial and industrial wastes, must be prosecuted and held accountable for any degradation caused to the watershed environmental systems. Unfortunately, many dumpers are successful in their illegal activities because the designated inspectors are overworked and uninformed or unaware of the reality of the situation. Some illegal dumping activities continue to occur throughout the watershed, often in the floodplain. Groups such as watershed organizations, should consider playing an expanded role of "watchdog" whereby citizen complaints are filtered through a special "Dumping Task Force" group which takes action and lodges the complaint, both locally with the municipality and with PADEP, and then follows up with compliance oversight. A combination of improved regulatory enforcement and increased community awareness will be the most influential method to combat dumpers in the Neshaminy Creek Watershed. DRN maintains a HOTLINE (1-800-8-DELAWARE) that can be called to reports threats to the health of local streams.



3. EARTH RESOURCES

When sky so bright above thee
Is held in thy embrace,
We see thy pictured soul
Reflected in thy face.
The margin of thy waters,
Fair banks and flower and tree,
Tell too their little story,
O, dear Neshaminy!

Verse Three from *Neshaminy*
by M.R.K. Darlington (1896)

Postcard provided by Richard Albert, DRN

3. EARTH RESOURCES

A. Geology

Geologic Overview: Age and History

Generally, the Upper and Middle Neshaminy Creek Watershed are situated on rock that dates from the Mesozoic era. The Mesozoic era is divided into three periods: the Triassic (245-208 Million Years Ago), the Jurassic (208-146 mya), and the Cretaceous (146-65 mya). Specifically, the Neshaminy Creek Watershed is situated in an area of rock dating from the Jurassic and Triassic periods, though a small portion of the watershed sits within ancient rock dating from the Cambrian period (500-570 mya) of the (Figure 3-1).

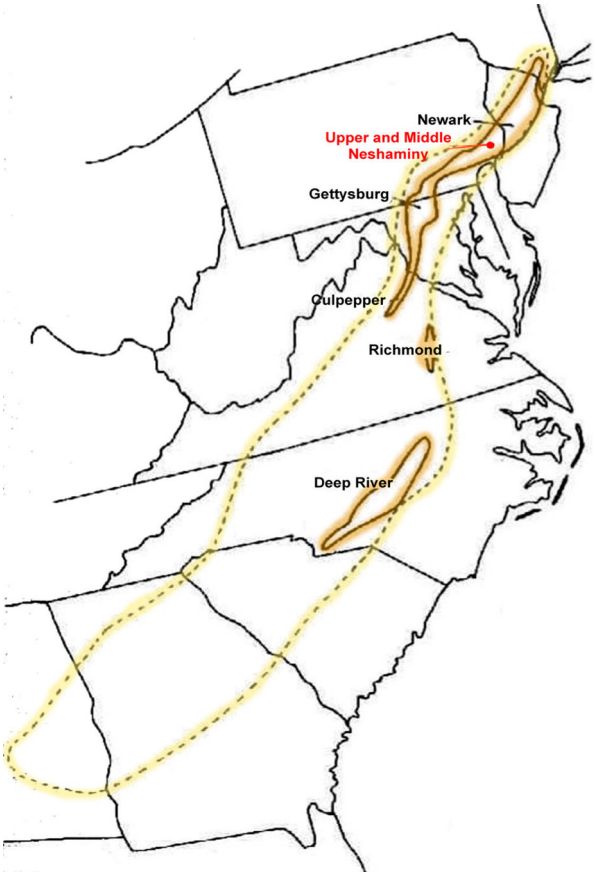


Figure 3-2. Triassic Basins in Eastern America

Plate tectonic movements during the Earth's early history forced land masses together multiple times. One of the most significant of these "collisions" occurred 300 million years ago as the eastern margin of North America collided with South America and Africa. The impact lifted the land and produced the *Appalachia* mountain range with elevations well over 15,000 feet, rivaling today's Alps and Himalayan ranges. Pangaea, the supercontinent created from the impact, subsequently began to break up and rift during the Triassic period to create the modern day Atlantic Ocean.

Remnants of the historical rifting activity occur in areas where younger rock was downfaulted into the older rock, creating Triassic Basins (Figure 3-2). Triassic basins are modern day remnants of a geologic transition period. Through the millions of years of intense geologic activity, the Appalachian range underwent vigorous erosion by wind and water, as well as cycles of uplifting and rifting, which created the present geology and landform within the Neshaminy Creek Watershed region.

To put this historic activity into watershed perspective, the Neshaminy basin is the eroded remnant of what once was a massive mountain range. Watershed residents are currently residing on the weathered and eroded geologic material of the historic Appalachian mountain range. Weathering and erosion of these various rock types has produced the rolling topography of the Neshaminy Creek Watershed.

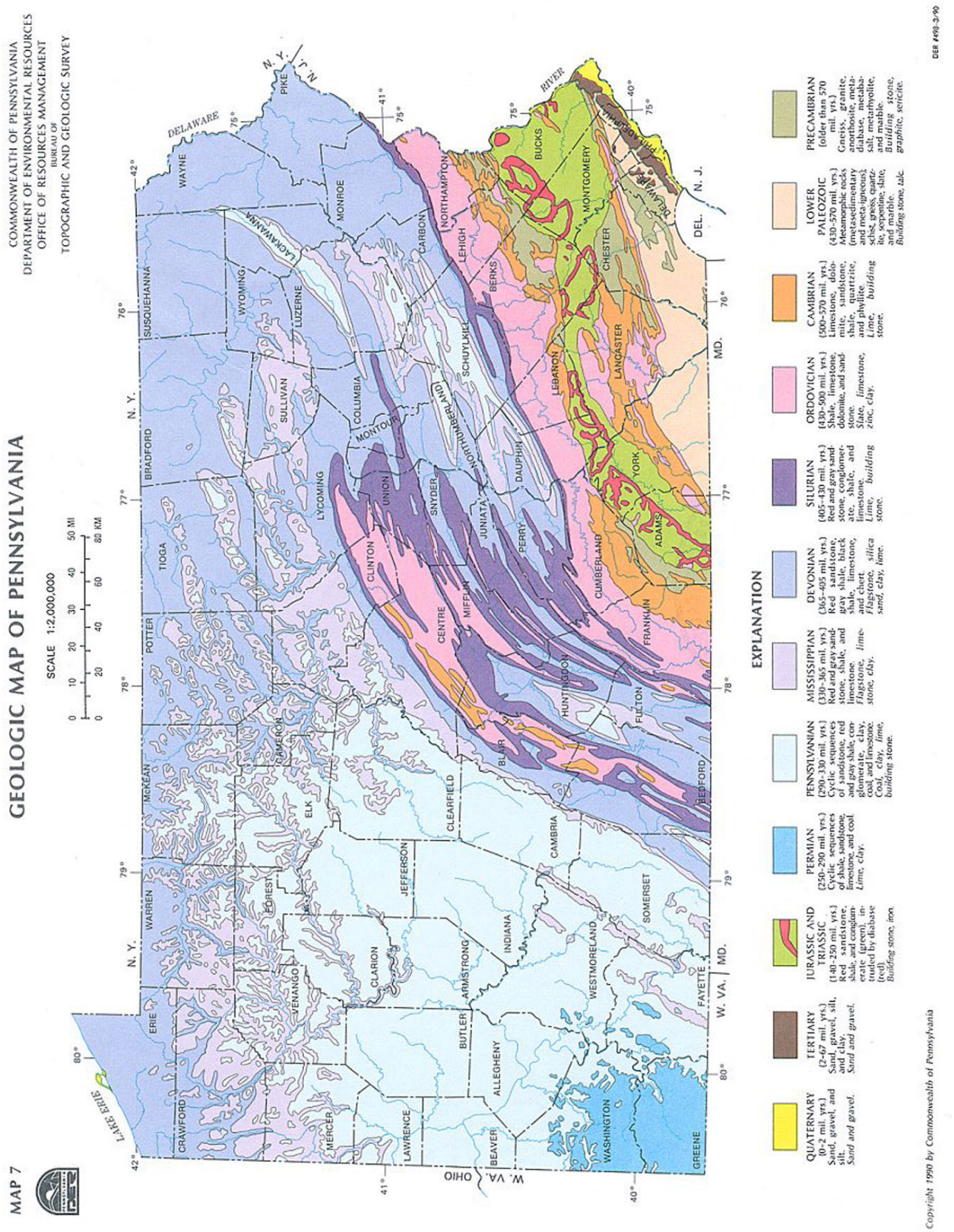


Figure 3-1. Geologic Formations of Pennsylvania

Geologic Formations
The Neshaminy Creek Watershed predominantly consists of Stockton (oldest), Lockatong, and Brunswick (youngest) geologic Formations. These formations are sedimentary rocks from the Triassic periods, as identified on the watershed geologic map (Figure 3-3). Sedimentary rocks are comprised of sands and mud washed down from the highlands and deposited in the alluvial environment.

Physiography
The Upper and Middle Neshaminy Creek Watershed lie within the Piedmont Uplands Physiographic Province (Figure 3-4) in both Bucks and Montgomery Counties. A physiographic province is the expression of bedrock at the surface of the land. The Piedmont, meaning "foot of the mountains," is a region of gently rolling hills, fertile valleys, and well-drained soils. Weathering and erosion over the years have produced the rolling topography, often more deeply cut by streams with deeply incised stream valleys traversing the landscape. All the land in the Piedmont has undergone similar geological processes in the past which have produced a characteristic topography. The Piedmont Uplands is characterized by generally very old and hard upland rocks, resulting from the erosion of the Appalachian Mountains.

Physiography is represented through manipulation of digital elevation models (DEM) using a GIS. The DEM is transformed into a "hillshade" image in order to show the change in elevations at the land surface. Overlay the existing stream network (Figure 3-5) on to the hillshade and we can see the connection between historic geologic activity and the existing land surface.

Topography and Land Form
The tectonic forces of the earth's shifting crustal plates, combined with hundreds of millions of years of erosion by wind and water, shaped the topography of the Neshaminy Creek Watershed. Present day topography is based on the physiographic region in which the watershed lies, as discussed above. In the rolling hills of the Piedmont Plain of the Neshaminy Creek Watershed, elevations generally range from 0 to 971 feet above sea level.

Although elevations are not great in the Piedmont, change in elevation, and therefore steeply sloped areas, can occur in the deeply incised stream valleys which have been cut over the years. The geological history and variability is often revealed in the attractive, even dramatic rock outcroppings which are exposed in the Neshaminy Creek's stream valleys.

B. Soil Characteristics

Major Soil Series & Characteristics
The soils in the Neshaminy Creek Watershed (Figure 3-6) reflect the weathering process of the parent bedrock geology. In areas where we have concentrated our building and development, we see a predominance of Urban Land and Made Land soil categories. This soil classification is soil that has been altered from its native state and cleared for homes, farms, and businesses. In the Upper and Middle Neshaminy Creek Watershed, Urban/Made land accounts for 27 square miles of land, or 21% of the entire watershed (Figure 3-7 pie chart).

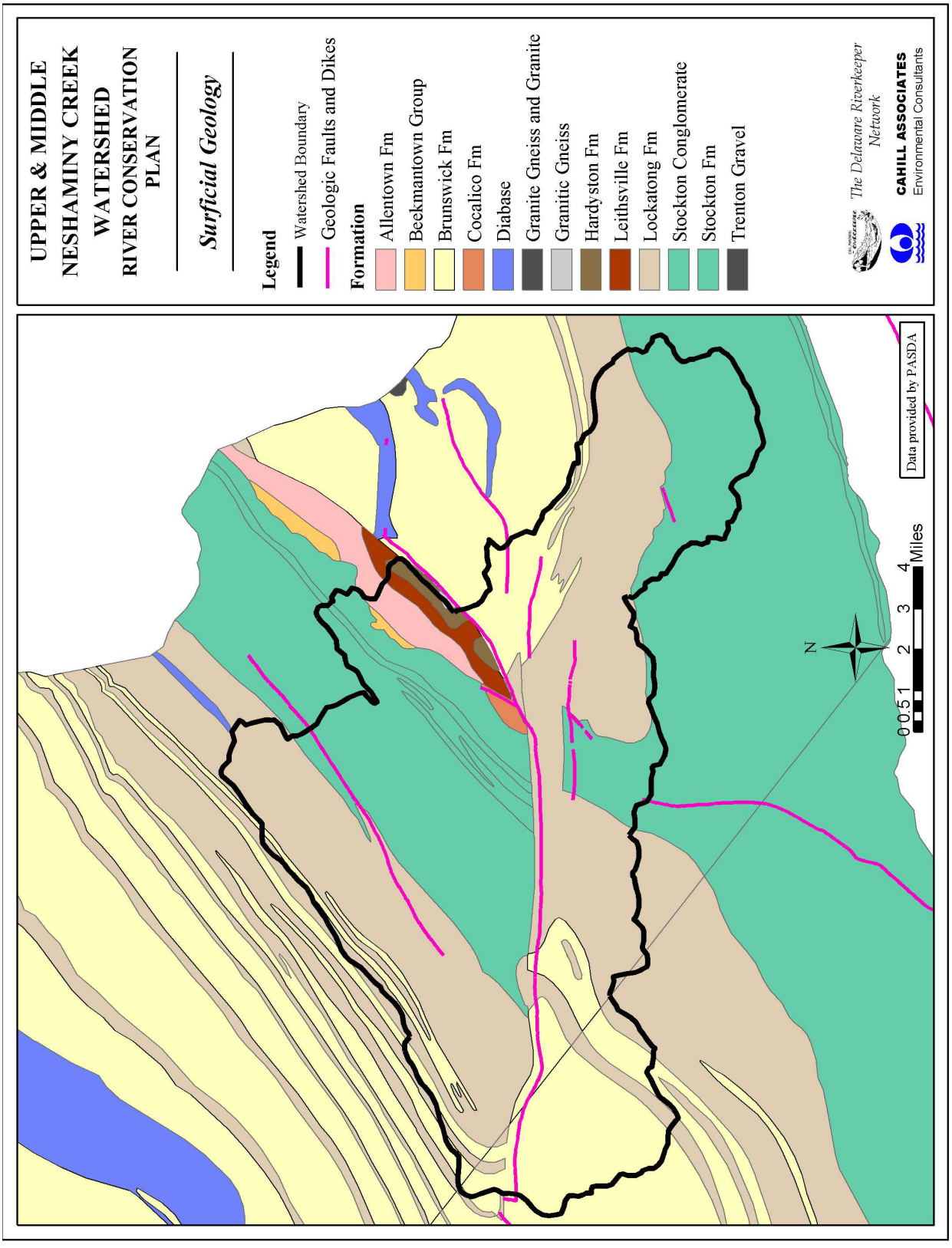


Figure 3-3. Surficial Geology of the Neshaminy Creek Watershed

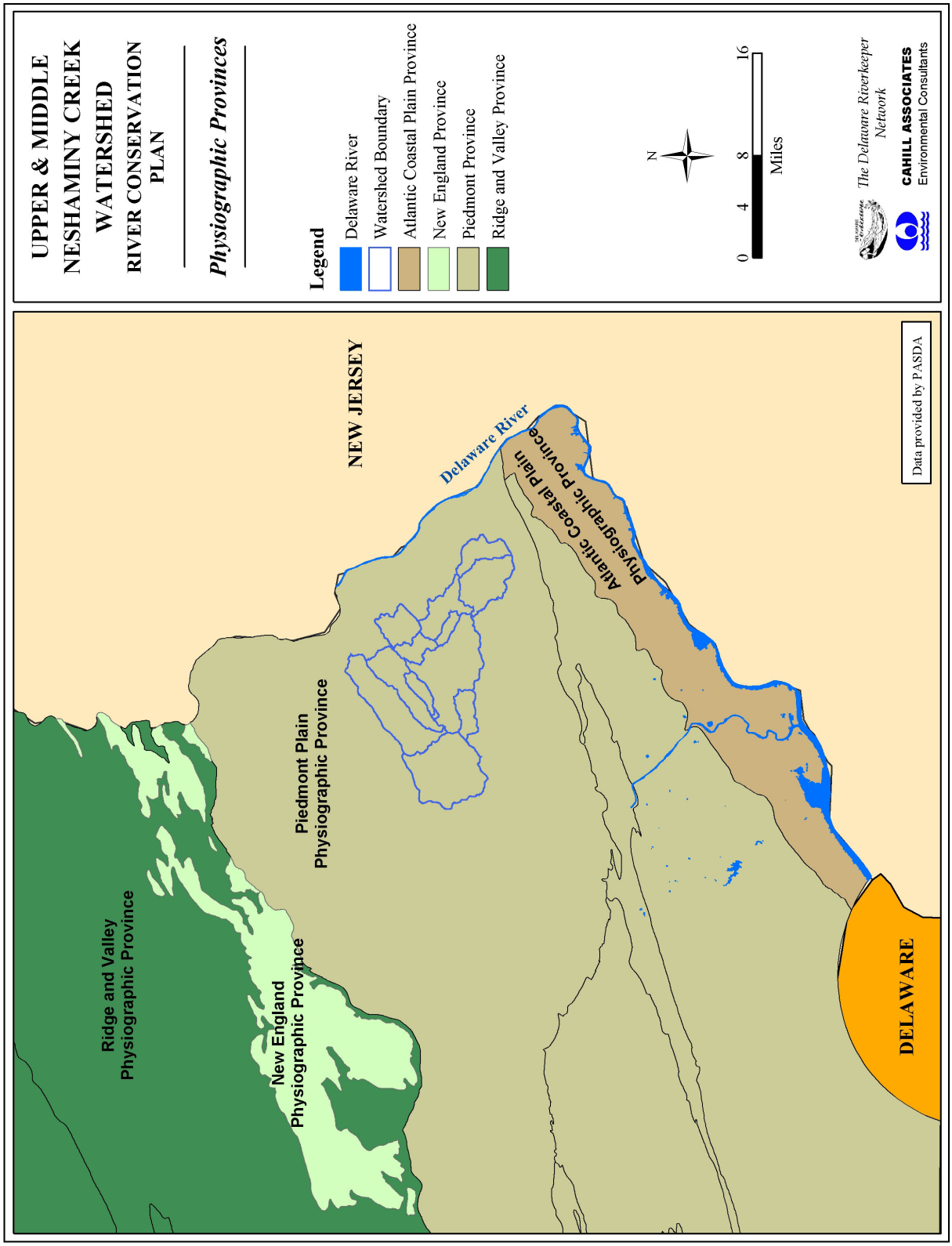


Figure 3-4. Physiography of the Upper and Middle Neshaminy Creek Watershed

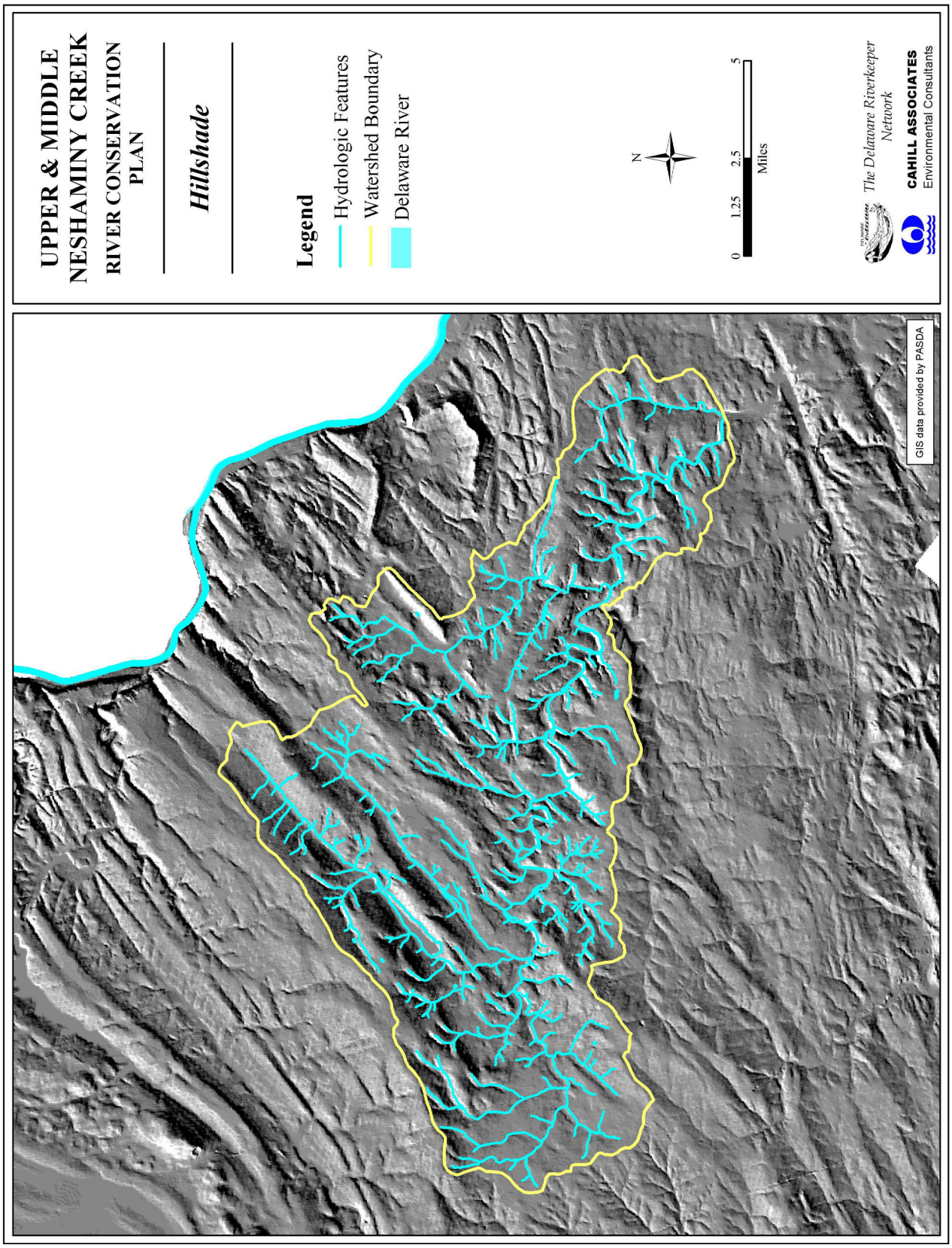


Figure 3-5. Hillshade Image with Existing Stream Network in the Watershed

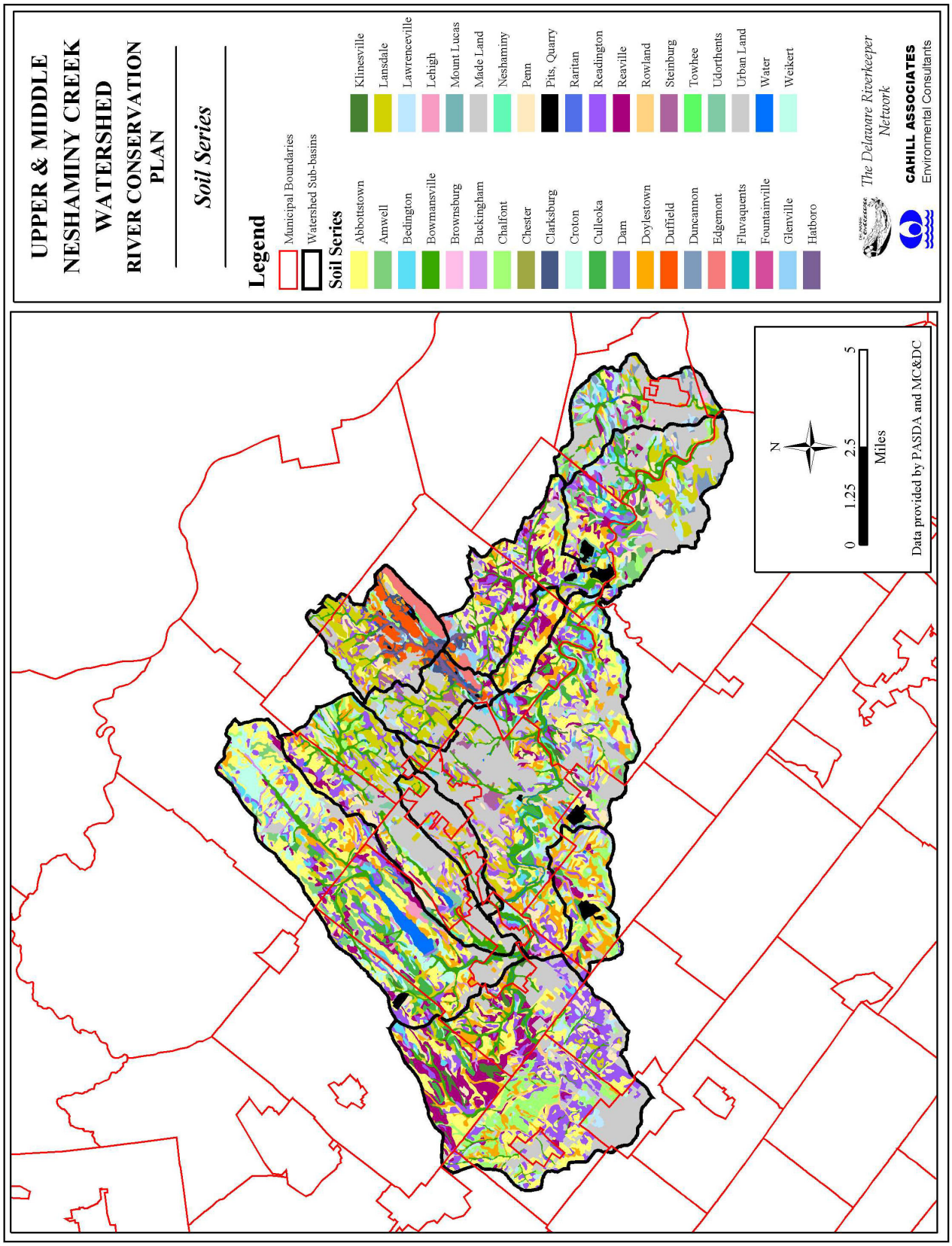


Figure 3-6. Soil Series in the Watershed (MC&DC, 2001)

Table 3-1 lists the soil types by percentage of composition in watershed. Abbottstown makes up the largest portion of total watershed soils, accounting for almost 19 square miles (14%). Abbottstown series are typically associated with Doylestown (6% of watershed), Readington (10%) and Reaville (5%) soils, all of which formed in loamy and silty material that weathered from shale and sandstone. This association is deep and drainage conditions are dependant on seasonal water table (see Hydrologic Soil Group discussion, below) (USDA, 1975).

Floodplain and alluvial soils include Bowmansville, Rowland, Buckingham, and Lansdale, which together make up approximately 15% of the watershed soils. These soils, typically found stream-side, formed in loamy alluvium washed from upland soils. As Figure 3-6 shows, Buckingham soils are primarily found in the headwaters of the Neshaminy Creek tributaries (USDA, 1959).

Hydrologic Soil Groups

The relationship between water resources and land development impacts can be expressed by the Hydrologic Soil Group (HSG) classification of the soil series (Figure 3-8 and Table 3-1). HSG is given a rating, A through D. These HSG ratings describe the physical drainage properties of each soil series, including texture and permeability, as well as certain physiographic properties, such as depth to bedrock and water table. HSG Group A is well drained and highly permeable, in contrast to HSG Group D which is poorly drained and which produces much greater runoff. The HSG classification is of importance in determining the feasibility of using infiltration or recharge-oriented Best Management Practices (BMPs) for stormwater management, as well as for deter-

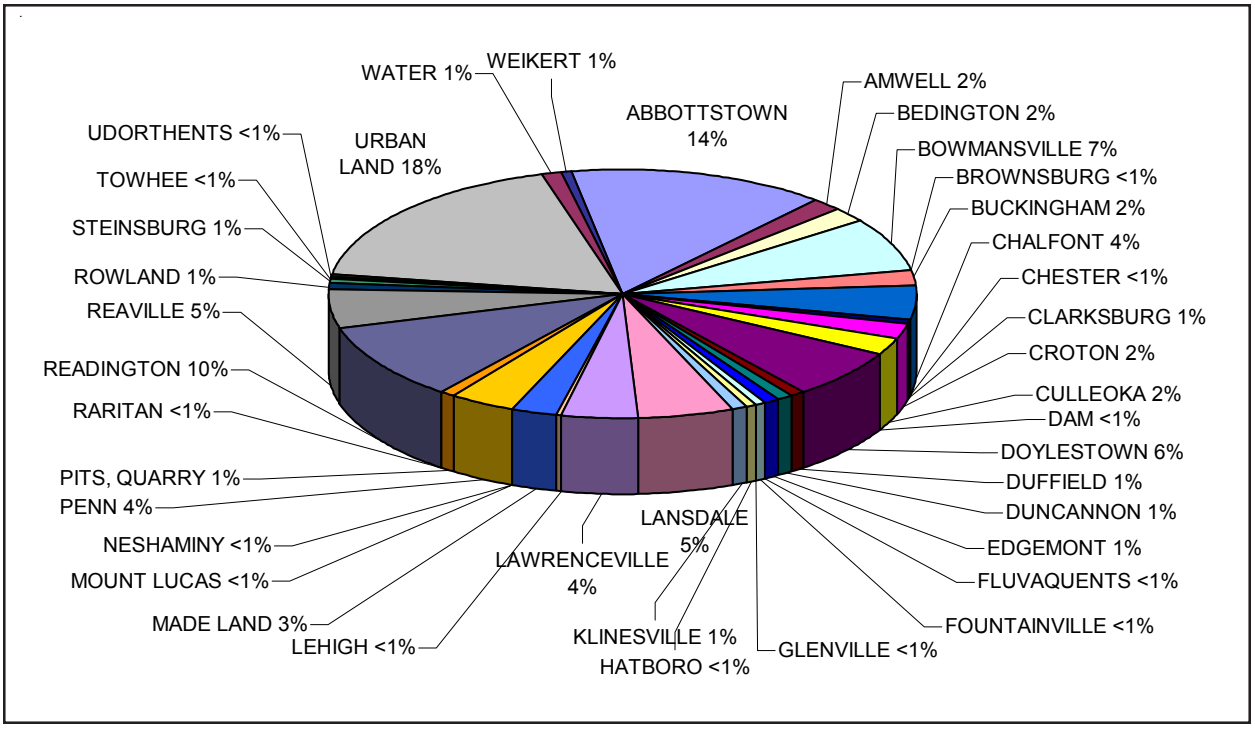


Figure 3-7. Soil Series in the Upper and Middle Neshaminy Creek Watershed

mining feasibility of land-based wastewater treatment technologies that recycle wastewater effluent (USDA, 1975).

There are no soils classified as Group A in this watershed. Approximately 20% of the watershed is classified as B, while almost half (48%) of the watershed contains soil classified as C. Watershed lowlands along stream valleys typically consist of HSG Groups D soils, reflecting an almost constant saturation/poor drainage condition. Soils classified as Group C or D requires detailed site investigation, including percolation tests, to determine whether infiltration BMPs will succeed.

Table 3-1. Soil Series in the Upper and Middle Neshaminy Creek Watershed

Soil Series	Area (sq mi)	Percentage of Watershed	Hydrologic Soil Group
ABBOTTSTOWN	18.75	14%	C
AMWELL	2.19	2%	C
BEDINGTON	2.36	2%	B
BOWMANSVILLE	9.22	7%	B/D
BROWNSBURG	0.18	<1%	B
BUCKINGHAM	2.42	2%	C
CHALFONT	5.66	4%	C
CHESTER	0.02	<1%	B
CLARKSBURG	0.71	1%	C
CROTON	2.77	2%	D
CULLEOKA	2.87	2%	B
DAM	0.04	<1%	NA
DOYLESTOWN	8.20	6%	D
DUFFIELD	1.24	1%	B
DUNCANNON	1.19	1%	B
EDGEMONT	1.03	1%	B
FLUVAQUENTS	0.14	<1%	C
FOUNTAINVILLE	0.44	<1%	C
GLENVILLE	0.29	<1%	C
HATBORO	0.52	<1%	D
KLINESVILLE	1.09	1%	C
LANSDALE	7.13	5%	B
LAWRENCEVILLE	5.32	4%	C
LEHIGH	0.26	<1%	C
Made Land	3.30	3%	NA
MOUNT LUCAS	0.11	<1%	C
NESHAMINY	0.08	<1%	B
PENN	4.87	4%	C
PITS, QUARRY	0.98	1%	D
RARITAN	0.05	<1%	C
READINGTON	13.04	10%	C
REAVILLE	6.73	5%	C
ROWLAND	0.88	1%	C
STEINSBURG	0.92	1%	B
TOWHEE	0.10	<1%	D
UDORTHENTS	0.41	<1%	B, B/D, A/D
URBAN LAND	23.82	18%	NA
WATER	1.49	1%	NA
WEIKERT	0.73	1%	B/D

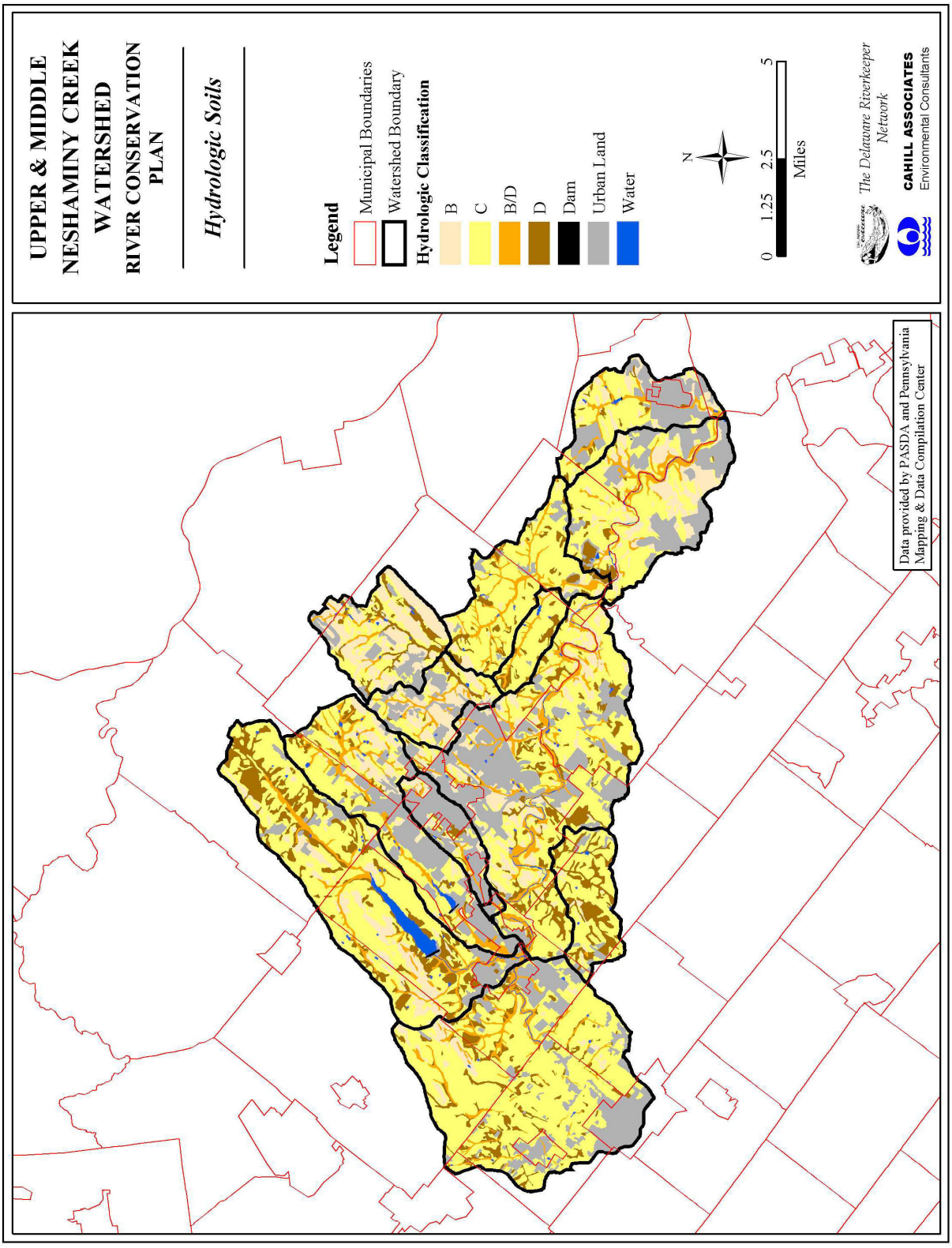


Figure 3-8. Hydrologic Soil Group Classification

Soils that have been altered or disrupted during construction and development tend to be limited in their drainage capabilities. These soils are classified as "Urban Land" or " Made Land" and also require site-specific investigations to determine suitability for recharge or infiltration BMPs, and therefore, have no HSG rating. Much of the land in the Upper and Middle Neshaminy Creek Watershed has been developed, redeveloped, or altered from its original state. According to GIS data provided by the Pennsylvania USDA – Natural Resources Conservation Service's Map Compilation & Digitizing Center (http://mcdc.cas.psu.edu/), 21% (27 square miles) of the Upper and Middle Neshaminy Creek Watershed is classified Urban or Made Land.

Sinkholes

Sinkholes are depressions in the land surface that occur as a natural process of erosion of limestone or carbonate formations by water. In pre-development times, sinkholes were usually triggered by heavy rains or a flood that made the soil "roof" so heavy that it eventually collapsed. Presently, droughts also lower the groundwater levels, which reduce the buoyant support of a cavity roof and cause a collapse. Once sinkholes form, they provide a direct flow channel to groundwater and can carry pollutants and thus affect groundwater quality. Sinkholes can be found in any area in which soils are formed in materials weathered from carbonate sedimentary rock.

Limestone rock, as evidenced by Allentown, Hardyston, and Leithsville geologic formations is present only in central Buckingham Township. According to the PADCNR Geologic Survey's Sinkhole Inventory (http://www2.dcnr.state.pa.us/sinkhole/), seven sinkholes exist in Buckingham Township. These sinkholes occur over the Allentown and Leithsville formations.

I've watched thee in the springtime
All laughing in the sun
As tho' with thy companionship
New life had just begun
I've sat beside thy waters
In summers glad and free
To watch thy changing beauties
O, dear Neshaminy!

Verse Four from *Neshaminy*
by M.R.K. Darlington (1896)

4. WATER RESOURCES

Photo Postcard provided by Richard Albert, DRN

4. WATER RESOURCES

A. Surface Waters: Streams and Major Tributaries

The Upper and Middle Neshaminy Creek Watershed drains an area of 131.5 square miles, with several major tributaries and numerous small streams, as illustrated in Figure 4-1. The major tributary sub-basin areas are listed by name in Table 4-1, and stream lengths are also shown. A total of 255 miles of perennial channels wind their way through the gently rolling landscape. The West Branch is the largest single tributary, and drains about 24.9 square miles, or 18.9 percent of the total study area watershed.

Table 4-1. Neshaminy Creek Watershed Sub-basins: Area and Stream Length

Neshaminy Watershed Sub-Basins	Area (sq. miles)	% of Total Watershed Area	Length (miles)	% of Total Watershed Length
Cook's Run	3.3	2.5%	5.0	1.9%
Lahaska Creek	7.0	5.3%	9.9	3.9%
Mill Creek (north)	8.4	6.4%	18.0	7.1%
Mill Creek (south)	4.9	3.7%	13.1	5.1%
Neshaminy Creek (direct-drainage)	38.6	29.4%	83.4	32.7%
North Branch Neshaminy Creek	20.0	15.2%	39.0	15.3%
West Branch Neshaminy Creek	24.9	19.0%	46.5	18.2%
Newtown Creek	6.3	4.8%	9.6	3.8%
Pine Run	11.6	8.9%	18.9	7.4%
Robin Run	2.3	1.7%	5.8	2.3%
Watson Creek	4.3	3.3%	6.1	2.4%
TOTALS	131.5	100.0%	255.2	100.0%

Source: (PASDA)

There are several man-made impoundments in the watershed (Figure 4-2), all of which have been created as a result of the Federally-sponsored PL-566 program during the late 1960's, an effort by the US Soil Conservation Service to address flooding problems on small rivers and streams. Many of the impoundments that were designed with a permanent pool for recreation and water supply purposes now suffer from water quality problems, caused by runoff from the surrounding watersheds. Lake Galena, the largest of the lakes, surrounded by Peace Valley Park on the North Branch, has been eutrophic from its earliest days, with severe algae blooms and anaerobic releases downstream of the dam. The critical pollutant in all of these enriched lacustrine systems is Phosphorus, transported into the lake with sediments from the surrounding farm fields. As the various watersheds have become urbanized, the farm field pollution load has been replaced with runoff from the "lawnscapes" of suburbia, with the same net effect on the lakes. In addition, fecal coliform concentrations have exceeded PA water quality standards at Lake Galena due to both human and animal wastes, preventing any use for contact recreation, and rendering useless the bathing beaches designed for the original lake. Lake Galena is currently listed on the 303d list as impaired due to three conditions; excessive nutrient loading; suspended solids from agriculture and urban runoff; and on-site wastewater. The end result is a polluted body of water. Similar conditions have been found in Lake Luxembourg at Core Creek Park in the Lower Neshaminy Watershed, and are indicative of the overall water quality problems in this watershed.

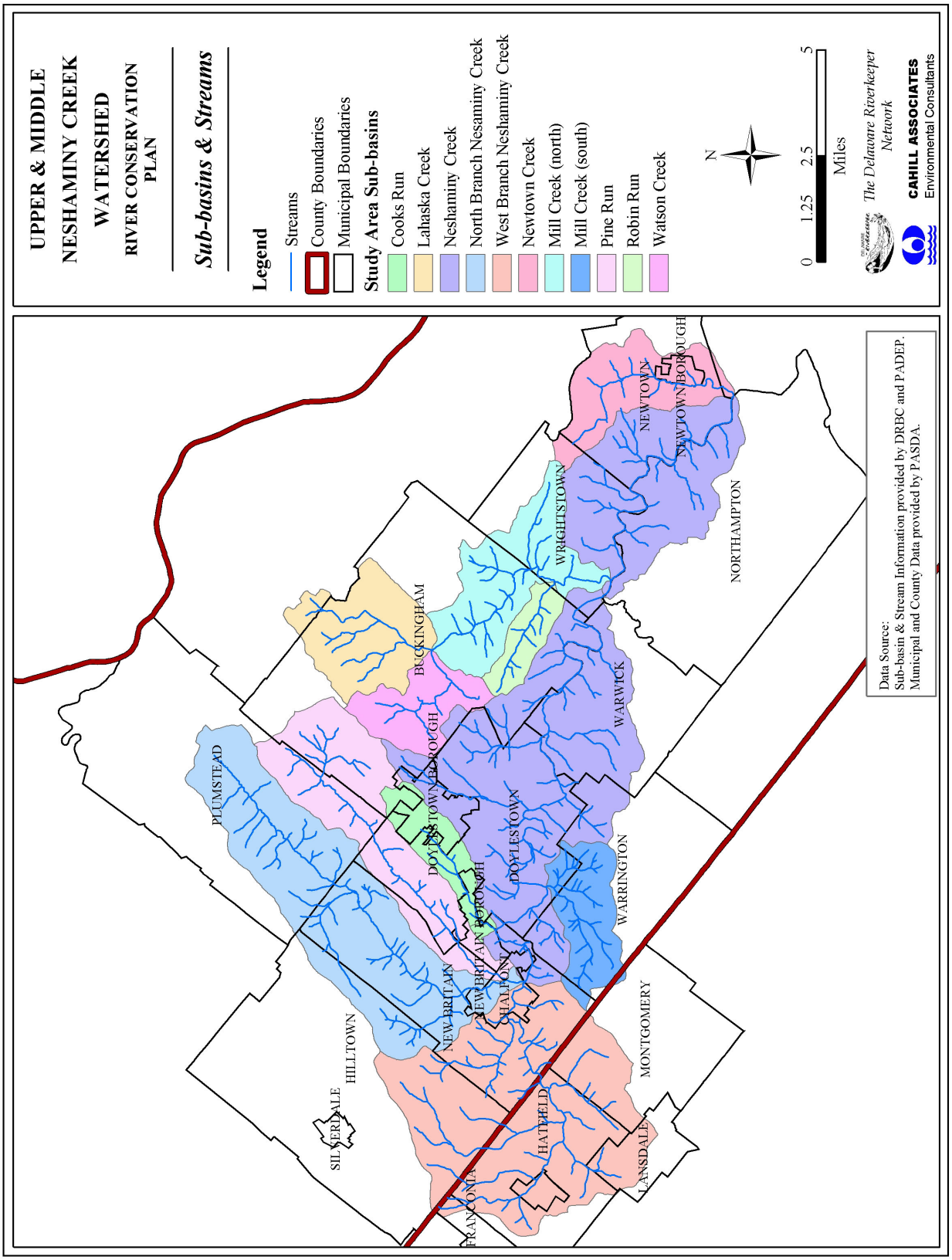


Figure 4-1. Upper and Middle Neshaminy Creek Watershed Sub-basins and Streams

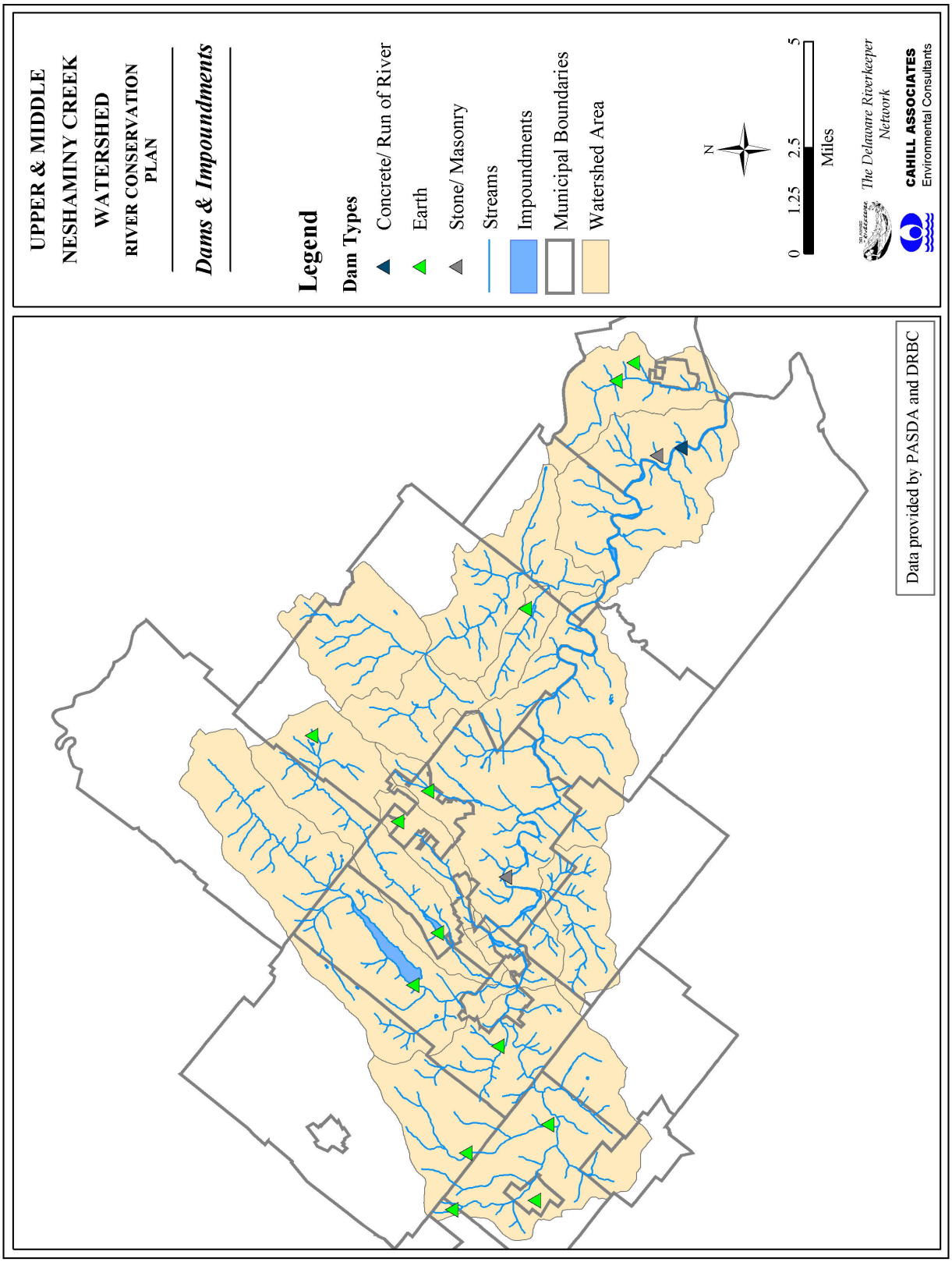


Figure 4-2. Dams and Impoundments in the Upper and Middle Neshaminy Watershed

In the urbanized portions of the watershed, the increases in land development have led some communities to fill in small stream channels and convey the original stream in a pipe through the developed area. While not as widespread a practice in this basin as in several of the neighboring watersheds, the common practice of "buried" streams (Figure 4-3) has major impacts on water quality, and is now recognized as environmentally destructive. The placement of a natural stream in an underground pipe deprives the stream of essential sunlight and oxygen from the atmosphere, and the filling of the riparian section destroys vegetation that plays a critical role in the transformation and removal of pollutants. The aquatic habitat in the stream itself is virtually eliminated, and with it the feeding and spawning areas of finfish and the complex community of micro- and macro-organisms that support the system. As the drainage area becomes more developed and impervious, the increased runoff velocities and quantities overtax "buried" streams, and require the installation of ever-larger conveyance pipes contributing to downstream flooding. At the same time, the groundwater discharge into the natural channel is greatly inhibited, thus reducing base flow.

We should note here that Richard Pinkham's *Daylighting: New Life for Buried Streams* (Rocky Mountain Institute, 2000) provides a useful discussion of the problems relating to burial and channelizing of streams, and the benefits resulting from their "liberation" through various daylighting techniques. Where feasible, daylighting strategies should be explored in all those areas in the watershed where streams have been buried.

Figure 4-3. Tributary to the West Branch Neshaminy Creek in a residential neighborhood.

Special Protection Watersheds and Chapter 93 Designations (Existing Uses)

Pennsylvania has implemented a program to protect high quality waters since 1968. This program consists of three tiers of protection: Existing Uses, such as warm or cold water fisheries and potable water supply; High Quality Waters, those that have been found to have water quality better than that necessary to protect existing uses; and Exceptional Value Waters, waters having the best or unique water quality as compared to other streams in Pennsylvania. There are no sub-basins in the Upper and Middle Neshaminy that have been designated as High Quality or Exception Value. However, every sub-basin in the watershed has an Existing Use Designation and they are listed in Table 4-2. The Water Use Designations for the Upper and Middle Neshaminy are protected as stated in Chapter 93 of the Pennsylvania Code; surface water quality must be preserved such that the streams maintain their designated use.

Table 4-2. PA Chapter 93 Designated Uses in the Upper and Middle Neshaminy Watershed (Pennsylvania Code, Ch. 93. Water Quality Standards)

Stream	Zone	Water Uses
West Branch Neshaminy Creek	Basin, Source to Confluence with North Branch	WWF, MF
North Branch Neshaminy Creek	Basin, Source to Tailwaters of Lake Galena	WWF
North Branch Neshaminy Creek	Basin, Lake Galena	WWF
North Branch Neshaminy Creek	Basin, Lake Galena Dam to Confluence with West Banch	TSF, MF
Neshaminy Creek (Main Stem)	Main Stem, Confluence of West and North Branches to PA 614 Dam	TSF, MF
Unnamed Tributaries to Neshaminy Creek	Basins, Confluence of West and North Branches of PA 614 Dam	TSF, MF
Cooks Run	Basin	WWF, MF
Mill Creek	Basin	TSF, MF
Neshaminy Creek *	Non-Tidal portions of Main Stem, PA 614 to Mouth	WWF, MF
Unnamed Tributaries to Neshaminy Creek *	Non-Tidal portions of Basins, PA 614 to Mouth	WWF, MF
Mill Creek	Basin, Source to Watson Creek	CWF, MF
Watson Creek	Basin	CWF, MF
Mill Creek	Basin, Watson to Mouth	WWF, MF

* Include some stream segments outside of study area
CWF - Cold Water Fish
WWF - Warm Water Fish
MF - Migratory Fish
TSF - Trout Stocking

Stream Order

Another important aspect of the stream system is the concept of stream order, where each stream segment is classified by where it fits in the network. The small individual streams that form from springs and seeps in the small valleys are first order, or single flows also known as headwaters. When two first order streams combine, they form a second order, and so forth down the river. First order streams are the lifeblood of any river, especially important to watershed life because they comprise the largest percentage of the total stream system on a lineal percentage basis. These headwaters are the locations of critical ecological functions, where the exchange of energy from land to water occurs most directly and is vital. Because flows in these small headwaters are especially small, these first order streams are extremely sensitive and are the first streams to dry up when groundwater levels decline. Figure 4-4 is a map of first order streams in the Upper and Middle Neshaminy Creek Watershed. One can imagine that a mapping of historical first order streams would show considerably more channels. This condition is true for many watersheds in the region because small headwater streams are often impacted by development, through burial or diversion. In some parts of the watershed, such as the more rural areas where large parcels of land are held by single landowners and suburban development has not occurred, the majority of first order streams are likely intact. Typically, as an area becomes more urbanized or suburbanized the impact to first order headwater streams is exacerbated.

B. Floodplains and Riparian Buffers

Floodplains and the riparian areas buffering streams, rivers, lakes, and other water bodies are especially sensitive watershed zones. In their naturally vegetated and undisturbed state, floodplains and riparian areas buffer or protect the stream and provide critical stormwater management and flood control functions, both in terms of water quantity and water quality. For example, floodplains intercept and reduce unmanaged sheet flow runoff from uplands and temporarily store out-of-bank flows as storms increase in runoff volume. Flood flows are slowed and the sediment pollutant load settles out on the floodplain, producing fertile soils in larger river systems. Substantial physical filtering of nonpoint pollutants, especially particulates, occurs as stormwater and flood flows move across and through the vegetated floodplain, and a host of chemical and biological actions subsequently takes place on the surface and in the sub-surface to reduce and convert nonpoint source pollutant loadings, especially nutrients, into biomass.

Aquatic species are often sensitive to water temperature, and the naturally vegetated floodplain and riparian zone typically provides substantial stream shading through the tree and shrub canopy, which reduces overheating of waters in the summer. The vegetation also provides a balanced level of detritus, or dead organic matter, such as leaves and twigs, which serves as an important food source for aquatic biota. Floodplain vegetation anchors the stream bank and prevents scouring, undercutting, and overall erosion, which in turn helps to maintain the stream's morphology, with its system of pools and riffles that provide aquatic habitat. When floodplains are conserved as a watershed is developed, they provide a system of greenways linking larger open space areas and migration pathways for wildlife. In short, undisturbed floodplains and riparian areas are essential natural watershed elements.

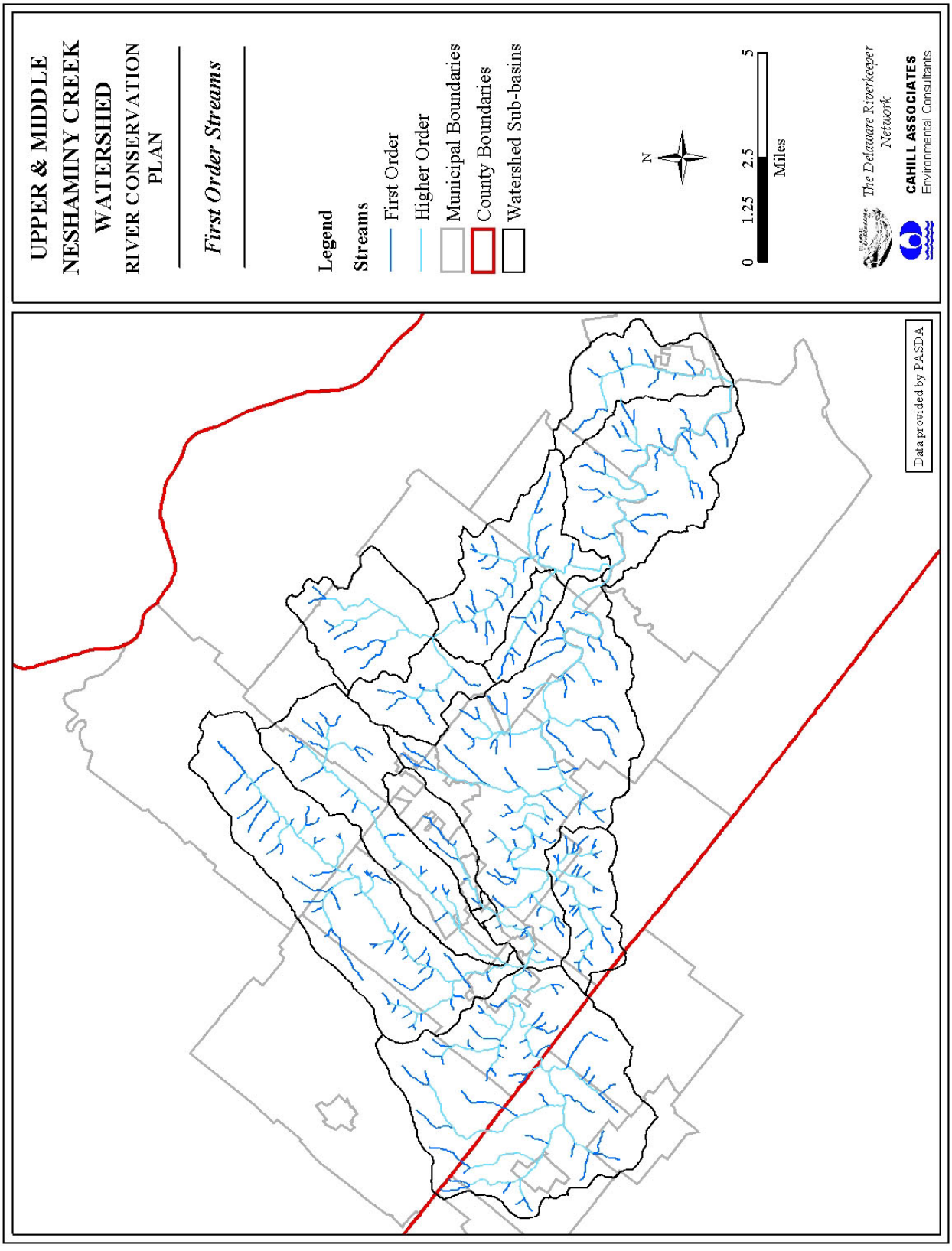


Figure 4-4. First Order Streams in the Upper and Middle Neshaminy.

These positive floodplain functions are closely interrelated to the dimensions, or width, of the riparian buffer. Assuming a riparian buffer width of 20 to 200 feet in urbanized areas (measured from the top of the stream bank), the floodplain and desired riparian buffer may be virtually one and the same, although they are not identical (DVRPC, 1998). The above buffer width is a recommendation, but buffer width should be based on need. For example, a highly urbanized area may require a wider buffer, while a buffer surrounded by low-intensity development may not (May and Horner, 2000). In this discussion, floodplain and riparian buffer functions and benefits are treated as one. Floodplains are shown in Figure 4-5.

Over the years, development has encroached substantially into floodplains of the watershed. In many places, this development has resulted in total stream enclosure or channel burial in pipes for substantial segments, with elimination of any semblance of the floodplain. Elsewhere, streams have been substantially altered or "channelized", with concrete or stone structures shaping a stream section that is built into and on the floodplain. As the demand for more buildable land has increased, fill has been placed within floodplain areas to accommodate parking, roads, and other development elements. Even the relatively inoffensive clearing of floodplain areas to serve as lawn and other landscaped areas takes its toll on the water quality and quantity functions of the natural floodplain.

The encroachment of floodplains is usually synonymous with the loss of riparian buffers. In addition to urbanization, encroachment often occurs during development for agricultural purposes, as the natural vegetation is converted to cultivated land. During 2001, the Heritage Conservancy of Doylestown released a study that assessed the riparian buffer loss in the Neshaminy Creek Watershed. The information was gathered using digital aerial photography and helicopter flyovers to compile and map a GIS file that showed the extent of missing buffers in the watershed. The study covered the main stem Neshaminy, as well as small tributaries and headwater streams.

Four riparian buffer classifications were identified and categorized as follows:

1. Good buffer, defined as a band of forest extending 50 feet from the top of the bank with 50% canopy closure
2. Thin buffer, defined as a band of forest extending 50 feet from the top of the bank, but with less than 50% canopy closure
3. Scrubby buffer, defined as a vegetative buffer consisting of shrubs and tree seedlings extending 50 feet from the top of the bank.
4. Bad buffer, defined as lacking 50 foot width OR lacking 50% canopy closure.

The results of the assessment for the watershed are shown in Figure 4-6. Many sections of headwater streams, as well as the main stem of the Neshaminy, were completely devoid of any riparian vegetation. Other reaches had buffer loss on only one side of the stream or had only a partial riparian buffer along the stream channel. Table 4-3 shows the total stream miles and the length of stream miles with riparian buffer loss within the RCP study area. The North Branch had the greatest riparian buffer loss with a total of 12.4 stream miles or 31% of the total stream miles impacted by buffer loss.

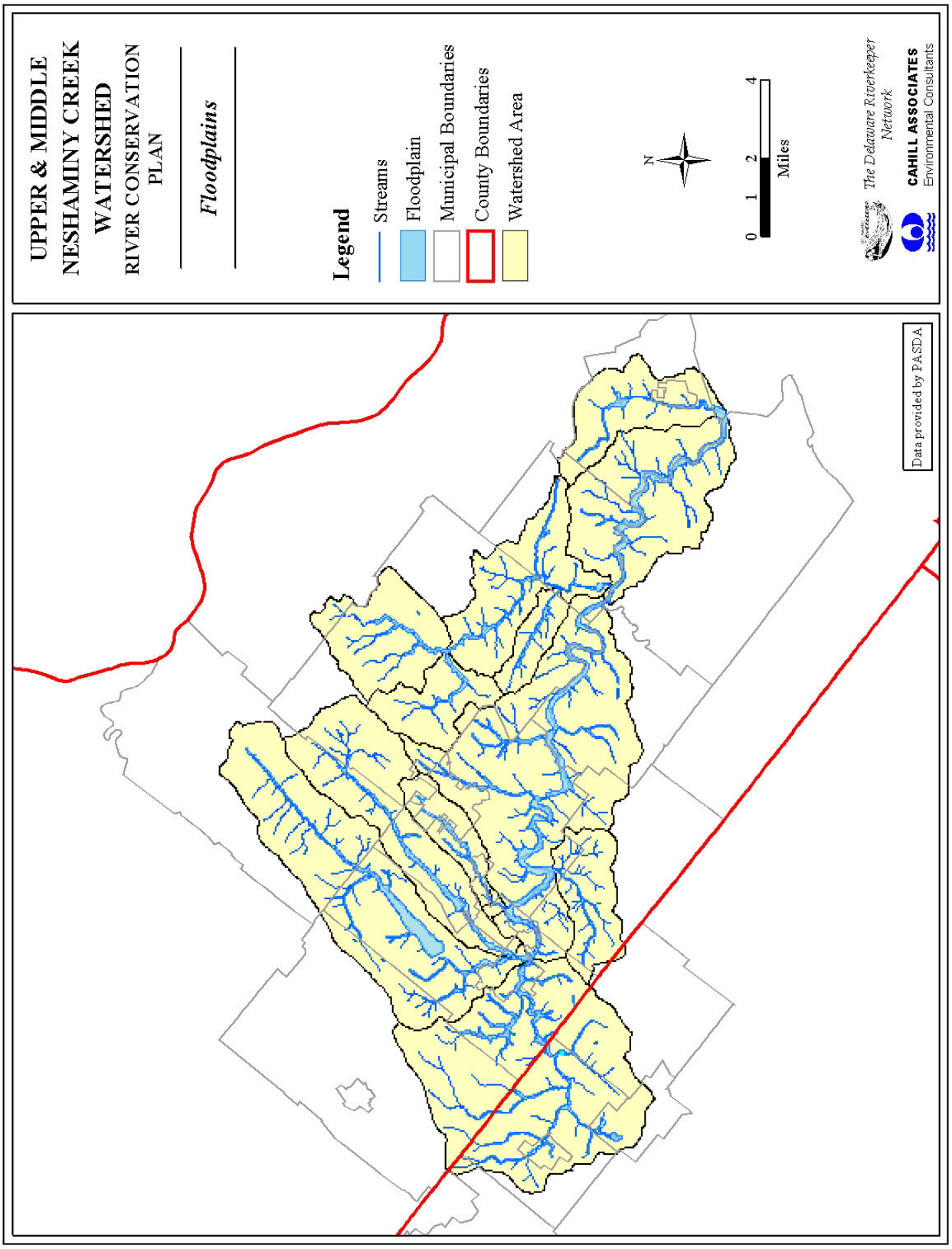


Figure 4-5. Floodplain Map of the Upper and Middle Neshaminy Watershed.

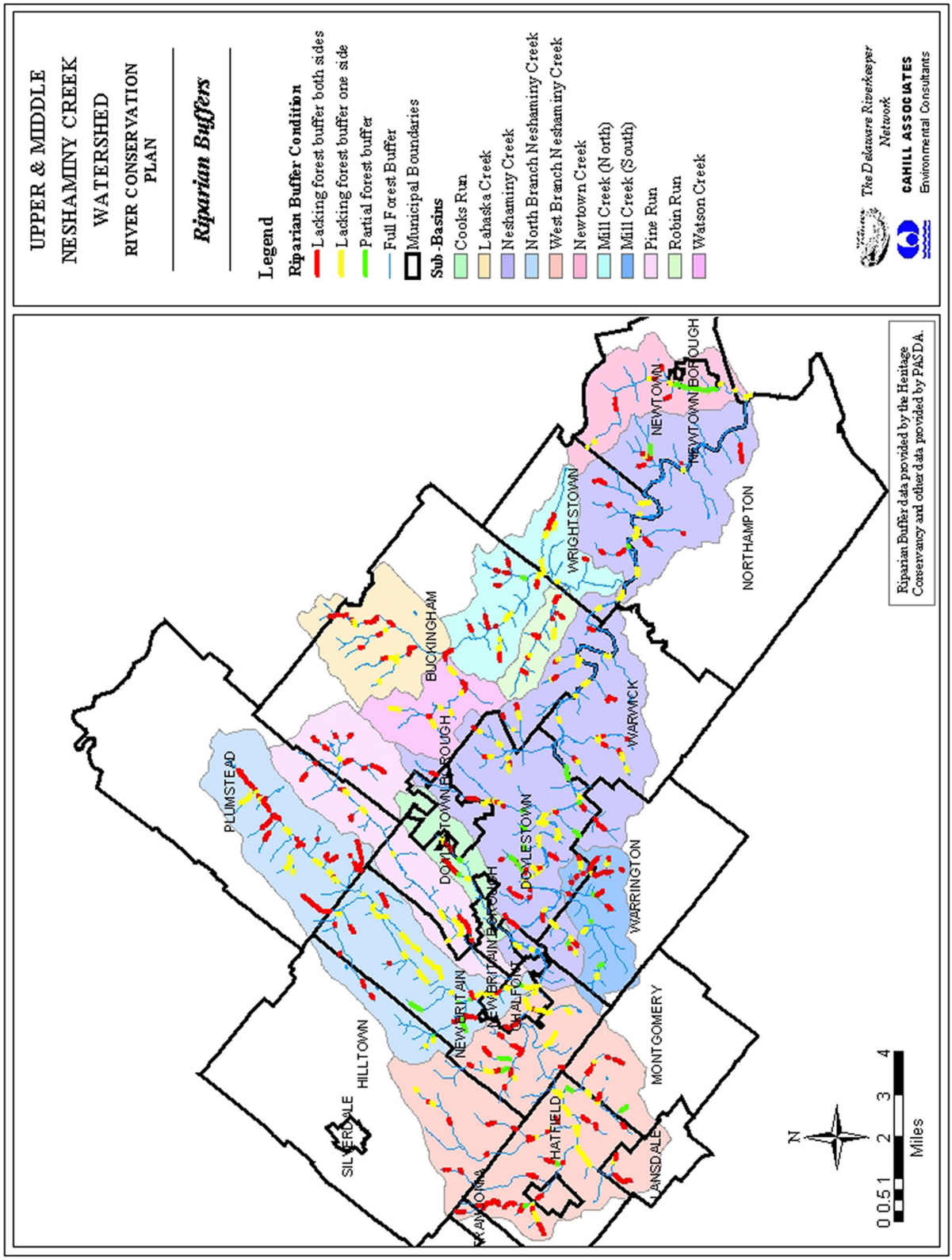


Figure 4-6. Riparian Buffer Conditions in the Watershed.

Table 4-3. The Neshaminy Creek Watershed Sub-Basins: Riparian Area

		Impaired Buffer (miles)				
Neshaminy Watershed Tributaries	**Miles with Full Forest Buffer**	**Partial Forest Buffer**	**Forest Buffer One Side**	**No Forest Buffer**	**Total Impaired Buffer**	**Percent Impaired**
Cook's Run	3.8	0.1	0.2	0.8	1.2	23%
Lahaska Creek	7.7	0.0	0.4	1.7	2.2	22%
Mill Creek (north)	14.8	0.1	1.3	1.7	3.2	18%
Mill Creek (south)	10.7	0.2	0.6	1.5	2.4	18%
Neshaminy Creek (lower direct-drainage)	69.8	1.4	6.3	5.9	13.6	16%
North Branch Neshaminy Creek	26.5	0.8	4.7	7.0	12.4	32%
West Branch Neshaminy Creek	34.1	1.1	3.9	7.4	12.4	27%
Newtown Creek	7.4	1.1	0.6	0.5	2.1	22%
Pine Run	15.7	0.1	1.1	2.0	3.2	17%
Robin Run	4.9	0.0	0.3	0.7	1.0	16%
Watson Creek	4.7	0.0	0.8	0.5	1.3	22%
TOTAL:	200.3	4.8	20.4	29.6	54.9	22%

Federal Emergency Management Agency (FEMA)

Floodplain management in an undeveloped watershed is important, but becomes more critical as a watershed develops, when the benefits of the remaining floodplain and riparian zone take on heightened importance. A major problem is that portions of the watershed were developed before the adoption of any floodplain regulations. The Federal Emergency Management Agency (FEMA) set minimum floodplain standards some thirty years ago, which were modified and made more rigorous in the mid-1990's. At this time, all of the municipalities of the watershed participate in the FEMA floodplain program. Most municipalities have incorporated minimum FEMA standards into their respective codes and ordinances, although some may not be in strict compliance with the FEMA program, especially given the FEMA program changes that occurred in the mid 1990's. In any case, a cursory review of the municipal ordinances requested from and made available by the municipalities for this RCP indicates that most municipalities have not gone beyond FEMA minimum requirements, although they are enabled to enact more rigorous floodplain controls.

Important points need to be made here regarding floodplain management and the FEMA program in the Neshaminy Creek Watershed. Of course, all new development projects and redevelopment projects must comply with these minimum floodplain standards, as part of municipal regulation. However, development pressures have led to some development in the floodplain and to filling, legally and likely illegally, of floodplain and even floodway areas for building foundations, parking lots, and other ancillary facilities. In fact, a substantial amount of land in the floodplain was developed prior to the existence of any floodplain management program, whether it was the FEMA program or any other more local initiative.

It is important to recognize that the minimum FEMA standards themselves allow for substantial floodplain and riparian zone development and substantial impacts to continue to occur, even when fully and completely implemented and enforced. FEMA standards focus primarily on the protection of life, limb, and property, and not on thoroughgoing environmental protection. Although standards were improved in the mid-1990's, FEMA standards are not intended statutorily to be a program of floodplain protection and rigorous watershed management. Removal of vegetation, grading, paving and even filling and structural construction may occur, even within the highest risk floodway zone, provided that hydraulic and floodway impacts are not substantial and first floor areas are properly flood-proofed. Even more extensive clearing, filling and paving are possible in the "flood fringe" portion of the floodplain. These very generous allowances in the existing local and Federal regulations explain why development projects continue to be approved within the floodplain and riparian zone in the Neshaminy Creek Watershed, and why watershed impacts, especially in terms of flooding, may grow even more serious in the years ahead. As this watershed has developed and the overall hydrology has been altered so dramatically by development, the floodplain is being required to accommodate and mitigate flood events which impinge upon it with greater and greater frequency and with more intensity. To add insult to injury, at the same time, the floodplain itself is paved, filled, and otherwise impacted by innumerable land development projects, even further reducing and compromising its critical natural functions.

As challenging and difficult as this might be, watershed municipalities must realize that rigorous floodplain and riparian buffer protection is cost effective in the long run and ultimately the wisest course of action. Development and redevelopment projects must avoid floodplains and riparian zones in order to prevent future flooding. To protect intensive development in adjacent areas, the floodplain itself must be kept as fully and densely vegetated as possible and structures in the floodplain could be removed, so that the floodplain can provide maximum flow reduction and retention. Ordinances, Land Use Plans and Floodplain Restoration Programs are needed to preserve and restore natural floodplain/riparian buffer functions. Though this restoration will take many years and comes at a cost, given the current level of impact, benefits will begin as quickly as structures are removed from the floodplain, as this immediately removes flood damage possibility to the structure permanently. Various community and government programs that provide the support needed to carry out floodplain repair can supplement the cost of restoration. For example, Bucks County with the Federal Government recently purchased severely flooded property in the Lower Neshaminy so that structures could be removed and the floodplain restored. With floodplain restoration, further benefits accrue to watershed residents who will also benefit in so many other ways from this floodplain and riparian zone restoration.

C. Wetlands

Wetlands and vernal ponds are transitional lands between terrestrial and aquatic environments, and include lands commonly known as swamps, marshes, bogs, springs, and seeps. Wetlands include land that may not always have standing water, and soils that are only saturated for a portion of the year. These unique environments provide critical ecological and environmental functions, which ultimately have natural, economic, and even social benefits. These functions include water storage, floodwater abatement, water quality improvement and provision of vital plant and wildlife habitat, including an inordinate proportion of Pennsylvania's rare, threatened, and endangered species. All seeps and springs are groundwater discharges that maintain stream base flow, and actually provide groundwater recharge in some topographic settings, such as glaciated lands. Because an unknown quantity of wetlands and vernal ponds have been lost to development (i.e., filled) over the years in the watershed, those that remain are of particular importance and are deserving of special protection.

National Wetlands Inventory Program

Wetlands within the Upper and Middle Neshaminy Creek Watershed have been identified and mapped (Figure 4-7) based on National Wetland Inventory (NWI) data. The NWI wetland classification system is hierarchal, with habitats divided among five major systems at the broadest level. Three major systems are represented in the watershed; the other two classes, Marine and Estuarine, are not. Lacustrine systems (lakes and ponds) cover some 423 acres, or 0.5% of the study area, with Palustrine systems (marshes and swamps) forming 1955 acres or 2.3%, and Riverine (rivers, creeks, and streams) systems only 157 acres or 0.2%, for a total wetland area of 3% in the watershed, with the remaining 97% classified as Upland. The NWI data source provides an approximate mapping of wetlands and is appropriate for use in this Plan. NWI wetlands delineation is based on interpretation of high altitude aerial photography and should not be used for regulatory purposes. Many small wetlands and vernal ponds typically are omitted from NWI mapping.

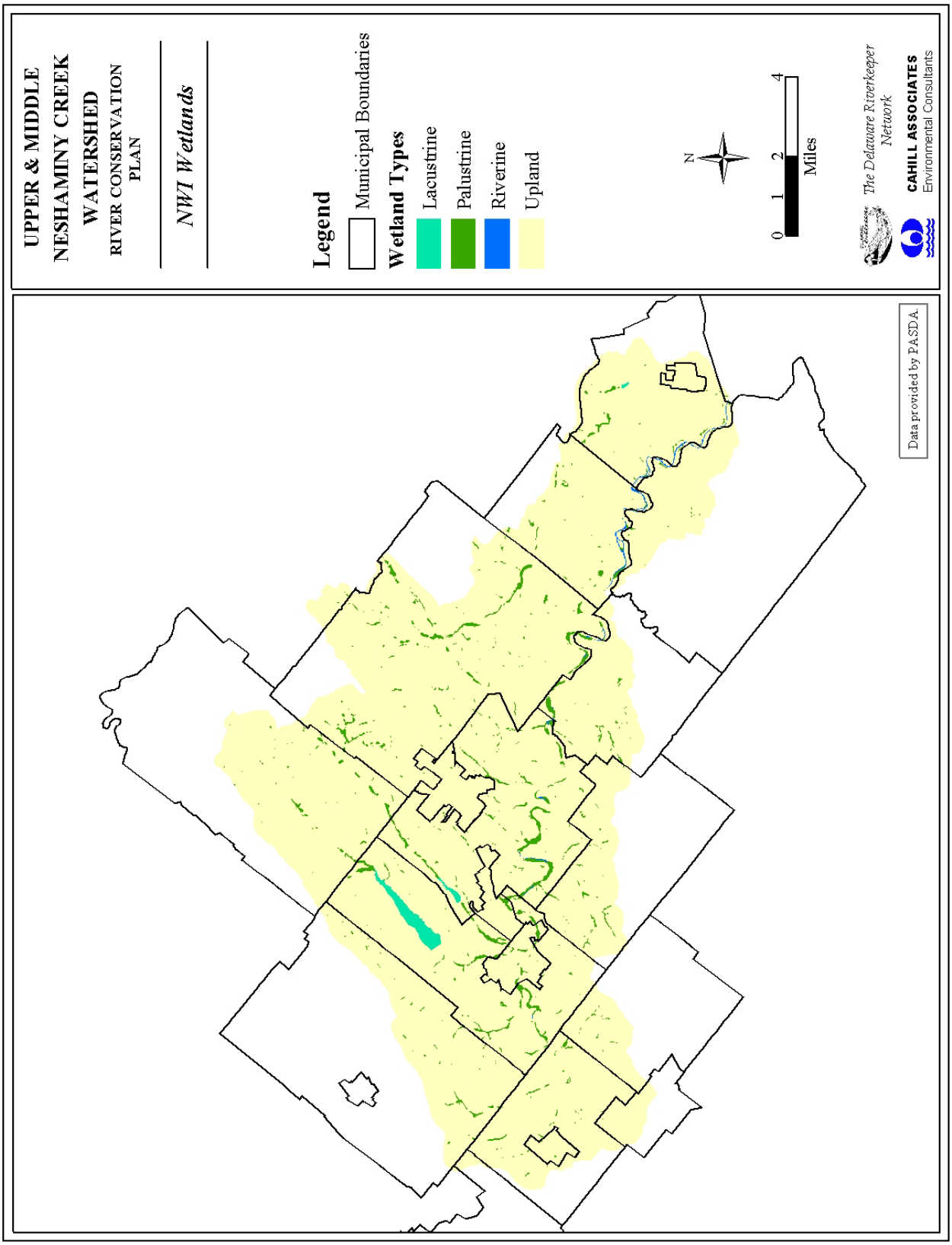


Figure 4-7. NWI Wetlands Map in the Upper and Middle Neshaminy.

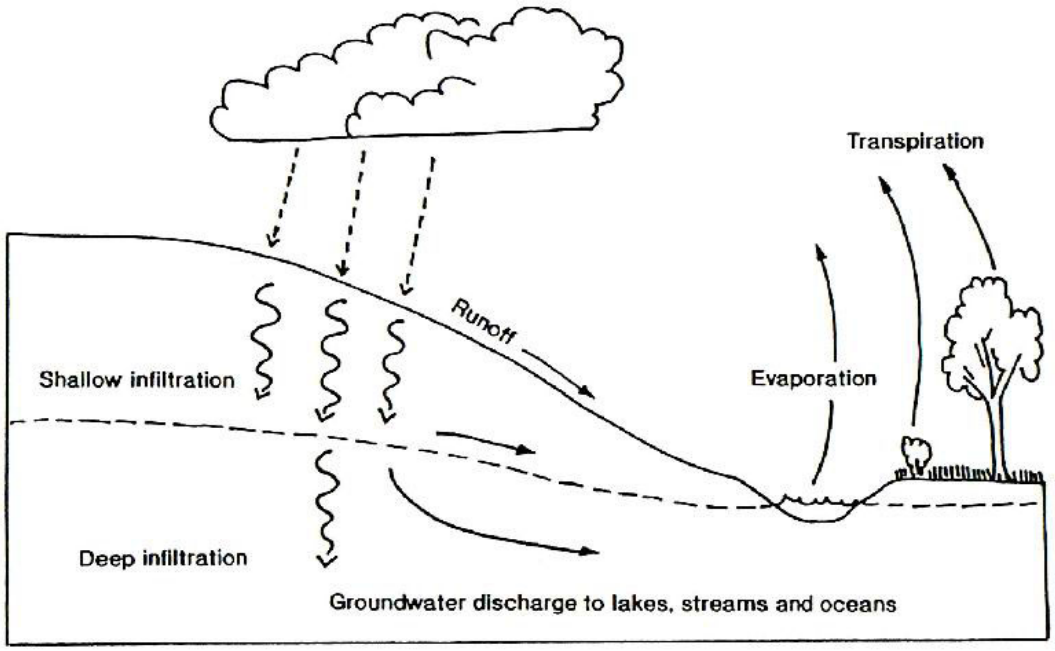


Figure 4-8. The Hydrologic Cycle

D. The Water Cycle

Understanding the water cycle and how human development actions have affected this cycle is especially important in understanding the Upper and Middle Neshaminy Creek Watershed. Figure 4-8 illustrates the essential dynamics of the water or hydrologic cycle, with the arrows illustrating continuous movement. Of all the aspects of the water cycle that must be emphasized, its dynamic quality—the never-ending cycling from atmosphere to the land and then to surface and groundwater pathways and back to the atmosphere—is most critical to appreciate. The often-heard observation that we drink the same water today that the Native Americans drank hundreds of years ago is a function of this continuous cycling and recycling.

The water cycle for an average year in our general climate zone includes a set of elements that can be displayed in the form of a relatively simple system flow chart (Figure 4-9). Precipitation data is based on rain gauges and includes data recorded over many years at many different stations. The closest official National Oceanic Atmospheric Administration (NOAA) rain gauge is located at the Doylestown Airport, located in Buckingham Township. Stream flow data similarly is obtained from stream gages operated and recorded by the US Geological Survey (USGS). The stream flow data can be analyzed to distinguish direct stormwater runoff from base flow, provided by groundwater discharge occurring during dry weather. USGS stream gage locations within the watershed are shown in Figure 4-10. Different watersheds with different land cover, geology and aquifer characteristics will demonstrate some variation in both runoff and baseflow volumes in average years, although the general relationships between the two are remarkably consistent in the Piedmont region.

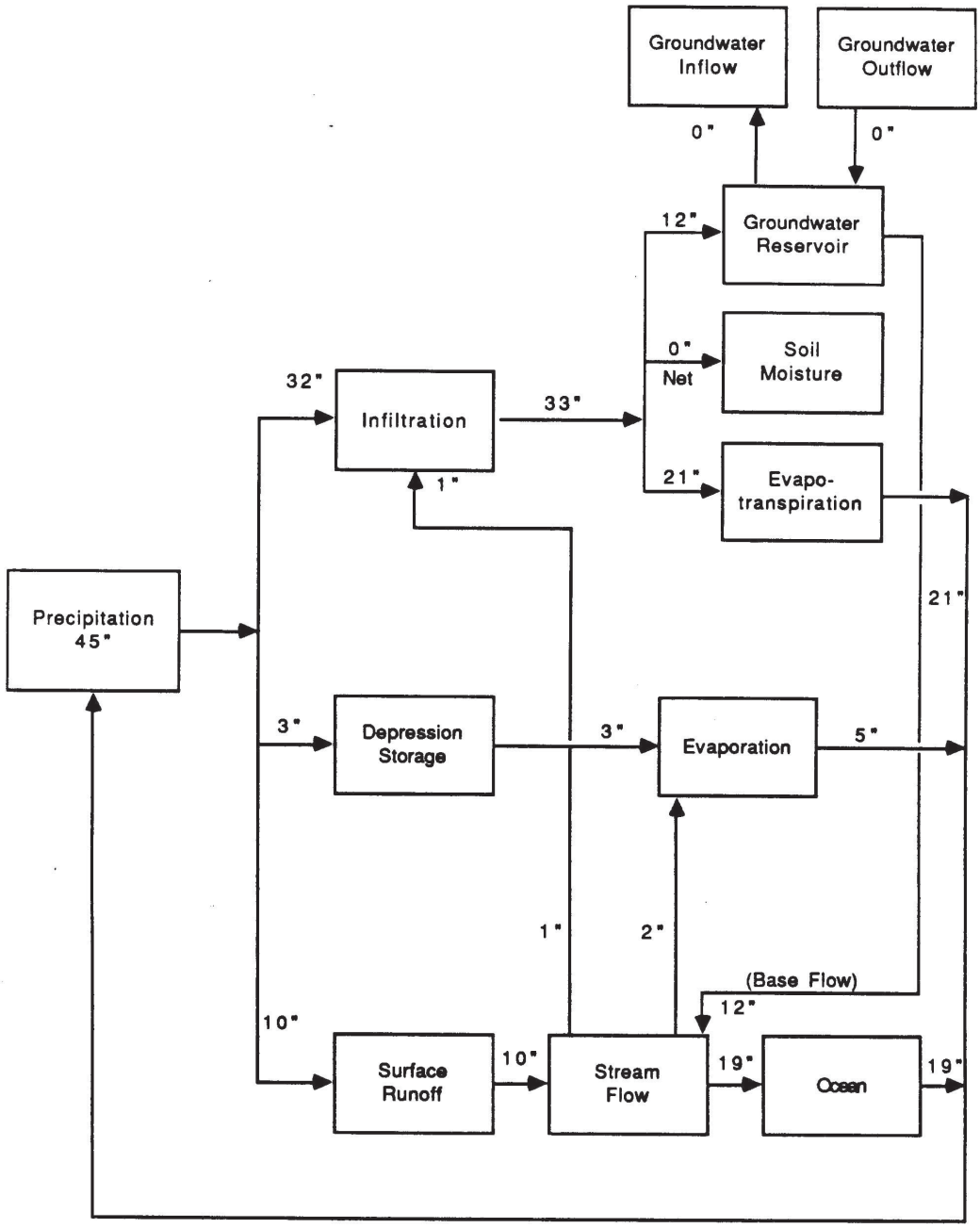


Figure 4-9. A Generalized Hydrologic Cycle for the Piedmont Region of the Neshaminy (Cahill, 1988)

Before delving into any one of the water cycle elements in greater detail, it is important to stand back and appreciate that the system is a closed loop. What goes in must come out. Impacts on one part of the cycle by definition create comparable impacts elsewhere in the cycle. If inputs to infiltration are decreased by 10 inches, then inputs to surface runoff and/or depression storage must be increased by the same amount to balance the cycle. Further along in the cycle, infiltration outputs will have to be reduced by the same 10 inches. Following along on the flow diagram, the groundwater reservoir,

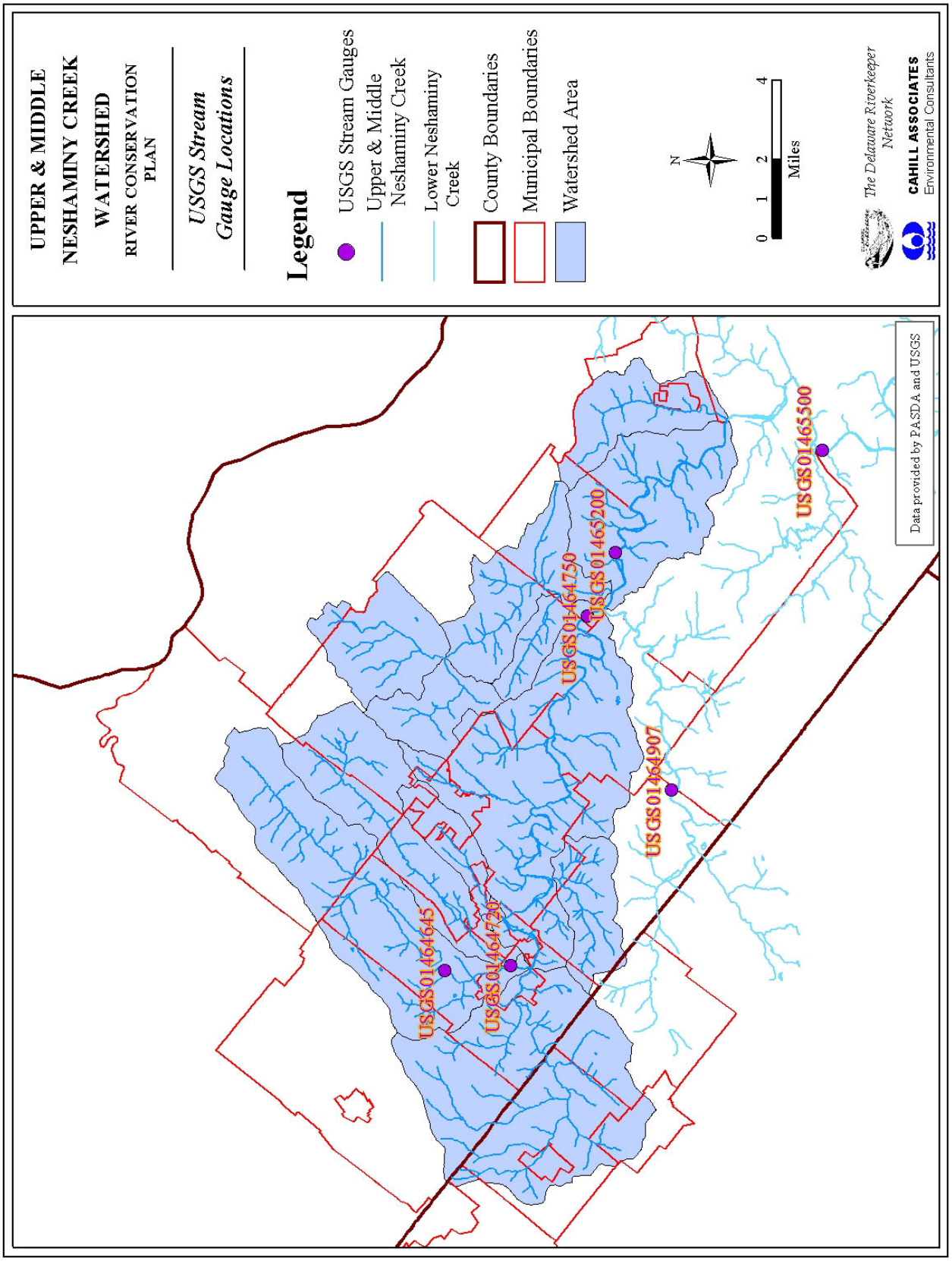


Figure 4-10. USGS Stream Gauges in the Neshaminy Watershed.

evapotranspiration and soil moisture elements together would be reduced by 10 inches, which would be reflected in stream base flow reductions.

Impacting one part of the water cycle invariably affects the entire system. This action/reaction system sensitivity has important ramifications for any attempt to manipulate and manage individual elements within the water cycle. Management programs that purport to focus exclusively on one aspect of the water cycle—for example, controlling only for peak rates of stormwater runoff, without paying attention to the total water cycle volume impacts—produce all sorts of impacts elsewhere in the cycle such as increased stream erosion and sedimentation and a decrease in stream baseflow during dry periods. Management programs that do not consider a number of water cycle variables typically do not accomplish a balanced water cycle.

Land development has come to mean a significant change in the natural landscape, including creation of vast areas of impervious surfaces. When we pave over and create impervious surfaces, we greatly increase surface runoff. Every square foot of new impervious surface adds about three cubic feet of additional runoff every year. Picture your local shopping center parking lot covered with 3 feet of water and you begin to appreciate the impact of impervious cover on the hydrologic cycle, and why it is the root cause of stormwater problems. When we increase direct surface runoff from 8 inches a year to 45 inches, which is the net effect of paving over land in this watershed, we also deprive the groundwater aquifers of essential recharge (12 inches a year, Cahill, 1988), reducing the water table and contributing to dry streams months later during drought (American Rivers, NRDC & Smart Growth America, 2002*)*. While it is true that small streams may dry up naturally during a drought due to their connection to the groundwater aquifer, this condition is exacerbated in developed watersheds because groundwater recharge is prevented in areas covered by impervious surfaces.

In older development areas built prior to 1975, even the simple detention basin was not built, and these stormwater collection systems directly discharge any and all stormwater runoff into the nearest stream, without <u>any</u> type of peak rate control, volume control, or water quality control. The detention basins that have been built during the past twenty-five years have been engineered to satisfy municipal regulations that have focused on the need of peak rate control, in order to prevent flooding on adjacent parcels downstream. Current design practices included in most municipal stormwater management regulations have focused on mitigation of the peak rate of stormwater runoff. According to these municipal regulations, peak rates of runoff at a site, pre- to post-development, are to be held constant, although large increases in <u>total runoff volumes</u> are allowed. Experience has shown that these increased volumes combine downstream and flooding actually gets worse, in spite of numerous detention basins. Because the peak rate control management efforts are so limited in concept, and because this approach to stormwater management fails to acknowledge and design for volume control, the existing stormwater management system itself has become a problem, rather than a solution.

Precipitation

Precipitation in our region has been classified by the frequency of storm events as below:

1-year storm	2.4 inches in 24 hours
2-year storm	3.2 inches in 24 hours
10-year storm	5.6 inches in 24 hours
100-year storm	7.2 inches in 24 hours

Frequency means that the 1-year storm has a 100 percent chance of occurring during any one year, a 2-year storm has a 50 percent chance of occurring in any one year, and so forth. The largest storms, certainly the 100-year storm, tend to be associated with the remnants of tropical storms, including hurricanes, although not all large storms fit the hurricane pattern.

The hydrologic cycle begins with rainfall. In southeastern PA, average annual precipitation does vary to some extent from location to location, but long-term rain gauge data generally indicates average annual precipitation to be about 45 inches —in other words, a relatively humid climate pattern, the relatively recent droughts notwithstanding. Overall, this water cycle is distinguished by substantial precipitation that tends to be distributed throughout the year in frequent events of modest size. The long-term charting of precipitation month-by-month confirms this relatively even distribution. No one specific month or season tends to be excessively wet or dry, though certainly times of precipitation extremes have occurred (especially hurricanes).

Also important is the distribution of rainfall by size of event. A storm event can be defined as the amount of rainfall and its distribution for a given area over a specific time period. Data records indicate that the largest portion of annual precipitation occurs during small storm events. Based on previous analyses of southeastern Pennsylvania data for various rain gauges, over 95 percent of the total number of precipitation events occurring during the last several decades were classified in the "less than 2 inches in 24-hours" (approximately the 1-year storm) categories. Even more important from a water cycle perspective, over 95 percent of the average annual rainfall **total volume** occurred in storms or "events" of less than 3 inches (less than the 2-year storm); 85 percent of the average annual rainfall **volume** occurred in storms or "events" of less than 2 inches. Over half of the total volume of the average annual precipitation occurs in "less than 1-inch" precipitation events. In short, the vast bulk of precipitation occurs in the smaller and more frequent storm events. Surface water management strategies, especially stormwater and flooding management programs, have historically dwelled on only the largest catastrophic events, such as the 100-year storm or flood, but the smaller storms are actually more critical when water cycle impacts and outputs are most affected. If our concern is keeping the water cycle in balance, storm size distribution data suggests using the 2-year frequency rainfall as the basis for the design of infiltration Best Management Practices, rather than the larger 100-year storm. If an infiltration system is designed to prevent any increase in runoff volume resulting from new impervious surfaces during the 2-year rainfall, it can be designed to also mitigate the peak rate during the 100-year rainfall. This last fact regarding peak rates is important because typically regulations require that stormwater management structures mitigate the rate of runoff (peak rate), not the volume. In order to successfully implement an infiltration BMP for stormwater management, the structure must mitigate peak rate of some given storm event (often the 100-year rainfall).

Stormwater and the Groundwater Reservoir/ Stream Baseflow

When rainfall occurs on a naturally vegetated landscape, most of the incident precipitation soaks into the soil mantle. Only 7 or 8 inches actually runs from the surface in a given year. Evaporation can occur from depression storage, consisting of small "nooks and crannies" that cover the natural surface. The larger amount of rainfall that soaks in is quickly taken up by the vegetative system and returned to the atmosphere as transpiration, and the moisture stored in the upper soil mantle is gradually used in the same fashion. The total of evaporation and transpiration amounts to some 22 to 28 inches, or about half of the annual rainfall. A lesser amount of precipitation that soaks into the soil mantle actually passes through the upper soil mantle and drains down to the zone of saturation or water table, where it recharges the aquifer and begins a long slow journey down gradient towards the nearest surface stream.

The focus of interest for stormwater management lies with both infiltration and surface runoff. As discussed above, increased surface runoff by definition means decreased infiltration. Land development creates both impervious surfaces and altered pervious surfaces such as lawns, both of which result in reduced quantities of infiltration when compared with the pre-development natural condition. Important here is the pre-development vegetative cover condition of the site; existing stands of forest, meadow or even scrub vegetation allow for considerably more infiltration than will occur with a post-development lawn on a disturbed and at least partially compacted soil base.

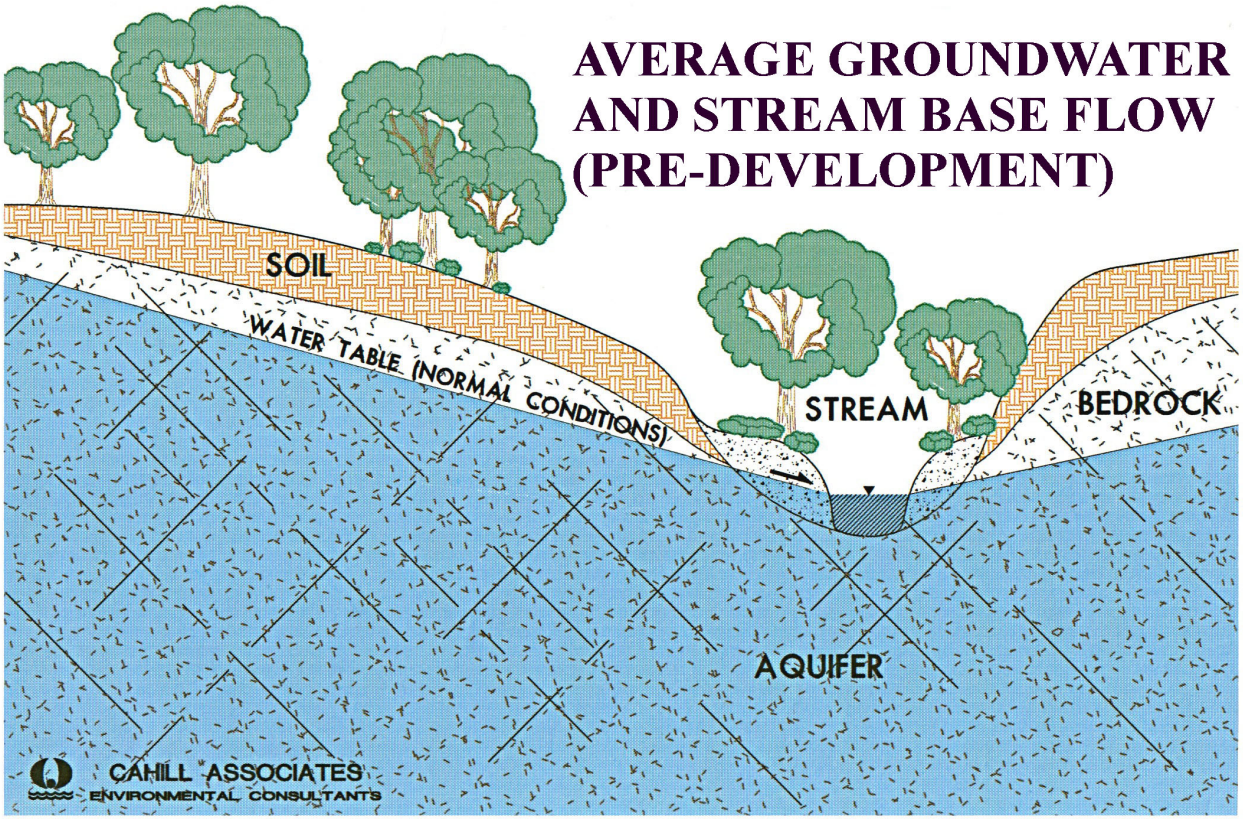


Figure 4-11. Groundwater and stream flow with pre-development activities.

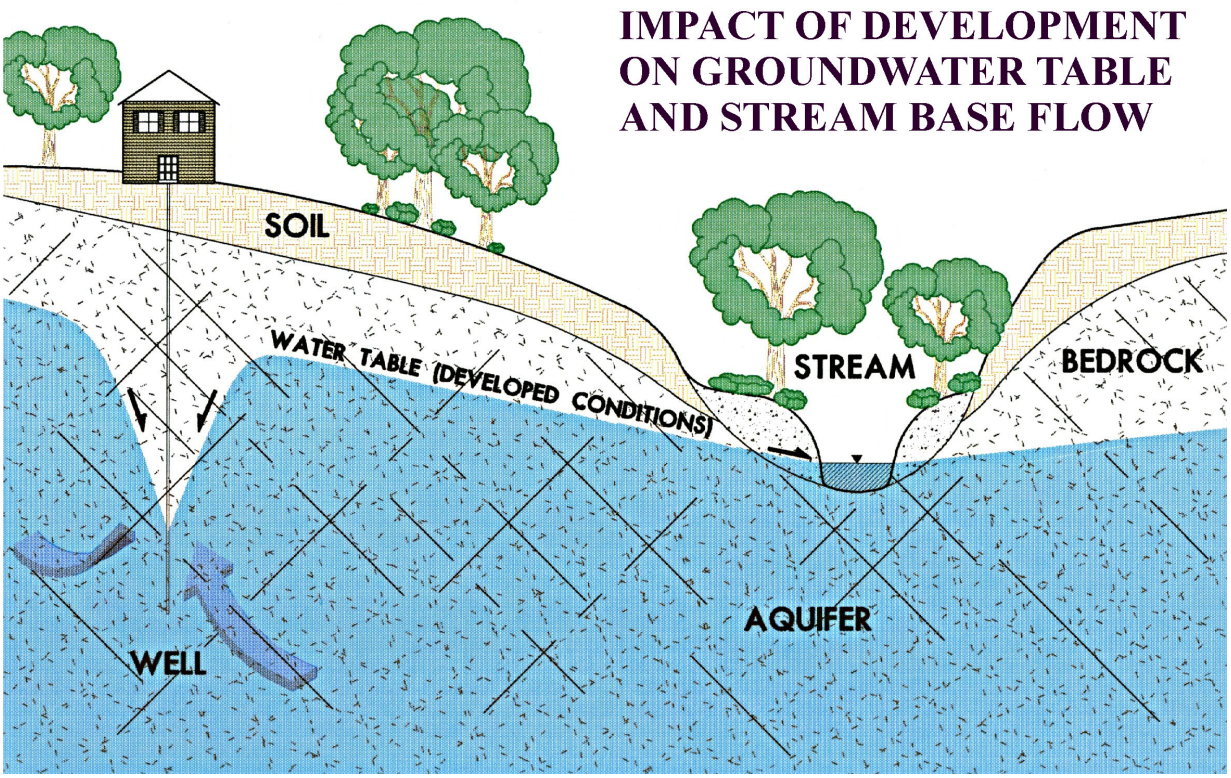


Figure 4-12. Groundwater and stream flow affected by development activities.

A critical water cycle impact here focuses on the groundwater reservoir component, also commonly referred to as groundwater or aquifer recharge. Decreases in infiltration mean decreases in the groundwater reservoir volume. Subtract from infiltration and you subtract from the groundwater reservoir. As these subtractions continue acre-by-acre, development-by-development, their cumulative effect grows larger. As the effects accumulate, groundwater reservoir depletion grows more serious, and the water table, the uppermost surface of this groundwater reservoir, declines as well. Figure 4-11 illustrates a simplified pre-development situation in cross-section, where normal precipitation patterns combine with natural vegetation to produce a particular groundwater reservoir or aquifer condition. In the post-development condition (Figure 4-12), water well development and withdrawal and impervious surfaces have been added, resulting in reduced inputs to the groundwater reservoir. The water table declines. If we add in the effect of drought, further reducing groundwater reservoir inputs and further lowering the water table, the cumulative effects of development and drought become quite significant. Springs and streams—especially first order headwater streams—that may only dry up naturally under very extreme drought conditions are jeopardized, and may even dry up during minor droughts that occur often during the summer months. Wells, especially older shallow wells, may fail, and Piedmont wetlands, typically fed by groundwater discharge, may be adversely impacted. Thus flood and drought are both related as part of the impact of development, and the proper management of stormwater can mitigate both situations (American Rivers, NRDC & Smart Growth America, 2002).

When the water table is lowered by lack of recharge, most wells can be re-drilled to greater depths, though at considerable expense. This is not the case for headwater streams and springs—the lifeblood of the stream system. The illustrations in Figures 4-11 and 4-12, though simplified, clearly establish the dynamic and critical relationship between the groundwater reservoir and stream baseflow. If the water table declines, stream baseflow declines by definition. The groundwater reservoir might be thought of as a saturated sponge, where precipitation inputs are added from time to time on the surface. In the consolidated aquifers of the Piedmont, groundwater then moves gradually through a myriad of pathways down and through the fractures in the bedrock, ultimately flowing gradually out of the groundwater reservoir as stream baseflow. However slow the movement and indirect the pathways might be for this continuous flow, however distant the point of stream discharge might be, when subtractions are made from this groundwater reservoir flow the impact will be seen in the form of a lowered water table and reduced stream baseflow discharge.

In the Piedmont physiographic region and the Neshaminy Watershed, direct stormwater runoff comprises stream flow for a small fraction of the time, perhaps less than 8 percent of the time in first order headwater streams. The vast bulk of the time, stream flow consists of discharges from the groundwater reservoir. This stream baseflow discharge occurs continuously, a reflection of the continuous movement occurring within the groundwater, the distinguishing characteristic of the water cycle.

It should be noted that this presentation of the water cycle and the groundwater phase of this cycle has been highly simplified for this discussion. In fact, the hydrogeologic context can be quite complex. Rock types may vary from high capacity carbonate formations to tighter and less water-yielding rock. These variations and complexities notwithstanding, the basic dynamics of the simplified hydrogeologic model described above remain valid.

Of course during dry periods, both the water table and stream baseflow decline as well. When the effects of drought and development are combined, the groundwater reservoir and water table may be so reduced that flows ultimately are virtually eliminated from the stream, and the stream dries up with catastrophic ecological consequences (American Rivers, NRDC & Smart Growth America, 2002). Although stream flow reduction can occur naturally during severe drought periods, the problem is exacerbated and typically more frequent with an increase in impervious cover. Furthermore, even if stream baseflow is not entirely eliminated, reductions in flow occur which also adversely stress the aquatic community in a variety of ways, well before total dry up results. In addition to potential loss of base flow, adding to the gravity of the problem is the fact that these stormwater-related impacts are magnified in the smallest and most vulnerable streams—the headwaters zones—of the total stream system.

Headwaters are defined here as 1st-order perennial streams, where the stream system with its aquatic community literally begins. In headwaters, stream baseflow by definition is modest even in pre-development and non-drought conditions. Therefore, any subtraction from flows in these small streams proportionally has great adverse impact. The potential for actual dry up is greatest in this most vulnerable, most sensitive headwaters zone. Furthermore, headwaters zones comprise the largest percentage of the total stream system on a lineal percentage basis (about 90%). Headwaters are the initial channels where detrital material (leaves and other organic food sources) are initially broken down by bacteria and processed for use by higher organisms in the food chain. Of course, the

system stops functioning if the stream goes dry, and so the life of the system is very much dependant on the continual biochemical operation of these first order streams (Cahill, 1997). Headwaters zones therefore are both most sensitive and of special value.

In some cases, the groundwater reservoir does not discharge to a stream, but rather to a wetland. Frequently, wetlands are zones of groundwater discharge and are in fact "fed" and kept alive by the groundwater reservoir. In these instances, reduced infiltration and a lowered water table ultimately translates into changes to the hydroperiod or "feeding schedule" of the wetlands leading to the loss of wetlands themselves, reduced wetland extent, reduced wetland vibrancy and ecological richness, and loss of wetland functions in the ecosystem.

In sum, reduction of groundwater recharge and stream baseflow due to impervious cover has serious and far-reaching consequences. Comprehensive stormwater management must strive to recognize the full range of functional impacts occurring when new land development generates increased stormwater runoff. Comprehensive stormwater management strategies must maintain as many of these critical water cycle-linked functions as possible. Because the balance in the Upper and Middle Neshaminy Creek Watershed has already been so impacted by existing development, it is especially critical that new development projects do not make the problems even worse.

Stormwater and Surface Runoff

Because land development alters the water cycle by increasing stormwater runoff, stormwater management has historically focused on handling excess water to prevent flooding. In fact, flood prevention continues to be the focus of most conventional stormwater management programs, and generally focuses on allowing a stormwater flood peak to pass through the stream network and downstream as fast as possible. This practice is fraught with problems.

Understanding stormwater runoff means understanding the concept of a hydrograph. If an observer stood at a bridge over a stream during a storm, he/she would observe the water level rise and fall. As the water level rises, the volume of water passing under the bridge increases. This volume of water passing under the bridge at any given time, known as the flow rate or discharge, is commonly expressed in units of cubic feet per second (cfs) or cubic meters per second. A hydrograph is the graphical depiction of the flow rate or discharge (cfs) over time (as illustrated in the following hydrographs). The area under this curve is a representation of the volume of water conveyed by runoff during the storm. Hydrographs can be developed for sites of any size—one acre, 100 acres, or 1,000 acres—and for all different sized storm events. Stream level (and flow) is usually measured at a fixed station or gage in the channel, and recorded by various devices. This data can be used to estimate flows throughout the drainage system through a variety of mathematical modeling methodologies (the most typical approach). Figure 4-13 presents a hydrograph for a typical site showing both pre- and post-development conditions (note that the actual discharge values, site sizes, etc. are largely irrelevant for the sake of the comparison developed here). A storm—hypothetically, the 100-year storm—commences. As can be seen from the pre-development hydrograph, runoff from the site does not begin for a while, until hour 5 or so, at which point the site soils have become saturated (when rate of precipitation exceeds the rate of permeability of the soils). At this time, the rate of precipitation is assumed to increase such that the rate of runoff increases rapidly. As precipitation rates decline, runoff rates decline as well.

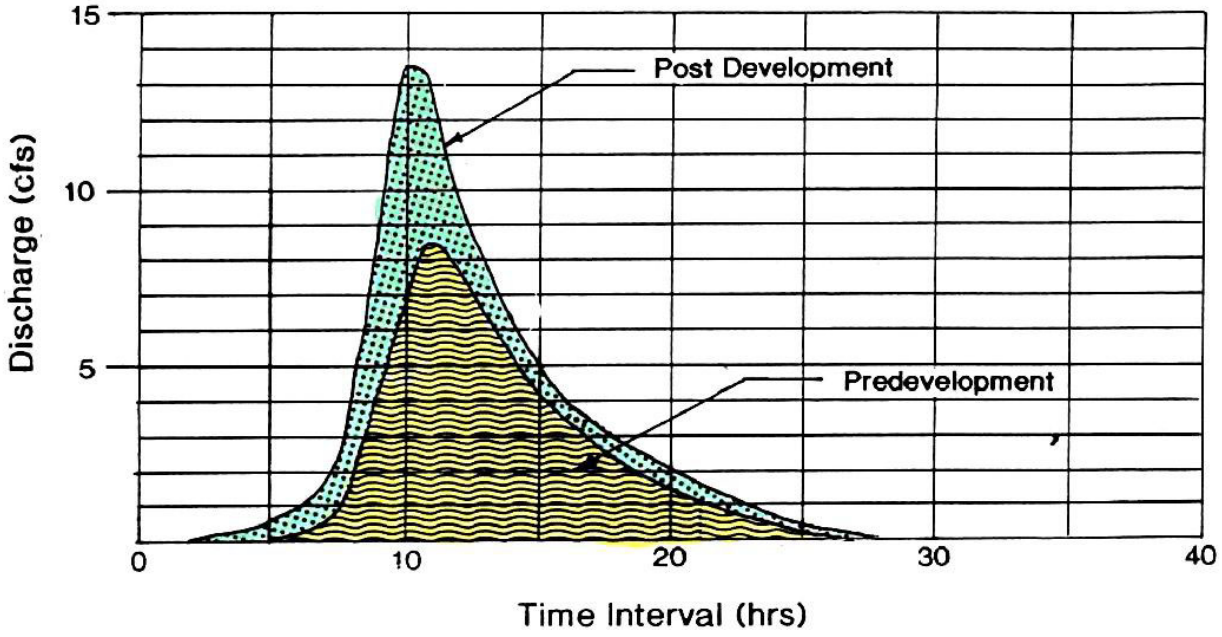


Figure 4-13. Pre-development and post-development stormwater hydrograph (no SW controls).

Figure 4-13 shows the changes that result from development at the hypothetical site and presents a Post-Development hydrograph without any stormwater management controls in place. Several observations relating to the two hydrographs can be made. First, the Post-Development hydrograph rises or increases earlier in time when compared with Pre-Development. Runoff starts occurring earlier in a Post-Development scenario because portions of the site have been made impervious and immediately start to discharge as rain begins to occur. More importantly, Post-Development runoff rapidly increases and peaks at a runoff rate that is considerably higher than the peak rate of runoff for Pre-Development. The extent of this peak rate increase is very much linked to the amount of impervious surface and other land cover changes involved in the development process. If only 5 percent or so of the site were to be made impervious, then the increase in peak rate would not be so great. If 50 percent of the site were made impervious, the increase in peak rate would be dramatic. Furthermore, the area under the Post-Development Uncontrolled curve is considerably larger than the area under the Pre-Development curve, meaning that the Post-Development volume discharge is larger as well.

Now let's introduce stormwater management to the picture. Figure 4-14 adds a Post-Development with Detention hydrograph to the comparison, where management is in the form of a detention basin which functions to keep the peak rate of runoff at pre-development levels by engineering design. However, because the detention basin simply collects and detains the added runoff and then discharges this increased volume at the maximum pre-development rate over an extended period of time, the end result is that the total area under the Post-Development with Detention hydrograph is considerably larger than the Pre-Development hydrograph. Thus total volume of stormwater being discharged by Post-Development with Detention is significantly increased. By design, detention facilities control runoff rates, but do not reduce post-development runoff volumes.

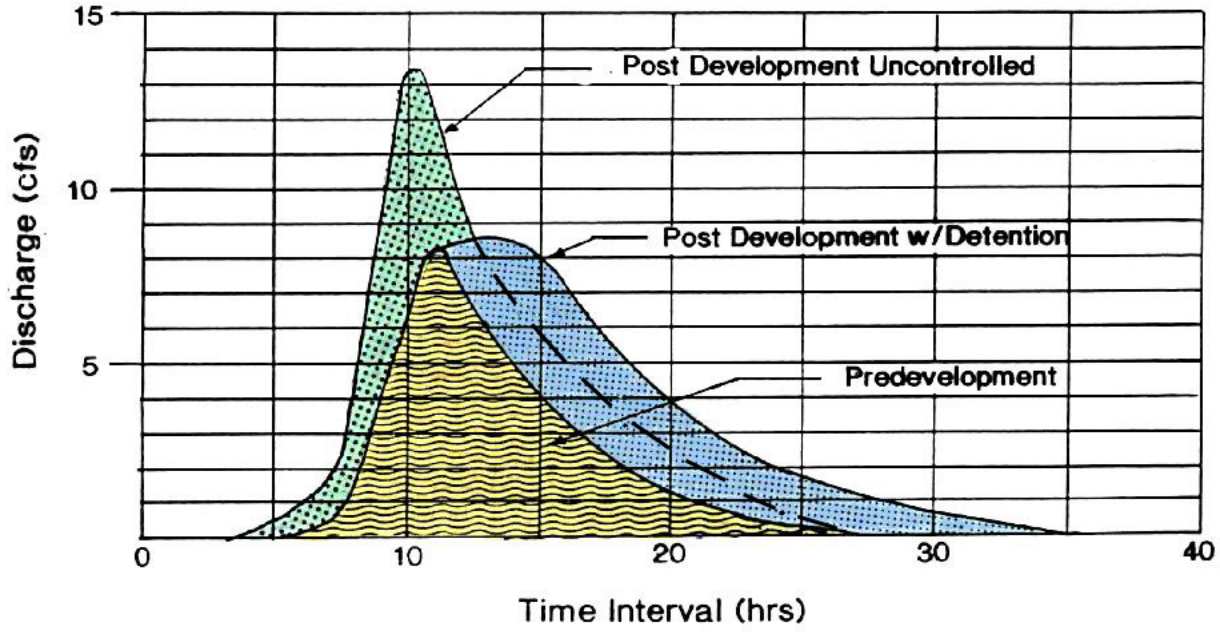


Figure 4-14. Comparison of pre- and post-development stormwater hydrographs.

Peak rate control is a stormwater management strategy in large part designed to protect the adjacent downstream property from flooding, ignoring properties farther downstream. That limited objective is usually achieved. If the studied area is extended to the broader sub-watershed or watershed area, the effect of this increased volume of runoff can be seen farther downstream. What happens when many different sites throughout the watershed are developed with many different detention facilities discharging these increased volumes site-by-site? What is the cumulative watershed impact of widespread development? Real-world examples of such development show that even if detention basins are employed to only limit the peak rate of runoff, flooding has worsened nonetheless. According to Bucks County Flood Recovery and Mitigation Strategy Report, recent suburbanization in central Bucks County (where detention basins were likely employed for stormwater management) has contributed to flooding events in lower Bucks County (DVRPC, 1998).

Figure 4-15 illustrates the possible flooding impacts (depending upon the location within the watershed) which can result when a peak rate control philosophy is used watershed-wide. The illustration shows a hypothetical watershed comprised of five sub-basin development sites, or Sub-Basins 1 through 5, each of which undergoes development and relies on a peak rate control/ detention basin approach to stormwater management. Pre-Development, when the hypothetical storm occurs, five different hydrographs result for each Sub-Basin, and combine to create a resultant Pre-Development hydrograph for the watershed, shown in blue (note that the vertical y-axis value for the total watershed hydrograph is simply the addition of the 5 y-values for the 5 sub-basins at any one time).

Figure 4-15 assumes that all five developments utilize detention basins. The five hydrographs are modified as shown, with Pre-Development peak rates not being exceeded, but being extended over time. What is the impact at the base of the watershed? As these extended peak rates are added up, the resultant watershed hydrograph grows taller. Not surprisingly, the resultant Post-Development with

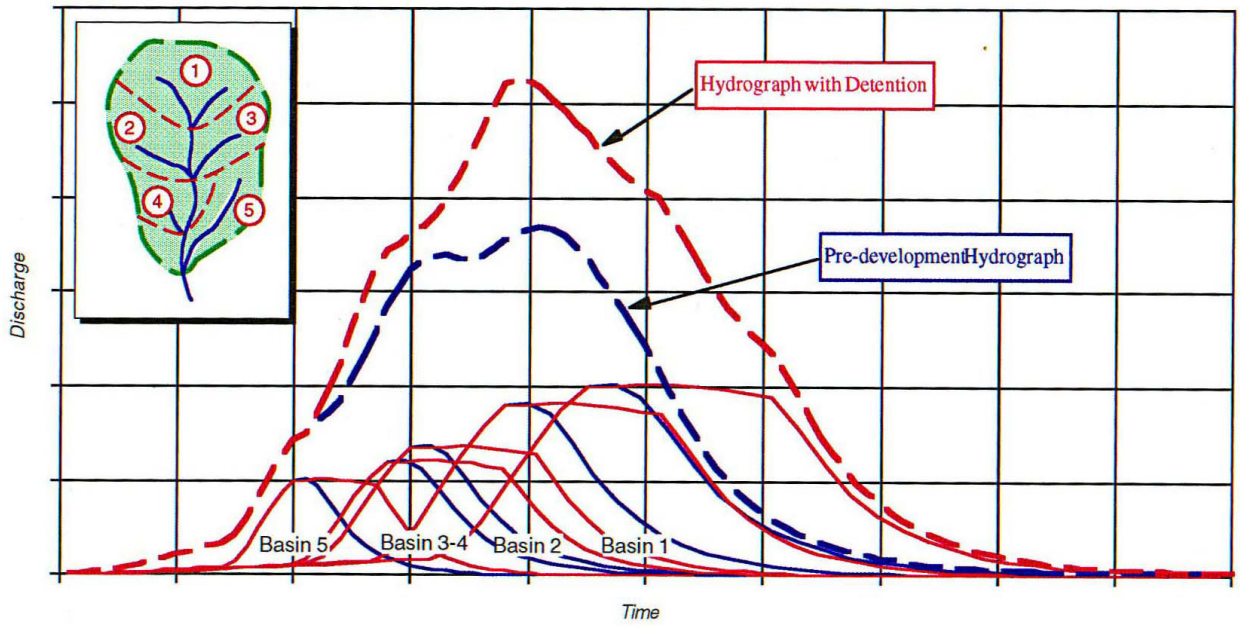


Figure 4-15. Possible effects of stormwater detention in a hypothetical watershed.

Detention hydrograph for the watershed not only exceeds the Pre-Development hydrograph in terms of total area under the respective curves (i.e., more volume clearly is discharged Post-Development, which would be anticipated), but the peak rate of runoff for the watershed increases considerably, because these increased volumes compound as they are routed down the watershed system. In short, flooding worsens considerably downstream, even though elaborate and costly detention facilities have been installed at each individual development. The floodplain limit by definition will be expanded. Property loss, possible loss of life and limb—all the costs associated with flooding—can be expected to worsen.

Based on Figure 4-15, the peak rate increases significantly, as does the duration of flood flows. In the Pre-Development condition, the peak runoff rate may last for an hour or so. In the Post-Development with Detention condition, the peak rate or near peak rate may last for 11 or 12 hours. Although the hypothetical nature of all of these hydrographs must be kept in mind, the point here is that the time of peak flooding can be expected to increase, as well as the rate at which these flood waters move through the lower watershed. This increased flooding results in serious impacts to the stream system, including but not limited to:

- significant stream bank erosion
- bank undercutting
- elimination of meanders
- channel widening and hardening
- increased sedimentation and deposition
- elimination of pools riffles and natural bottom
- reduced aquatic life

Over time, these impacts can transform a stream from a high quality waterway, with excellent species diversity and richness, literally to a functional storm sewer.

E. General Water Quality Issues

The importance of water quantity issues notwithstanding, important changes in water quality result from development. We sometimes make this distinction between water quality and water quantity, as though the two issues were separate and unrelated, but the truth is that both aspects of water management are inextricably linked, and many management strategies that effectively address water quantity will in many cases address quality as well. Runoff from impervious surfaces both increases volume and rate of runoff. This means that pollutants are scoured and swept into the sensitive aquatic ecosystem. Strategies that reduce this impervious surface and/or redirect runoff into natural swales or other BMP's directly reduce the stormwater runoff source and indirectly reduce the transport of stormwater-linked pollutants. If we reduce runoff quantitatively, erosion by definition will be reduced. Once in the stream, increased volumes and rates of runoff mean increased streambank erosion, undercutting, flattening and straightening of the channel, re-suspension of sediment, all of which become serious quality problems. Even if flooding is not worst case, full or near full bank flooding has serious water quality ramifications. Therefore, although the focus of this chapter has been on water quantity and the water cycle, both quantity and quality are very much at issue.

Even so, not all quality pollutant loads can be eliminated through quantity reduction techniques. Roads and highways are necessary, and will generate vehicle use and pollution by definition (i.e., there is some proportion of these pollutant loads which are not variable and will be generated even if maximum reduction in quantity can be achieved). At the other end of the quantity spectrum—reductions in stream baseflow—water quality and water quantity issues emerge as well. To the extent that any fixed or constant source of pollution—for example, point source discharges or malfunctioning onsite septic systems—continues to generate pollution loads as infiltration and stream baseflow decline, this reduced stream baseflow translates into increased concentrations of instream pollutants, and pollution-related problems grow more severe.

Nonpoint Source Pollution

Water quality aspects of stormwater management have become a major concern nationwide. In fact, stormwater-linked nonpoint source pollution—the mix of pollutants that is washed off the earth's surface with each precipitation event—is often cited as the primary water quality problem in the nation today. As a result, numerous manuals such as the new *Pennsylvania Handbook of Best Management Practices for Developing Areas* have been produced setting forth management programs designed to minimize stormwater-linked water quality problems.

Stormwater-linked pollutants vary with type of land use and intensity of land use and have been shown to include bacteria, suspended solids, nutrients, hydrocarbons, metals, herbicides and pesticides, other toxics, organic matter, and others. Pollutant loads are generated both from impervious areas ("hot spots" such as gas stations, fast food parking lots, and heavily traveled roadways are primary culprits) as well as from pervious zones, such as the chemically maintained lawns and landscaped areas, where chemical maintenance can be considerable. Agricultural land use also contributes

a significant load of nutrients and organic matter. Some nonpoint pollutants are even air-borne, deposited onto the land surface and then washed into receiving water bodies.

Sources of this pollution include:

- vehicles
- vegetative decay (leaves, grass, etc.)
- direct atmospheric deposition
- general litter, including pet litter
- soil erosion
- road surface applications (salt, sand, etc.)
- fertilizers
- pesticides/herbicides
- human fecal coliforms (failed septic systems)

Point Source Pollution

Additionally, an important source of pollutant loading in selected portions of the Upper and Middle Neshaminy Creek Watershed are direct discharges to the stream system from both municipal and industrial wastewater facilities. Many point sources exist throughout the watershed and are shown in Figure 4-16. Furthermore, in the publicly sewered areas there are likely problems of inflow and infiltration, or "I/I" as it is commonly called, when sewer lines located in and adjacent to the stream bed leak wastewater into the stream.

Physical Types of Pollutants: Soluble vs. Particulate

The physical form of the pollutant has major bearing on all aspects of water quality management. One very important way of differentiating pollutants is the extent to which pollutants are particulate vs. soluble in nature. Good examples of this comparison are the nutrients phosphorus and nitrogen. Phosphorus typically occurs in particulate form, often bound to soil particles. Because of this physical form, stormwater management practices which rely on physical filtering and/or settling out can be largely successful for phosphorus removal. In stark contrast is nitrogen, which tends to exist in highly soluble forms where any sort of attempt at physical filtering has little if any effect. As a consequence, management approaches for nitrogen must be quite different in approach (wetlands/wet ponds and other approaches where anaerobic conditions are promoted and where denitrification can occur are preferable).

Natural Mechanisms for Stormwater Pollutant Reduction/Mitigation

Although stormwater-related pollution often can be reduced if not eliminated through preventive Best Management Practices (BMPs) driven by quantity reduction objectives, not all stormwater pollution can be avoided. In such cases, an array of natural pollutant removal processes is available for use and should be exploited to the maximum extent possible. Because these processes tend to be associated with, or even reliant upon, both the vegetation and soil realms, they can be readily incorporated into many BMPs. Such natural pollutant removal processes include:

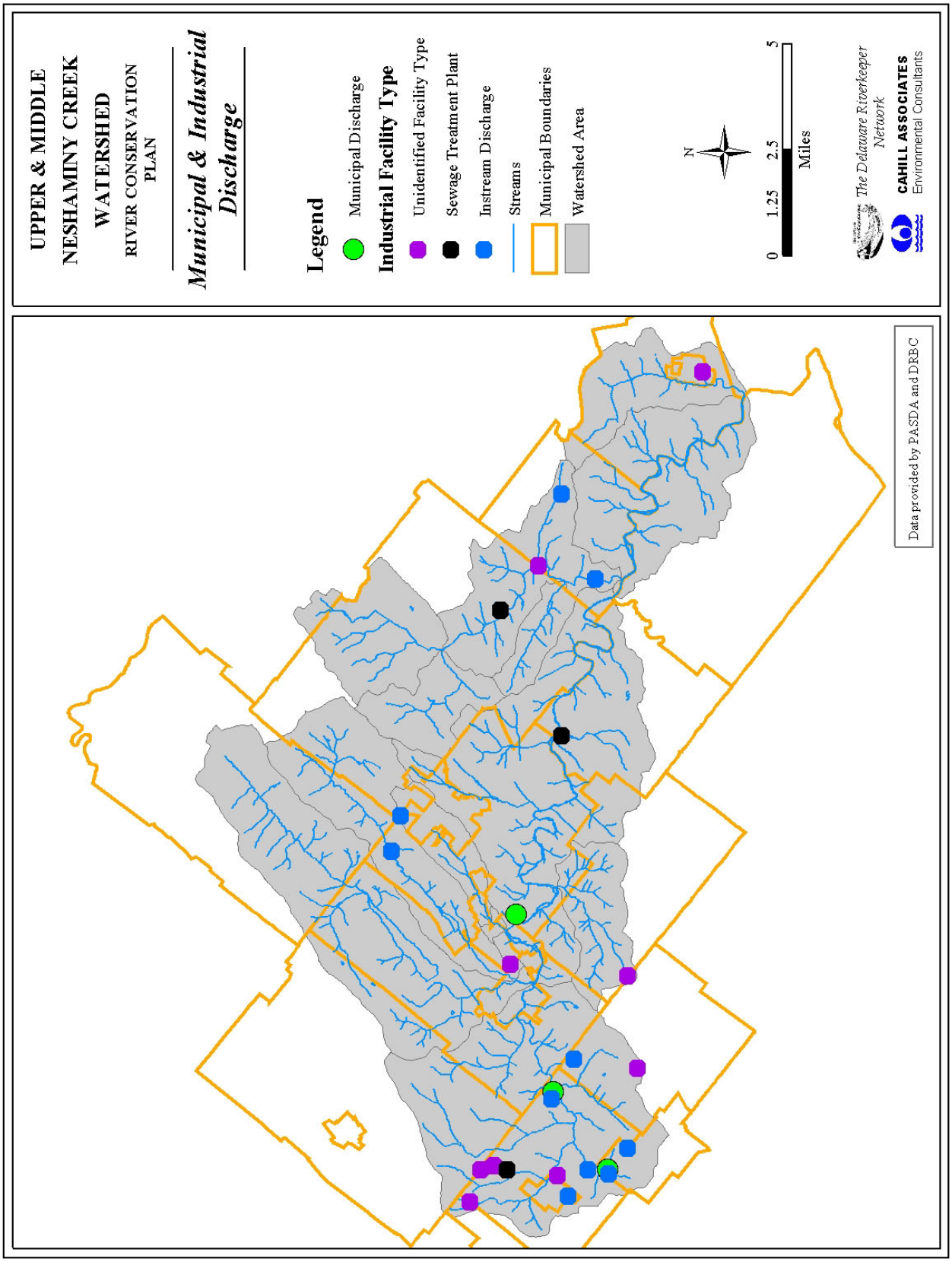


Figure 4-16. Industrial and municipal discharges in the Watershed

Settling As discussed above, the kinetic energy of stormwater washes all types of matter; particulate form and other, from land cover surfaces. Particles remain suspended in stormwater flows as long as the energy level is maintained. Larger particles require more kinetic energy in order to remain in suspension. As the energy level declines—as the storm flow slows, these suspended particles begin to settle out by gravity, with larger, heavier particles settling out most quickly and the smallest colloidal particles requiring considerably more time for settling. To the extent that time can be maximized, more settling can be expected to occur, holding all other factors constant. Therefore, approaches which delay stormwater movement or approaches that reduce kinetic energy in some manner (e.g., energy dissipaters) serve to maximize settling and deposition.

Filtering Another natural process is physical filtration. As pollutants pass through the surface vegetative layer and then down through the soil, larger particles are literally physically filtered from stormwater. Vegetation on the surface ranging from grass blades to underbrush removes larger pollutant particles. Stormwater sheet flow through a relatively narrow natural riparian buffer of trees and understory herbaceous growth has been demonstrated to physically filter surprisingly large proportions of larger particulate-form stormwater pollutants from stormwater flows. Both filter strip and grassed swale BMPs rely very much on this filtration process. Filtration may also occur in stormwater which is infiltrated and then gradually moves downward through the various soil layers, although once this infiltration process begins, a variety of other pollutant removal processes (see below) are set into motion as well.

Biological Transformation and Uptake/Utilization Though grouped as one type, this category includes a complex array of different processes that reflect the remarkable complexity of different vegetative types, their varying root systems, and their different needs and rates of uptake of different "pollutants" (in this case, clearly "resources out of place"). An equally vast and complex community of microorganisms exists within the soil mantle, and though more micro in scale, the myriad of natural processes occurring within this realm is just as remarkable. Certainly both nutrients phosphorus and nitrogen are essential to plant growth and therefore are taken up typically through the root systems of the various vegetative types, from grass to trees. Nitrogen processing is quite complex, a function of nitrate/nitrite and ammonia/ammonium forms. The important process of denitrification occurs through the action of widely present facultative heterotrophs, which function to facilitate the exchange of ions in the absence of oxygen and ultimately convert nitrates for release in gaseous form. These processes ultimately become chemical in nature, as discussed in the next section). As wetland species are introduced, all of this processing becomes more chemically complex.

Chemical Processes For that stormwater which has infiltrated into the soil mantle and then moved vertically toward groundwater aquifers, various chemical processes also occur within the soil. Important processes occurring include adsorption through ion exchange and chemical precipitation. Cation Exchange Capacity (CEC) is a rating given

to soil which relates to a particular soils ability to remove pollutants as stormwater infiltrates through the soil mantle (i.e., through the process of adsorption). Adsorption will increase as the total surface area of soil particles increases; this surface area increases as soil particles become smaller, as soil becomes tighter and denser (in other words, large particle sandy soils end up having considerably lower total surface areas per unit volume measure than a heavy clayey soil. CEC values typically range from 2 to 60 milliequivalents (meq) per 100 grams of soil.) Coarse sandy soils have low CEC values and therefore are not especially good stormwater pollutant removers (a value of 10 meq is often considered to be the minimum necessary to accomplish a reasonable degree of adsorption-related pollutant removal). Conversely, "tighter" soils such as clayey types have much higher CEC values.

Through reliance on these processes, management practices can be applied which substantially increase pollutant removal potential above and beyond any mitigation being provided by the detention basins currently utilized by most municipalities in the watershed. Through a combination of vegetative-linked removal combined with a host of processes occurring within the soil mantle, pollutants suspended or dissolved in stormwater runoff can be removed and even eliminated.

F. Water Quality Issues: Interaction between Water Quantity and Quality

Water quantity and water quality typically are closely interrelated. As the natural flow patterns of a watershed undergo change, water quality and the aquatic biota present in the stream system typically change as well. Usually these changes are not for the best. This is certainly true of the Upper and Middle Neshaminy Creek Watershed.

The considerable urbanization, which has occurred in the Upper and Middle Neshaminy Creek, has translated into encroachment into the floodplain and directly into the stream channel itself (in the most extreme, completely burying the stream underground in some cases). Changes in the natural hydrology—in the patterns of infiltration and runoff—have resulted in extreme stream channelization, creating a system, which is not in dynamic equilibrium. Time to peak has been decreased, sometimes dramatically; peak flow rates are increased equally dramatically. Smaller rainfall events produce more and more bankfull and out-of bank flooding, unable to be accommodated by the existing stream channels, floodplains, and wetlands. More erosion occurs; more sediment is deposited. Increased flood flows scour stream banks, fill pools and cover riffles with sediment. A more short-lived, homogeneous, and unstable species system is created with increased sediment deposition and decreased habitat diversity. The aquatic ecosystem has lost much of its critical energy linkage in first order streams and wetlands, as these valuable areas are disturbed or paved over in some cases and their ecological functions destroyed.

Benthic Macroinvertebrates

The PADEP, as part of the PA Surface Waters Assessment Program (303d), has conducted stream assessments throughout the Neshaminy Creek Watershed in order to determine the number of lakes and stream miles supporting their designated use for aquatic life. The state has used a

widely accepted method similar to the US EPA's Rapid Bioassessment Protocol in which select stream locations are sampled for benthic macroinvertebrates and examined for habitat impairment (stream conditions examined). The bottom dwellers of the stream, benthic macroinvertebrates, are critical links in the food chain and are crucial for the support of the high order icythyfaunal (fish) community. Animals in this group include a variety of aquatic insects and insect larvae, as well as worms and crustaceans. Benthic macroinvertebrates are commonly used in water quality assessment because they are continually exposed during their life cycles to extremes in the environment, and therefore they are ideally suited to serve as environmental indicators. For example, the Mayfly, Stonefly and Caddisfly families are sensitive to pollution and therefore, their presence in a stream indicates very good water quality or very low levels of organic pollutants.

The PA DEP has located 24 sampling stations in the Upper and Middle Neshaminy for this assessment. At each station, macroinvertebrate sampling and stream habitat evaluation was conducted. Once samples were collected, DEP biologists identified the invertebrate organisms and reviewed the taxonomic families collected, their relative abundances, and pollution tolerance ratings. The results were evaluated using biological criteria to determine whether the stream was healthy or impaired. Of the 24 stations sampled, 8 stations received impaired biology ratings alone and 6 stations received both impaired biology and impaired habitat ratings. Typical reasons for biological impairment were either a lack of abundance of organisms with good indicator status such as mayfly individuals, or a dominance of invertebrate families with low water quality indicator status (PADEP, 2002).

Unfortunately, it appears the impacts of urbanization have hit the benthic macroinvertebrate community especially hard. Data from the PA DEP (2002) indicates that many of the stream segments have impaired habitat, often because of riffle embeddedness caused by sedimentation and/or poor substrate and bank conditions. Because macroinvertebrate organisms rely heavily on the stream's system of natural riffles as primary habitat for most of their life cycle activities, the increased flows, plus sediment deposition and scouring that have resulted in the Upper and Middle Neshaminy Creek system, have adversely impacted the reproductive and feeding activities of many macroinvertebrates. Eggs are either scoured downstream or covered with sediment. Many species, particularly those not tolerant of poor water quality, have been tremendously reduced in terms of richness and abundance. Organisms adapted to hydrologic and water quality extremes proliferate.

Fish

As with the benthic macroinvertebrates, habitat change can mean fish species change or dominance by species that are more tolerant to environmental extremes. Those species reliant on riffles, rocks and vegetation for egg depositing, or those where egg nests located in larger constant pools are guarded by parents, can be seriously impacted. Sudden changes in flow regimes physically destroy eggs, which have been deposited and kill the fry. At the other end of the spectrum, sudden stream flow reductions and reduced stream baseflows means that biotic life in pools can be killed off quickly as these pools heat up and literally dry up.

Further, stormwater outfalls and sewage treatment plant effluent worsen the overall stream condition for the aquatic community by increasing flood flows, increasing sedimentation and erosion, increasing stream temperature, and then reducing water quality (e.g., high nutrient releases ultimately result in reduced dissolved oxygen levels that is insufficient to support fish life).

There is little data available on fish species diversity in the Upper and Middle Neshaminy and so it is difficult to quantify the effects of habitat impairment. One section of the watershed that was sampled in 2001 is the West Branch Neshaminy Creek in Hatfield Township. The PA DEP sampled the stream upstream and downstream of the Hatfield Sewage Treatment Plant (STP). Although one sample should not be regarded as representative of fish populations throughout the watershed, it can help to identify native species and perhaps those species that are more tolerant of water quality extremes due to the sample's close vicinity to the Hatfield STP.

The sample produced a list of species found and their relative abundances. The most abundant species found both above & below the STP effluent outfall were the Banded Killifish (*Fundulus diaphanous*), Tessellated Darter (*Estheostoma olmstedi*), American Eel (*Anguilla rostrata*), Satinfin Shiner (*Cyprinella analostana*), White Sucker (*Catostomus commersoni*), and the Redbreast Sunfish (*Lepomis auritus*). While some of these species are highly tolerant to environmental extremes, not all of them are found in waters with poor water quality. However, the Banded killifish, which was the most abundant species overall, tolerates areas with low oxygen and crowded conditions very well. Other tolerant species that were present in the sample included the Swallowtail Shiner (*Notropis hudsonius*), Fathead minnow (*Pimephales promelas*), and the Blacknose Dace (*Rhinichthys atratulus*). Also, it is interesting to note that some of the tolerant species (Swallowtail shiner & Fathead minnow) were found in greater abundance downstream of the STP effluent outfall, leading to the conclusion that more tolerant species may thrive in localized areas of lower water quality (these tolerant species can compete more easily in areas prone to low dissolved oxygen, high turbidity, or high levels of organic pollutants). All of the species found in the sample were native to Pennsylvania and are common in freshwater streams and rivers in the region (PA DEP, 2001 & PWD, 2001).

While the fish sampling conducted on the West Branch provides some indication of the fish species that can be found in the Upper and Middle Neshaminy, it does not represent species abundance throughout the entire watershed, due to environmental variability. Much more data must be collected throughout the watershed before a comprehensive fish species diversity assessment can be made.

G. Water Quality Sampling Data and Water Quality Problems in the Watershed

Although water quality in the Upper and Middle Neshaminy is not as well-documented as we might like, our understanding has benefited tremendously by recent data gathering and analysis work performed by the Pennsylvania Department of Environmental Protection. In the last several years, biological assessments have been conducted by the PADEP for various locations throughout the Upper and Middle Neshaminy Watershed (Figure 4-17). Macroinvertebrate sampling and stream condition information was collected at each site, and based on this information, the degree of impairment was determined and recorded. The information was then used to compile a list of impaired streams in the watershed and was the basis for Neshaminy Stream Listings on the State's 303d list of impaired streams.

The Delaware Riverkeeper Network (DRN) has also established a Volunteer Monitoring Program in the Neshaminy Watershed. Several water quality sampling stations have been routinely sampled (monthly) over the last several years (1998 – present). Sampling stations are located at the following sites:

1. Rt. 263 and Valley Road at the 8 Arch Stone Bridge (canoe launch) in Warwick Township
2. New Britain Park off of Matthews Road in New Britain Township
3. Upper Peace Valley Park in New Britain Township

DRN has established a comprehensive sampling program that includes chemical sampling and evaluation of streambank conditions and aquatic habitat. Chemical parameters include nitrate/nitrogen, ortho-phosphates, pH, dissolved oxygen, and temperature. Habitat and stream bank assessment includes embeddedness, consolidation, substrate composition, stream depth, and wildlife observations. Over the last several years, the sampling data observed consistently shows nitrate levels greater than 1 mg/L and dissolved oxygen levels of 11.1 mg/L. The pH readings typically range from 7-8.5. The nutrient levels (nitrate) suggest that water quality is diminished at these locations. Research suggests that normal nitrate levels in freshwater streams should be closer to 0.5 mg/L and the nitrate levels sampled here are a cause for concern, particularly when we consider the effect on downstream impoundments (such as Lake Galena). Nitrate levels of 1 mg/L are detrimental in lake systems and can lead very quickly to eutrophication, or enrichment.

There are five USGS surface water-quality stations in the entire Neshaminy Creek Watershed (three of the stations also served as stream flow stations). All five are currently inactive, although one, located on the Neshaminy Creek at PA Rt. 213 Bridge near Langhorne (outside of study area), was sampled as recently as 1999. Other sources of information included DEP inspection reports (permitted discharges), discharge monitoring reports (DMR's) for point sources, and background monitoring reports (BMR's) for groundwater monitoring wells.

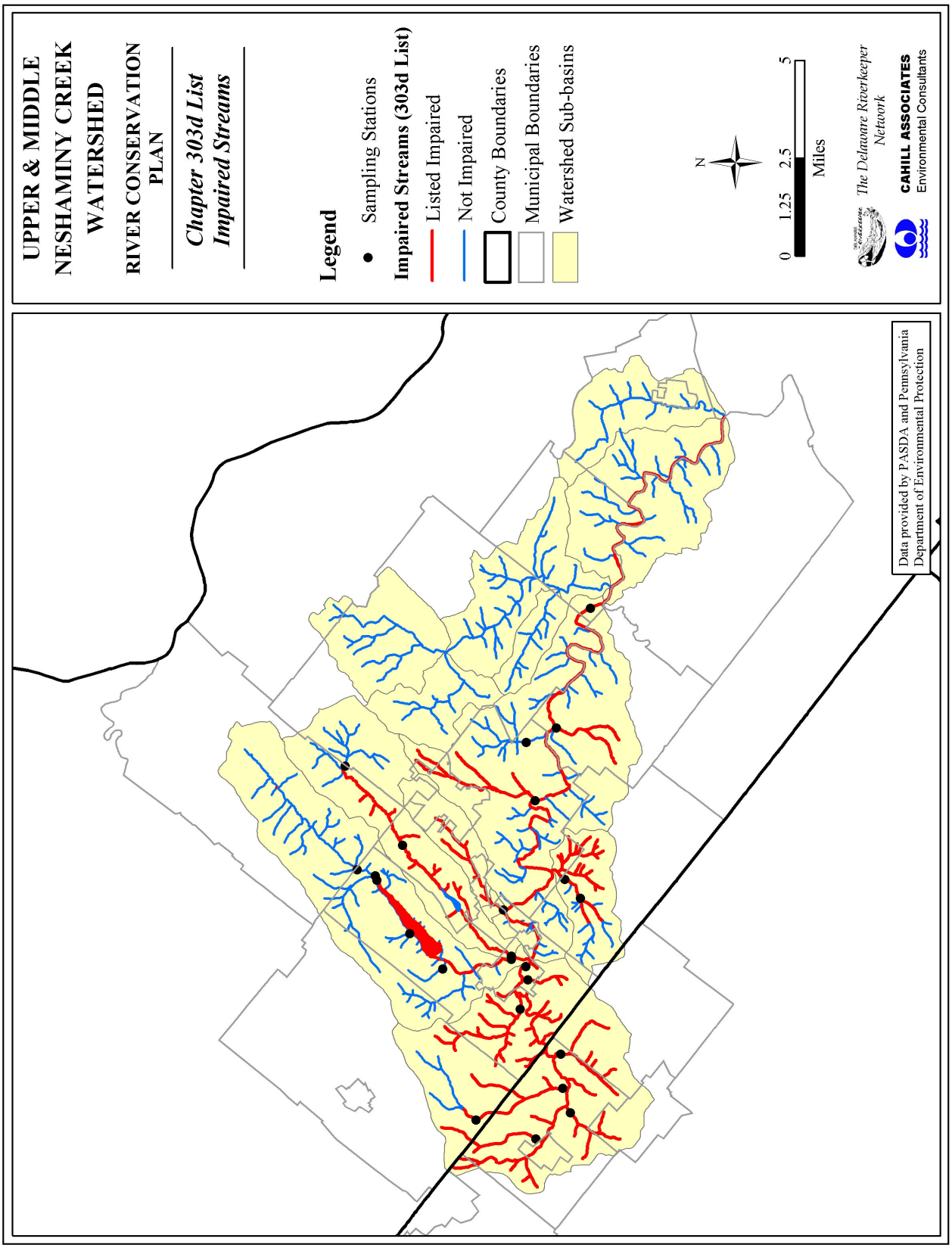


Figure 4-17. Impaired streams (303d) and sampling locations in the Watershed (PA DEP, 2002).

H. Water Quality and Aquatic Biota

PA Department of Environmental Protection, 1998 –2001

PADEP has performed biological assessment of the Neshaminy Creek Watershed in 1998-2001, including 24 stations using EPA's Rapid Bio-Assessment Protocol and habitat assessment methods. The purpose of this special study was to determine stream impairment, based on quality and quantity of habitat and the macroinvertebrate community data. This work also was to be used as the basis for the 303(d) list that PADEP is required to develop under the Federal Clean Water Act. Figure 4-17 indicates the findings based on this sampling. Substantial portions of the Upper and Middle Neshaminy Creek system (41.5 percent of the stations) are classified as "impaired," with the bulk of the impairment being located in the West Branch Neshaminy Subbasin and in the Main Stem Neshaminy Creek. Stream assessment details for each impaired stream are provided in Table 4-4. The sources/causes of impairment varied across the watershed, but consistent reasons included siltation and excessive algal growth due to high nutrient loadings from both point sources and urban runoff/storm sewers. Other causes of impairment were flow alterations from mining operations or other sources and algal growth from land development and upstream impoundments. As a result of the extent of impairment in the Upper and Middle Neshaminy, the watershed has been placed on the Unified Watershed Assessment Priority List and a TMDL is currently being developed for the pollutants causing stream impairment. (Watershed Restoration Action Strategy, PA DEP: 2000)

I. Point and Intermittent Point Sources of Pollution

Wastewater Treatment

There are various municipal wastewater treatment facilities within the Upper and Middle Neshaminy Creek Watershed. These facilities are publicly owned and treat wastewater from homes, public buildings, commercial establishments, and industries. In the Upper and Middle Neshaminy, municipal treatment plants discharge into the Main Stem Neshaminy Creek and Lahaska Creek. Municipal treatment plants are located in the following townships: Chalfont-New Britain, Lansdale Borough, Hatfield, Doylestown, Warwick, Buckingham, Montgomery, and Warrington. Figure 4-16 shows municipal and industrial discharges as provided by DRBC from 1998. A total of about 11 million gallons per day (MGD) are discharged from municipal wastewater treatment plants to the Neshaminy Creek.

Point sources of pollution also may include private wastewater treatment plants, including industrial processing facilities. There are 22 industrial dischargers in the watershed, none of which is especially significant in terms of quantity of flow and severity of pollutant load (according to voluntary reports from discharges). Most of the industrial discharge flow is composed of non-contact cooling water or manufacturing wastewater treated to remove organic pollutants, metals and other toxics. Obviously these treatment plant discharges themselves are not the cause of the water quality problems in the Neshaminy and its tributaries discussed here, although to the extent that these treatment plant effluents are discharged into the stream, water quality is negatively affected to some extent.

Table 4-4. Neshaminy Creek Watershed Sub-Basins: Impaired Streams
(PA DEP, 2002)

Neshaminy Watershed Tributaries	Length (miles)	Length of Impaired Stream (miles)	% of Tributary Impaired	Cause Of Impairment
Cook's Run	5.0	4.9	97.9%	Nutrients from urban runoff/ storm sewers
Lahaska Creek	9.9	0.0	0.0%	
Mill Creek (north)	18.0	0.2	1.3%	Flow alterations, siltation from surface mining, urban runoff/storm sewers & small residential runoff; nutrients from municipal point source
Mill Creek (south)	13.1	8.4	64.3%	
Neshaminy Creek (direct-drainage)	83.4	34.5	41.3%	Siltation from land development; Siltation, nutrients & water/ flow variability from urban runoff/ storm sewers & municipal point sources; Siltation & flow alterations from surface mining; Excessive algal growth & siltation from agriculture; Organic enrichment/Low D.O. and pH from municipal point sources
North Branch Neshaminy Creek	39.0	3.5	9.1%	Water/ flow variability and siltation from upstream impoundment
West Branch Neshaminy Creek	46.5	43.0	92.6%	Excesive algal growth from agriculture & municipal point sources; Water/ flow variability from land development; Pathogens from municipal point source
Newtown Creek	9.6	0.05	0.5%	
Pine Run	18.9	11.3	59.8%	Excessive algal growth from upstream impoundment; Siltation from land development
Robin Run	5.8	0.0	0.0%	
Watson Creek	6.1	0.0	0.0%	
TOTALS	255.2	105.9	***Total Impairment: 41.5%***	

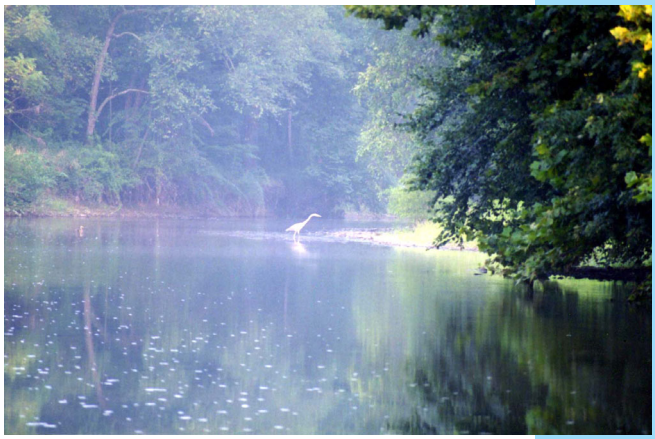
Source: Pennsylvania Department of Environmental Protection

Stream degradation associated with excess nutrients, phosphates, nitrates, sludge, fecal coliform bacteria, copper, chlorine, and bacteria from sewage treatment plants have been reported in the Neshaminy Creek, West and North Branch Neshaminy Creek and Cooks Run (WRAS, DEP: 2001). These impacts are exacerbated during low flow periods (when stream baseflow is lowest) and the stream flow is mostly comprised of wastewater effluent. Careful planning is necessary to prevent further impairment due to wastewater discharges, especially in light of the tremendous growth occurring in the watershed. As growth continues, several of the municipal plants may reach their capacity and expand as needed to accommodate future population projections. This will result in additional point source loadings in the watershed; frequently in the headwater streams, which are already stressed due to low baseflow, caused by increased groundwater withdrawal and reduced infiltration from developed areas.

Combined Sewer Overflows

Although combined sewer overflows are not specifically a point source of pollution (they are really intermittent point sources), and can be a significant source of pollution. Combined sewers are both a water quality blessing and a curse, in that combined wastewater and stormwater runoff flows are directed into wastewater treatment facilities up to a point at which treatment capacity is exceeded. At this point in order to protect the treatment plant, the system is designed to deflect overflows directly into a receiving stream without treatment, meaning that raw sewage plus runoff is discharged into the stream. Conversely, the good news is that before this overflow occurs, both sanitary wastewater as well as some amount of stormwater runoff (and this typically is the initial flush most laden with nonpoint source pollutants) is being treated at the wastewater treatment plant, in contrast to other conventional stormwater systems which discharge directly into streams.

Combined sewers are often found in older cities where one pipe is used to convey sanitary sewage and storm water runoff. During wet weather, flows of stormwater and wastewater, which exceed the wastewater treatment plant capacity are conveyed, untreated, to local water bodies. There are only 2 CSOs located in the watershed and both are in Lansdale Borough, but they are still a concern given the high level of impairment in the West Branch Neshaminy Sub-basin. Additionally, numerous former dumpsites and failing septic systems may also contribute to the water quality problems in the West Branch. All possible pollutant sources should be addressed in order to reduce the impact on the West Branch.



5. BIOLOGICAL RESOURCES

With every changing season,
With every rising sun,
With every passing shadow
Do the shifting scenes move on.
In the crimson tinge of sunset
Thy charms transported me,
And I've felt the glow reflected,
O, dear Neshaminy!

Verse Five from *Neshaminy*
by M.R.K. Darlington (1896)

Photo provided by DRN

5. BIOLOGICAL RESOURCES

A. Introduction

In the late 1600's, King Charles II of England gave William Penn the charter to a territory of almost 48,000 square miles (30 million acres) to repay a debt owed to Penn's father. "*The soil is good, air serene and sweet from the cedar, pine and sassafras, with wild myrtle of great fragrance"* wrote Penn in an early description of Penn's Woods. Pennsylvania was largely forested – though the Lenape burned and actively farmed the land – upon Penn's arrival, and he recommended, "…*care to be taken to leave one acre of trees for every five acres cleared*."

Philadelphia, built strategically near the confluence of the tidal sections of the Delaware and Schuylkill, rapidly evolved into the dominant city of both Pennsylvania and the new American nation directly because of Penn's Quaker ideals and comprehensive planning approach. The metropolitan population of Philadelphia quickly outgrew the city boundaries and numerous villages sprang up around its periphery. Connected to the villages was a regional network of plantations which supplied agricultural resources to support the growing population and economy (Fairmont Park Natural Lands Restoration Master Plan, 1999).

The natural physical characteristics of the Neshaminy Creek Watershed region – the soil and climate, fertile valleys, abundance of natural resources – influenced the development of agriculture, industry, and commerce. Early settlers realized the values associated with the Neshaminy Watershed landscape and cleared the woodlands to support their new life in the New World. Subsequently, farmers in the interior of the region demanded better transportation facilities to market their products, and during the years 1790 – 1820, a system of radial transportation routes extended from Philadelphia, and other important centers in the region. As regional transportation elements – the automobile, improved subway, and electrification of commuting rail services – progressed during the late 1800's, more and more city residents relocated to the country. The distribution between urban and suburban population became apparent during the early-to-mid-1900s, when the 1930 census showed a dynamic population increase in the suburbs and comparatively slower gains in the older established urban centers.

As discussed in Sections 2 and 6, suburban sprawl began during the 1970s and peaked throughout the 1980s and 1990s. The low-density development and sprawl that historically and presently occurs has diminished the existing natural biological and ecological resources of the Upper and Middle Neshaminy Creek Watershed. The simplest way to view the effects of land development on environmental resources is to compare the developed land to the undeveloped land (Figure 5-1). Using 1995 Land Use data provided by DVRPC (the most current GIS data available at Plan writing), we see that the Upper and Middle Neshaminy Creek Watershed have approximately 60% of the area classified in undeveloped uses (agriculture, wooded, vacant and water). All other uses comprise 40% of watershed area, though if we allow for the impacts of the last seven years of development, we can roughly estimate that 50% of watershed land is in developed uses and therefore 50% is in undeveloped uses. (It must be emphasized here that this assessment is certainly not comprehensive and detailed, and does not characterize the watershed

as a true Impervious Cover Analysis. Rather, this method is a general assessment used in a broad sense to show development impacts on the environment and natural resources).

The Wooded land that remains in the watershed (Figure 5-2), according to 1995 data, comprises 28 square miles, or 21%, of watershed area. This number, though likely decreased as described above, is overall an indicator of good watershed health. The remaining woodland primarily surrounds the main stem of Neshaminy Creek, though many of the important headwater tributaries include a wooded riparian zone.

This riparian zone is the most important area for high ecological resources and biodiversity since development has not encroached. The stream valley greenway that currently exists in the watershed is the primary natural resource feature in our suburban watershed, though it survives as a fragmented, disconnected resource. A patchy natural habitat has damaging implications for the ecological system including reduced species diversity, increased rates of species extinction, and establishment of invasive species. The existing greenway should be supplemented and restored with more and more "green" islands, in order to connect and link the environmental natural features.

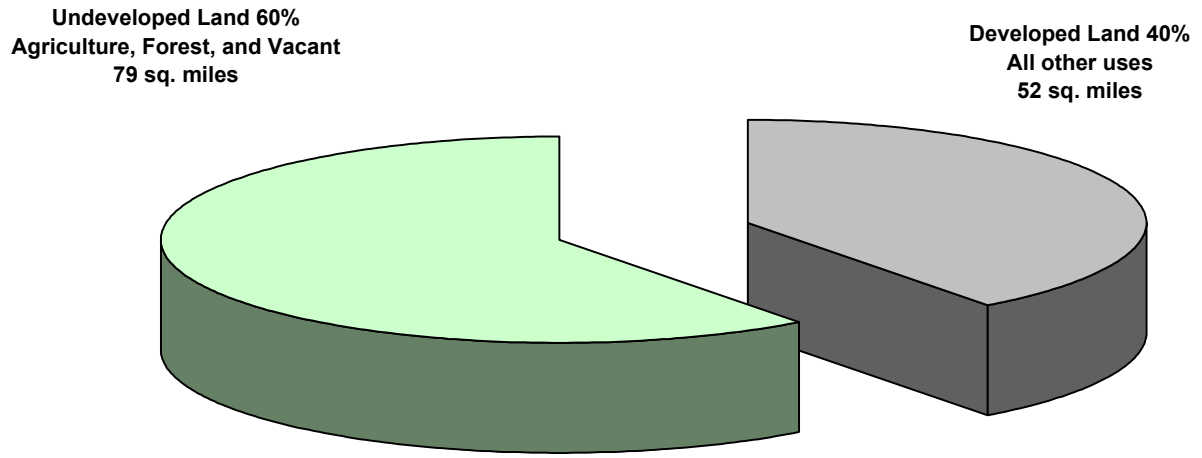


Figure 5-1. Developed Land Uses compared with Undeveloped Land in the Upper and Middle Neshaminy Creek Watershed (DVRPC, 1995 Land use data)

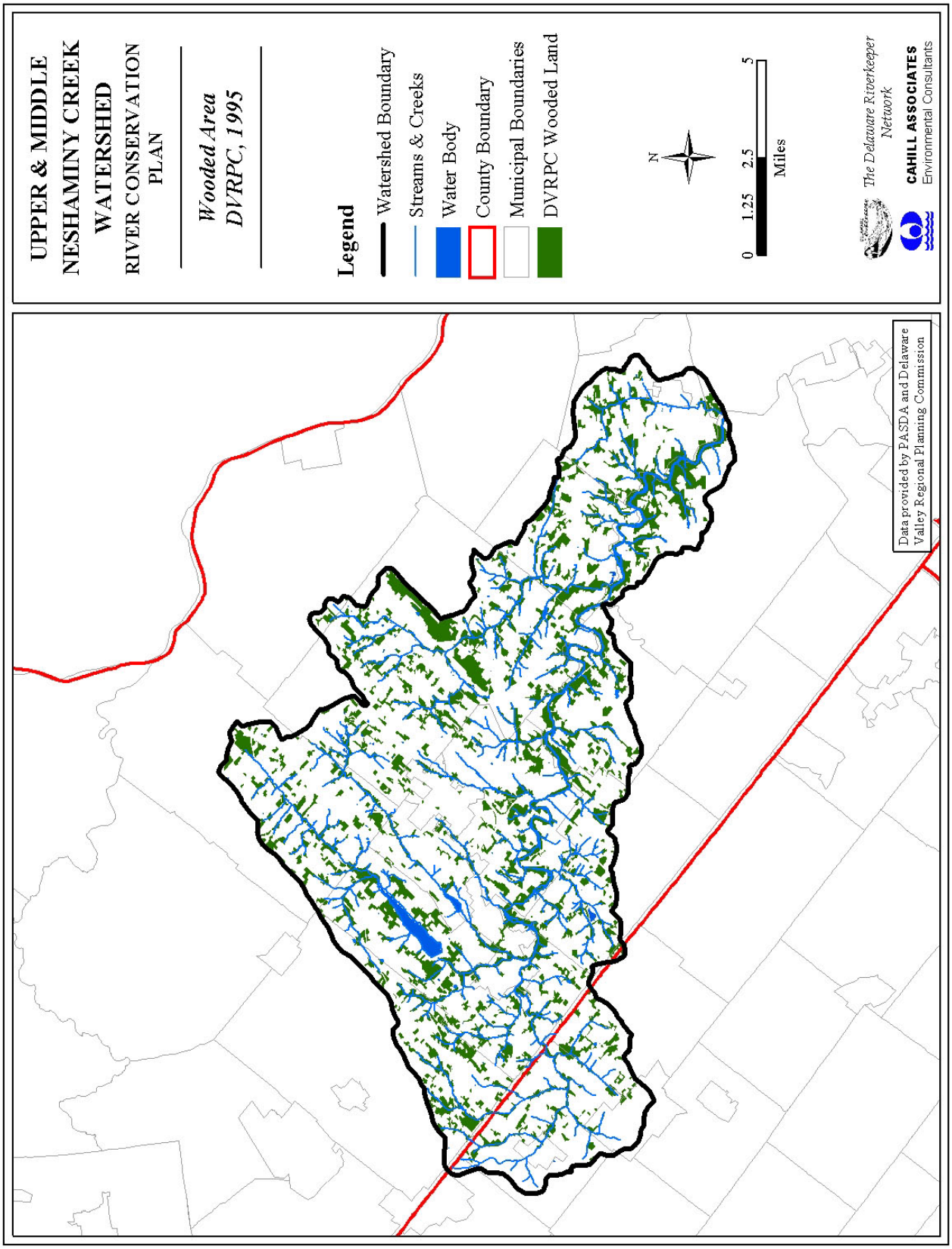


Figure 5-2. Wooded Land in the Upper and Middle Neshaminy Creek Watershed

B. Endangered Species at the Federal Level and Commonwealth Level

The Federal Endangered Species Act (ESA) passed in 1973 has been the primary mechanism of protection for plant and animal species that are in danger of extinction. The U.S. Fish & Wildlife Service (http://endangered.fws.gov/) is responsible for implementing the ESA in order to conserve and recover listed species and the ecosystems upon which listed species depend for survival. Under the Act, species may be listed as *endangered*, where a species is in danger of extinction throughout all or a significant portion of its range; or *threatened*, where a species is likely to become endangered within the near future. All plant and animal species (except pest insects) are eligible for listing, but have to first make the *proposed* or *candidate* list. An obvious challenge facing an endangered or threatened species is that by the time they make the list, they are already on the verge of extinction. The process of listing a species is quite complex but is the only legal means of long-term protection for the species at the federal level. Pennsylvania has 17 species on the federal list as endangered or threatened (Table 5-1) (http://ecos.fws.gov/webpage/). [Please note that plan preparers were unable to access more current data from the ESA database based on the following message: *Due to circumstances beyond the control of the U.S. Fish and Wildlife Service, the Environmental Conservation Online System and all related subsystems (CAP, CIMAS, HabITS and TESS) have been offline since December 7, 2001. Data updates have not occurred during this time period.*]

The protection of species is also achieved through federal partnership with the Commonwealth. In Pennsylvania, the responsibility for protecting vulnerable species lies with three separate agencies. The Bureau of Forestry within the Department of Conservation and Natural Resources (DCNR, http://www.dcnr.state.pa.us/wrcf/contents.htm) is responsible for protecting all plant species.

Table 5-1. Federally listed species in Pennsylvania (USFWS Threatened and Endangered Species System, 11/01/01)

ANIMALS		
Status	**Common Name**	**Scientific Name**
E	Plover, piping	*Charadrius melodus*
E	bat, Indiana	*Myotis sodalis*
E	clubshell	*Pleurobema clava*
T	eagle, bald	*Haliaeetus leucocephalus*
T	lynx, Canada	*Lynx canadensis*
E	mucket, pink (pearlymussel)	*Lampsilis abrupta*
E	pearlymussel, cracking	*Hemistena lata*
E	pigtoe, rough	*Pleurobema plenum*
E	pimpleback, orangefoot (pearlymusse	*Plethobasus cooperianus*
E	puma (=cougar), eastern	*Puma (=Felis) concolor couguar*
E	riffleshell, northern	*Epioblasma torulosa rangiana*
E	ring pink (mussel)	*Obovaria retusa*
T	turtle, bog (=Muhlenberg)	*Clemmys muhlenbergii*
E	wedgemussel, dwarf	*Alasmidonta heterodon*
PLANTS		
E	bulrush, Northeastern	*Scirpus ancistrochaetus*
T	pogonia, small whorled	*Isotria medeoloides*
T	spiraea, Virginia	*Spiraea virginiana*

The Pennsylvania Game Commission (PGC, http://sites.state.pa.us/PA_Exec/PGC/endangered/) is responsible for bird and mammal protection and the Pennsylvania Fish and Boat Commission (FBC, http://sites.state.pa.us/PA_Exec/Fish_Boat/etspecis.htm) has jurisdiction over fish, reptiles, and amphibians. DCNR hosts a web site (http://www.dcnr.state.pa.us/wrcf/contents.htm) that describes Pennsylvania-listed species, their native habitat, and provides maps of historic and present species distributions. A total of 67 species are listed as threatened or endangered in Pennsylvania

Table 5-2. Pennsylvania listed species from PADCNR, PAGC, PAFBC; 11-01-01

Status	Common Name
BIRDS AND MAMMELS	
T	American Bittern *
E	Bald Eagle
E	Black Tern
E	Delmarva Fox Squirrel
T	Eastern Woodrat
T	Great Egret *
E	Indiana bat
E	King Rail *
T	Least Bittern *
E	Least Shrew
E	Loggerhead Shrike
E	Osprey *
E	Peregrine Falcon *
T	Sedge Wren *
E	Short-Eared Owl *
T	Small-Footed Myotis
T	Upland Sandpiper *
T	West Virginia Water Shrew
T	Yellow-Bellied Flycatcher
T	Yellow Crowned Night Heron *
PLANTS	
T	Box Huckelberry
E	Canby's Mountain-lover
E	Eared False-Foxglove
E	Glade Spurge
E	Hispid Gromwell
E	Jacob's Ladder
T	Jeweled Shooting-Star
E	Large-Flowered Marshillia
E	Northeastern Bulrush
T	Serpentine Aster *
T	Shale-Barren Evening Primrose
T	Showy Lady's Slipper
E	Small Whorled Pogonia
E	Spreading Globeflower
E	Swamp Pink
E	Tall Larkspur
E	Variable Sedge *
E	White Monkshood
FISH	
T	Atlantic sturgeon *
T	Bluebreast darter
T	Burbot
T	Channel darter
E	Eastern sand darter
T	Gilt darter
E	Gravel chub
E	Lake sturgeon
E	Longhead darter
E	Longnose sucker
T	Mountain brook lamprey
T	Mountain madtom
E	Northern brook lamprey
T	Northern madtom
T	Ohio lamprey
E	Shortnose sturgeon *
E	Spotted darter
E	Tippecanoe darter
REPTILES	
E	Bog turtle *
E	Kirtland's snake
E	Massasauga rattlesnake
T	Red-bellied turtle *
T	Rough green snake
AMPHIBIANS	
E	Coastal plain leopard frog *
E	Eastern mud salamander
T	Green salamander
E	New Jersey chorus frog
MUSSELS	
E	Clubshell
E	Northern riffleshell

* *Historically or presently found in study area*

(Table 5-2). According to PADCNR records, ten birds, two fish, two reptiles, one amphibian, and two plants (8 endangered, 9 threatened) have habitat within the watershed region. Additionally, there are some species that are not listed as threatened or endangered but whose range has been altered. For example, the Dwarf Wedge Mussel (*Alasmidonta heterodon*) historically inhabited the entire Neshaminy Watershed as well as other areas of the Delaware River drainage. Currently, the mussel's range is significantly reduced and the species is presumed extirpated in the Neshaminy Watershed.

C. Pennsylvania Natural Diversity Inventory

Pennsylvania Natural Diversity Inventory (PNDI, http://www.dcnr.state.pa.us/forestry/pndi/pndiweb.htm) was established in 1980 as a cooperative project with the PADCNR Bureau of Forestry, The Nature Conservancy (TNC, http://nature.org/), and Western Pennsylvania Conservancy (http://www.paconserve.org/). PNDI partners collect data and conduct inventories to describe and identify Pennsylvania's endangered, threatened and rare species ("special concern" species), storing this information in a computerized data management system. In addition to species, PNDI provides for the most outstanding examples of Pennsylvania's natural communities and geologic features ("Critical Sites" or "Priority Areas"). After surveying the ecological resources of a county and identifying the outstanding species and areas, each site is ranked from 1 to 5 (1 being the highest priority) in order to prioritize conservation of these areas. The goal of the PNDI program is "…to provide accurate and accessible ecological information needed for conservation, development planning, and natural resource management."

In 1999, the Morris Arboretum collaborated with the Bucks County Open Space Task Force and PNDI to complete a *Natural Areas Inventory* for submittal to the Bucks County Commissioners. This inventory identifies and prioritizes the most significant remaining natural features in Bucks County, and thus serves as a tremendously valuable resource to this RCP. Though concerns exist with explicitly showing locations and species types, it is important for plan readers to be aware that rare species, areas of high biodiversity, and outstanding natural communities do exist in the watershed. Below is a summary of the findings of the Bucks County Natural Areas Inventory and the Montgomery County Natural Areas Inventory. The descriptions included highlight those areas in the watershed which must be conserved and protected and offer steps for appropriate resource management.

Dark Hollow County Park

The Bucks County Commissioners dedicated Dark Hollow Park (Figure 5-3) in 1989 when they first cancelled the Dark Hollow Dam proposal. The park extends along the Neshaminy Creek for a distance of almost 6 miles, through Buckingham, Doylestown, and Warwick Townships. Dark Hollow Park is over 650 acres of permanently protected land, with a variety of landscapes including floodplains, forested steep slopes, and overhanging rock cliffs known as the Neshaminy Palisades (DRN Fact Sheet #2). The floodplain contains vernal ponds that provide reptile and amphibian habitat. Plant communities range from early successional floodplain stands to mature talus slope forests. Three locally rare plant species are found in Dark Hollow Park. This site is listed as a Priority 2 Site based on its overall quality, diversity, and importance of the resources contained.

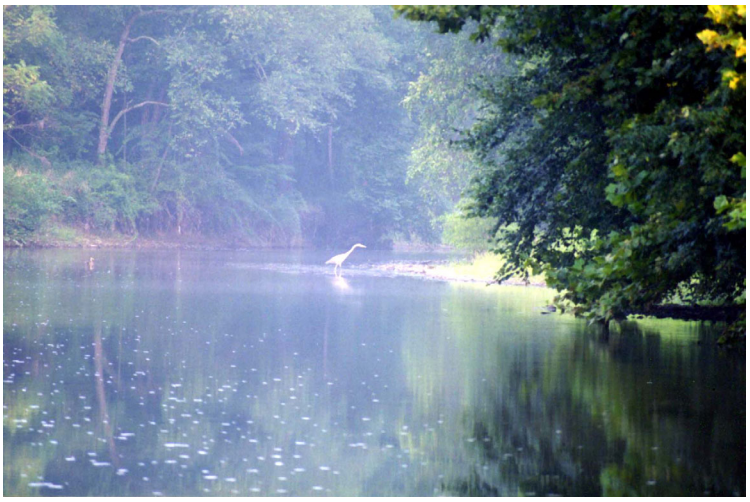


Figure 5-3. Dark Hollow Park in Bucks County

Forks of the Neshaminy

The confluence of the Little Neshaminy Creek with main-stem Neshaminy Creek is within Warwick, Wrightstown, and Northampton Townships. According to the Bucks County Natural Area Inventory, no rare species exist, but is considered a Priority 2 Site based on the pristine nature of the surrounding riparian and floodplain zone. The site contains extensive wooded slopes, with species such as red oak, sycamore, silver maple, birch and tulip tree.

Peace Valley Park

Peace Valley Park (Figure 5-4) consists of almost 1500 acres of public land surrounding a 365-acre impoundment of Lake Galena. Along with Lake Galena, the park's hydrologic resource includes the North Branch Neshaminy Creek within New Britain Township. A population of red belly turtles (*Pseudemys rubriventirs*), which have a status of Pennsylvania threatened, have habitat near the lake. Peace Valley Park is designated a National Audubon Important Bird Area (see Birds discussion below for more description) because of the number and diversity of water-fowl present throughout the year.

Figure 5-4. Peace Valley Park in Bucks County

D. Local Species Interactions

All forms of life evolve in close interaction with their immediate environment. Native plant and animal species co-evolved under a variety of local pressures to fit the conditions of today's environment. Species develop individual mechanisms to protect themselves from predators. Native plants have built-in capacities to handle stress and meet the nutrient requirements of native wildlife. However, when a new species is introduced - accidentally or not - it can have disastrous impacts on native flora and fauna that have no defenses against such invaders.

Non-native species - also known as introduced species, invasive species, exotics, or aliens – cause substantial harm to existing ecosystems, second only to habitat destruction and fragmentation. Introduced into an environment in which they did not evolve, exotic species usually have fewer predators or diseases and thus their populations may grow uncontrolled by local biological factors. Prey organisms may not have evolved defense mechanisms and native species may not compete successfully for space or food, and so are often pushed to extinction. Since exotic species are often self-perpetuating, they can become a permanent threat to biodiversity, equal to overexploitation and habitat loss. Invasive species are considered as a factor contributing to the endangered or threatened status of 42% of animals and plants on the U.S. Federal endangered species list, according to USFWS.

The Upper and Middle Neshaminy Creek Watershed sits in the *Eastern Broadleaf Oceanic Forest Ecological Province* (Figure 5-5). Historically this area was characterized as an oak-chestnut forest, named for the dominant native tree species the American chestnut (*Castanea dentata)*. Up until the early 1900's, the chestnut was a major tree co-dominating forests in the region, reaching over 100 feet in height and outnumbering all other tree species. Ecologically and commercially, this species was important throughout much of Eastern North America. By 1940, three and a half billion American chestnuts perished from blight, a Chinese fungus brought into America accidentally on a shipment of Asian nursery stock. The lethal fungus spread rapidly throughout the eastern forests, dispersed by wind, rain, birds and other animals, resulting in one of the worst ecological disasters in North American history. The chestnut (Figure 5-6) is now considered biologically extinct throughout the region. Chestnut blight is but one example of the potentially catastrophic impact that an exotic species can have on a previously healthy ecosystem. (Another such example is the devastating effect that Dutch elm disease had on the American elm; see below.)

Vegetation and Flora – Native and Introduced

The Pennsylvania Flora Project, Botany Department, Morris Arboretum of the University of Pennsylvania (http://www.upenn.edu/paflora/index.htm) provides an online database of plant species found in Pennsylvania, searchable by many attributes, including native/introduced, federal/state status, growth habit, wetland status, or federal/state noxious weed status.

The Eastern Broadleaf Coastal Forest Ecological Province ecoregion is dominated by Appalachian oak forests, and characterized by white oak (*Quercus alba)* and northern red oak (*Q. rubra)*. Other deciduous or evergreen trees that are native to Pennsylvania and found within the watershed region include eastern hemlock, pitch pine, sweetgum, elm, sycamore, pin oak, red,

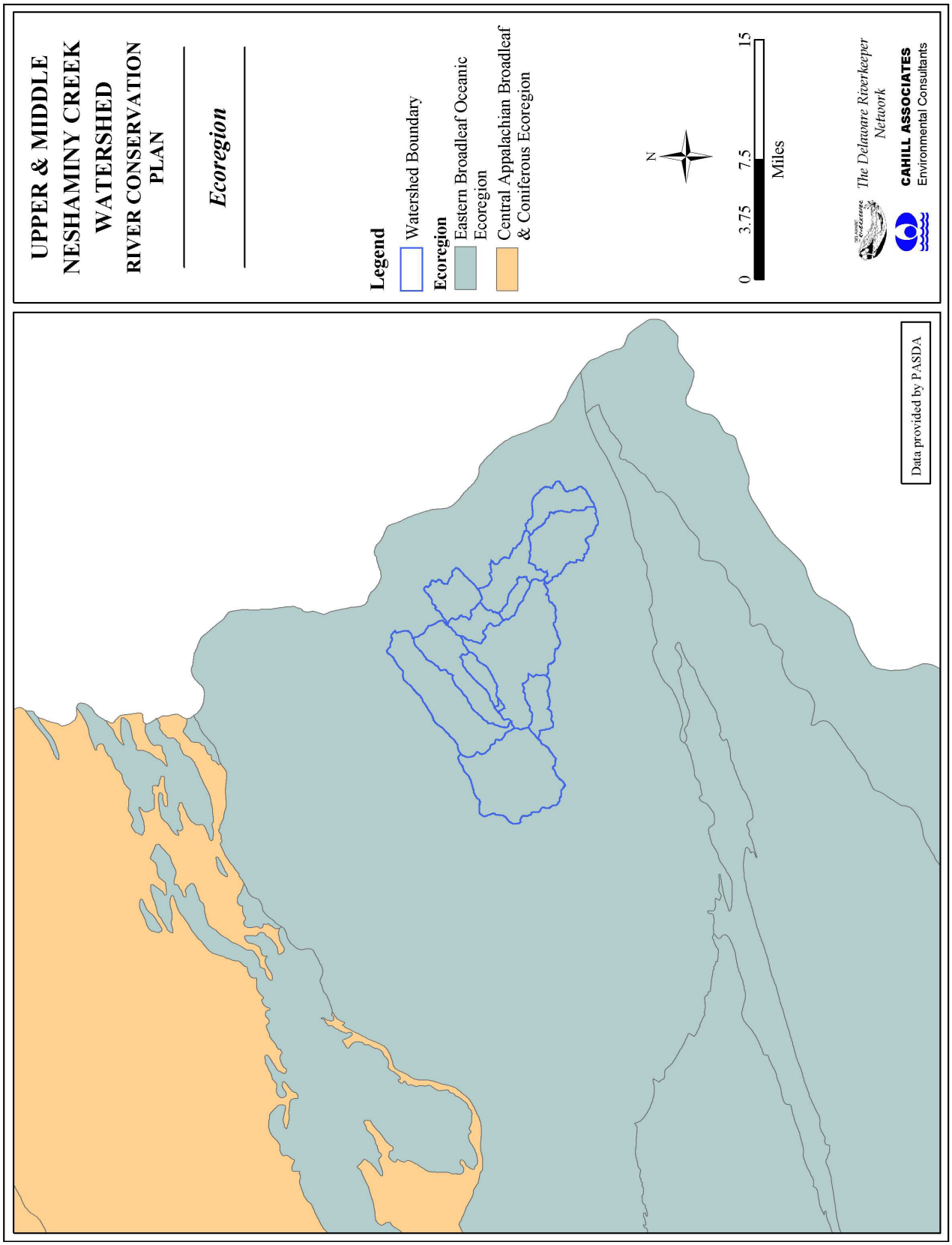


Figure 5-5. Eastern Broadleaf Oceanic Forest Ecoregion

Figure 5-6. The American chestnut tree was once common in Eastern North America

sugar and silver maple, white ash, American beech, black birch, sassafras, black cherry, tulip tree, hickory, black walnut, and flowering dogwood. Introduced deciduous or evergreen trees now commonly found growing wild throughout the Neshaminy Creek Watershed include Norway spruce, horsechestnut, tree-of-heaven (ailanthus), princess tree (royal paulownia), silktree mimosa, weeping willow, ginkgo, Japanese maple, and Norway maple. Trees which are native to other regions of the US, but introduced to the watershed, include baldcypress, osage-orange, jack pine, catalpa, and red, blue and white spruce. Additionally, the American elm population has been severely impacted due to the introduction of Dutch elm disease into the watershed region (www.na.fs.fed.us/spfo/pubs/howtos/ht_ded/ht_ded.htm).

Typical native shrubs found in the Neshaminy Creek Watershed include witch hazel, rhododendron, mountain laurel, high-and low-bush blueberry, viburnum and spicebush. Native vines found in the area include dewberry, purple clematis, Virginia creeper, poison ivy, and trumpet creeper. Non-native shrubs and vines that may dominate the shrub layer include Japanese and bush honeysuckle, wisteria, Japanese knotweed, multiflora rose, and autumn olive. Some invasive vines become wound tightly around trees as they grow, sometimes strangling them, resulting in death to part or the entire tree. In this watershed, several invasive vines that are a substantial problem to the local ecosystem include wild grape, oriental bittersweet, English ivy, and kudzu.

Kudzu, a high-climbing perennial vine from eastern Asia, is severe example of a highly invasive exotic vine species. In the 1930s, the Soil Conservation Service promoted kudzu as a soil builder and erosion control aid, and actually paid farmers to plant it. Although the vines are killed each year by frost, the deep fleshy roots survive through winters and resprout with vigor each spring. Kudzu is abundant throughout the southeastern United States and is now encroaching northward, with disastrous effects. Kudzu grows on roadsides and railroad embankments, in vacant lots, in timberlands, and in fields (Figure 5-7)

Typical native wildflowers found in the watershed region include jack-in-the-pulpit, mayapple, dog-tooth violet, spring beauty, phlox, purple coneflower, eastern columbine, brown-eyed susan, speedwell, and milkweed. Many cultivated flower species are used in landscaping and may escape to the wild environment, causing substantial harm to the native population. Over-browsing by deer also worsens problems with invasive exotic species of plants, as deer feed preferentially on native species, allowing non-native invaders to expand and prosper. Due to the combined impact of deer over-browsing and competition from invasive species, native forest wild-

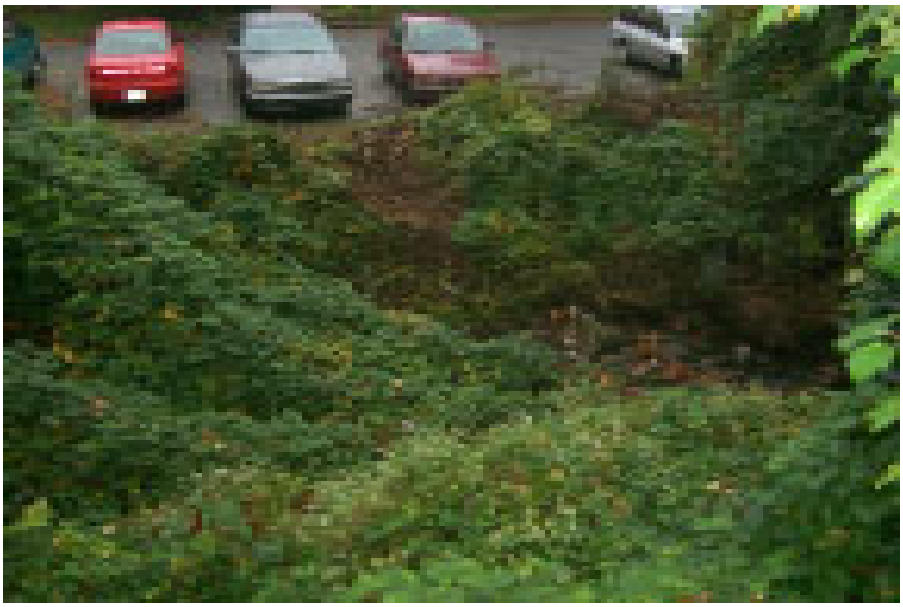


Figure 5-7 Kudzu vine growing over a stream bank

flowers have been replaced by stands of invasives, like stiltgrass, garlic mustard, lesser celandine, and crown vetch.

Deliberate removal of invasive shrubs, vines, and wildflowers on both public and private land should be implemented immediately in accordance with RCP goals (see Section 7). Physical removal of the plants, rather than chemical herbicide spraying, is preferable, in light of the obvious hazard of ground-water contamination from harsh, toxic herbicides. These chemicals are almost always poisonous to people, as well as other animals, and can ultimately do more harm than good to the ecosystem, even when carefully applied.

Wildlife

Inherently connected to the flora within the oak-chestnut forest (or oak-hickory forest as it is also known) are the associated faunal species. A healthy vegetative community is an assemblage of plants and animals coexisting and interacting. Overall, the fragmented nature of the sites vegetative community provides habitat for species most commonly associated with forest/field edges (e.g., eastern cottontail, white-tail deer, raccoon, song sparrow, mockingbird, red-tailed hawk) and small woodlots (e.g., Carolina chickadee, downy woodpecker). Species requiring larger tracts of unbroken forest such as Neotropical migrant forest warblers, vireos, and thrushes are

probably limited in number in the watershed, but likely are regular breeders in any remaining lots of mature forest.

Mammals

White-tailed deer, chipmunk, woodchuck (groundhog), opossum, skunk, red fox, eastern cottontail, raccoon, flying squirrel, bat, muskrat, eastern mole, rat, field mouse, and the ubiquitous gray squirrel are common mammalian species currently found throughout the watershed region. These species are typically found in the rest of the state as well. This may appear to be somewhat non-notable, but the lack of observed species diversity is directly based on the elimination of the all-important species habitat. Few animals, other than those listed above, are willing or even able to co-exist with humankind when faced with the enormous impacts of urban development on their habitat. Mammals that have been completely eliminated or that no longer have significant breeding populations in the watershed include bear, moose, beaver and mountain lion. Some of the above species may be returning however, as in recent years there have been individual observations of the mountain lion and the eastern coyote. Small beaver communities have also been observed in the watershed, although it is unknown whether these individuals are native or are migrants from other areas.

Deer are a normal component of the forests of Pennsylvania; however, deer numbers have grown to unnaturally high levels because of the elimination of large predators and the availability of abundant habitat and food sources such as agricultural fields, suburban landscaping, and edge habitat resulting from suburban development and sprawl. High deer populations can alter the diversity and structure of forests through browsing of the understory vegetation. The ability of a forest to regenerate is threatened when seedling and sapling trees are over-browsed, along with forest floor plants such as wild flowers, grasses, and sedges. Deer also feed preferentially on native species, allowing exotic invaders to flourish.

Birds

Habitat loss and fragmentation are the most serious threats facing populations of birds across America and locally within the Neshaminy Creek Watershed. Unless rapid destruction and degradation of habitat can be slowed, populations of many birds may decline to dangerously low levels. Of the world's 9,700 bird species, almost 4,300 occur in the Americas. Of most concern to scientists is that 353 of these are classified as threatened with extinction, and many more are suffering from long-term population declines. Pennsylvania harbors a significant portion of the world breeding population for many forest bird species as well as over-wintering and migration habitat. Local organizations, including the Pennsylvania Audubon Society, Bucks County Audubon Society, and others are promoting conservation, education, and habitat restoration for bird species within the watershed area.

The Important Bird Area (IBA) Program (managed by the National Audubon Society http://www.audubon.org/bird/iba/state_coords.html and coordinated through state offices) is a worldwide effort to identify and protect outstanding habitats for birds and is pivotal to a continent-wide bird conservation strategy. Pennsylvania was the first state to develop an IBA program in the United States. Based on strict scientific criteria, a group of scientific advisors (known as the Ornithological Technical Committee) selected 73 Important Bird Areas encompassing over one million

acres of public and private lands within the state. Peace Valley Park in New Britain Township is the only IBA in the Neshaminy Creek Watershed, with more than 250 birds observed. The IBA Technical Committee selects additional IBA sites in Pennsylvania on an ongoing basis. Future work of the IBA program will include the development of volunteer bird monitoring efforts, public education, conservation and management plans, and identification of additional IBAs. Important Birding Areas are a PADCNR conservation priority, and funding is available to help plan or acquire potential areas.

THE OLDEST HOUSE IN BUCKS COUNTY.

6. RECREATIONAL & CULTURAL RESOURCES

Flow on, thou peaceful stream,
And teach me while I'm here,
For when I'm parted from thee
Will many an hour seem drear.
I'll search for sister streams,
But none can ever be
The same dear bosom friend of mine,
As thou, Neshaminy!

Verse Six from <u>*Neshaminy*</u>
by M.R.K. Darlington (1896)

6. RECREATIONAL AND CULTURAL RESOURCES

A. Recreational Resources

The Upper and Middle Neshaminy Creek Watershed contains an abundance of recreation sites and facilities. Their locations have been mapped using municipal Open Space Plans and state-wide GIS data available online from Pennsylvania Spatial Data Access (Figure 6-1). These valuable recreation areas are a wonderful beginning to conservation efforts in the watershed and provide opportunities for growth and expansion throughout the study area. In this RCP, several different types of land uses were classified as recreational areas because of their potential for passive or active recreation. These land use types varied from areas clearly designated for recreational use such as state or county parks, to areas that may not typically be considered recreation sites such as wooded areas and private and municipal open space. These latter areas often encompass large areas utilized for passive recreation. Recreation types incorporated into this RCP include the following: state, county and municipal parks, county, municipal and private open space, nature centers, municipal recreation centers, private recreation areas, school yards, and wooded areas.

A total of 1,351 acres of recreational land from DVRPC 1995 land use files also are included as existing recreation areas within this watershed (Figure 6-1). Overall, recreational sites are well distributed within the watershed, with many locations adjacent to or in the vicinity of surface water features. For example, several of the impoundments situated in the watershed serve as recreational locations that provide boating and fishing opportunities for residents and visitors alike (Figure 6-2). The main stem Neshaminy Creek could be considered a recreational site in itself as it provides space for popular activities such as canoeing and fishing (Figure 6-3).

Figure 6-2. Boating is a popular recreation activity at Lake Galena in Peace Valley Park.

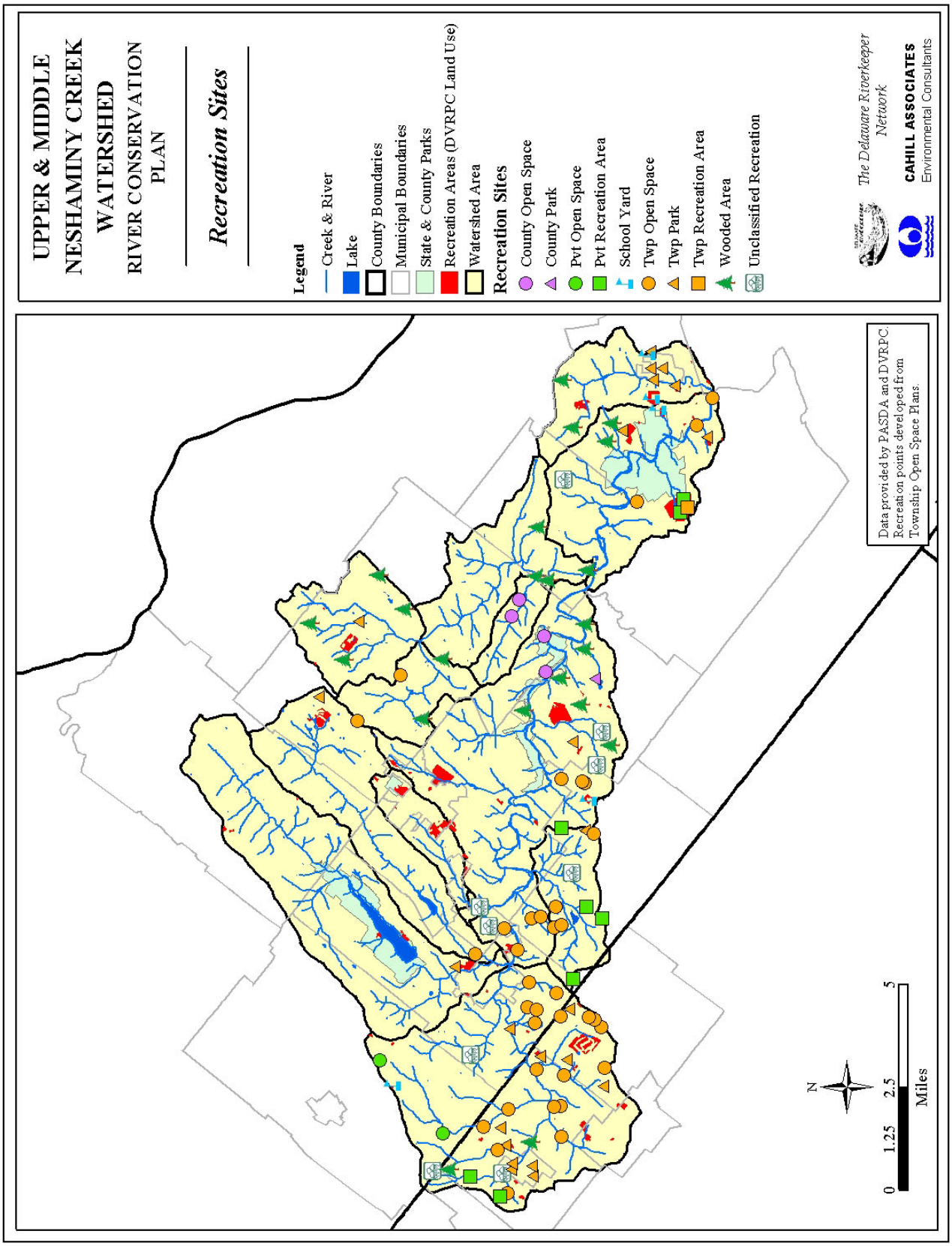


Figure 6-1. Recreation Sites in the Upper and Middle Neshaminy Creek Watershed

Figure 6-3. A fisherman along the Creek.

The wealth of open space and recreation areas, many of which have been permanently protected, are a great asset to this watershed, particularly when we put into perspective the tremendous growth that the watershed has experienced in the last several decades. It is extremely important that as growth planning continues in this watershed, stakeholders and decision makers realize that it is not too late to permanently protect certain areas of this watershed, and that they endeavor to balance growth and conservation. At this point, the watershed is highly vulnerable to the severe watershed degradation often caused by careless planning and development decisions. This is the time to act and to change policy and decision making practices so that the Neshaminy does not become like so many other urban watersheds, virtually devoid of open space with critically impaired water resources (quality and quantity).

State Park System – Tyler State Park

One very large and important recreational holding within the watershed is Tyler State Park, located in Newtown and Northampton Townships. The park is situated on the Neshaminy Creek within the lower Main Stem Neshaminy drainage and is approximately 1,670 acres in size. This park and the areas surrounding it, such as Bucks County Community College and other institutional land, provide a protective buffer for 3.2 stream miles of the Main Stem Neshaminy Creek and about 4.7 miles of tributaries to the Main Stem. Considering the intense development located along many portions of the Neshaminy, the protection provided by Tyler State Park is critical to this vital resource.

Many recreational opportunities exist within the park as it provides picnicking areas, various trail systems, a frisbee golf course, fishing, boating, overnight accommodations, and an environmental education program (Figure 6-4). The extensive trail system includes 10.4 miles of paved bicycle trails, 4 miles of gravel hiking trails and 9 miles of bridle trails. Fishing can be enjoyed

Figure 6-4. Pedestrians enjoy the view along the Neshaminy in Tyler State Park.

along the banks of the Neshaminy or from a canoe, which are seasonally available for rent at the park. A boat launch is provided for registered non-motorized boaters.

The park also contains several historical features. Before becoming a state park, the land was owned by Mr. and Mrs. George Tyler who operated a successful dairy and livestock farm on the property. There are various examples of early farm dwellings of rural Pennsylvania located within the park, several of which now serve as cultural resources. The Spring Garden Mill, originally a grain and feed mill, is leased to the Langhorne Players. It has been converted to a theatre and is used for recreational and cultural events in the park (www.dcnr.state.pa.us/stateparks/parks/tyler.htm#recreation). Another historic feature is the Schofield Ford Covered Bridge. The bridge, built in 1874, is the largest covered bridge in Bucks County. Although the bridge was destroyed by fire in 1991, a group of concerned citizens organized the reconstruction of the 166-foot bridge using authentic materials and methods.

Recognizing the region's place in history, the park continues to lease about one quarter of the property for cultivation. Crops are maintained using modern conservation practices and in 1999 several fields were planted with native grasses to provide habitat for a variety of wildlife. The park is enjoyed by thousands of visitors each year and provides a valuable recreation area within the lower portion of the Upper and Middle Neshaminy Creek Watershed.

County Park System

There are two county parks located in the Upper and Middle Neshaminy Creek Watershed. Peace Valley Park, situated in the North Branch Sub-basin and Dark Hollow Park, located in the Main Stem Neshaminy drainage provide steam corridor buffers and protection from development. The parks are quite different in atmosphere, with Peace Valley Park offering more tradi-

tional park programs, while Dark Hollow Park is an undeveloped natural area useful for more passive recreation.

Peace Valley Park and Nature Center, located in New Britain Township, is 1500 acres in size and supplies a variety of recreational opportunities. A major feature of the park is Lake Galena, a 365 acre manmade lake created by a dam constructed for flood control in the 1970's (Figure 6-5). Although the lake suffers from water quality problems caused primarily by agricultural and urban runoff, it provides a space for active water sports. A boat rental operates seasonally at the park for non-motorized watercraft and fishing is permitted. Several playgrounds and picnicking areas

Figure 6-5. Aerial view of Lake Galena

are located in the park, and it contains paved bicycle trails and 14 miles of nature trails. The nature center and gift shop are open year round and the nature center offers environmental education programs that are utilized by local schools and community groups.

Dark Hollow Park is a 650-acre linear park situated along the Main Stem Neshaminy Creek in Warwick, Buckingham, and Doylestown Townships. The park is not developed and serves as a protected natural area along the Creek. The park can almost be considered one large riparian buffer surrounding the Main Stem Neshaminy for approximately 7.8 stream miles. The primary recreational use in the park is fishing and trout stocking takes place annually. The park is open year round and provides a more passive recreation area for those who prefer a peaceful interaction with nature.

Township Parks and Other Recreation Sites

There are 24 township parks and 31 Township owned open space areas in the Upper and Middle Neshaminy Watershed. A variety of other recreational areas, both privately and publicly owned, exist in the watershed as well. All of these recreation types and their locations are shown in

Figure 6-1. A majority of the recreational areas within the watershed are situated near the Neshaminy Creek and its tributaries. All of these recreation areas and their associated stream systems provide a variety of leisure opportunities for residents and visitors of the watershed. Because they are typically located adjacent to surface water features, their protection and enhancement coincides with that of the creeks themselves. By evaluating the locations of the various recreational elements, one can begin to realize the potential for recreational and conservation linkages in the watershed. Although the watershed has undergone a tremendous amount of growth and development in the last several decades, remarkably the watershed continues to provide a rural open space atmosphere in many areas. With careful planning, this rural landscape can continue to be protected and enhanced in the Upper and Middle Neshaminy Watershed.

Stream Stocking Program

The Pennsylvania Fish and Boat Commission (PFBC) undertake an annual fish-stocking program in various streams throughout the Commonwealth. Fish stocking includes trout (3.8 million per year) as well as 100 million fry, fingerling, and adult warm water fish. Last fiscal year (9 July 2000 through June 2001), PFBC maintained a Fall Trout Stocking Program (146,000 legal size trout in 161 waterways), a Winter Trout Stocking Program (95,000 adult trout in 61 lakes) and a Late Winter Program (90,000 adult trout in 58 waterways). In the 2002 season, PFBC has designated one segment of the Neshaminy in the Upper and Middle Neshaminy Creek Watershed for stocking, as outlined below. Clearly, this stocking program has tremendous recreational value for the watershed.

Neshaminy Creek	4/22/02 4/29/02 5/22/02	Fr second tributary above Rt. 263 (York Rd); downstream to second tributary below Mill Rd. in Dark Hollow Park

B. Trail Resources

Surprisingly, with the large amount of recreational areas in the watershed, there is a lack of significant trail systems outside of Park Trail Systems. However, as noted in the municipal open space plans, additional trails are being proposed, particularly trails that link recreational areas and parks and those that create greenways along the Neshaminy and its tributaries. The existing and proposed trail systems in the Upper and Middle Neshaminy Watershed are shown in Figure 6-6. This data was developed from Municipal Open Space and Comprehensive Plans.

The majority of existing trails are located in the northern part of the watershed in the North Branch Sub-basin. Trails situated in the North Branch Sub-basin include the Neshaminy-North Branch Trail, the Point Pleasant Trail, and the Peco Trail. The portion of the Neshaminy-North Branch Trail within the study area starts in New Britain Township on the North Branch at the New Britain Twp. boundary with Chalfont Borough. It traverses adjacent to the main stem of the North Branch through Peace Valley Park and Lake Galena. The trail continues along the North Branch into Plumstead Township. In Plumstead Township the Neshaminy Trail meets another trail, the East & West Peco Trail. The West Peco Trail meets the Neshaminy Trail on the North Branch just before Valley Park Road and the East Peco Trail meets it just above Durham Road at the headwaters of the North Branch. After the crossroads of the Neshaminy and E. Peco Trail the Neshaminy Trail becomes the Point Pleasant Trail and heads towards the Delaware River.

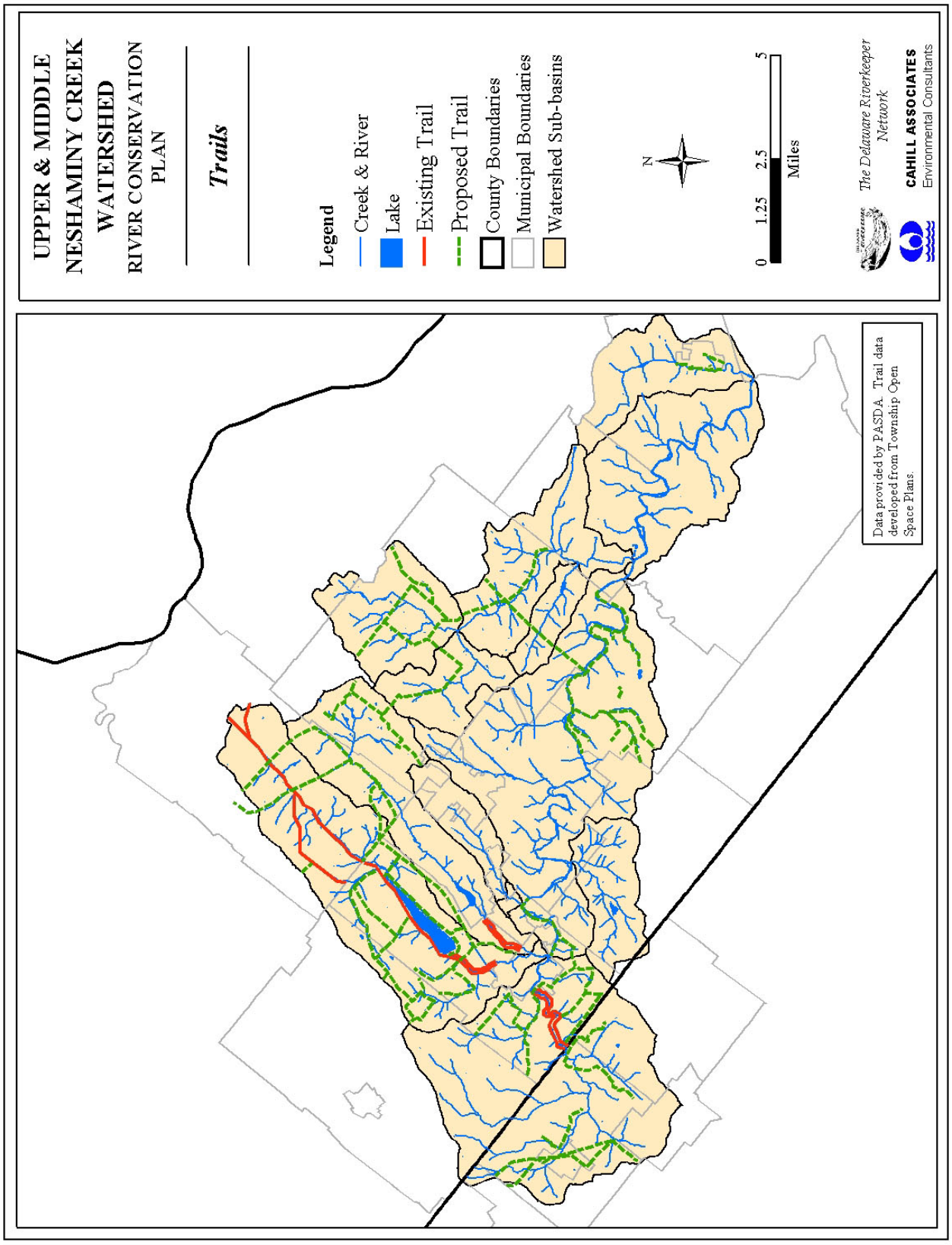


Figure 6-6. Existing and proposed trails in the Upper and Middle Neshaminy Creek Watershed

Two other trails are located within the study area in the West Branch Sub-basin and in the Pine Run Sub-basin. The West Branch Trail traverses along both sides of the main stem of the West Branch from the Montgomery Twp and New Britain Twp boundary to Chalfont Borough. The Pine Run Trail travels along the Pine Run in New Britain Twp. from Chalfont Borough to the Doylestown Township boundary.

Important Recreation and Open Space Programs

Although special funding and grant programs are enumerated and discussed in Section 7 at the conclusion of this RCP, it is important to mention two parallel programs, the Bucks County Open Space Program and the Montgomery County Open Space Program, which have been enacted and which have had and will continue to have great importance for recreation and open space planning in watershed communities. Bucks County Commissioners established their program after a referendum was overwhelmingly passed by Bucks County voters on May 20, 1997, the purpose being "To develop a practical plan to protect in perpetuity those natural resource areas and farmlands deemed essential to preserve the unique character of Bucks County." A $59 million bond issue was authorized to fund the program; Municipal Open Space Guidelines were developed to administer the distribution of grants to municipalities and other recipients, as well as to guide the overall planning. As the result of this Program, virtually all of the municipalities in the watershed have developed "open space, recreation, and environmental resources" plans many of which constitute significantly advanced inventorying and analysis. A major objective has been to provide substantial funding to municipalities for the expansion of their open space systems, including parcel acquisition.

A parallel program was enacted in Montgomery County, funded by an even larger bond issue ($100 million). This program has been equally successful and has resulted in comparable responses by municipalities here.

These plans provide a very important step in open space, recreation, and environmental resources planning and serve to "jump start" many of the recommendations being made in this RCP.

C. Historical Resources

Brief History of the Upper and Middle Neshaminy Watershed (from the History of Bucks County, 1905)

The Upper and Middle Neshaminy Watershed has a rich history, both before and after European settlement. The Lenapes were the first Native American inhabitants of the watershed and were called the Delaware Indians by the English settlers. Those tribes that lived within the Neshaminy Watershed were called Neshaminies, probably due to their location in the Neshaminy Creek Valley, and the Creek got its name from the Native Americans who called it "Neshaminy" meaning "place where we drink twice". The Neshaminies cultivated the land and grew crops of maize and tobacco. The creek and the surrounding land were used for fishing, hunting, and for transportation, which facilitated trade.

The Native Americans have a long and rich history dating back thousands of years before European Settlement (www.tolatsga.org/dela.html). The Lenape were one of several Algonquin-

speaking tribes and had settlements located in the Delaware River Valley from Cape Henlopen, Delaware north to include the west side of the lower Hudson Valley in southern New York. The Lenape were not a single tribe in 1600 but were a set of independent villages and bands. There was no central political authority, and Lenape sachems (captains) controlled only a few villages usually located along the same stream. The Lenape were a warm and hospitable people and their contact with European settlers was usually peaceful, as they engaged in trade with the Europeans (More in Archeological Section).

The first European settlers in the region were the Dutch and the Swedes in the early 1600's. The settlements were located along the Delaware River and did not expand into Bucks County and the Upper and Middle Neshaminy Watershed until the late 1600's. The Dutch engaged in the fur trading business and purchased small areas of land from the Native Americans to use for trading posts and small settlements. The Swedes were the first to purchase large land parcels from the Indians and hence began some permanent settlements along the Delaware and in what is now Lower Bucks County. At this time in history, there was very little settlement in the Upper and Middle Neshaminy Watershed as most colonists settled along the Delaware and did not move very far inland.

The Dutch surrendered to the English in 1664 and the lower Neshaminy Creek area became English. William Penn arrived in 1673 after having been given a 40,000 acre grant from King Charles II who had been indebted to Penn's father. Attracted by the favorable conditions of the region, Penn brought with him settlers and set out to establish the city of Philadelphia along the Delaware River. As many of the settlers colonized Philadelphia, William Penn himself chose land in lower Bucks County where he had surveyed the location for his rural home, Pennsbury Manor (Figure 6-7). About half of the English settlers that arrived with Penn also made permanent settlement in lower Bucks County. Except for a few areas cleared for cultivation by the Swedes, most of the Neshaminy Watershed was wilderness and the settlers often relied on the generosity of the Neshaminy Indians to survive until the land was cleared and could be cultivated.

It is believed that a treaty was made with the Indians August 30, 1686, to purchase land in the lower Neshaminy Watershed. According to the treaty, the Indians conveyed to Penn: -

> "All those lands lying and being in the province of Pennsylvania, beginning upon a line formerly laid out from a corner spruce tree, by the river Delaware, and from thence running along the ledge or the foot of the mountains west north-west (west south-west) to a corner white oak marked with the letter "P" standing by the Indian path that leadeth to an Indian town called Playwikey, and from thence extended westward to Neshaminy creek, from which said line, the said tract or tracts thereby granted doth extend itself back into the woods, as far as a man can go in one day and a half, and bounded on the westerly side with the creek call Neshaminy, or the most westerly branch thereof, and from thence by a line to the utmost extent of said creek one day and a half's journey to the aforesaid river Delaware, and thence down the several courses of the said river to the first mentioned spruce tree."

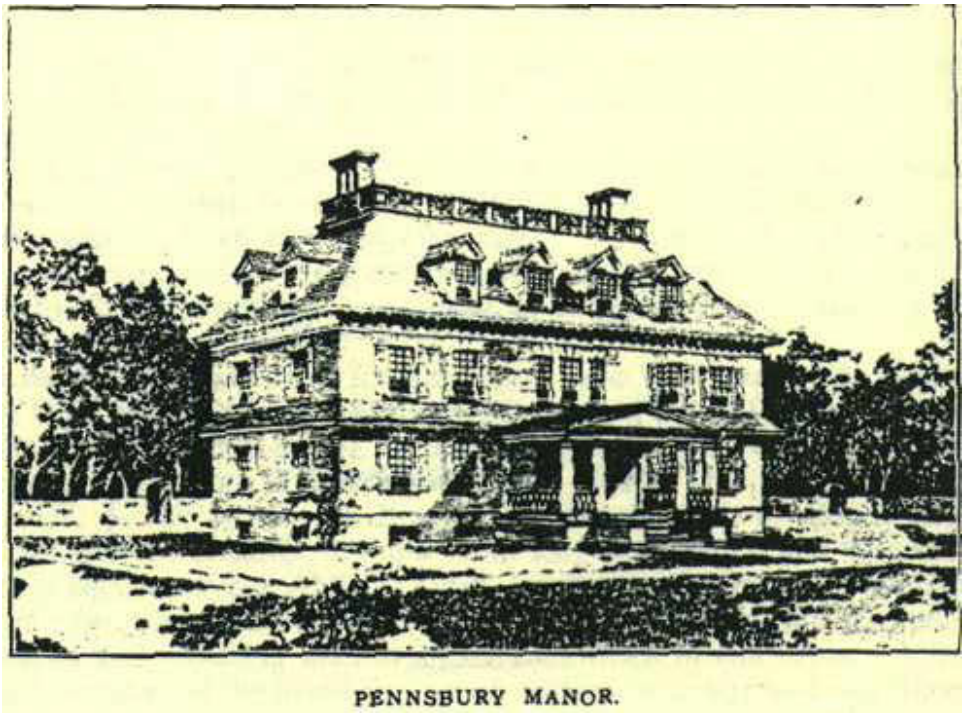


Figure 6-7. Pennsbury Manor, the country home of William Penn (Davis, 1905)

By the late 1600's colonists began to move northward into the Upper and Middle Neshaminy and there were settlements in several existing townships in the watershed, including Northampton, Newtown, Wrightstown, Warwick, and Warrington. Eventually, descendents of William Penn, John and Thomas Penn, officially purchased the remaining area that is now Bucks County from the Indians in 1737 (Figure 6-8). Settlement continued in the watershed with farming and animal husbandry being the main livelihood of these rural peoples. The farmers raised wheat, rye, barley, buckwheat, Indian corn, peas, beans, hemp, flax, turnips, potatoes and parsnips. A considerable number of cattle were raised with individual farmers having as high as forty or sixty head. The country was favorable to stock raising, the woods being open, often covered with grass, and the cattle roamed at will. Land had increased considerably in value, for example, some land near Philadelphia that was worth six or eight pounds per hundred acres when the country was first settled could be bought for just under one hundred and fifty pounds at the close of the century. This province was a happy and prosperous commonwealth; food and supplies were cheaper than in England and wages were higher. These flourishing conditions led to an increase in immigration and growth of the county and watershed.

The townships of Bucks County were typically laid out in groups, with townships west of the Delaware River and East of the Neshaminy Creek being formed first. Most of the Townships located in the Upper and Middle Neshaminy were officially formed in the early 1700's. The county seat changed several times but in 1725 the county seat was located in Newtown Borough and remained there until 1813 when it was moved to Doylestown.

The region was a highly successful farming area due to the fertile soils. As the watershed grew with successful farms, tradesman began to flourish to provide essential services. The farmers of

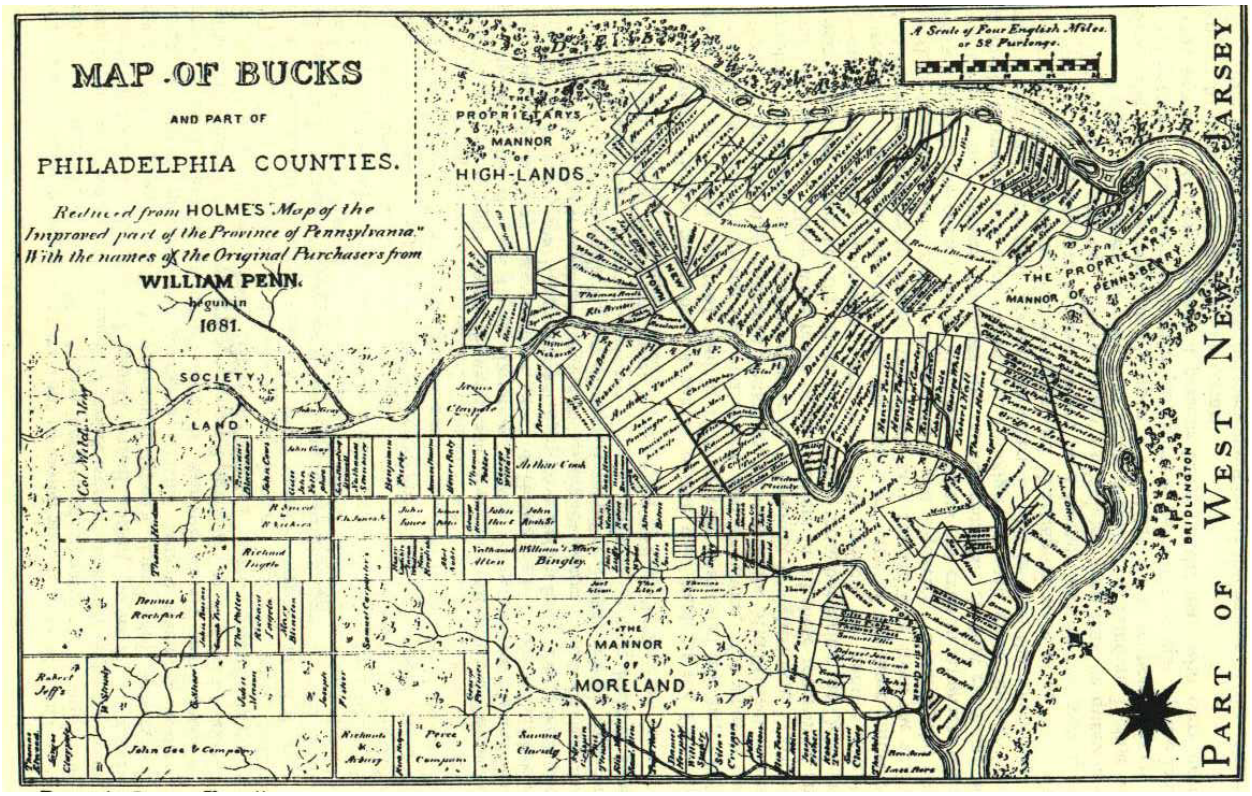


Figure 6-8. One of the original maps of Bucks County and surrounding region (Davis, 1905)

the region exported their crops to Philadelphia where they were sold in city markets or shipped from ports on the Delaware River. The transport of crops was made easier by the construction of major road systems through the watershed. One very important road was Old York Road, which was the major thoroughfare between Philadelphia and New York.

Many areas of the Upper and Middle Neshaminy Watershed were important locations during the Revolutionary War. General George Washington was known to stay in several locations within the watershed. At one time his headquarters were located just outside the watershed in Warwick Township at the Moland House not far from the Intersection of York and Bristol Roads (Figure 6-9). Various locations served as battlefields and encampments as well. In Buckingham Township, the area around the General Greene Inn (then known as Bogart's Tavern), was used by continental soldiers who encamped in the flat valley between the tavern and Buckingham Mountain.

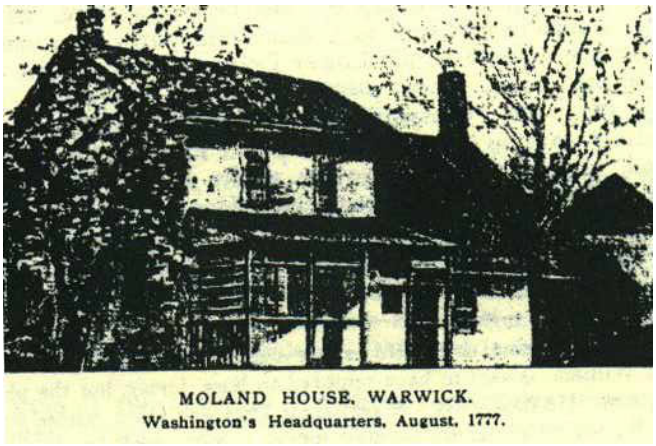


Figure 6-9. Moland House in Warwick Township (Davis, 1905)

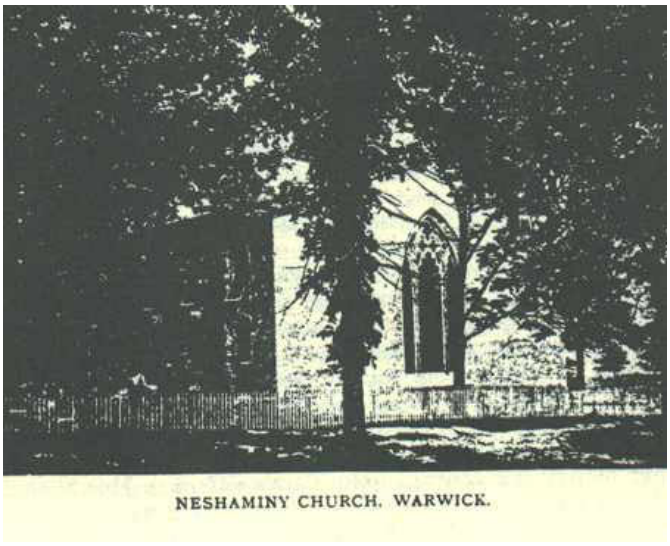


Figure 6-10. The Neshaminy Church (Davis, 1905)

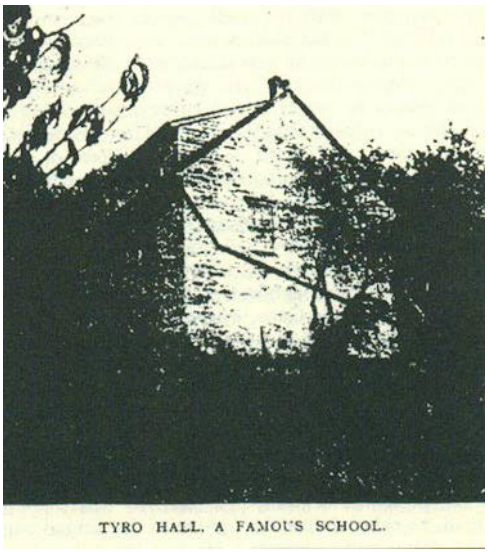


Figure 6-11. Tyro Hall (Davis, 1905)

After the period of the Revolutionary War the watershed experienced a prosperous period. Many different livelihoods were supported such as farming, milling and quarrying, practicing trades and some manufacture of coaches and farm tools. Grist mills were very successful along the many stream systems and many continued operation into the 20th century. Cultural and social societies flourished and many religious associations were established (Figure 6-10). Many schools were established with the help of endowments. Some schools, such as Tyro Hall in Buckingham, were famous for educating well-known scholars of the time (Figure 6-11).

Before and during the Civil War there were various sections of the Underground Railroad located within the watershed. During these years the Underground Railroad passed through a narrow area starting from Bristol through Bucks County via Attleborough, Newtown, and Buckingham to New Hope, where the slaves were transferred to another line.

In the mid-1800's railroad lines were being built throughout the region. In the Upper and Middle Neshaminy Watershed railroad lines connected town centers and villages with regional cities such as Philadelphia and Trenton. One of the first railroads in the watershed was an extension of the North Pennsylvania Railroad that traversed from Lansdale to Doylestown. Eventually, the railroad reached Ivyland and traveled along portions of the Neshaminy Creek up through Wrightstown and Buckingham to Wycomb and Lahaska on its way to New Hope (Figure 6-12). The advent of the railroad brought further prosperity as transportation of farm products was now much easier.

The railroad system and the industrial revolution had a profound effect on the development of several boroughs in the watershed. This was particularly true in Lansdale and Hatfield Boroughs, which were located along the route of the North Pennsylvania Railroad. The railroads aided in the development of both boroughs as business, residential, and transportation centers.

Figure 6-12. Historic Wycomb Station

Around the turn of the century, trolleys lines were established within the watershed to advance the connections between town centers. The trolley lines traversed through Newtown, Wycomb, Furlong and Doylestown. However, with the widespread introduction of the automobile in the early 1900's, the trolley's heyday came to an end.

Throughout the early 20th century the watershed remained primarily an agricultural region. It wasn't until after World War II that the population began to increase dramatically. During the 40's and 50's the watershed began to experience the beginnings of development. This trend continued in the watershed creating a need for more commercial centers to support the new population. Despite, the growth during this period the watershed remained very rural with agriculture still the leading land use. It wasn't until the late 1970's to the present that development and suburban sprawl rapidly infected the watershed. In fact, the years between 1980 and 1990 were a tremendous growth period for the watershed. During this period, many of the more rural townships experienced huge population increases (sometimes as high or higher than 50% growth). This growth is probably the largest and most worrisome threat to historic resources in the watershed. The Upper and Middle Neshaminy Watershed has a rich history that warrants respect and preservation. With the increasing pressures of development and the losses inevitably incurred, it is ever more important to protect the remaining historical structures and landmarks from destruction.

The Commonwealth's Role in Protecting Historic Resources

The Pennsylvania Historical and Museum Commission's Bureau for Historic Preservation (http://www.phmc.state.pa.us/) is the official agency in the Commonwealth for the conservation of Pennsylvania's historic heritage. The Bureau manages the National Register of Historic Places for the state through the National Historic Preservation Act of 1966. Properties listed in the Register include sites, buildings, structures, objects and districts that are significant in American

history, architecture, archaeology, engineering, and culture. Properties considered potentially eligible for the National Register are generally more than 50 years old, and follow some general guiding criteria:

- are associated with events that have made a significant contribution to the broad patterns of our history;
- are associated with the lives of persons significant in our past;
- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction;
- may be likely to yield or have yielded, information important in prehistory or history.

The process of listing a property in the National Register is thorough and complex, yet it encourages public participation in the protection of local historic resources. To be considered for the Register, an individual (or local government, or local historical society) must first submit a *resource inventory form* to the Bureau. Once the property information is processed through the Bureau's database system, the state's review board – composed of professionals in the fields of American history, architectural history, architecture, prehistoric and historic archaeology, and other related disciplines – provides a Determination of Eligibility (DOE) for each resource. The board (through the DOE assignment process) assigns a status of Eligible, Ineligible, or Contributing to a historic district. Assuming enough supporting information has been provided for the property, the nomination (only for Eligible or Contributing properties) is then submitted to the National Park Service to determine whether the property actually becomes Listed on the National Register. Properties that have been submitted to the Bureau but do not have a completed Determination of Eligibility are included in the historic property database and classified as Undetermined.

Listing in the National Register does not interfere with a private property owner's right to alter, manage or dispose of property. Listing in the National Register contributes to preserving historic properties in a number of ways:

- Recognition that a property is of significance to the nation, the state, or the community.
- Consideration in the planning for federal or federally assisted projects.
- Eligibility for federal tax benefits.
- Qualification for federal assistance for historic preservation, when funds are available.

Important Historic Sites in the Upper and Middle Neshaminy Creek Watershed

A variety of important historic sites remain within the Upper and Middle Neshaminy Creek Watershed area and its 14 municipalities in Bucks and Montgomery Counties. Some of these sites are documented; many are not. Some are protected; most are not. The challenge of this RCP is to both recognize those historic and archaeological values which have been documented, as well as work to better catalog those values which have not been adequately inventoried.

Plan preparers consulted with PHMC officials in order to create a watershed map of historic sites that are "listed" on the National Register of Historic Places and "eligible" for listing on the National Register. The map also includes sites where the possibility of listing is Undetermined in order to approximate the number of historic resources that have not been evaluated for protec-

Table 6-1. Historic Sites and Districts in the Upper and Middle Neshaminy Watershed.

	Historic Sites				Historic Districts		
Municipality	Listed	Eligible	Undetermined	NHL	Listed	Eligible	Total
Buckingham	6	7	61	4	5	1	84
Hatfield Borough			14				14
Hatfield Township	1	1	23		1		26
Hilltown Township		2					2
Lansdale Borough		2	29				31
Montgomery Township		6	7				13
New Britain Township	2	16	19				37
Newtown Borough	5		452		2		459
Newtown Township	4	5	249		3		261
Northampton Township	1		8			1	10
Plumstead Township		1	6		1	2	10
Warrington Township		8	1				9
Warwick Township	1	2	9				12
Wrightstown Township	5	4	47		1	1	58
TOTAL	25	54	925	4	13	5	1026

Source: Pennsylvania Historic and Museum Commission

tion. In the Upper and Middle Neshaminy Creek Watershed, 54 properties are Eligible for listing, while 25 are listed on the National Register (Figure 6-13 & Table 6-1). There are several historic districts in the watershed as well. These districts are comprised of many historic sites located in proximity to one another (usually along a section of a street or in a town block). There are 13 Listed historic districts and an additional 5 that are Eligible for listing (see map and table above). Many other sites and properties have historical importance (in the sense that someone submitted a resource inventory form) but are not legally protected. These Undetermined sites are vulnerable to demolition and redevelopment. Newtown Township and Newtown Borough have the largest number of vulnerable sites based on the PHMC database.

The majority of historic sites are located in the townships east of the Neshaminy Creek and west of the Delaware River with high concentrations of site in Newtown Township and Borough, Wrightstown, and Buckingham. Because this watershed is so rich in historic sites and districts, it is extremely difficult to discuss each property listed on the National Historic Register. Instead, this RCP will highlight a few specific sites that represent the diversity of historic places in the watershed. A full listing of Eligible, Listed, and Undetermined historical sites and districts is located in Appendix A.

The Upper & Middle Neshaminy Creek Watershed – Highlighted Historic Sites

Hatfield Township in Montgomery County was established in the early 1700's. The original inhabitants of the township were the Lenape Indians who abandoned their last encampment (located along the Neshaminy Creek off of Orvilla Road) in 1777. According to local folklore, the Township was named after an early Welsh settler, John Hatfield, but there is no documentation of such a person. Most likely the township was named after a Welsh village in Hertfershire, England (http://www.hatfieldtownship.org/historichatfield.cfm). The township prospered as many other settlements in the watershed due to the successful farming operations made possible by the rich and fertile soils of the region. The townships grew tremendously with the advent of the Pennsylvania railroad. By 1857 two railroad lines ran through the township, thereby trans-

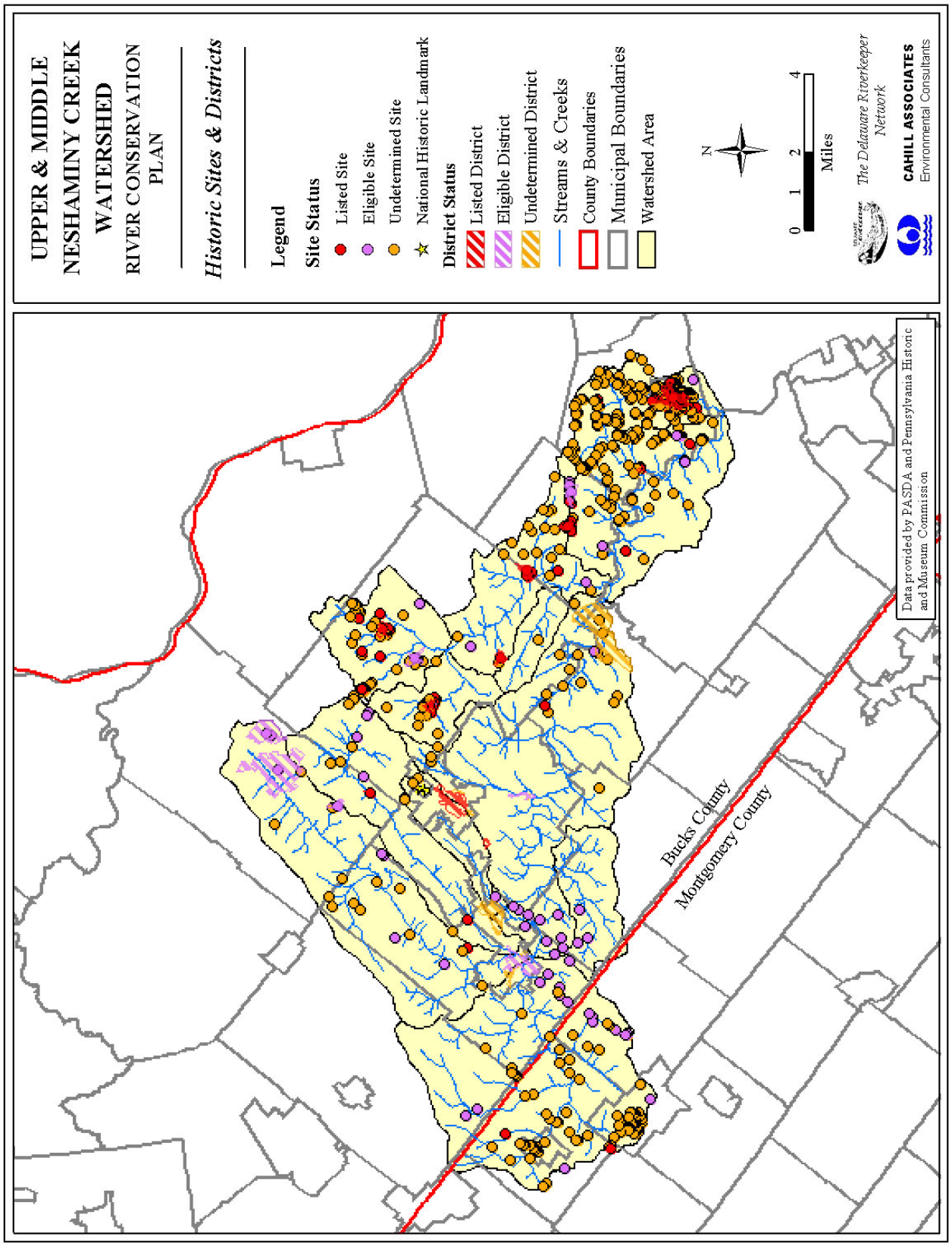


Figure 6-13. Historic Sites in the Upper and Middle Neshaminy Creek Watershed

Figure 6-14. Historic train line as it passes through Hatfield Township in the 50's (Hatfield Twp. website)

forming the township into a prosperous farming, commercial, and transportation center (Figure 6-14). While there are not many historic sites in the township that are listed on the National Register, there are about 23 sites that have Undetermined status. One site that is listed is the Orvilla bridge located on Orvilla Road over the West Branch Neshaminy Creek. The stone bridge was built in 1874 and is owned by the Pennsylvania Department of Transportation. Although this is not the oldest bridge in the watershed, it represents the role that new transportation systems played in the growth and prosperity of this historical watershed.

Plumstead Township was formed in the early 1700's by English Quakers. One of the townships first settlers was John Dyer, a Quaker elder from Gloucestershire, England. He came to Plumstead Township in 1718 and purchased 151 acres that included the area of present day Dyerstown. John Dyer built the first mill in the township about where the present mill stands on the Pine Run at Dyerstown, near the intersection of Stony Lane and Old Easton Road. This mill and surrounding historic structures comprise the Dyerstown Historic District which is listed on the National Register. The existing mill was built from stone and brick and is most likely not the original mill built by John Dyer as it is listed as being constructed in 1800, almost 100 years from the time that John Dyer lived in Plumstead Township (Davis, 1905). Nonetheless, it remains a reminder of the historic function of this small community and emphasizes the importance of the Neshaminy streams systems to the lives of early settlers in the watershed.

Buckingham Township was one of three "Founder's Counties" because it was one of the original townships formed by William Penn in 1682. The settlers of this township were mostly English Quakers who began settlement around 1699. One of the most important community buildings was the Friends Meeting House, originally built by the early settlers in 1706 on a ten acre parcel entrusted to the Friends. The meeting house was constructed of logs in the place where the existing Buckingham Meeting House stands today on Old York Road. In 1731 a stone house

Figure 6-15. Buckingham Friends Meeting House (Davis, 1905)

with a 2nd floor stone addition for the use of the women was built nearby the original structure (Figure 6-15). In 1768 a fire started by the stove destroyed the stone meeting house, however another was reconstructed the same season (Davis, 1905). The Buckingham Meeting House remains in existence today and is listed on the National Register.

A very important historic structure in the Watershed is located in Warwick Township just south of Route 263 on Old York Road. This structure is the Eight Arch Bridge. The Eight Arch Bridge was constructed over the Neshaminy Creek in 1803 and is the last remaining eight arch bridge in Pennsylvania. The 218 foot long structure was hand laid with stone and morter and features distinctive and graceful arches. The Eight Arch Bridge is listed on the National Register of Historic Places.

Newtown Township and Borough were surveyed in 1683 by Thomas Holme, under direction from William Penn. Penn called it the "New Town", hence its existing name Newtown. A small community was well established by 1700 and in 1725 the county seat was moved from Bristol to Newtown and remained there for 88 years. Newtown has a vast amount of historical sites, many of which are listed on the National Register or are eligible for listing. The town played an important role during the Revolutionary War. A battle was fought in the borough on South State Street near the Court house and George Washington and several of his officers had headquarters in the town after the historic battle in Trenton. One such location was the Harris House, the homestead of John Harris a wealthy landowner in the town. Washington made his headquarters there from December 27-30, 1776 (Figure 6-16). It was located near the Newtown Presbyterian Church on Sycamore Street. The Church is listed on the National Register along with many other structures of the era. Newtown Township and Borough are extremely rich in historic resources as it was a

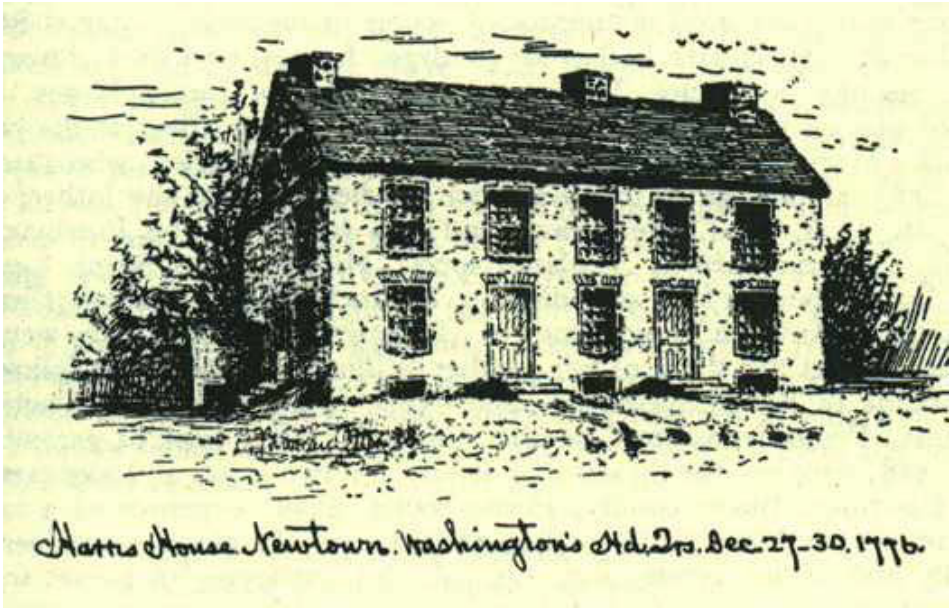


Figure 6-16. Harris House in Newtown was Washington's headquarters in 1776 (Davis, 1905)

thriving residential, commercial, and transportation center in the early years of the Nation's development (Newtown Borough Comprehensive Plan, 1999).

D. Archeological Resources

The Upper and Middle Neshaminy Watershed is rich in archeological resources. Most date to prehistoric times or before European Settlement. The original inhabitants of the watershed, the Lenape Indians (called the Delaware Indians by Europeans) were not migratory and had permanent settlements in the watershed for thousands of years before the Europeans arrived. Many of the archeological sites existing today contain remains (ceramics and other artifacts) from the Native American settlements that thrived years ago.

The Lenape Tribes (Lenape means "the people") were really made up of smaller villages or bands that usually settled near streams and creeks. Lenape villages were often populated with several hundred people during the summers, but there was no real concept of land ownership among the different villages. In the winter, villages did separate hunting territory. Three types of wigwams were used: round with dome roof, oblong with arched roof, and oblong with a ridge pole. Dug-out canoes were used and men did the hunting and fishing. Most of the Lenape's diet came from farming which was solely the responsibility of the women. Corn, squash and beans (called "the three sisters" by the Lenape) were grown, and fields often covered more than 200 acres (www.tolatsga.org/dela.html and NAABC, Ed Fell).

The Lenape clothing was made from deerskin and was often decorated with items such as shell beads or porcupine quills, feather mantels, and other ornaments. The Lenape used a lot of copper, obtained through trade, to fashion pipes and arrowheads or to hammer into ornaments. By the late 1700's, the Lenape became more stylish with their dress and used brighter colors and

silver ornaments obtained from trade with the Europeans (Figure 6-17). Many of these items along with other prehistoric artifacts have been found in the watershed.

The Lenape Indians had a profound effect on the history of the watershed and many clues to their existence in the region remain today. Unfortunately, European settlement disrupted this peoples' way of life and the Lenape people were forced to move northward and westward as more and more Europeans arrived in the region. Today, the Lenape people have returned to the Neshaminy Valley and surrounding region and continue to celebrate their heritage (Figure 6-18).

Pennsylvania Historic and Museum Commission Archeologic Database

The Pennsylvania Historic and Musuem Commission (PHMC) maintains an extensive database of archeological resources for the region. In the Upper and Middle Neshaminy Watershed there

Figure 6-17. Traditional women's dress of the Lenape .

are 79 listed archeological sites. Of those sites, only six are considered eligible for protection and four are considered ineligible. There is insufficient data for the rest of the sites. This is an obvious vulnerability for these archeological resources which at this time are afforded no protection from destruction. There are two general dating categories for archeological sites. Prehistoric sites are those that date back before European settlement and historic sites are those that date after European settlement (Tables 6-2 and 6-3). There are a total of 58 prehistoric sites, many of which contain artifacts such as ceramics and ground stone tools. There are 20 historic sites in the watershed. Locations of these sites can not be provided due to the sensitive nature of the sites.

Figure 6-18. In August 2002, Chief Bob Red Hawk of the Lenape participated in a Treaty Signing Ceremony with cooperating organizations to perpetuate the Lenape Culture

E. Issues and Opportunities

The Upper and Middle Neshaminy Creek Watershed tells the story of how its natural resources continually attracted development, beginning with its first Swedish settlements. The Neshaminy Creek story continues with agriculture and the channeling of the Creek's power for the development of production mills, needed for the growth and the survival of the emerging nation, and later trade. This era was followed by the mills' demise, as the era of improved power efficiency opportunities in surrounding areas emerged. As more and more people gained access to the area with the construction of new roads and rail systems, small urban centers or boroughs developed as commercial and transportation centers. Later, as emigration from nearby cities ensued middle class housing developments proliferated throughout the watershed, devouring much of its agricultural land. As more people became attracted to the new "suburbia", the watershed experienced tremendous growth and much of the natural landscape was developed.

Many of the numerous historic sites in the watershed go unrecognized, "lost" amidst vast housing developments or other development or unmanaged open space. Not only are these individual sites historically important, but as a group, these sites could tell the story of the historical development of the Upper and Middle Neshaminy Creek Watershed, a story important to the nation, if they were properly linked. This linking can happen in several ways. A program (system) of interpretive signage throughout the watershed could offer a comprehensive story about the settlement and growth of the watershed area. With such a interpretive system, those visiting sites as a destination both from afar and from nearby would be welcomed and guided, in most cases pleasantly surprised to realize that their history lesson had just begun. The interpretive system

Table 6-2. Prehistoric Archeological Sites

SITE NAME	STATUS	CONDITION	SITE TYPE
General John Lacy Homestead	Eligible		Historic and Prehistoric
Site 1	Eligible		Open Habitation, Prehistoric
Leedom Tennant Site	Eligible		
	Eligible	90% - 100% Intact	Open Prehistoric Site, Unknown Function
Site 3	Eligible		Open Habitation, Prehistoric
Site 2	Eligible		Lithic Reduction
Oakleigh Farm	Not Determined		Historic Domestic Site
Oakleigh Farm	Not Determined		Lithic Reduction
Feeney-Cutter Tract	Not Determined		Open Prehistoric Site, Unknown Function
Feeney-Cutler Tract	Not Determined		Open Prehistoric Site, Unknown Function
Prehistoric Site 9	Not Determined		Open Habitation, Prehistoric
Prehistoric Site 10	Not Determined		Open Habitation, Prehistoric
Prehistoric Site 11	Not Determined		Open Habitation, Prehistoric
Neshaming East Site	Not Determined		Historic and Prehistoric
Roth Rock Tract Site	Not Determined		Quarry
Lapp	Not Determined		Lithic Reduction
Prehistoric Site 12	Not Determined		Open Habitation, Prehistoric
Mill Creek Site	Not Determined		Lithic Reduction
Water Treatment	Not Determined	90% - 100% Intact	Open Habitation, Prehistoric
Fisher	Not Determined	90% - 100% Intact	Open Habitation, Prehistoric
Taylor	Not Determined	90% - 100% Intact	Open Habitation, Prehistoric
Farmers Daughter	Not Determined	90% - 100% Intact	Open Habitation, Prehistoric
Quarry 1 Lower Field	Not Determined	90% - 100% Intact	Lithic Reduction
Quarry 1 Upper Field	Not Determined	90% - 100% Intact	Lithic Reduction
Prehistoric Site 8	Not Determined		Lithic Reduction
Prehistoric Site 5	Not Determined		Lithic Reduction
Prehistoric Site 6	Not Determined		Lithic Reduction
Prehistoric Site 1	Not Determined		Lithic Reduction
Prehistoric Site 3	Not Determined		Lithic Reduction
Lauri	Not Determined		Lithic Reduction
Tyler	Not Determined	50% - 89% Intact	Unknown Function
Bridge Valley Site	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Berlinger Site	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Felton Site	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Keller Road	No Information		Open Habitation, Prehistoric
Creek Road	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Unnamed Rockshelter	No Information	90% - 100% Intact	Rock Shelter/Cave
Railroad Avenue	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Atkinson Site	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Chain Bridge Site II	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Chain Bridge Site 1	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Iron Bridge	No Information	90% - 100% Intact	Open Habitation, Prehistoric
School House Bend	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Tyler #4	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Featherbed Hill	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Tyler #5	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Tyler #6	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Ali Site	No Information		Open Habitation, Prehistoric
Bucks Co Comm. Coll. Site	No Information		Open Habitation, Prehistoric
Rockshelter	No Information		Rock Shelter/Cave
Jamison Site	No Information	90% - 100% Intact	
Tyler State Park Site	No Information	90% - 100% Intact	Quarry
Sugar Bottom	No Information		Open Habitation, Prehistoric
Bryan-Edoff Site	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Tyler #3	No Information		Open Habitation, Prehistoric
Tyler #2	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Doylestown By-Pass	No Information	11% - 49% Intact	Unknown Function
Barry Road	No Information	90% - 100% Intact	Open Habitation, Prehistoric
Wrightstown Site	No Information		Open Habitation, Prehistoric

Table 6-3. Historic Archeological Sites

SITE NAME	STATUS	CONDITION	SITE TYPE
Fell Farmstead	Eligible		Historic Domestic Site
Site 4	Eligible		
Haldeman Macnair	Not Eligible		Historic Domestic Site
William Huttin Farmstead	Insufficient Data		Historic Domestic Site
Historic Site 12	Insufficient Data		Historic Industrial Site
Old Cider Mill	Insufficient Data		Historic Industrial Site
Magiu Site	Insufficient Data		Historic Domestic Site
Buckman Site	Insufficient Data		Historic Domestic Site
Garner Site	Insufficient Data		Historic Domestic Site
Demp House Site	Insufficient Data		Historic Domestic Site
N.J. Hines Site	Insufficient Data		Historic Domestic Site
Kenner Farmstead Site	Insufficient Data		Historic Domestic Site
Weir Farmstead Site	Insufficient Data	90% - 100% Intact	Historic Domestic Site
Historic Site 1	Insufficient Data		Historic Domestic Site
N. Weir Farmstead Site	Insufficient Data		Historic Domestic Site
Historic Site 2	Insufficient Data	90% - 100% Intact	Historic Domestic Site
	Insufficient Data	90% - 100% Intact	Historic Domestic Site
McHenry Farmstead Site	Insufficient Data		Historic Domestic Site
Smith Pottery	No Information		Quarry

could demonstrate how other historic watershed sites and structures are accessible via walking/biking/hiking/driving along an historical story route

This linking of historical sites and structures could increase the knowledge of and visitation of isolated sites and thus increase possible donations for the upkeep and maintenance of many of these nonprofit-owned sites. This linking could also lead to increased volunteer support of one or many sites. Not only would these connected sites and structures explain the history of the watershed, but they would also help preserve the future of the watershed. Where possible, a formal link via a proposed trail could prevent further development of this landscape, increasing the conservation awareness of those living in and outside of the area of the watershed. In this way, support for the conservation of the watershed from those not even aware of its existence should increase over time.

Historic areas and sites can also be linked by the piecing together of historic corridors, many of which can follow the tributaries and main stem of the Neshaminy. For instance, Dark Hollow Park could be extended as a historic corridor that maps the Eight Arch Bridge adjacent to Rt. 263 with the many early farms, mills and village sites, both historic and pre-historic, that line the Neshaminy Creek as it flows through Dark Hollow and on to Tyler State Park. The value of such a historic corridor is compounded by the natural resource benefits that will so naturally mesh with a stream-centered program.

Valuable resources, historical and other, will not be saved and preserved unless they are first recognized. Awareness is key. With a system of interpretive signage linking the numerous sites and structures in the watershed, watershed visitors, both children and adults, would be able to experience a complete interactive history lesson focusing on this remarkable watershed.

Municipal Actions for Better Inventorying and Analysis of Cultural Resources
In addition to the visions set forth above, municipalities have available to them a number of different tools which they should be using in the watershed to better identify and manage cultural resources. Although various watershed municipalities and counties to some extent have inventoried and evaluated their cultural resources to date, there remains a substantial amount of work to do to more carefully document the resources that remain.

Historic Resource Surveys
The good news is that the watershed is rich in history, notwithstanding the fact that development has likely already eliminated many of these historical values. The bad news is that many values remain undocumented or poorly documented. Although all watershed townships have developed Open Space and Comprehensive Plans, not all have compiled adequate information on historical and archaeological resources. The first step for most municipalities is to develop better inventories of historic resources; in some cases, there are existing databases already compiled, sometimes residing in the County Planning Department's individual municipal files, sometimes in the municipal offices themselves. These existing listings should be reviewed and organized, through preparation of a Historic Resources Survey, including both standing structures as well as archaeological resources. The Survey should be as comprehensive and complete as possible and include: resource descriptions (both written and photographic property descriptions, with a narrative or feature checklist describing the structure from the front façade, circling the structure and addressing major features such as style/period, building materials, building size and shape, roof material and shape with dormers, chimneys, cornices, other decorative features discussed, window treatment, porches/patios, doors and entrances, auxiliary buildings with an adequate photographic record of total facades plus individual details being documented); resource documentation (including written research from local histories, records of local historical societies, oral histories, paintings/etchings, old maps, legal records, interviews with existing and past owners); and archaeological data. Substantial guidance is available through the Brandywine Conservancy, through the Pennsylvania Historical and Museum Commission, through County Planning Departments, through the US Department of the Interior's *Guidelines for Local Surveys,* and other sources. The Pennsylvania Historical and Museum Commission maintains a program of matching grants, available to assist municipalities in this inventorying and evaluation effort (see discussion below).

Surveys require work. A municipality with substantial resources may choose to hire professionals to prepare its Survey. On the other hand, a large budget is not necessary if local labor is volunteered. A subcommittee including interested members of the municipal planning Commission, other interested officials and citizens committed to historical resource protection can be formed to undertake the Survey, including the necessary reviews of structures and sites in order to evaluate what is worthy of recognition and protection. The evaluative phase of the Survey process can be reinforced with professional consulting talent to the extent that this is possible.

Ultimately, the goal is often to list historic resources in the Survey on the National Register of Historic Places, created by the National Historic Preservation Act of 1966, administered cooperatively by the US Department of the Interior and the respective State Historic Preservation Of-

fices. The process required to be listed on the National Register or deemed Eligible for Listing on the National Register guarantees that the historical resource is of value to the nation, state, or local community; that it will be considered when planning any federally-assisted or federally permitted project or action; that it will be eligible for various federal tax benefits and for other federal assistance when these programs are available. As with all historic resources, types of resources may include individual buildings, historic districts, sites, other structures (canals, bridges, etc.), objects (statues, fountains, monuments, etc.), and multiple "thematic resources" related to an historical person or event or development type and so forth. There are about 3,000 registered sites in Pennsylvania, which is one of the top states in the nation for listings. It is important to note that although the overall significance of gaining National Register status can be great, many Register structures have been destroyed. Register status in no way guarantees protection. Private owners, and most Register structures are privately owned, are free to alter, even demolish their structures unless municipal regulation exists or unless some federal action or authority is involved.

Historic Resources Ordinances

In terms of regulation, the State adopted the Historical Architectural Review Act (Act 167 of 1961 as amended) which authorizes municipalities "…to create historic districts within their geographic boundaries; providing for the appointment of Boards of Historical Architectural Review: empowering governing bodies…to protect the distinctive historical character of these districts and to regulate the erection, reconstruction, alteration, restoration, demolition or razing of buildings within the historic districts." The Pennsylvania Historical and Museum Commission (PHMC) must certify the historical significance of each historical district designated by a municipality after an ordinance has been put in place. A Board of Historical Architectural Review (five members, including a registered architect, a licensed real estate broker, a building inspector, and two people with interests in historic preservation) must be appointed to advise the governing body. The governing body then has the power to "…certify the appropriateness of the erection, reconstruction, alteration, restoration, demolition or razing of any building, in whole or in part, within the historic district…and shall consider the effect which the proposed change will have upon the general historic and architectural nature of the district."

The Municipalities Planning Code also authorizes municipalities to enact zoning ordinances which take into account cultural resources. Historic preservation standards to accomplish these objectives are authorized. A historic resources overlay may be included as an overlay in the zoning ordinance. This overlay may divide historic resources into classes: Class I (resources already on the National Register or Eligible); Class II (resources important historically but which have been already altered); Class III (a broad class often just relating to age, such as anything over 100 years in age). Special ordinance provisions applying to this overlay may include demolition permits, delay of demolition, area and bulk waivers, special buffering requirements, expanded use opportunities and other special provisions. The municipality may establish a Municipal Historical Commission through this ordinance (in contrast to the HARB) to act in concert with its ordinance requirements and act to support its overall historic resource protection program. This Commission, appointed by the governing body, can act as a planning, advisory, and review body for both the local planning commission and governing body for all historic resource issues (beyond any Act 167 jurisdiction, if any). The Commission can manage all Survey work

and oversee all ordinance development and actions related to such ordinances (e.g., reviewing all building and demolition permit applications which have the potential to threaten the municipality's historic resources). The Commission can process Act 167 districting and HARB formation and can oversee National Register nominations and other historic preservation-related activities, such as grant applications. Commissions may rely heavily on a wide variety of published resources to accomplish their work, such as the US Department of the Interior's *Standards for Rehabilitation* and *Guidelines for Rehabilitating Historic Buildings*.

Better Overall Management through Historic Resources Plans

Because there are multiple aspects to historic resource inventorying, evaluation, and management, municipalities in the watershed should consider unifying all of this work into a local preservation plan, or Historic Resource Protection Plan, which integrates all of elements discussed above. This plan can be viewed as part of a municipality's Comprehensive Plan. Such a Plan establishes the community's general history and the nature and extent of its cultural resources, as well as consensus on the nature and extent of protection to be achieved. The Plan unifies both public sector and private sector initiatives. On the public sector side, the Plan integrates federal, state, county, and local resources. A critical step in this Plan process is the clear identification of goals, more explicit objectives related to these goals, and finally the implementing actions needed to make the Plan a reality. This framework provides essential guidance and structure as the many different challenges are confronted and surmounted.

Grants and Other Resources Available

Although volunteer support for cultural resources programming on the local level is tremendously important, money—grants—helps, too. There are a surprising number of programs which exist and which may be relevant to a watershed municipality's program. For example, on the broadest of levels (federal or national;), the National Historic Preservation Fund has been created and it funds the Certified Local Government Program, all under the US Department of the Interior, National Park Service. This source is best accessed via the PHMC. The federal government also has a program of Technical Preservation Assistance, as well as the Archaeological Assistance Program. The Community Development Block Grant program also can be used for cultural resource programming. The National Trust for Historic Preservation has a Grant Program as well as a National Preservation Loan Fund, and there are a variety of private programs (Inner-City Ventures Fund, Critical Issues Fund, Preservation Services Fund, Preservation Pennsylvania) and private foundations (Pew Charitable Trust, William Penn Foundation, Stockton Rush Bartol Foundation), all of which have supported cultural resources programming. In sum, it is never easy to get grants, but the programs do exist. Advice can be obtained locally, especially at county planning departments and commissions, and then at the Pennsylvania Historical and Museum Commission. The Brandywine Conservancy also has excellent information available; refer to their *Environmental Management Handbook*.

Taylor Oughton painting provided by Maya K. van Rossum, Delaware Riverkeeper.

7. RECOMMENDATIONS

7. RECOMMENDATIONS

A. River Conservation Plan Goals

The planning process, including the active participation of the Technical Advisory Committee and Municipal Advisory Committee, has carefully defined a set of goals, which are stated below. Major goals are supplemented with related sub-goals which more explicitly define the goal statements. These goals as they are presented below are not intended to suggest priority. In fact, all compete for top priority, all are critically important in this RCP.

Upper and Middle Neshaminy River Conservation Plan Goals

A. Sustain and Restore the Quantity and Quality of Streams and Groundwater
(1) Maintain stream baseflows – Don't let the streams go dry.
(2) Restore a healthy water balance.
(3) Reduce and prevent ground and surface water contamination by point and nonpoint source pollution.
(4) Protect the quantity and quality of existing and future wells.
(5) Reduce impacts of quarrying on groundwater and surface water.

B. Maintain and Improve Healthy Streams
(1) Restore/protect aquatic communities, habitats, and stream channels.
(2) Restore/protect natural floodplain and riparian corridors.
(3) Restore/protect intermittent channels as flow pathways.

C. Protect and Restore Wetlands and Related Vegetative and Hydrologic Systems

D. Improve Stormwater Management Practices
(1) Manage stormwater runoff volume.
(2) Increase infiltration of stormwater from new and existing development.
(3) Manage for water quality in all stormwater planning.

E. Improve Wastewater Management
(1) Reduce pollution from onlot sewer systems.
(2) Reduce/prevent wastewater discharges to lake systems.
(3) Reduce pollution from public sewage treatment systems.
(4) Promote environmentally responsible wastewater treatment approaches.

F. Protect and Maintain Natural and Recreational Resources

(1) Protect wildlife and flora of the watershed.
(2) Protect endangered and protected species of flora and fauna.
(3) Restore and improve natural recreation and fishing areas.
(4) Canoeing, stream access, and greenways.
(5) Restore, maintain, and/or increase trout stocking.

G. Protect and Maintain Cultural, Historical, and Scenic Resources

(1) Enhance protection and awareness of Native American, historic, and scenic sites.
(2) Restore, improve, and encourage ecotourism.
(3) Enhance the link between community businesses and the Neshaminy Creek.

H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas

(1) Promote integration of RCP and its goals and actions with Municipal comprehensive plans and ordinances.
(2) Promote sustainable land practices – runoff quantity and quality, erosion control, groundwater protection, chemical and fertilizer use.
(3) Promote watershed based zoning and land use planning.
(4) Promote re-use of existing sites and infrastructure.

I. Educate Municipal Officials, Community Groups, and the Public

(1) Promote inter-municipal cooperation in planning.
(2) Promote review of development plans by the township's EAC.
(3) Create EAC's in all municipalities.
(4) Promote educational programs for municipal engineers and park and recreation personnel.
(5) Promote educational programs for homeowners.

B. Implementation of Goals: The Action Plan

The goals set forth above are ambitious. Achieving these goals will be challenging, will take time and other resources, and will happen only through the cooperative actions of many different watershed stakeholders.

During the course of the planning process, RCP participants have identified a set of implementing policies and recommended actions designed to achieve the goals which have been defined for the watershed. These actions appear below. Note that the respective elements of the Action Plan have been cross-referenced to Watershed Goals given previously and these linkages are shown in Table 7-1.

Upper and Middle Neshaminy RCP Action Plan

IMPLEMENT RIVER CONSERVATION PLAN PROJECTS - The various projects identified in the River Conservation Plan should be developed in greater detail and implemented with support funding through DCNR.

CHANGE THE WAY WE DEVELOP THE LANDSCAPE - It is possible to develop the landscape and protect land and water resources at the same time. All municipalities should consider the adoption of a second Ordinance relating to Land Development that includes better protection of water resources by more sensitive land development techniques. Issues considered in this Ordinance include earthwork limitations, tree protection, steep slope limits, use of on-site systems, drainage and grading, fertilization/chemical maintenance and site protection.

REVISE ALL MUNICIPAL COMPREHENSIVE PLANS TO INCLUDE THE NESHAMINY WATERSHED PLAN. The Neshaminy Watershed is comprised of many municipalities. Protecting the watershed can only happen when the municipalities work and plan together. Each municipality should consider revision of their Comprehensive Plan to include this Watershed Plan and Goals. Where specific environmentally sensitive areas exist within a given municipality, they can be included in the Official Map.

ESTABLISH GROUNDWATER PROTECTION ZONE – While much of the drinking water is served by public water supplies, there are many areas that rely on both community and private wells. In these cases municipalities should establish a Groundwater Protection Zone to protect the water supply quality and quantity.

REMOVE/PROTECT STRUCTURES IN FLOODPLAIN AND RESTORE THE NATURAL FLOODPLAIN - Each municipality should evaluate local flooding conditions and determine if existing structures can be relocated outside of the current flood plain or floodproofed. Floodplain restoration could include the daylighting of buried streams where feasible.

PROVIDE RIPARIAN BUFFER ZONES ALONG STREAMS - Riparian buffer zones keep development back from the edges of a stream by a set distance. This allows vegetation along the stream to slow down and reduce runoff, reducing downstream flooding, and allows the vegetation to remove pollutants. Trees and vegetation provide shade, reducing stream temperatures and making the stream healthier for fish. It is recommended that each municipality consider the creation of a Riparian Buffer Zone along all perennial streams within their boundaries.

MANAGE STORMWATER DIFFERENTLY - Impervious surfaces create more runoff because rainfall can no longer infiltrate into the soil and groundwater. Detention basins slow the **rate** of runoff, but still send a much greater **volume** of runoff (and pollutants) downstream. All municipalities should consider the adoption of new guidance for stormwater management that requires, where possible, the use of systems that recharge the groundwater, and that prevents new development from increasing the volume of runoff discharged downstream. A Model Stormwater Management Ordinance (Appendix C) is included in the River Conservation Plan for municipal consideration. The Ordinance covers related issues, such as floodplain protection,

nonpoint source pollution, protection of wetlands, soil erosion, riparian buffer zones, and aquifer recharge protection.

MAINTAIN AND IMPROVE (RETROFIT) EXISTING STORMWATER STRUCTURES - Existing stormwater detention basins can be identified within each municipality to determine maintenance needs, as well as the potential for retrofitting for quality and quantity improvements. Maintenance of existing infrastructure is a critical issue.

MAINTAIN AND IMPROVE EXISTING/FUTURE WASTEWATER FACILITIES AND ON-SITE SEPTIC SYSTEMS – Wastewater treatment, when not managed properly, can have detrimental water quality & quantity effects to both surface and groundwater resources. Maintain or improve existing facilities, especially older on-site septic systems that may not be functioning properly, to prevent groundwater or surface water contamination. For new or re-development projects, investigate the use of innovative wastewater treatment technologies where feasible.

MONITOR WATER QUALITY - The changes in aquatic habitat and water quality during wet and dry periods should be monitored for use in tracking the success of land management measures in the future.

CONTROL FERTILIZERS AND SEDIMENTS DRAINING TO LAKES AND RESERVOIRS - In lake drainage areas, local community associations and/or municipalities can evaluate land fertilization and erosion control practices within the local drainage area and recommend changes or restrictions that reduce sediment and related nutrient runoff to lakes.

PURCHASE UNDEVELOPED LAND AS PROTECTED OPEN SPACE – There are many opportunities within the watershed to purchase undeveloped parcels to be preserved as open space. These areas could be utilized for recreation, environmental education, scenic and natural areas, or simply preserved land. These areas could also serve to link existing natural or recreation areas for a variety of uses.

IMPROVE EXISTING RECREATION AREAS AND CREATE STREAM ACCESS AREAS – Many outdoor enthusiasts and fisherman use areas, particularly in and around streams, that are not designated recreation or access areas. This often causes trampling of vegetation and unwanted disposal of garbage. Creating managed access areas that provide trails, trash disposal, and fishing and boat access should decrease damage to natural areas and increase awareness of the problems associated with using non-designated areas.

EDUCATE, EDUCATE, EDUCATE! Simple steps such as not mowing to the edge of streams and in detention basins can make a significant difference in reducing nonpoint source pollution. Municipal Public Works and Recreation Department personnel, as well as the public, should be educated in sustainable landscaping practices. The Watershed Plan will only work if the residents of the Neshaminy Watershed understand the how and why, and what it means to them.

Table 7-1. RCP Goals and Actions Linkage Table

GOALS	ACTION PLAN: Implement River Conservation Plan Projects	Change the way we develop the landscape	Revise All Municipal Comprehensive Plans to Include the Upper and Middle Neshaminy RCP	Establish a Groundwater Protection Zone	Remove/Protect Structures in the Floodplain	Provide Riparian Buffer Zones Along Streams	Manage Stormwater Differently	Maintain and Improve (Retrofit) Existing Stormwater Structures	Maintain and Improve Existing/Future Wastewater Facilities and On-site Septic Systems	Monitor Water Quality	Control Fertilizers and Sediments Draining to Lakes and Reservoirs	Purchase Undeveloped Land as Protected Open Space	Improve Existing Recreation Areas and Create Stream Access Areas	Educate, Educate, Educate!
A. Sustain and restore the quantity and quality of streams and groundwater	■			■			■		■					
(1) Maintain stream baseflows	■			■			■		■					
(2) Restore a healthy water balance	■			■			■							
(3) Reduce and prevent ground and surface water contamination by point and nonpoint source pollution	■			■			■		■	■	■			
(4) Protect the quantity and quality of existing and future wells	■			■			■		■	■				
(5) Reduce impacts of quarrying on groundwater and surface water	■			■										
B. Maintain and Improve Healthy Streams	■				■	■								
(1) Restore/protect aquatic communities, habitats, and stream channels	■				■	■								
(2) Restore/protect natural floodplain and riparian corridors	■				■	■								
(3) Restore/protect intermittent channels as flow pathways.	■				■	■								
C. Protect and Restore Wetlands and Related Vegetative and Hydrologic Systems	■					■						■		
D. Improve Stormwater Management Practices	■						■	■						
(1) Manage stormwater runoff volume	■						■	■						
(2) Increase infiltration of stormwater from new and existing development	■						■	■						
(3) Manage for water quality in all stormwater planning	■						■	■						
E. Improve Wastewater Management	■								■					
(1) Reduce pollution from onlot sewer systems.	■								■					
(2) Reduce/prevent wastewater discharges to lake systems.	■								■					
(3) Reduce pollution from public sewage treatment systems.	■								■					
(4) Promote environmentally responsible wastewater treatment approaches.	■								■					
F. Protect and Maintain Natural and Recreational Resources	■	■	■	■								■	■	
(1) Protect wildlife and flora of the watershed.	■											■	■	
(2) Protect endangered and protected species of flora and fauna.	■											■	■	
(3) Restore and improve natural recreation and fishing areas	■											■	■	
(4) Canoeing, stream access, and greenways.	■												■	
(5) Restore, maintain, and/or increase trout stocking.	■												■	
G. Protect and Maintain Cultural, Historical, and Scenic Resources	■	■										■	■	
(1) Enhance protection and awareness of Native American, historic, and scenic sites	■												■	
(2) Restore, improve, and encourage ecotourism.	■												■	
(3) Enhance the link between community businesses and the Neshaminy Creek.	■											■		
H. Promote Sustainable Land Use and Conservation Practices, including Agricultural and Developed Areas	■	■		■										
(1) Promote integration of RCP and its goals and actions with Municipal comprehensive plans and ordinances.	■	■	■	■										
(2) Promote sustainable land practices – runoff quantity and quality, erosion control, groundwater protection, chemical and fertilizer use.	■	■		■			■							
(3) Promote watershed based zoning and land use planning	■	■		■			■							
(4) Promote re-use of existing sites and infrastructure.	■	■												
I. Educate Municipal Officials, Community Groups, and the Public	■										■			■
(1) Promote inter-municipal cooperation in planning.	■													■
(2) Promote review of development plans by the township's EAC.	■													■
(3) Create EAC's in all municipalities.	■													■
(4) Promote educational programs for municipal engineers and park and recreation personnel.	■													■

The recommended Action Plan is flexible and should be expanded and modified as to always reflect the changing needs within the watershed . Ultimately the most critical step in the RCP implementation process is the identification of Specific Projects which link to the Action Plan, as discussed in the next section.

C. Specific Projects: Current and Future

Plan implementation will occur primarily through the identification and development of specific projects. In many cases, these projects will be modest in scale and scope: a measured length of riparian buffer to be restored, the retrofitting of one or two existing detention basins in a specific municipality, and so forth. Although such small scale projects individually may appear to be quite limited in impact and potential watershed benefit, their incremental and cumulative effects will over time mount, such that the adverse impacts of so much land development in the watershed will begin to be reversed. Over time, the larger goals of the RCP such as reversal of water quality degradation will be achieved. At the same time, the intent of the RCP is to inspire watershed stakeholders to think with a broader vision and to begin to make geographical linkages which expand the scope of projects being conceptualized.

In many cases, projects are already happening. A listing of projects has been developed during the course of this planning process and presents a variety of watershed projects which are either past tense (completed or well on their way toward completion), underway, or planned for the future. Although implementation of the Action Plan is far-reaching and challenging, the point is that already much has been done, already much is happening. These projects, moving forward even without the benefit of the unifying force of the River Conservation Plan, reflect the understanding and commitment of so many different watershed stakeholders; the list of all entities and organizations which have contributed to this listing of projects is included in Table 7-2.

Creative partnering is the key to successful RCP implementation. From business groups and private industries to a long list of service organizations from scout groups to Rotary, Elk, and Kiwanis Clubs, successful implementation means engaging the energies of these many different groups. At the top of the implementation list are municipalities. Without a doubt, many of the Action Plan elements involve either quite directly or at least indirectly significant municipal action, from enacting new and better stormwater management regulations, to revising overall land use and growth management regulations in their zoning and land development ordinances, to outright purchase and acquisition of open space parcels as some municipalities are beginning to do, to improving recreational facilities. Although it's dangerous to assign excessive implementation responsibilities to municipal governments, already so laden with increased responsibilities in so many different areas, the fact remains that the municipalities are absolutely essential actors in RCP implementation. Every effort must be made to help municipalities in this process, to facilitate their understanding of RCP Action Plan recommendations, and to help them make it happen. Nothing could be more important to the success of the overall planning.

Upper and Middle Neshaminy River Conservation Plan
Recommended Projects

Recreation & Trails Projects

1. **Dark Hollow Bridge Restoration** - Remove existing old vehicular bridge and rebuild footbridge in a way that protects Neshaminy Creek, Dark Hollow (Warwick and BCA).
2. **Canoe Access Areas** – Create canoe access areas where portage is required and additional put-ins and take-outs along the creek (NAABC, Watershed Stakeholders).
3. **Seven Mile Nature Trail** – Trail encircling Lake Galena, Peace Valley Park, New Britain Twp. - Include interpretive signs for environmental education. (Peace Valley Nature Center)
4. **YMCA Trail System** - Environmentally Friendly Trail System surrounding Central Bucks Family YMCA in Doylestown Township. Includes new playground with interpretive signage and environmental education components. (YMCA)
5. **Big Meadow Park Enhancement** - Enhance Big Meadow Park on Stoney Ford Road in Holland for passive recreation and a nature study area along the Neshaminy Creek (Northampton).
6. **Northampton Township Trail Development** – Trail along the Neshaminy Creek from Big Meadow Park on Stoney Ford Road through the following properties: Bryan's Farm and Bryan's Island on Rt. 232 and two parcels north of Bryan's Farm along the Neshaminy. Need to develop Master Plan (Northampton).
7. **Montgomery Township Trail Plan** – Implementation of plan included in Montgomery Twp. Open Space Plan that links Horsham Township through Windlestrae Park in Montgomery Township connecting to the Route 202 Bypass Trail. The trail will be enhanced and connected by building a pedestrian bridge across the Neshaminy at Windlestrae Park (Montgomery).
8. **Warrington Trail Expansion** – Enhance and expand the trail that will be built as a part of the Route 202 Expressway through existing Township open space on Upper Stump Road between Pickertown and Bristol Roads (Warrington).
9. **Warrington Stream Trail System** – Develop a trail system through the stream valley that flows through the school district property that contains the Mill Creek Elementary School and the future Central Bucks High School (Warrington).
10. **Wrightstown Trail Project** – Develop a trail system along Mill Creek linking to an existing open space preserve and other trail systems (Wrightstown).
11. **Warwick Trail Program** – Implement goals and projects from the Warwick Township Natural and Historical Trails Program (Warwick).
12. **Hardiaken Creek Trail** – Riparian buffer, walking/recreational trail with possible connection to Plumstead North Branch Trail and Seven Mile Trail. Trail system located in over 168 acres of township preserved land in which additional park uses will be developed (New Britain).
13. **Railroad Creek Recreation Enhancement** – Enhance 60+ acre site leased from the county to be used for a natural preserve and walking trail. Provide pedestrian views and access via the Walters Road trail (New Britain).

14. **PennDOT Wetlands Trail** – Create a walking/recreational trail through PennDOT Wetlands between Schoolhouse Road and SR 152, Limekiln Pike/Main St. Wetlands are adjacent to the West Branch and incorporate other efforts by neighboring townships (New Britain).

Conservation and Restoration

1. **Parcel Protection** - Permanent protection of parcels along the Forks of the Neshaminy and riparian areas and their adjacent lands. 425 acres planned to be purchased for conservation by Heritage Conservancy (Watershed Stakeholders).
2. **Windlestrae Park Restoration** - Montgomery Township Watershed Restoration Project to maintain and preserve Windlestrae Park (Montgomery).
3. **Stream bank Restorations –** Restore stream areas with erosion and degradation (BCA & Watershed Stakeholders).
4. **Restore Riparian Buffers** – Restore buffers and stream bank vegetation and protect existing systems. Assist and encourage private landowners to restore riparian buffers on their property (Plumstead, Hilltown, Wrightstown, NWA & Watershed Stakeholders).
5. **Cook's Run Rehabilitation** - Rehabilitation of Cook's Run through Doylestown Borough, Doylestown Twp, and New Britain Twp. Project includes stream bank stabilization, water quality upgrades, and a 1-mile trail. (BCCD & municipalities).
6. **Plumstead Twp. Greenway** - Implementation of the recommendations proposed in the Plumstead Township Greenway and Trail Linkage Feasibility Study (Plumstead).
7. **Northampton Stream Bank Stabilization** - Project in Northampton Township for stream bank stabilization. The township and partners are currently evaluating stream locations for restoration (BCCD & Northampton).
8. **Stream Bank Restoration/Riparian Buffer Creation** - Paunnacussing Creek along Indian Spring Road & Watson's Creek near None Such Farms & Lindquist Farm (Buckingham).
9. **Hatfield Stream Assessment Implementation Projects** – Implementation of Stream Restoration and Riparian Buffer Restoration Projects listed in the Hatfield Township & Hatfield Borough Visual Stream Assessment Priority List for the West Branch Neshaminy Creek, N. Hatfield Creek, Unionville Creek, Lansdale Creek, and Colmar Creek (Hatfield Township & Hatfield Borough).
10. **Open Space Acquisition, Neshaminy Watershed** - Fund Municipalities for Open Space Acquisition (Wrightstown, New Britain, NWA & Watershed Stakeholders).
11. **Riparian Corridor Greenways** – Protect existing greenways and create new greenways where possible (Wrightstown & Watershed Stakeholders).
12. **Headwater Stream Restoration & Protection** – Restoration of impaired first and second order streams and protection of non-impaired headwaters (Hilltown & Watershed Stakeholders).
13. **Wildlife Restoration** - Restoration of existing wildlife habitat throughout the watershed (NWA).
14. **Reforestation of Open Space** – Hilltown Township

15. **Stream Clean-Up** - Removal of trash, debris and downed trees from stream corridors, specifically the east side of the Neshaminy Creek between Newtown-Richboro Road and Buck Road (Newtown).
16. **Exotic Invasive Plant Removal** – Removal of invasive plant species, particularly in the riparian corridor (PVC).
17. **Buckingham Township Land Preservation** – Preserve agricultural and other open space parcels for permanent protection to curb suburban sprawl and protect rural character of the township (BCA).
18. **Wrightstown Township Riparian Restoration** – Enhance the riparian buffer along Anchor Run a tributary to the Neshaminy which traverses Wrightstown's Open Space Preserve (Wrightstown).
19. **Wrightstown Environmental Education Area Development** – Provide an area for environmental education in the Township Open Space Preserve that would include "demonstration projects" showing stream protection methods such as vegetated buffers and agricultural practices that promote conservation of soils and adjacent water bodies (Wrightstown).
20. **Plumstead Land Preservation** – Preservation of a large land parcel on Ridgeview Drive and Durham Road. The Parcel contains valuable ecological resources including wetlands, vernal pools, forest, and a successional field. The area is also adjacent to a 40 acre of Township open space (Plumstead).
21. **Stream and Habitat Restoration at Plumstead Open Space Preserve** – Begin a program to repair and restore a headwater stream with a focus on water quality and habitat enhancement. The stream has been severely degraded by stormwater runoff from a nearby development. Stream restoration will include sediment removal and streambank stabilization (Plumstead).
22. **Forest Ecology Study and Enhancement, Plumstead Open Space Preserve** – Remove current basin levee along the Forest Border with the Fox Hunt development. Inventory tree species, assess deer grazing damage, remove invasives, plant understory trees for succession, and plant additional edge trees (Plumstead).
23. **Meadow & Wetland Restoration at Plumstead Open Space Preserve** – Re-vegetate meadow and wetland areas with native species to enhance biodiversity and habitat value. Include education interpretation areas such as bird and wildlife watching areas and a raised boardwalk in the wetlands. Construct a raised boardwalk ending in an observation deck adjacent to the Pine Run and link it to an existing parking area (Plumstead).
24. **Newtown Township Land Preservation** – Purchase 134 acres of open space (Melsky Tract) in Newtown and Upper Makefield Townships for preservation. The large parcel contains valuable wetlands (Newtown).
25. **Stewart, Nicholas Property Preservation Corridor** – Preserve corridor along the West Branch and incorporate a trail and wetlands preservation (New Britain).
26. **Pine Run Creek Trail and Preservation** – Obtain land for easement along Pine Run from Keller/Iron Hill to the juction with the North Branch for development of nature trail along the creek (New Britain).

Stormwater Best Management Practices

1. **Pennswood Village Retirement Community**: Design and Construction of a Multi-functioning Riparian Corridor for the Management of Stormwater Quality and a landscaping plan using native plants for a new development project (PVC).
2. **Stormwater Management Wetlands** - A Well Developed Plan to Restore and Create Wetlands for Stormwater Management (Buckingham).
3. **Detention Basin Retrofits** - Retrofit Existing Detention Basins to Infiltrate Stormwater for the purposes of reduced flooding, increased groundwater recharge, water quality, reduce stream bank erosion (Warwick, Plumstead & Buckingham Townships).
4. **Sewage Recycling Project** – Model project to demonstrate how sewage recycling works on a single lot basis (HLA and New Britain).
5. **Durham Ridge Stormwater Retrofit Project** - Implementation of Phase II to include "daylighting" of storm drain pipes through a created wetland, fish stocking in vegetated retention pond, building of nature trails, establishing a community outreach program (educational video/kiosk, site tours) (Plumstead & PRWI).
6. **Open Space Enhancement** - Utilize open space areas for aquifer recharge through retrofitting and through preservation/enhancement of existing functions such as forest communities (Hilltown).
7. **Cattle Crossing** - Fence and Cattle Crossing along Streams (HLA).
8. **Flood Prevention and Control Project, Shrine/Pine Run Community** - Address current flooding with multiple solutions including infiltration basins, porous pavement for parking lots, and re-engineering of stormwater infrastructure in order to reduce volume and velocity of runoff and to protect streambanks and water quality in cooperation with PennDOT and neighboring municipalities (New Britain).
9. **Native Plantings and Infiltration Project** — Expand existing detention basin, providing infiltration enhancement and native plantings to reduce erosion and runoff (DH).
10. **Northampton Municipal Park and Community Center Basin Analysis** - Conduct an environmental engineering analysis of the detention basins to assess how to protect the environmentally sensitive grounds at these 2 municipal properties (Northampton).
11. **Catch Basin Stenciling** – Boroughs, town centers, and commercial areas to stencil catch basins with pictures or phrases to discourage dumping. Eg. "DO NOT DUMP, GOES TO STREAM" (Buckingham & Watershed Stakeholders).
12. **Fox Hunt Detention Basin Retrofit** – Retrofit a very large detention basin for infiltration to reduce stormwater volume impacting a nearby headwater stream and to increase infiltration feeding the adjacent high value forest (Plumstead).
13. **Railroad Creek Stormwater Improvements** – Enhance stormwater management by installing infiltration structures that capture and infiltrate runoff from the Twin Maples basin (New Britain).
14. **Detention Basin Investigation** – Investigate the mitigating effects of naturalized drainage basins on stormwater releases into receiving streams, investigate the effect of basin naturalization on biodiversity in and around the naturalized area, and educate residents regarding the benefits of naturalized basins and BMPs (Montgomery).

15. **Warwick Township Stormwater Management Assessment** – Assess the functionality, maintenance, and management of existing stormwater structures in Warwick Township (Warwick).

Regulatory & Management Programs

1. **Archeological/Historic Protection Program** - Require developers to conduct archeological/historic and prehistoric surveys before starting new development projects in probable areas (NAABC, Watershed Stakeholders).
2. **Ordinance Revisions** - Municipal Revisions to Stormwater and Erosion Control Ordinances to encourage Groundwater Recharge, Reduction in Nonpoint Source Pollution and flood reduction using non-structural approaches (NWA, Wrightstown, Watershed Stakeholders).
3. **Update Stormwater Regulations** - Municipal Stormwater regulations to prevent stormwater runoff and to recharge groundwater and streams (BCA & NWA).
4. **Riparian Buffer Regulations** - Require a riparian buffer in municipal regulations (NWA).
5. **Sewage Management District** - Create management district for subsurface sewage disposal systems to assess problems, educate owners as to maintenance, and set up community fund for repairs. Investigate alternatives for areas where individual lot systems are not functioning or feasible (HLA, NWA & New Britain).
6. **Stream Monitoring Program** – Program involving volunteers and students (PVC).
7. **Goose Control Program** (HLA)
8. **Municipal Assistance Program** - Assist municipalities in revising planning and subdivision ordinances to encourage minimum disturbance techniques for development projects (Watershed Stakeholders, NWA, Wrightstown).
9. **Stormwater Structure Assessment Program** - Program for the assessment of all existing and proposed stormwater management facilities in the watershed to help municipalities better program and organize observation, repair, and maintenance functions for stormwater facilities that may be creating hazardous conditions in the watershed (BCPC).
10. **Native Habitat Creation Program** - Programs that encourage the inclusion of new habitat within stormwater and erosion control facilities (NWA).
11. **Open Space Management Program** – A management program that promotes water quality improvement and wildlife habitat preservation in the Pine Run Sub-watershed (PRWI).
12. **Ordinance Revisions 2** – Consider Zoning as a tool for Riparian Protection and TMDL and BMP enforcement to enhance water quality in impaired streams (Buckingham, Watershed Stakeholders).
13. **Watershed HOTLINE** - Phone number to report threats to the Neshaminy Creek (PVC).
14. **Deer Population Management Program** (PVC)
15. **Nonpoint Source Sediment Control Program** (Buckingham, Wrightstown)

Planning and Research

1. **Hydrogeology Study** - Technical Study of hydrogeology of region to assess sustainable water use (Wrightstown & Watershed Stakeholders).

2. **Watershed Protection Plan** – Plan throughout the Upper and Middle Neshaminy Watershed focused on Stormwater Management and Water Quality (Watershed Stakeholders).
3. **Stormwater Infrastructure Survey** - Survey of stormwater inlets within Buckingham Township to determine upgrade needs and recharge potential (Buckingham).
4. **Geology Mapping** - Mapping of karst limestone belt within Buckingham Township (Buckingham).
5. **Riparian Program** – Program for riparian buffer protection and reestablishment, could include Planning, Assessment or a Research Study (Watershed Stakeholders, NWA).
6. **Water Quality Studies** – Attempt to accurately determine the causes/sources of stream pollution so that mitigation programs can be designed and implemented (BCA).
7. **Water Redemption Project** - An analysis and plan of action for how to manage water resources related to quarrying activities in Hilltown Twp (Hilltown).
8. **Mill Creek Water Quality Study**- Water Quality study for Mill Creek in Wrightstown Township (Wrightstown).
9. **Warwick Township Environmental Assessment** – Complete a study to assess the health of Warwick Township Water Resources and other Environmental Resources. Study should include assessment of existing and potential stormwater BMP's, water and sewage treatment, land preservation, and stewardship. Problems and Solutions should be implemented (Watershed Stakeholders).
10. **Dark Hollow Stream Assessment** – Complete a study of the Neshaminy Creek and its tributaries in the Dark Hollow Area of Warwick Township. Study should focus on local stormwater impacts from uphill developments, water quality, and stream morphology (Watershed Stakeholders).
11. **New Britain Twp**. **Sewage Treatment Assessment** - Assess the functionality of aging on-site septic systems in New Britain Twp., especially those systems in the Lake Galena drainage area. Study should aid in developing solutions to failed septic systems impacting the water quality of Lake Galena. May include development of alternative wastewater technologies to replace failed systems (Watershed Stakeholders).

Education and Community Programs

1. **Water Resource Education for Community** (PVC, Wrightstown).
2. **Landscape Education** - Distribute "25 Ways" brochure and other educational brochures widely as part of a homeowner/neighborhood education program to encourage landscape practices for homeowners that don't rely upon pesticides, herbicides and excessive fertilization (PVC & NWA).
3. **Stream Monitoring Program** - Development of a volunteer stream-monitoring program with an associated curriculum to involve local schools (Buckingham).
4. **Mosquito Prevention Program** – Program to educate the community about mosquito prevention through habitat education of residents (PVC).
5. **Stream Dumping Prevention Program** - Public Education Program that discourage illegal dumping along and into streams and waterways (Watershed Stakeholders, NWA).

6. **Hatfield Stream Assessment Implementation** - Implementation of the Community Education Programs listed in the Hatfield Township & Hatfield Borough Visual Stream Assessment Priority List for the West Branch Neshaminy Creek, N. Hatfield Creek, Unionville Creek, Lansdale Creek, and Colmar Creek (Hatfield Twp. & Hatfield Borough).
7. **Motorized Recreational Vehicle Prevention Program** - Education and Enforcement Programs that deal with illegal and destructive use of ATV's and other motorized vehicles in and adjacent to waterways, wetlands and stream buffers (Watershed Stakeholders, NWA).
8. **Municipal Maintenance Training** - Training Programs for municipal public works departments that focus upon reducing or finding alternative to deicing material use for snow and ice control and minimizing the use of pesticide, herbicide and fertilizers in the maintenance of municipal facilities. The program should address mowing practices near streams and in stormwater management structures (Watershed Stakeholders, NWA).
9. **Outdoor Classrooms** - Educational Program for school children that utilizes watershed resources as outdoor classrooms to develop a first hand familiarity and respect for natural surroundings and to focus on the benefits of protecting natural resources (NWA & PVC).
10. **Homeowner Education** - Education of residents who live adjacent to/near streams about restoration and protection/enhancement of naturally vegetated riparian buffers to decrease mowing and eliminate turf and non-native plants along waterways and ponds (Plumstead, Hatfield Township, Hatfield Borough, Wrightstown & NWA)
11. **Northampton Municipal Park Education Area** - Provide an area for environmental education at park located on Hatboro and New Rds., including a boardwalk. Master Site Plan for this park identifies a wetlands and aquatic education area in the northern portion of the Park surrounding the main drainage area, including existing wetlands and vegetative buffer (Northampton).
12. **Educational Program for On-site Septic Systems** – Educate septic system owners to encourage proper maintenance and management of existing septic systems. Could be a video on the cable channel, meetings, or written materials (Wrightstown).
13. **Educational Video on Watershed Problems** – Educate public on landscape practices and other means of preserving streams and lakes (Watershed Stakeholders).
14. **Education for Township Engineers and Developers** – Educate personnel to encourage sustainable design practices and the use of BMP's for stormwater management. Create a BMP manual specifically geared for these professionals (Watershed Stakeholders).
15. **Alternative On-site Sewage System Education** – Wrightstown Township would like to initiate an education program for residents in alternative onsite sewage disposal system (ie. Drip systems as opposed to sand mounds), (Wrightstown).
16. **Neighborhood Watershed Stewardship Program** – Educate the public and landowners about minimizing lawn fertilization and practicing watershed stewardship (Plumstead).

A total of 97 projects were recommended by various organizations throughout the Middle and Upper Neshaminy Creek Watershed. Organization types included Municipalities, Non-profit Groups, Private Landowners and Community and Environmental Organizations. The following is a list of organizations that contributed to this process and identified projects, as listed in Table 7-2.

Table 7-2. Recommended Projects: Contributing Organizations

Buckingham Township
Buckingham Civic Association (BCA)
Bucks County Conservation District (BCCD)
Bucks County Planning Commission (BCPC)
Central Bucks YMCA (YMCA)
Doylestown Hospital (DH)
Hatfield Borough
Hatfield Township
Hilltown Landowners Association (HLA)
Hilltown Township
Montgomery Township
Native American Alliance of Bucks County (NAABC)
Neshaminy Watershed Association (NWA)
New Britain Township
Newtown Borough
Newtown Township
Northampton Township
Peace Valley Nature Center (PVNC)
Pennswood Village Community (PVC)
Pine Run Watershed Initiative (PRWI)
Plumstead Township
Warrington Township
Warwick Township
Wrightstown Township

Finally, Table 7-3 takes RCP project listings and provides additional information to assist in their evaluation and prioritization. Some of the information provided here is descriptive and relatively straightforward, such as the project sponsors, status of the project, stream status, and so forth. However, a summary analysis has been made as to the potential for additional watershed partnerships to be formed during the execution of the project, because this partnering can be so important for future implementation. Another rating, Potential Multiple Benefit, also has been included which involves a degree of judgment; however, because many projects clearly have the capacity to generate a variety of spinoff benefits, including additional environmental benefits as well as recreational and other goal-related benefits, this is an important factor to include in the matrix.

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Recreation & Trails Projects

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Dark Hollow Bridge Restoration Replacement with Footbridge	BCA Warwick	YES	Some funding (PennDOT)	In-progress	Impaired	YES
Canoe Access Areas	NAABC			Future	Impaired	
Seven Mile Nature Trail	PVNC		Some Funding (BC Parks Dept.)	Concept Complete	Impaired	YES
YMCA Trail System	CB YMCA			Concept Complete	Impaired	YES
Big Meadow Park Enhancement	Northampton			Future	Impaired	YES
Northampton Trail Development	Northampton			Future	Impaired	
Montgomery Trail Plan	Montgomery			Concept Complete	Impaired	
Warrington Trail Expansion	Warrington			Future	Impaired	
Warrington Stream Trail System	Warrington			Future	Impaired	
Wrightstown Trail Project	Wrightstown			Future	Not Impaired	YES
Warwick Trail Program	Warwick			Future	Varies	
Hardiaken Creek Trail	New Britain	YES		Future	Impaired	YES
Railroad Creek Recreation Enhancement	New Britain			Future	Impaired	
PennDOT Wetlands Trail	New Britain	YES		Future	Impaired	YES

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Conservation & Restoration Projects Projects

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Parcel Protection	Heritage Conservancy		Some Funding (Heritage Cons.)	Concept/ In progress	Impaired	
Windlestrae Park Restoration	Montgomery	YES		Future	Impaired	YES
Stream Bank Restoration	BCA			Future	Impaired	YES
Restore Riparian Buffers	Muli-municipal NWA	YES		Future	Impaired	YES
Cooks Run Rehabilitation	BCCD Multi-municipal	YES	Some Funding	Concept/ In progress	Impaired	YES
Plumstead Twp. Greenway	Plumstead			Concept Complete	Impaired	YES
Northampton Streambank Stabolization	Northampton BCCD	YES	Some Funding	Concept/ In progress	Impaired	
Stream Bank Restoration/Riparian Buffer Creation	Buckingham			Future	Not Impaired	YES
Hatfield Steam Assessment Implementation Projects	Hatfield Twp. Hatfiled Borough	YES	Some Funding	Concept/ In Progress	Impaired	YES
Open Space Acquisition, Neshaminy Watershed	Multi-municipal NWA	YES		Future	Varies	YES
Riparian Corridor Greenways	Wrightstown			Future	Varies	YES
Headwater Stream Restoration & Protection	Hilltown			Future	Varies	YES
Wildlife Restoration	NWA			Future	Varies	
Reforestation of Open Space	Hilltown			Future	Varies	

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Conservation & Restoration Projects Projects (Continued)

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Stream Clean-Up	Newtown			Future	Not Impaired	
Exotic Invasive Plant Removal	PVC	YES		Future	Not Impaired	YES
Buckinham Land Preservation	Buckingham			Future	Not Impaired	
Wrightstown Riparian Restoration	Wrightstown			Future	Not Impaired	
Wrightstown Environmental Education Area Development	Wrightstown			Future	Not Impaired	YES
Plumstead Land Preservation	Plumstead			Future	Varies	YES
Stream & Habitat Restoration at Plumstead Open Space Preserve	Plumstead			Future	Varies	YES
Forest Ecology Study & Enhancement at Plumstead Open Space Preserve	Plumstead			Future	Varies	YES
Meadow & Wetland Restoration at Plumstead Open Space Preserve	Plumstead	YES		Future	Varies	YES
Newtown Township Land Preservation	Newtown	YES		Future	Not Impaired	YES
Stewart, Nicholas Property - Preservation Corridor	New Britain			Future	Impaired	
Pine Run Creek Trail & Preservation	New Britain			Future	Impaired	

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Stormwater Best Management Practices

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Pennswood Village Retirement Community Riparian Corridor Project	PVC	YES		Concept Complete	Not Impaired	YES
Stormwater Management Wetlands	Buckingham			Concept Complete	Not Impaired	YES
Detention Basin Retrofits for Infiltration and/or Water Quality	Multi-municipal	YES	Some Funding	Concept Complete/ In Progress	Varies	YES
Sewage Recycling Project	New Britain HLA			Future	Varies	YES
Durham Ridge Stormwater Retrofit	Plumstead PRWI	YES	Some Funding	Concept Complete/ In Progress	Impaired	YES
Open Space Enhancement	Hilltown			Future	Varies	YES
Cattle Crossing	HLA			Future	Varies	
Flood Prevention and Control Project Shrine/Pine Run Community	New Britain	YES		Concept/ In Progress	Varies	YES
Native Plantings and Infiltration Project	DH			Concept	Impaired	YES
Northampton Municipal Park & Community Center Basin Analysis	Northampton			Future	Not Impaired	
Fox Hunt Detention Basins Retrofit	Plumstead			Future	Impaired	
Railroad Creek Stormwater Improvements	New Britain			In-progress	Impaired	YES
Catch Basin Stenciling	Multi-Municipal			Future	Varies	
Detention Basin Investigation	Montgomery			Concept Complete/ In Progress	Varies	YES
Warwick Township Stormwater Management Assessment	Warwick			Concept Complete/ In Progress	Varies	

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Regulatory amd Management Programs

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Archeological/Historic Protection Program	NAABC			Future	Varies	
Ordinance Revisions Stormwater & Erosion Control	Wrightstown NWA			Future	Varies	YES
Update Stormwater Regulations	BCA NWA			Future	Varies	YES
Riparian Buffer Regulations	NWA			Future	Varies	YES
Sewage Management District	New Britain HLA & NWA	YES		Future	Varies	YES
Stream Monitoring Program	PVC	YES		Future	Not Impaired	
Goose Control Program	HLA			Future	Varies	
Municipal Assistance Program	NWA Wrightstown			Future	Varies	
Stormwater Sturcture Assessment Program	BCPC	YES		Concept/ In Progress	Varies	YES
Native Habitat Creation Program	NWA			Future	Varies	YES
Open Space Management Program Pine Run Watershed	PRWI			Future	Impaired	YES
Ordinance Revisions 2	Buckingham			Future	Varies	YES
Watershed Hotline	PVC			Concept/ In Progress	Varies	
Nonpoint Source Sediment Control Program	Buckingham Wrightstown			Future	Varies	
Deer Population Management Program	PVC			Future	Varies	

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Planning and Research

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Hydrogeology Study	Wrightstown			Future	Varies	YES
Watershed Protection Plan	Watershed Stakeholders			Future	Varies	Yes
Stormwater Infrastructure	Buckingham			Future	Not Impaired	
Geology Mapping	Buckingham			Future	Not Impaired	
Riparian Program	NWA			Future	Varies	YES
Water Quality Studies	BCA			Future	Varies	YES
Water Redemption Project	Hilltown			Future	Varies	
Mill Creek Water Quality Study	Wrightstown			Future	Not Impaired	YES
Warwick Township Environmental Assessment	Watershed Stakeholders			Future	Varies	YES
Dark Hollow Stream Assessment	Watershed Stakeholder			Future	Varies	
New Britain Township Sewage Treatment Assessment	Watershed Stakeholders			In-Progress	Impaired	

Table 7-3. Upper and Middle Neshaminy RCP Projects Priority Matrix

Education and Community Programs

PROJECT	Sponsors	Potential Partnerships	Funding Commitment	Planning Stage/Status	Stream Status	Potential Multiple Benefit
Water Resource Education for Communities	PVC Wrightstown	YES		Future	Not Impaired	YES
Landscape Education	PVC & NWA			Concept	Varies	YES
Stream Monitoring Program	Buckingham	YES		Future	Varies	YES
Mosquito Prevention Program	PVC			Future	Varies	
Stream Dumping Prevention Program	NWA			Future	Varies	
Hatfield Stream Assessment Implementation	Hatfield Twp Hatfield Borough	YES		Concept Complete	Impaired	YES
Motorized Recreation Vehicle Prevention Program	NWA			Future	Varies	YES
Muncipal Maintenance Training	NWA	YES		Future	Varies	YES
Outdoor Classroom	NWA & PVC	YES		Future	Varies	
Homeowner Education	Multi-municipal NWA	YES		Future	Varies	YES
Northampton Municipal Park Education Area	Northampton			Concept Complete	Varies	
Education Program for On-site Septic Systems	Wrightstown	YES		Future	Not Impaired	
Educational Video on Watershed Problems	Stakeholders	YES		Future	Varies	
Education for Township Engineers and Developers	Stakeholders	YES		Future	Varies	YES
Alternative On-site Sewage System Education	Wrightstown	YES		Future	Not Impaired	
Neighborhood Watershed Stewardship Program	Plumstead			Future	Varies	

D. Project Implementation and Funding Assistance at PADCNR and Beyond

Implementation will take resources. One of the most effective incentives for watershed stakeholders, especially municipalities, to undertake projects which implement the RCP Action Plan is the availability of PADCNR matching grants through several different funding programs, as discussed below. Additional programs are summarized in the section which follows.

Detailed PADCNR Grant Information

www.dcnr.state.pa.us/grants.htm

The above site details all of the grant categories & requirements offered by PADCNR. It was too much information to list here. Detailed Information is provided in Appendix B. Here are some highlights:

Grant Cycle

- Proposals due in Fall (October), 2002
- Awards Granted in March or April, 2003

Available Funds:

- Total of about $30 Million for all DCNR grant categories state wide.
- Additional Pot of about $1.4 Million for Rivers Conservation Plans and Implementation Projects.
- Rivers implementation projects are eligible for a 50% match from DCNR, however DCNR will match in cash either in-kind contributions or cash contributions from the grantee. In other words a grantee can make their 50% of the total funds needed as in-kind services, not cash. This is good news.

Application Process:

- Grantees will need to apply for a grant under the specific DCNR grant category that relates to their project. The applicant must mention that their project is listed and/or recommended by the Neshaminy RCP in the application. The advantage is that if DCNR chose not to fund the project under the category in which it applied, they could fund it with the additional pot of money ($1.4 Million) for Rivers. The fact that it is included in the plan may also help the grantee compete with other proposals.
- *Note: Sometimes grant proposals that go to PADCNR (such as Water Quality studies and Stream bank restoration/stabilization) can be funded by PADEP with "Growing Greener" grants; the future of "Growing Greener" is currently being evaluated.*

Whether the implementation actions to be undertaken are by the public or private or any other sectors, funding is critical (though funding by itself is by no means the single watershed solution). A variety of potential funding sources are listed and described here. These programs are in a relatively constant state of flux, especially given the rapidly changing landscape of public sector budgets. Some of this information may need to be updated. Nevertheless, these descriptions provide a good start at understanding resources available.

Many of these grant programs are matching grant programs (the bad news). The good news is that it is possible to use one grant to match another grant in some, though not all cases. The matching requirement is often used by potential funding sources as a test of an applicant's determination and commitment. On the municipal level, matching funds can be raised in a variety of ways over and above the general fund through a dedicated income tax and municipal bonds. The point is that though grantsmanship is never easy and always takes time and energy, there is money out there. As has been pointed out several times by PADCNR spokespersons during the course of this RCP preparation, many other watersheds, many other areas are successfully garnering large shares of PADCNR monies for their projects through creative matching of grants and funding sources.

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APPENDICES

APPENDIX A

Upper and Middle Neshaminy Creek Watershed

Historic Sites and Districts

Historic Districts

Municipality	Status	Resource	Address
Buckingham Township	Eligible	District	Durham Rd. (Rte. 413), Rte. 202, Old York Rd. (Rte. 263)
Northampton Township	Eligible	District	Langhorne Players Theater Richboro Rd. Rte. 332
Plumstead Township	Eligible	District	4570-4900 Old Easton Rd, 4300 Block Pt Pleasant Pike
Plumstead Township	Eligible	District	E Rte. 413, Mt. Pleasant Pk, McNeil Rd.
Buckingham Township	Ineligible	District	Lower York Rd.
Buckingham Township	Listed	District	Along Rte. 413 (Durham Rd.) at Mechanicsville Rd.
Buckingham Township	Listed	District	Forest Grove & Lower Mountain Rds.
Buckingham Township	Listed	District	Forest Grove Rd., Pineville Rd., Mill Creek Rd.
Buckingham Township	Listed	District	Mill Rd. & U.S. 202
Buckingham Township	Listed	District	U.S. 202 & Holicong Rd.
Hatfield Township	Listed	District	Oak Blvd., Forest Ave., Park Ave.
Newtown Borough	Listed	District	Liberty; Congress; Chancellor Sts.; Lincoln Ave.
Newtown Borough	Listed	District	Pa. 413 & Pa. 332
Newtown Township	Listed	District	Swamp Rd.
Newtown Township	Listed	District	Sycamore St. East Side
Newtown Township	Listed	District	Sycamore St. W/S Of
Plumstead Township	Listed	District	Old Easton Rd. & Stony Ln.
Buckingham Township	Undetermined	District	
Buckingham Township	Undetermined	District	Almshouse Rd., Rushland Rd., L. Neshaminy Creek
Newtown Borough	Undetermined	District	105 Centre Ave.
Newtown Borough	Undetermined	District	106 Washington
Newtown Borough	Undetermined	District	108-110 E Washington
Newtown Borough	Undetermined	District	112 S Chancellor St.
Newtown Borough	Undetermined	District	114-116 E Washington
Newtown Borough	Undetermined	District	119 N State St.
Newtown Borough	Undetermined	District	122 E Penn St.
Newtown Borough	Undetermined	District	13-15 Maple Ave.
Newtown Borough	Undetermined	District	19 Court St.
Newtown Borough	Undetermined	District	20 S Congress St.
Newtown Borough	Undetermined	District	21 Court St.
Newtown Borough	Undetermined	District	25 S State St.
Newtown Borough	Undetermined	District	31 S State St.
Newtown Borough	Undetermined	District	33 S State St.
Newtown Borough	Undetermined	District	35 S State St.
Newtown Borough	Undetermined	District	40 S State St.
Newtown Borough	Undetermined	District	410 E Washington Ave.
Newtown Borough	Undetermined	District	43 S State St.
Newtown Borough	Undetermined	District	501 Washington Ave.
Newtown Borough	Undetermined	District	99 Center Ave.
Newtown Borough	Undetermined	District	E Washington Ave.
Newtown Township	Undetermined	District	
Wrightstown Township	Eligible	District	Rte. 413 at Junction Wrightstown, Penns Park, Brownsburg Rds.
Wrightstown Township	Listed	District	2nd St. Pike & Penns Park Rd.

Historic Sites

Municipality	Status	Resource	Address
Buckingham Township	Eligible	Building	Cold Spring Creamery Rd.
Buckingham Township	Eligible	Building	Holicong Rd.
Buckingham Township	Eligible	Building	Landisville Rd. T-399
Buckingham Township	Eligible	Building	Mechanicsville Rd. L.R. 09058
Buckingham Township	Eligible	Building	Upper Mountain Rd. East Side
Buckingham Township	Eligible	Structure	Mill Rd.
Buckingham Township	Ineligible	Building	3630 Rte. 202
Buckingham Township	Ineligible	Building	3662 E State St.
Buckingham Township	Ineligible	Building	Old York Rd. (Rt. 263) & Durham Rd. (Rt. 413)
Buckingham Township	Ineligible	Structure	Dark Hollow Rd.
Buckingham Township	Ineligible	Structure	Holicong Rd.
Buckingham Township	Ineligible	Structure	Upper Mountain Rd.
Buckingham Township	Listed	Building	5042 Anderson Rd.
Buckingham Township	Listed	Building	Forest Grove Rd.
Buckingham Township	Listed	Building	Holicong Rd.
Buckingham Township	Listed	Building	Rte. 202
Buckingham Township	Listed	Object	Byecroft Rd., of U.S. 202
Buckingham Township	Listed	Structure	Forest Grove Rd. L.R. 09049
Buckingham Township	NHL	Building	Court St. & Swamp Rd. (Pa. Rte. 313)
Buckingham Township	NHL	Building	E Court St. At Intersection of Pa. 313
Buckingham Township	Undetermined	Building	3179 Mozart Rd.
Buckingham Township	Undetermined	Building	3805 Rte. 202
Buckingham Township	Undetermined	Building	4663 Landisville Rd.
Buckingham Township	Undetermined	Building	5667 York Rd.
Buckingham Township	Undetermined	Building	5685 York Rd.
Buckingham Township	Undetermined	Building	5743 Lower York Rd.
Buckingham Township	Undetermined	Building	5744 Old York Rd.
Buckingham Township	Undetermined	Building	5752 Lower York Rd.
Buckingham Township	Undetermined	Building	5761 Lower York Rd.
Buckingham Township	Undetermined	Building	Ash Mill Rd.
Buckingham Township	Undetermined	Building	Bogart Tavern Rd.
Buckingham Township	Undetermined	Building	Church School Rd. In Spring Valley
Buckingham Township	Undetermined	Building	Cold Spring Creamery Rd.
Buckingham Township	Undetermined	Building	Durham Rd.
Buckingham Township	Undetermined	Building	Forest Grove Rd.
Buckingham Township	Undetermined	Building	Holicong
Buckingham Township	Undetermined	Building	Holicong Rd.
Buckingham Township	Undetermined	Building	Lower York Rd. North Side
Buckingham Township	Undetermined	Building	Mechanicsville Rd.
Buckingham Township	Undetermined	Building	Northwest Corner Rt. 413 & Rt. 202 in Buckingham
Buckingham Township	Undetermined	Building	Old York Rd.
Buckingham Township	Undetermined	Building	Street Rd. South Side
Buckingham Township	Undetermined	Building	Sugar Bottom Rd.
Buckingham Township	Undetermined	Building	Swamp Rd.
Buckingham Township	Undetermined	Building	Upper York Rd. South Side
Buckingham Township	Undetermined	Building	York Rd.
Buckingham Township	Undetermined	NA	Lot .811a 50 Ft on W S S.R. 263 244 Ft N T-386
Buckingham Township	Undetermined	NA	Lot 1.02a E S S.R. 413 155 Ft South of L.R. 09058

Municipality	Status	Resource	Address
Buckingham Township	Undetermined	NA	Lot 1.20a Northeast Cor Swamp Rd. & T-400
Buckingham Township	Undetermined	NA	Lot 1.279a 430 Ft W S S.R. 263 260 Ft N T-386
Buckingham Township	Undetermined	NA	Lot 1.292a 879 Ft Northwest T-389 262 Ft T-380
Buckingham Township	Undetermined	NA	Lot 1.325a Northeast Cor S.R. 413 & L.R. 09058
Buckingham Township	Undetermined	NA	Lot 1.33a E S Durham Rd. 323 Ft S L.R. 09058
Buckingham Township	Undetermined	NA	Lot 1.414a S S T-391 490 Ft E S.R. 313
Buckingham Township	Undetermined	NA	Lot 1.45a Northeast Cor U.S. 611 & Swamp Rd.
Buckingham Township	Undetermined	NA	Lot 1.69a E S S.R. 263 129 Ft S T-386
Buckingham Township	Undetermined	NA	Lot 11.02a W S S.R. 413, 1363 Ft North of L.R. 09058
Buckingham Township	Undetermined	NA	Lot 17.7a N S Swamp Rd. 3137 Ft W T-391
Buckingham Township	Undetermined	NA	Lot 2.128a N S U.S. 202 685 Ft E S.R. 313
Buckingham Township	Undetermined	NA	Lot 3.9a N S Swamp Rd. 4048 Ft W T-391
Buckingham Township	Undetermined	NA	Lot 30.19a N S T-386 300 Ft Southeast S.R. 263
Buckingham Township	Undetermined	NA	Lot 6.59a 309 Ft W T-391
Buckingham Township	Undetermined	NA	Lot 8.786a Northwest Cor T-380 & T-389
Buckingham Township	Undetermined	NA	Lot Northeast Cor U.S. 202 & T-386
Buckingham Township	Undetermined	NA	Lot Northwest Cor Mechanicsville Rd. & Durham Rd.
Buckingham Township	Undetermined	NA	Lot Northwest Cor S.R. 263 & T-386
Buckingham Township	Undetermined	NA	Lot Southeast Cor S.R. 413 & L.R. 09058
Buckingham Township	Undetermined	NA	Lot Southeast Cor T-386 & S.R. 263
Buckingham Township	Undetermined	NA	Lot Southwest Cor L.R. 09058 & S.R. 413
Buckingham Township	Undetermined	NA	Lot W S Durham Rd. 183 Ft N L.R. 09058
Buckingham Township	Undetermined	NA	Lot W S Durham Rd. 468 Ft S L.R. 09058
Buckingham Township	Undetermined	NA	Lot W S S.R. 413 1190 Ft North of L.R. 09058
Buckingham Township	Undetermined	NA	N S T-386 254 Ft W S.R. 263
Hatfield Borough	Ineligible	Structure	Broad St.
Hatfield Borough	Undetermined	Building	14 Market St.
Hatfield Borough	Undetermined	Building	200 N Main St.
Hatfield Borough	Undetermined	Building	206 Lincoln Ave.
Hatfield Borough	Undetermined	Building	30 Lincln Ave.
Hatfield Borough	Undetermined	Building	316 Union St.
Hatfield Borough	Undetermined	Building	40-42 N Maple Ave.
Hatfield Borough	Undetermined	Building	5-17 E Broad St. 5, 13, 17
Hatfield Borough	Undetermined	Building	6 W Broad St.
Hatfield Borough	Undetermined	Building	63 E Broad St.
Hatfield Borough	Undetermined	Building	8 E Broad St.
Hatfield Borough	Undetermined	Building	Market St.
Hatfield Borough	Undetermined	Building	N Maple & Union Sts.
Hatfield Borough	Undetermined	Building	S Main St. & Towamencin Ave.
Hatfield Borough	Undetermined	Building	W Broad St.
Hatfield Township	Eligible	Building	Forty Foot Rd.
Hatfield Township	Ineligible	Building	518 Bethlehem Pk.
Hatfield Township	Ineligible	Building	East of Orvilla & Koffel Rd. Intersection
Hatfield Township	Listed	Structure	Orvilla Rd. L.R. 46046
Hatfield Township	Undetermined	Building	102 Bethlehem Pk.
Hatfield Township	Undetermined	Building	1047 Cowpath Rd.
Hatfield Township	Undetermined	Building	126 Bethlehem Pk.
Hatfield Township	Undetermined	Building	136 Oak Blvd.

Municipality	Status	Resource	Address
Hatfield Township	Undetermined	Building	137 Oak Blvd.
Hatfield Township	Undetermined	Building	1931 Orvilla Rd.
Hatfield Township	Undetermined	Building	1941 Orvilla Rd.
Hatfield Township	Undetermined	Building	2134 Orvilla Rd.
Hatfield Township	Undetermined	Building	2169 Walnut St. Lenhart Rd.
Hatfield Township	Undetermined	Building	2240 Orvilla Rd.
Hatfield Township	Undetermined	Building	2509 Lenhart Rd.
Hatfield Township	Undetermined	Building	2810 Bergey Rd.
Hatfield Township	Undetermined	Building	2929 Penn St.
Hatfield Township	Undetermined	Building	2991 Walnut St.
Hatfield Township	Undetermined	Building	3017 Elroy Rd.
Hatfield Township	Undetermined	Building	706 Fairgrounds Rd.
Hatfield Township	Undetermined	Building	749 Oak Park Rd.
Hatfield Township	Undetermined	Building	840 Orvilla Rd.
Hatfield Township	Undetermined	Building	842 Orvilla Rd.
Hatfield Township	Undetermined	Building	90 County Line Rd.
Hatfield Township	Undetermined	Building	Orvilla Rd.
Hatfield Township	Undetermined	Structure	Orvilla Rd.
Hilltown Township	Eligible	Building	18 Park Rd.
Hilltown Township	Eligible	Building	Fairhill School Rd. Off L.R. 09112
Hilltown Township	Ineligible	Building	30 Church Rd. L.R. 090112
Hilltown Township	Ineligible	Building	Mill Rd. Off, 500 Yds Northwest of Junction with Keystone Dr.
Hilltown Township	Ineligible	Structure	Church Rd.
Lansdale Borough	Eligible	Building	482 E Main St.
Lansdale Borough	Eligible	Building	Main & Walnut Sts. at Railroad Tracks
Lansdale Borough	Ineligible	Building	17 Woodland Dr.
Lansdale Borough	Ineligible	Building	450 E Main St.
Lansdale Borough	Ineligible	Building	493 E Main St.
Lansdale Borough	Ineligible	Building	500 E Main St.
Lansdale Borough	Ineligible	Building	520 E Main St.
Lansdale Borough	Ineligible	Building	526 E Main St.
Lansdale Borough	Ineligible	Building	532 E Main St.
Lansdale Borough	Ineligible	Building	538 E Main St.
Lansdale Borough	Ineligible	Building	559 E Main St.
Lansdale Borough	Ineligible	Building	S Broad St. & Vine St.
Lansdale Borough	Undetermined	Building	101-125 E 3rd St.
Lansdale Borough	Undetermined	Building	13 Jenkins Ave.
Lansdale Borough	Undetermined	Building	210 W Main St.
Lansdale Borough	Undetermined	Building	215 W Main St.
Lansdale Borough	Undetermined	Building	221-223 W 7th St.
Lansdale Borough	Undetermined	Building	23 Richardson Ave.
Lansdale Borough	Undetermined	Building	300-304 W Main St.
Lansdale Borough	Undetermined	Building	301 N Broad St.
Lansdale Borough	Undetermined	Building	307 Valley Forge Rd.
Lansdale Borough	Undetermined	Building	309-311 N Main St.
Lansdale Borough	Undetermined	Building	316-344 W 5th St.
Lansdale Borough	Undetermined	Building	325-331 W Main St.
Lansdale Borough	Undetermined	Building	328-330 Columbia Ave.

Municipality	Status	Resource	Address
Lansdale Borough	Undetermined	Building	337 N Broad St.
Lansdale Borough	Undetermined	Building	405 N Broad St.
Lansdale Borough	Undetermined	Building	41-43 Main St.
Lansdale Borough	Undetermined	Building	415 N Broad St.
Lansdale Borough	Undetermined	Building	418 Pierce St.
Lansdale Borough	Undetermined	Building	428 W Main St.
Lansdale Borough	Undetermined	Building	500 Columbia Ave.
Lansdale Borough	Undetermined	Building	501 N Cannon Ave.
Lansdale Borough	Undetermined	Building	516 N Broad St.
Lansdale Borough	Undetermined	Building	534-536 Columbia Ave.
Lansdale Borough	Undetermined	Building	601 W Main St.
Lansdale Borough	Undetermined	Building	733-739 W 3rd St.
Lansdale Borough	Undetermined	Building	Lansdale Ave.
Lansdale Borough	Undetermined	Building	Main St.
Lansdale Borough	Undetermined	Building	N Broad St.
Lansdale Borough	Undetermined	Building	S Broad St.
Montgomery Township	Eligible	Building	101 Gray 's Ln.
Montgomery Township	Eligible	Building	418 Doylestown Rd.
Montgomery Township	Eligible	Building	497 Doylestown Rd.
Montgomery Township	Eligible	Building	Bethlehem Pk.
Montgomery Township	Eligible	Building	Doylestown Rd.
Montgomery Township	Ineligible	Building	Bethlehem Pk.
Montgomery Township	Undetermined	Building	1425 Taylor Rd.
Montgomery Township	Undetermined	Building	202 Richardson
Montgomery Township	Undetermined	Building	Bethlehem Pk.
Montgomery Township	Undetermined	Building	Doylestown Rd.
Montgomery Township	Undetermined	Building	Doylestown Rd. & Montomgery Ave.
Montgomery Township	Undetermined	Building	Inters. of Bethlehem Pike & Horsham Rd.
New Britain Borough	Ineligible	Structure	Swamp Rd. Pa. 313
New Britain Township	Eligible	Building	119 Brittany Dr.
New Britain Township	Eligible	Building	1514 Upper State Rd.
New Britain Township	Eligible	Building	155 Limekiln Pk.
New Britain Township	Eligible	Building	1606 Upper State Rd.
New Britain Township	Eligible	Building	238 Almshouse Rd.
New Britain Township	Eligible	Building	290 Bristol Rd.
New Britain Township	Eligible	Building	321 W Butler Ave.
New Britain Township	Eligible	Building	420 Upper State Rd.
New Britain Township	Eligible	Building	421 W Butler Ave.
New Britain Township	Eligible	Building	525 W Butler Ave.
New Britain Township	Eligible	Building	55 Kings Rd. T-407
New Britain Township	Eligible	Building	900 Upper State Rd.
New Britain Township	Eligible	Building	Callowhill Rd.
New Britain Township	Eligible	Building	Manor Dr.
New Britain Township	Eligible	Site	Ferry Rd.
New Britain Township	Ineligible	Building	1 Highpoint Dr.
New Britain Township	Ineligible	Building	144 Limekiln Rd.
New Britain Township	Ineligible	Building	1502 Upper State Rd.
New Britain Township	Ineligible	Building	161 Limekiln Pk.

Municipality	Status	Resource	Address
New Britain Township	Ineligible	Building	166 Chapman Rd. T-358
New Britain Township	Ineligible	Building	1702 Upper State Rd.
New Britain Township	Ineligible	Building	1714 Upper State Rd.
New Britain Township	Ineligible	Building	224 Old Limekiln Rd. T-348
New Britain Township	Ineligible	Building	251 Bristol Rd.
New Britain Township	Ineligible	Building	283 Bristol Rd.
New Britain Township	Ineligible	Building	301 W Butler Ave.
New Britain Township	Ineligible	Building	329 W Butler Ave.
New Britain Township	Ineligible	Building	331 Bristol Rd.
New Britain Township	Ineligible	Building	339 W Butler Ave.
New Britain Township	Ineligible	Building	400 W Butler Ave.
New Britain Township	Ineligible	Building	423 W Butler Ave.
New Britain Township	Ineligible	Building	4251 Country Line Rd.
New Britain Township	Ineligible	Building	521 W Butler Ave.
New Britain Township	Ineligible	Building	722 Upper State Rd.
New Britain Township	Ineligible	Building	90 Limekiln Rd. T-350
New Britain Township	Ineligible	Building	910 Upper State Rd.
New Britain Township	Ineligible	Building	92 Chapman Rd. Off T-358
New Britain Township	Ineligible	Building	962 Upper State Rd.
New Britain Township	Ineligible	Building	Township Line Rd.
New Britain Township	Ineligible	Building	W Butler Ave.
New Britain Township	Ineligible	Structure	Callowhill Rd.
New Britain Township	Ineligible	Structure	Galena Rd.
New Britain Township	Listed	Building	Ferry Rd.
New Britain Township	Listed	Structure	T-340
New Britain Township	Undetermined	Building	14 New Galena Rd.
New Britain Township	Undetermined	Building	150 Ferry Rd.
New Britain Township	Undetermined	Building	23 Greenwood St.
New Britain Township	Undetermined	Building	24 Hilltown Pk.
New Britain Township	Undetermined	Building	300 King Rd.
New Britain Township	Undetermined	Building	34 Hilltown Pk.
New Britain Township	Undetermined	Building	4 Hilltown Pk.
New Britain Township	Undetermined	Building	430 King Rd.
New Britain Township	Undetermined	Building	48 Hilltown Pk.
New Britain Township	Undetermined	Building	492 New Galena Rd.
New Britain Township	Undetermined	Building	56 Walnut Rd.
New Britain Township	Undetermined	Building	82 E Pearce Valley Rd.
New Britain Township	Undetermined	Building	855 Myers Rd.
New Britain Township	Undetermined	Building	98 Railroad Ave.
New Britain Township	Undetermined	Building	New Galena Rd.
New Britain Township	Undetermined	Building	Swamp Rd.
New Britain Township	Undetermined	Site	147 Townshipline Rd.
New Britain Township	Undetermined	Site	Limekiln Rd.
New Britain Township	Undetermined	Structure	Chapman Rd. Across Lake Galena
Newtown Borough	Listed	Building	101-105 Court St.
Newtown Borough	Listed	Building	Court St.
Newtown Borough	Listed	Structure	Richboro Rd. L.R. 09042
Newtown Borough	Undetermined	Building	1 Centre Ave.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	10 N State St.
Newtown Borough	Undetermined	Building	100 S Chancellor St.
Newtown Borough	Undetermined	Building	100 S State St.
Newtown Borough	Undetermined	Building	100-102 Centre Ave.
Newtown Borough	Undetermined	Building	101 Centre
Newtown Borough	Undetermined	Building	101 Mercer St.
Newtown Borough	Undetermined	Building	101 Penn St.
Newtown Borough	Undetermined	Building	101 S Chancellor St.
Newtown Borough	Undetermined	Building	101 S Congress St.
Newtown Borough	Undetermined	Building	101 S State St.
Newtown Borough	Undetermined	Building	102 Penn St.
Newtown Borough	Undetermined	Building	102 S Chancellor St.
Newtown Borough	Undetermined	Building	103 E Penn St.
Newtown Borough	Undetermined	Building	103 S State St.
Newtown Borough	Undetermined	Building	104 Jefferson St.
Newtown Borough	Undetermined	Building	104 Penn St.
Newtown Borough	Undetermined	Building	104 S State St.
Newtown Borough	Undetermined	Building	105 E Washington Ave.
Newtown Borough	Undetermined	Building	105 Mercer St.
Newtown Borough	Undetermined	Building	105 N Chancellor St.
Newtown Borough	Undetermined	Building	105 Norwood Ave.
Newtown Borough	Undetermined	Building	105 S Chancellor St.
Newtown Borough	Undetermined	Building	105 S Congress St.
Newtown Borough	Undetermined	Building	106 Centre Ave.
Newtown Borough	Undetermined	Building	106 S Chancellor St.
Newtown Borough	Undetermined	Building	106-108 S State St.
Newtown Borough	Undetermined	Building	107 Court St.
Newtown Borough	Undetermined	Building	107 Mercer St.
Newtown Borough	Undetermined	Building	107 N Chancellor
Newtown Borough	Undetermined	Building	107 Norwood Ave.
Newtown Borough	Undetermined	Building	107 Penn St.
Newtown Borough	Undetermined	Building	107 S State St.
Newtown Borough	Undetermined	Building	108 S Lincoln Ave.
Newtown Borough	Undetermined	Building	108 Washington Ave.
Newtown Borough	Undetermined	Building	109 E Washington Ave.
Newtown Borough	Undetermined	Building	109 Mercer St.
Newtown Borough	Undetermined	Building	109 N State St.
Newtown Borough	Undetermined	Building	109 Norwood Ave.
Newtown Borough	Undetermined	Building	11 K Liberty St.
Newtown Borough	Undetermined	Building	11 S State St.
Newtown Borough	Undetermined	Building	11 Sterling St.
Newtown Borough	Undetermined	Building	110 Centre Ave.
Newtown Borough	Undetermined	Building	110 Congress St.
Newtown Borough	Undetermined	Building	110 E Jefferson St.
Newtown Borough	Undetermined	Building	110 N Lincoln Ave.
Newtown Borough	Undetermined	Building	110 S State St.
Newtown Borough	Undetermined	Building	111 Court St.
Newtown Borough	Undetermined	Building	111 Liberty St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	111 Mercer St.
Newtown Borough	Undetermined	Building	111 N Chancelor St.
Newtown Borough	Undetermined	Building	111 Norwood Ave.
Newtown Borough	Undetermined	Building	111 Penn St.
Newtown Borough	Undetermined	Building	111 S Congress St.
Newtown Borough	Undetermined	Building	111 S State St.
Newtown Borough	Undetermined	Building	112 Penn St.
Newtown Borough	Undetermined	Building	113 Court St.
Newtown Borough	Undetermined	Building	113 E Penn St.
Newtown Borough	Undetermined	Building	113 S Congress St.
Newtown Borough	Undetermined	Building	114 E Centre Ave.
Newtown Borough	Undetermined	Building	114 Jefferson St.
Newtown Borough	Undetermined	Building	114 Liberty St.
Newtown Borough	Undetermined	Building	114 N Lincoln Ave.
Newtown Borough	Undetermined	Building	114 S State St.
Newtown Borough	Undetermined	Building	114 State St.
Newtown Borough	Undetermined	Building	115 E Washington Ave.
Newtown Borough	Undetermined	Building	115 S Congress St.
Newtown Borough	Undetermined	Building	116 Jefferson St.
Newtown Borough	Undetermined	Building	116 N Chancellor St.
Newtown Borough	Undetermined	Building	116 N Congress St.
Newtown Borough	Undetermined	Building	117 Jefferson Ave.
Newtown Borough	Undetermined	Building	117 Lincoln Ave.
Newtown Borough	Undetermined	Building	117 N Chancellor St.
Newtown Borough	Undetermined	Building	117 S Congress St.
Newtown Borough	Undetermined	Building	118 Congress St.
Newtown Borough	Undetermined	Building	118 N Congress St.
Newtown Borough	Undetermined	Building	118 N State St.
Newtown Borough	Undetermined	Building	119 Liberty St.
Newtown Borough	Undetermined	Building	119 N State St.
Newtown Borough	Undetermined	Building	119-121 S State St.
Newtown Borough	Undetermined	Building	12 S State St.
Newtown Borough	Undetermined	Building	120 N Chancellor St.
Newtown Borough	Undetermined	Building	120 N Lincoln Ave.
Newtown Borough	Undetermined	Building	120 N State St.
Newtown Borough	Undetermined	Building	120 S Chancellor St.
Newtown Borough	Undetermined	Building	120 S State St.
Newtown Borough	Undetermined	Building	120 Washington Ave.
Newtown Borough	Undetermined	Building	121 Court St.
Newtown Borough	Undetermined	Building	121 S Chancellor St.
Newtown Borough	Undetermined	Building	122 N Congress St.
Newtown Borough	Undetermined	Building	123 Court St.
Newtown Borough	Undetermined	Building	123 Liberty St.
Newtown Borough	Undetermined	Building	124 S Chancellor St.
Newtown Borough	Undetermined	Building	125 Court St.
Newtown Borough	Undetermined	Building	125 Lincoln Ave.
Newtown Borough	Undetermined	Building	125 N Chancellor St.
Newtown Borough	Undetermined	Building	125 S Chancellor St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	126 N Chancellor St.
Newtown Borough	Undetermined	Building	126 N Congress St.
Newtown Borough	Undetermined	Building	126 N State St.
Newtown Borough	Undetermined	Building	126 S State St.
Newtown Borough	Undetermined	Building	127 Court St.
Newtown Borough	Undetermined	Building	127 Liberty St.
Newtown Borough	Undetermined	Building	128 N Congress
Newtown Borough	Undetermined	Building	128 N Lincoln Ave.
Newtown Borough	Undetermined	Building	128 N State St.
Newtown Borough	Undetermined	Building	128 S Chancellor St.
Newtown Borough	Undetermined	Building	129 Court St.
Newtown Borough	Undetermined	Building	129 Liberty St.
Newtown Borough	Undetermined	Building	129 N State St.
Newtown Borough	Undetermined	Building	129 S State St.
Newtown Borough	Undetermined	Building	13 S Chancellor St.
Newtown Borough	Undetermined	Building	13 S State St.
Newtown Borough	Undetermined	Building	13 Sterlin St.
Newtown Borough	Undetermined	Building	130 N State
Newtown Borough	Undetermined	Building	130 S State St.
Newtown Borough	Undetermined	Building	131 N Lincoln Ave.
Newtown Borough	Undetermined	Building	132 Liberty St.
Newtown Borough	Undetermined	Building	132 N Congress St.
Newtown Borough	Undetermined	Building	132 N Lincoln Ave.
Newtown Borough	Undetermined	Building	132-136 N State St.
Newtown Borough	Undetermined	Building	133 N Lincoln Ave.
Newtown Borough	Undetermined	Building	133 N State St.
Newtown Borough	Undetermined	Building	134 Liberty St.
Newtown Borough	Undetermined	Building	135 N Liberty St.
Newtown Borough	Undetermined	Building	136 Liberty St.
Newtown Borough	Undetermined	Building	136 N Chancellor St.
Newtown Borough	Undetermined	Building	137 N Lincoln Ave.
Newtown Borough	Undetermined	Building	138 Liberty St.
Newtown Borough	Undetermined	Building	138 N State St.
Newtown Borough	Undetermined	Building	139 N State St.
Newtown Borough	Undetermined	Building	14 S Chancellor St.
Newtown Borough	Undetermined	Building	14 S State St.
Newtown Borough	Undetermined	Building	140 N Liberty St.
Newtown Borough	Undetermined	Building	140 N State St.
Newtown Borough	Undetermined	Building	141 Liberty St.
Newtown Borough	Undetermined	Building	142 N Lincoln Ave.
Newtown Borough	Undetermined	Building	142 N State St.
Newtown Borough	Undetermined	Building	143 N State St.
Newtown Borough	Undetermined	Building	144 Liberty St.
Newtown Borough	Undetermined	Building	145 N State St.
Newtown Borough	Undetermined	Building	147 N State St.
Newtown Borough	Undetermined	Building	148 N Congress St.
Newtown Borough	Undetermined	Building	148 N Liberty St.
Newtown Borough	Undetermined	Building	148 N State St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	149 N State St.
Newtown Borough	Undetermined	Building	15 Liberty St.
Newtown Borough	Undetermined	Building	15 Sterling St.
Newtown Borough	Undetermined	Building	150-152 N State St.
Newtown Borough	Undetermined	Building	153 N Congress St.
Newtown Borough	Undetermined	Building	154 N State St.
Newtown Borough	Undetermined	Building	155 N State St.
Newtown Borough	Undetermined	Building	156 N Lincoln Ave.
Newtown Borough	Undetermined	Building	156 N State St.
Newtown Borough	Undetermined	Building	159 N State St.
Newtown Borough	Undetermined	Building	16 E Jefferson St.
Newtown Borough	Undetermined	Building	16 Liberty St.
Newtown Borough	Undetermined	Building	16 Maple Ave.
Newtown Borough	Undetermined	Building	16 S State St.
Newtown Borough	Undetermined	Building	16-18 N State St.
Newtown Borough	Undetermined	Building	17 S State St.
Newtown Borough	Undetermined	Building	17 Sterling St.
Newtown Borough	Undetermined	Building	18 E Jefferson St.
Newtown Borough	Undetermined	Building	18 S Chancellor St.
Newtown Borough	Undetermined	Building	18 S State St.
Newtown Borough	Undetermined	Building	18-20 Penn St.
Newtown Borough	Undetermined	Building	19 S Chancellor St.
Newtown Borough	Undetermined	Building	19 Sterling St.
Newtown Borough	Undetermined	Building	192 N Chancellor St.
Newtown Borough	Undetermined	Building	194 N Chancellor St.
Newtown Borough	Undetermined	Building	198 N Chancellor St.
Newtown Borough	Undetermined	Building	20 N Lincoln Ave.
Newtown Borough	Undetermined	Building	20 S Lincoln Ave.
Newtown Borough	Undetermined	Building	200 Court St.
Newtown Borough	Undetermined	Building	200 Jefferson St.
Newtown Borough	Undetermined	Building	200 N Chancellor St.
Newtown Borough	Undetermined	Building	200 S State St.
Newtown Borough	Undetermined	Building	201 Court St.
Newtown Borough	Undetermined	Building	201 Penn St.
Newtown Borough	Undetermined	Building	202 Jefferson St.
Newtown Borough	Undetermined	Building	202 N Chancellor St.
Newtown Borough	Undetermined	Building	203 Washington Ave.
Newtown Borough	Undetermined	Building	204 Jefferson St.
Newtown Borough	Undetermined	Building	204 Washington Ave.
Newtown Borough	Undetermined	Building	205 Court St.
Newtown Borough	Undetermined	Building	205 S Chancellor St.
Newtown Borough	Undetermined	Building	206 E Jefferson St.
Newtown Borough	Undetermined	Building	206 N Chancellor St.
Newtown Borough	Undetermined	Building	207 Court St.
Newtown Borough	Undetermined	Building	207 Penn St.
Newtown Borough	Undetermined	Building	208 N Chancellor St.
Newtown Borough	Undetermined	Building	208 Washington Ave.
Newtown Borough	Undetermined	Building	209 Court St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	21 Jefferson St.
Newtown Borough	Undetermined	Building	21 S State St.
Newtown Borough	Undetermined	Building	21 Sterling St.
Newtown Borough	Undetermined	Building	210 N Chancellor St.
Newtown Borough	Undetermined	Building	211 Court St.
Newtown Borough	Undetermined	Building	211 Washington Boro
Newtown Borough	Undetermined	Building	212 S State St.
Newtown Borough	Undetermined	Building	212 Washington Ave.
Newtown Borough	Undetermined	Building	212-216 S State St.
Newtown Borough	Undetermined	Building	214 N Chancellor St.
Newtown Borough	Undetermined	Building	215 S Chancellor St.
Newtown Borough	Undetermined	Building	216 Washington Ave.
Newtown Borough	Undetermined	Building	217 Washington Ave.
Newtown Borough	Undetermined	Building	219 Washington Ave.
Newtown Borough	Undetermined	Building	22 N Lincoln Ave.
Newtown Borough	Undetermined	Building	22 Penn St.
Newtown Borough	Undetermined	Building	22 S State St.
Newtown Borough	Undetermined	Building	22-24 N Congress St.
Newtown Borough	Undetermined	Building	220 Washington Ave.
Newtown Borough	Undetermined	Building	221 S Chancellor St.
Newtown Borough	Undetermined	Building	222 Court St.
Newtown Borough	Undetermined	Building	222 S Chancellor St.
Newtown Borough	Undetermined	Building	224 Court St.
Newtown Borough	Undetermined	Building	225 S Chancellor St.
Newtown Borough	Undetermined	Building	226 Court St.
Newtown Borough	Undetermined	Building	226 N State St.
Newtown Borough	Undetermined	Building	226 S State St.
Newtown Borough	Undetermined	Building	227 N State St.
Newtown Borough	Undetermined	Building	227 S Lincoln Ave.
Newtown Borough	Undetermined	Building	228 S Chancellor St.
Newtown Borough	Undetermined	Building	23 N State St.
Newtown Borough	Undetermined	Building	23 S Chancellor St.
Newtown Borough	Undetermined	Building	23 Sterling St.
Newtown Borough	Undetermined	Building	230 S State St.
Newtown Borough	Undetermined	Building	231 N State St.
Newtown Borough	Undetermined	Building	231 S Chancellor St.
Newtown Borough	Undetermined	Building	231 S Lincoln Ave.
Newtown Borough	Undetermined	Building	232 S Chancellor St.
Newtown Borough	Undetermined	Building	233 S Lincoln Ave.
Newtown Borough	Undetermined	Building	234 S State St.
Newtown Borough	Undetermined	Building	235 Court St.
Newtown Borough	Undetermined	Building	235 S Lincoln Ave.
Newtown Borough	Undetermined	Building	235 S State St.
Newtown Borough	Undetermined	Building	237 S Chancellor St.
Newtown Borough	Undetermined	Building	237 S Lincoln Ave.
Newtown Borough	Undetermined	Building	238 S State St.
Newtown Borough	Undetermined	Building	239 Court St.
Newtown Borough	Undetermined	Building	239 S Lincoln Ave.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	24 N Chancellor St.
Newtown Borough	Undetermined	Building	24 N State St.
Newtown Borough	Undetermined	Building	24 S Chancellor St.
Newtown Borough	Undetermined	Building	24-26 Liberty St.
Newtown Borough	Undetermined	Building	24-26 S Lincoln Ave.
Newtown Borough	Undetermined	Building	240 S Chancellor St.
Newtown Borough	Undetermined	Building	241 Court St.
Newtown Borough	Undetermined	Building	241 S Chancellor St.
Newtown Borough	Undetermined	Building	241 S Lincoln Ave.
Newtown Borough	Undetermined	Building	242 S State St.
Newtown Borough	Undetermined	Building	243 S Lincoln Ave.
Newtown Borough	Undetermined	Building	245 S Chancellor St.
Newtown Borough	Undetermined	Building	246 S State St.
Newtown Borough	Undetermined	Building	247 S Lincoln Ave.
Newtown Borough	Undetermined	Building	247 S State St.
Newtown Borough	Undetermined	Building	249 S Lincoln Ave.
Newtown Borough	Undetermined	Building	25 N Chancellor St.
Newtown Borough	Undetermined	Building	25 Sterling St.
Newtown Borough	Undetermined	Building	250 S Chancellor St.
Newtown Borough	Undetermined	Building	250 S State St.
Newtown Borough	Undetermined	Building	252 S State St.
Newtown Borough	Undetermined	Building	254 S Chancellor St.
Newtown Borough	Undetermined	Building	255 S Chancellor St.
Newtown Borough	Undetermined	Building	255 S Lincoln Ave.
Newtown Borough	Undetermined	Building	255 S State St.
Newtown Borough	Undetermined	Building	258 S State St.
Newtown Borough	Undetermined	Building	259 S Chancellor St.
Newtown Borough	Undetermined	Building	259 S Linclon Ave.
Newtown Borough	Undetermined	Building	26 N Chancellor St.
Newtown Borough	Undetermined	Building	26 N Congress St.
Newtown Borough	Undetermined	Building	26 N Lincoln Ave.
Newtown Borough	Undetermined	Building	26 S State St.
Newtown Borough	Undetermined	Building	260 S Chancellor St.
Newtown Borough	Undetermined	Building	27 Court St.
Newtown Borough	Undetermined	Building	27 N Chancellor St.
Newtown Borough	Undetermined	Building	27 N Lincoln Ave.
Newtown Borough	Undetermined	Building	27 S State St.
Newtown Borough	Undetermined	Building	28 Liberty St.
Newtown Borough	Undetermined	Building	28 N Chancellor St.
Newtown Borough	Undetermined	Building	28 N Congress St.
Newtown Borough	Undetermined	Building	28 N Lincoln Ave.
Newtown Borough	Undetermined	Building	28 S Chancellor St.
Newtown Borough	Undetermined	Building	28-30 S State St.
Newtown Borough	Undetermined	Building	29 N Chancellor St.
Newtown Borough	Undetermined	Building	29 S State St.
Newtown Borough	Undetermined	Building	29 Sterling St.
Newtown Borough	Undetermined	Building	30 Liberty St.
Newtown Borough	Undetermined	Building	30 N Chancellor St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	301 Edgeboro Dr.
Newtown Borough	Undetermined	Building	301 S Chancellor St.
Newtown Borough	Undetermined	Building	302-304 Washington Ave.
Newtown Borough	Undetermined	Building	304 Edgeboro Dr.
Newtown Borough	Undetermined	Building	309 Washington Ave.
Newtown Borough	Undetermined	Building	31 N Chancellor St.
Newtown Borough	Undetermined	Building	312 Washington Ave.
Newtown Borough	Undetermined	Building	312-314 S Lincoln Ave.
Newtown Borough	Undetermined	Building	313 Washington Ave.
Newtown Borough	Undetermined	Building	314 Washington Ave.
Newtown Borough	Undetermined	Building	314-316 Centre Ave.
Newtown Borough	Undetermined	Building	315 E Centre Ave.
Newtown Borough	Undetermined	Building	318 Center Ave.
Newtown Borough	Undetermined	Building	318 Washington Ave.
Newtown Borough	Undetermined	Building	319 E Centre Ave.
Newtown Borough	Undetermined	Building	319 Washington Boro
Newtown Borough	Undetermined	Building	32 S Chancellor St.
Newtown Borough	Undetermined	Building	32 S State St.
Newtown Borough	Undetermined	Building	32-34 Court St.
Newtown Borough	Undetermined	Building	320 Centre Ave.
Newtown Borough	Undetermined	Building	322 Centre Ave.
Newtown Borough	Undetermined	Building	322 Washington Ave.
Newtown Borough	Undetermined	Building	323 Centre St.
Newtown Borough	Undetermined	Building	324 Centre Ave.
Newtown Borough	Undetermined	Building	325 Centre St.
Newtown Borough	Undetermined	Building	326-328 Center Ave.
Newtown Borough	Undetermined	Building	328 S Lincoln Ave.
Newtown Borough	Undetermined	Building	33 N Lincoln Ave.
Newtown Borough	Undetermined	Building	33 Sterling St.
Newtown Borough	Undetermined	Building	330 S Lincoln Ave.
Newtown Borough	Undetermined	Building	330 S State St.
Newtown Borough	Undetermined	Building	333 S Lincoln Ave.
Newtown Borough	Undetermined	Building	335 S Linclon Ave.
Newtown Borough	Undetermined	Building	337 S Lincoln Ave.
Newtown Borough	Undetermined	Building	339 S Lincoln Ave.
Newtown Borough	Undetermined	Building	34 Liberty St.
Newtown Borough	Undetermined	Building	347 S Lincoln Ave.
Newtown Borough	Undetermined	Building	348 S Lincoln Ave.
Newtown Borough	Undetermined	Building	349 S Lincoln Ave.
Newtown Borough	Undetermined	Building	35 N Chancellor St.
Newtown Borough	Undetermined	Building	35 N Lincoln Ave.
Newtown Borough	Undetermined	Building	35 S Chancellor St.
Newtown Borough	Undetermined	Building	35 S Congress St.
Newtown Borough	Undetermined	Building	351 S Lincoln Ave.
Newtown Borough	Undetermined	Building	355 S Lincoln Ave.
Newtown Borough	Undetermined	Building	359 S Lincoln Ave.
Newtown Borough	Undetermined	Building	37 Sterling St.
Newtown Borough	Undetermined	Building	400 S State St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	401 E Washington Ave.
Newtown Borough	Undetermined	Building	401 S State St.
Newtown Borough	Undetermined	Building	408 S State St.
Newtown Borough	Undetermined	Building	41 Sterling St.
Newtown Borough	Undetermined	Building	414 E Washington Ave.
Newtown Borough	Undetermined	Building	415 E Centre Ave.
Newtown Borough	Undetermined	Building	415 Washington Ave.
Newtown Borough	Undetermined	Building	417 Centre Ave.
Newtown Borough	Undetermined	Building	417 E Washington Ave.
Newtown Borough	Undetermined	Building	418 E Washington Ave.
Newtown Borough	Undetermined	Building	420 Centre Ave.
Newtown Borough	Undetermined	Building	420 S State St.
Newtown Borough	Undetermined	Building	423 E Washington Ave.
Newtown Borough	Undetermined	Building	429 Greene St.
Newtown Borough	Undetermined	Building	43 Sterling St.
Newtown Borough	Undetermined	Building	436 E Washington Ave.
Newtown Borough	Undetermined	Building	44 Sterling St.
Newtown Borough	Undetermined	Building	440 E Washington Ave.
Newtown Borough	Undetermined	Building	442 E Washington Boro
Newtown Borough	Undetermined	Building	445 Centre Ave.
Newtown Borough	Undetermined	Building	446 E Centre Ave.
Newtown Borough	Undetermined	Building	446-448 E Washington Ave.
Newtown Borough	Undetermined	Building	450 E Washington Ave.
Newtown Borough	Undetermined	Building	451 Penn St.
Newtown Borough	Undetermined	Building	46 Sterling St.
Newtown Borough	Undetermined	Building	5 Maple Ave.
Newtown Borough	Undetermined	Building	5 S State St.
Newtown Borough	Undetermined	Building	5 W Washington Ave.
Newtown Borough	Undetermined	Building	500 S State St.
Newtown Borough	Undetermined	Building	505 Penn St.
Newtown Borough	Undetermined	Building	509 S State St.
Newtown Borough	Undetermined	Building	516 Centre Ave.
Newtown Borough	Undetermined	Building	524 Centre Ave.
Newtown Borough	Undetermined	Building	536 Centre Ave.
Newtown Borough	Undetermined	Building	547 Washington Ave.
Newtown Borough	Undetermined	Building	556 Centre Ave.
Newtown Borough	Undetermined	Building	602 E Penn St.
Newtown Borough	Undetermined	Building	7 Maple Ave.
Newtown Borough	Undetermined	Building	79 Jefferson St.
Newtown Borough	Undetermined	Building	8 N State St.
Newtown Borough	Undetermined	Building	9 S Chancellor St.
Newtown Borough	Undetermined	Building	95 Centre Ave.
Newtown Borough	Undetermined	Building	97 Centre Ave.
Newtown Borough	Undetermined	Building	98-100 Penn St.
Newtown Borough	Undetermined	Building	99 Centre Ave.
Newtown Borough	Undetermined	Building	Barclay St.
Newtown Borough	Undetermined	Building	Congress St.
Newtown Borough	Undetermined	Building	Corner Congress St. & Greene St.

Municipality	Status	Resource	Address
Newtown Borough	Undetermined	Building	Corner Liberty & Greene Sts.
Newtown Borough	Undetermined	Building	Corner Washington Ave. & State St.
Newtown Borough	Undetermined	Building	East side Congress St.
Newtown Borough	Undetermined	Building	Liberty St.
Newtown Borough	Undetermined	Building	N Congress St.
Newtown Borough	Undetermined	Building	N Lincoln Ave.
Newtown Borough	Undetermined	Building	N State St.
Newtown Borough	Undetermined	Building	Northeast Corner Liberty & Greene Sts.
Newtown Borough	Undetermined	Building	Northwest Corner Liberty & Greene Sts.
Newtown Borough	Undetermined	Building	Northwest Corner Washington Ave. & Liberty St.
Newtown Borough	Undetermined	Building	Penn & Congress Sts.
Newtown Borough	Undetermined	Building	Penn St. & Lincoln Ave.
Newtown Borough	Undetermined	Building	S Lincoln Ave.
Newtown Borough	Undetermined	Building	S State St.
Newtown Borough	Undetermined	Building	Southeast Corner S State & Penn Sts.
Newtown Borough	Undetermined	Building	Southeast Corner State St. & Sterling St.
Newtown Borough	Undetermined	Building	Southeast Corner Washington Ave. & Congress St.
Newtown Borough	Undetermined	Building	Southeast Corner of State & Sterling Sts.
Newtown Borough	Undetermined	Building	State & Greene Sts.
Newtown Borough	Undetermined	Building	State St. & Centre Ave.
Newtown Borough	Undetermined	Building	Washington Ave.
Newtown Borough	Undetermined	Building	Washington Ave. & Chancellor
Newtown Borough	Undetermined	Building	Washington Ave. & State St.
Newtown Borough	Undetermined	NA	1 S State
Newtown Borough	Undetermined	NA	10 S State St.
Newtown Borough	Undetermined	NA	102 E Jefferson St.
Newtown Borough	Undetermined	NA	103 N State St.
Newtown Borough	Undetermined	NA	105 Penn St.
Newtown Borough	Undetermined	NA	106 N State St.
Newtown Borough	Undetermined	NA	109 Court St.
Newtown Borough	Undetermined	NA	113 Norwood Ave.
Newtown Borough	Undetermined	NA	14 S Congress St.
Newtown Borough	Undetermined	NA	145 Liberty St.
Newtown Borough	Undetermined	NA	16 S Congress
Newtown Borough	Undetermined	NA	195 Greene St.
Newtown Borough	Undetermined	NA	225 S Lincoln Ave.
Newtown Borough	Undetermined	NA	229 S Lincoln Ave.
Newtown Borough	Undetermined	NA	35 Court St.
Newtown Borough	Undetermined	NA	40-42 Sterling St.
Newtown Borough	Undetermined	NA	50 Sterling St.
Newtown Borough	Undetermined	NA	Southwest Corner/Congress & Centre
Newtown Township	Eligible	Building	131 Richboro Rd.
Newtown Township	Eligible	Building	4 Sycamore St.
Newtown Township	Eligible	Building	Rte. 413, Double Woods Rd.
Newtown Township	Eligible	Building	Rte. 413, Newtown Pike
Newtown Township	Eligible	NA	Richboro Rd. Rt. 322
Newtown Township	Ineligible	Building	229 Wrights Rd.
Newtown Township	Ineligible	Building	Rte. 143, Newtown Pike

Municipality	Status	Resource	Address
Newtown Township	Ineligible	Building	Rte. 322
Newtown Township	Ineligible	Building	Rte. 413 Opposite Eagle Rd. - to Be Moved
Newtown Township	Ineligible	Building	S State St., Rte. 413 Newtown Pike
Newtown Township	Ineligible	Building	W/S of Rte. 413 (Newtown Pike), S. of Boro
Newtown Township	Ineligible	Structure	Bucks Rd. T-332
Newtown Township	Listed	Building	229 Wrights Rd.
Newtown Township	Listed	Building	Buck Rd. East Side
Newtown Township	Listed	Building	Off Richboro Rd., South of Newtown
Newtown Township	Listed	Structure	Tyler State Park
Newtown Township	Undetermined	Building	510 S State St.
Newtown Township	Undetermined	NA	
Newtown Township	Undetermined	NA	1 Sycamore St.
Newtown Township	Undetermined	NA	101 N Sycamore St.
Newtown Township	Undetermined	NA	101 N Sycamore St. Atchd to 103 N Sycamore St.
Newtown Township	Undetermined	NA	107 Richboro Rd. S/S
Newtown Township	Undetermined	NA	125 S Sycamore St. E/S No
Newtown Township	Undetermined	NA	131 Richboro Rd. S/S
Newtown Township	Undetermined	NA	161 Swamp Rd. W/S
Newtown Township	Undetermined	NA	181 S Sycamore
Newtown Township	Undetermined	NA	181 S Sycamore St.
Newtown Township	Undetermined	NA	185 Swamp Rd. W/S
Newtown Township	Undetermined	NA	214 Buck Rd.
Newtown Township	Undetermined	NA	2226 N Chancellor St.
Newtown Township	Undetermined	NA	226 N Chancellor St.
Newtown Township	Undetermined	NA	230 N Chancellor St.
Newtown Township	Undetermined	NA	232 Wrights Rd.
Newtown Township	Undetermined	NA	234 N State St. W/S
Newtown Township	Undetermined	NA	235 Durham Rd.
Newtown Township	Undetermined	NA	236 N State St. W/S
Newtown Township	Undetermined	NA	258 Durham Rd. E/S
Newtown Township	Undetermined	NA	265 N Lincoln Ave.
Newtown Township	Undetermined	NA	273 N Lincoln Ave. E/S
Newtown Township	Undetermined	NA	277 N Lincoln Ave.
Newtown Township	Undetermined	NA	281 N Lincoln Ave.
Newtown Township	Undetermined	NA	298 Wrightstown Rd. N/S Rte. 363
Newtown Township	Undetermined	NA	331 Lower Dolington Rd.
Newtown Township	Undetermined	NA	351 Eagle Rd. E/S
Newtown Township	Undetermined	NA	353 Eagle Rd. E/S
Newtown Township	Undetermined	NA	355 Wrights Rd. In Mardot Village
Newtown Township	Undetermined	NA	372 Swamp Rd. E/S
Newtown Township	Undetermined	NA	372 Wrights Rd. E/S -
Newtown Township	Undetermined	NA	381 Durham Rd. W/S
Newtown Township	Undetermined	NA	413 Stoopville Rd. S/S
Newtown Township	Undetermined	NA	416 Summit Ave.
Newtown Township	Undetermined	NA	421 Linton Hill Rd.
Newtown Township	Undetermined	NA	43 Swamp Rd. Corner Walnut & Swamp Rds.
Newtown Township	Undetermined	NA	52 Richboro Rd. S/S
Newtown Township	Undetermined	NA	53 German Ave. N/S

Municipality	Status	Resource	Address
Newtown Township	Undetermined	NA	54 Durham Rd. E/S
Newtown Township	Undetermined	NA	62 Durham Rd. W/S
Newtown Township	Undetermined	NA	647 Linton Hill Rd. W/S
Newtown Township	Undetermined	NA	68 Durham Rd. E/S
Newtown Township	Undetermined	NA	72 Maple Ln. W/S Rte. 413 (Windrace)
Newtown Township	Undetermined	NA	90 Eagle Rd.
Newtown Township	Undetermined	NA	Buck Rd.
Newtown Township	Undetermined	NA	Buck Rd. E/S at Neshaminy Creek
Newtown Township	Undetermined	NA	Buck Rd. W/S
Newtown Township	Undetermined	NA	Corner Jefferson St. & Sycamore St. E/S
Newtown Township	Undetermined	NA	Corner N Lincoln Ave. & Frost Ln.
Newtown Township	Undetermined	NA	Corner Rte. 532 & Linton Hill Rd.
Newtown Township	Undetermined	NA	Corner S Sycamore St. & Jefferson St.
Newtown Township	Undetermined	NA	Dolington Newtown Rd. W/S
Newtown Township	Undetermined	NA	Dolington-Newtown Rd. W/S
Newtown Township	Undetermined	NA	Dolington-Stoppville Rd. S/S 424
Newtown Township	Undetermined	NA	Durham East Side
Newtown Township	Undetermined	NA	Durham Rd. E/S
Newtown Township	Undetermined	NA	Durham Rd. E/S (No 258)
Newtown Township	Undetermined	NA	Durham Rd. E/S at Corner of Stoopville Rd.
Newtown Township	Undetermined	NA	Durham Rd. East Side
Newtown Township	Undetermined	NA	Durham Rd. W/S
Newtown Township	Undetermined	NA	Durham Rd. W/S Rte. 413-413
Newtown Township	Undetermined	NA	E/S Rte. 413
Newtown Township	Undetermined	NA	E/S Rte. 413 Approx 1400ft. Back from Rd.
Newtown Township	Undetermined	NA	E/S Rte. 532
Newtown Township	Undetermined	NA	E/South of N Sycamore St.
Newtown Township	Undetermined	NA	Eagle Rd. E/S
Newtown Township	Undetermined	NA	Eagle Rd. W/S
Newtown Township	Undetermined	NA	German Ave. N/S No 50
Newtown Township	Undetermined	NA	Howard Ave. W/S
Newtown Township	Undetermined	NA	Linden Ave. W/S -No 87
Newtown Township	Undetermined	NA	Linton Hill Rd. E/S
Newtown Township	Undetermined	NA	Linton Hill Rd. S/S
Newtown Township	Undetermined	NA	Linton Hill Rd. W/S 471
Newtown Township	Undetermined	NA	Linton Rd. W/S 471
Newtown Township	Undetermined	NA	Lower Dolington Rd. S/S Of
Newtown Township	Undetermined	NA	Maple Ln. N/S No. 46
Newtown Township	Undetermined	NA	N Chancellor St.
Newtown Township	Undetermined	NA	N Lincoln Ave. E/S
Newtown Township	Undetermined	NA	N Sycamore E/S
Newtown Township	Undetermined	NA	N Sycamore St. E/S
Newtown Township	Undetermined	NA	Newtown Richboro Rd.
Newtown Township	Undetermined	NA	Newtown-Richboro Rd. N/S
Newtown Township	Undetermined	NA	Northwest Corner Hidden Valley Ln. & York St.
Newtown Township	Undetermined	NA	Northwest Corner Lower Dolington Rd. & Silver Lake Rd.
Newtown Township	Undetermined	NA	Richboro Rd. N/S
Newtown Township	Undetermined	NA	S Sycamor St. E/S

Municipality	Status	Resource	Address
Newtown Township	Undetermined	NA	S Sycamore St.
Newtown Township	Undetermined	NA	S Sycamore St. E/S
Newtown Township	Undetermined	NA	Southeast Corner Eagle & Wrights Rds. (279)
Newtown Township	Undetermined	NA	Southeast side Rte. 532
Newtown Township	Undetermined	NA	Stoopville Rd. E/S
Newtown Township	Undetermined	NA	Stoopville Rd. N/S
Newtown Township	Undetermined	NA	Stoopville Rd. N/S Between 413 & Eagle Rds.
Newtown Township	Undetermined	NA	Stoopville Rd. N/S Between Eagle Rd. & 413
Newtown Township	Undetermined	NA	Stoopville Rd. N/S Bwtn 413 & Eagle Rd.
Newtown Township	Undetermined	NA	Stoopville Rd. N/S Bwtn Rte. 413 & Eagle Rds.
Newtown Township	Undetermined	NA	Stoopville Rd. North side
Newtown Township	Undetermined	NA	Stoopville Rd. S/S
Newtown Township	Undetermined	NA	Summit Ave. S/S
Newtown Township	Undetermined	NA	Swamp Rd. W/S
Newtown Township	Undetermined	NA	Swamp Rd. W/S at Junction of Bypass
Newtown Township	Undetermined	NA	Sycamore St. E /S
Newtown Township	Undetermined	NA	Sycamore St. E/S
Newtown Township	Undetermined	NA	Sycamore St. E/S -Atchd to South of Tax Map 29-12-8
Newtown Township	Undetermined	NA	Sycamore St. E/S Between Jefferson & Frost Ln.
Newtown Township	Undetermined	NA	Sycamore St. E/S at Corner with Centre Ave.
Newtown Township	Undetermined	NA	Sycamore St. S/S
Newtown Township	Undetermined	NA	Sycamore St. W/S
Newtown Township	Undetermined	NA	To Rear of 29-12-26
Newtown Township	Undetermined	NA	Twining Bridge & Swamp Rd.
Newtown Township	Undetermined	NA	Twining Bridge Rd. N/S
Newtown Township	Undetermined	NA	Twining Bridge Rd. S/S
Newtown Township	Undetermined	NA	W/S Rte. 413
Newtown Township	Undetermined	NA	W/S Rte. 532
Newtown Township	Undetermined	NA	Walnut St. W/S
Newtown Township	Undetermined	NA	Washington Crossing Rd. E/S (No 397)
Newtown Township	Undetermined	NA	Wrights Rd. N/S
Newtown Township	Undetermined	NA	Wrights Rd. N/S (Rte. 363)
Northampton Township	Ineligible	Building	513 Worthington Mill Rd.
Northampton Township	Ineligible	Structure	2nd St.
Northampton Township	Listed	Building	1925 2nd Street Pk. Rte. 232
Northampton Township	Undetermined	Building	No. 1 Lane Trail, Tyler State Park
Northampton Township	Undetermined	Building	Sackettsford Rd.
Northampton Township	Undetermined	Building	Tyler State Park
Northampton Township	Undetermined	NA	Covered Bridge Trail, Tyler State Park
Plumstead Township	Eligible	Building	5550 Twin Silo Rd.
Plumstead Township	Ineligible	Building	4907 Dillon Rd.
Plumstead Township	Ineligible	Structure	Curley Hill Rd.
Plumstead Township	Undetermined	Building	5835 Swamp Rd.
Plumstead Township	Undetermined	Building	Curley Hill Rd.
Plumstead Township	Undetermined	Building	Ferry Rd.
Plumstead Township	Undetermined	Building	Landisville Rd.
Plumstead Township	Undetermined	Building	Swamp Rd.
Warrington Township	Eligible	Building	1225 Upper State Rd.
Warrington Township	Eligible	Building	1397 Upper State Rd.

Municipality	Status	Resource	Address
Warrington Township	Eligible	Building	3575 Limekiln Pk.
Warrington Township	Eligible	Building	3679 Limekiln Pk.
Warrington Township	Eligible	Building	3796 Limekiln Pk.
Warrington Township	Eligible	Building	701 Upper State Rd.
Warrington Township	Eligible	Building	926 Stump Rd.
Warrington Township	Eligible	Structure	Pickertown Rd.
Warrington Township	Ineligible	Building	1039 Upper State Rd.
Warrington Township	Ineligible	Building	1058 Stump Rd.
Warrington Township	Ineligible	Building	3572 Limekiln Pk.
Warrington Township	Ineligible	Building	3640 Pickertown Rd.
Warrington Township	Ineligible	Building	3679 Pickertown Rd.
Warrington Township	Ineligible	Building	3751 Detweiler
Warrington Township	Ineligible	Building	3765 Limekiln Pk.
Warrington Township	Undetermined	Building	Stuckert Rd. East Side
Warwick Township	Eligible	Structure	Dark Hollow Rd.
Warwick Township	Ineligible	Building	1545 Almshouse Rd.
Warwick Township	Ineligible	Building	1555 Almshouse Rd.
Warwick Township	Ineligible	Building	2119 Old York Rd.
Warwick Township	Ineligible	Building	2132 York Rd.
Warwick Township	Ineligible	Building	2140 York Rd.
Warwick Township	Ineligible	Building	2150 Old York Rd.
Warwick Township	Ineligible	Building	2160 York Rd.
Warwick Township	Ineligible	Building	2249-2253 York Rd.
Warwick Township	Ineligible	Building	2875 Old York Rd. Rte. 263
Warwick Township	Ineligible	Building	2975 Valley Rd. T-383
Warwick Township	Ineligible	Building	301 Valley Rd. T-383
Warwick Township	Ineligible	Building	308 Valley Rd. T-383
Warwick Township	Ineligible	Building	Almshouse Rd. East Side
Warwick Township	Ineligible	Building	Stony Rd.
Warwick Township	Ineligible	Building	West side of S.R. 263
Warwick Township	Ineligible	Building	York Rd. Southwest Corner Of
Warwick Township	Ineligible	Structure	Dark Hollow Rd.
Warwick Township	Listed	Structure	Old York Rd.
Warwick Township	Undetermined	Building	1235 Almshouse Rd.
Warwick Township	Undetermined	Building	272 Meetinghouse Rd.
Warwick Township	Undetermined	Building	2836 Valley Rd.
Warwick Township	Undetermined	Building	312 Valley Rd. T-383
Warwick Township	Undetermined	Building	Almshouse Rd.
Warwick Township	Undetermined	Building	Dark Hollow Rd. Off L.R. 09149
Warwick Township	Undetermined	Building	Rushland Rd.
Warwick Township	Undetermined	Building	Wilkinson Rd.
Warwick Township	Undetermined	Structure	Mill Rd.
Wrightstown Township	Eligible	Building	484 Durham Rd.
Wrightstown Township	Eligible	Building	Penn's Park & Mill Creek Rds.
Wrightstown Township	Eligible	Building	South Corner of Rte. 232 & Swamp Rd.
Wrightstown Township	Ineligible	Building	Mill Creek & Swamp Rd.
Wrightstown Township	Ineligible	Building	Swamp Rd. & Penns Park Rd.
Wrightstown Township	Ineligible	Structure	Mill Creek Rd.

Municipality	Status	Resource	Address
Wrightstown Township	Ineligible	Structure	Rte. 413, 230ft South of Penn's Park Rd. in Wrightstown
Wrightstown Township	Ineligible	Structure	Swamp Rd.
Wrightstown Township	Ineligible	Structure	Swamp Rd. S.R. 2036
Wrightstown Township	Listed	Building	2310-2324 2nd St. Pike
Wrightstown Township	Listed	Building	Ceder Ln.
Wrightstown Township	Listed	Building	Corner of Mud Rd. & Penns Park Rd.
Wrightstown Township	Listed	Building	Rte. 413
Wrightstown Township	Undetermined	Building	Main St. Twp. Line Rd. in Wycombe (N.R. H.D.
Wrightstown Township	Undetermined	Building	Swamp Rd. Off L.R. 09048, North of Junction with L.R. 09047
Wrightstown Township	Undetermined	Building	Swamp Rd. S.R. 2036
Wrightstown Township	Undetermined	Building	Wrightstown-Taylorsville Rd. Just Northeast of Wrightstown
Wrightstown Township	Undetermined	NA	2nd Street Pk. East side 609 Ft N Penns Pk Rd.
Wrightstown Township	Undetermined	NA	2nd Street Pk. East side Penns Park
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 283 Ft North of T-389
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 364 Ft North of T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 416 Ft N T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 473 Ft N T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 495 Ft N T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side 542 Ft N T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side Between Rte. 413 & Cherry Ln.
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side N T-369
Wrightstown Township	Undetermined	NA	2nd Street Pk. West side of 828 Ft North of T-369
Wrightstown Township	Undetermined	NA	Cedar Ln. East side 507 Ft North of Rushland Rd.
Wrightstown Township	Undetermined	NA	Cedar Ln. East side, 2784 Ft North of Rushland Rd.
Wrightstown Township	Undetermined	NA	Cherry Ln. East side 2nd House from 2nd St. Pike
Wrightstown Township	Undetermined	NA	East side Rte. 413 App 200 Ft S Midland Rd.
Wrightstown Township	Undetermined	NA	Mill Creek Rd. 408 Ft W Cedar Ln.
Wrightstown Township	Undetermined	NA	Mud & Worthington Mill Rds.
Wrightstown Township	Undetermined	NA	Mud Rd.
Wrightstown Township	Undetermined	NA	Northeast Corner L.R. 09052 & Neshaminy Creek (Worthingtn Ml Rd.)
Wrightstown Township	Undetermined	NA	Northeast Corner Park Ave. & Cherry Ln.
Wrightstown Township	Undetermined	NA	Northwest Corner Swamp & Worthington Mill Rds.
Wrightstown Township	Undetermined	NA	Northwest side of L.R. 09052, 228 Ft East of Neshaminy Creek
Wrightstown Township	Undetermined	NA	Park Ave. North side 1060 Ft West of Rte. 413
Wrightstown Township	Undetermined	NA	Park Ave. North side Between Rte. 413 & Cherry Ln.
Wrightstown Township	Undetermined	NA	Penns Park Wrightstown Rd. North Side
Wrightstown Township	Undetermined	NA	Penns Park Wrightstown Rd. South Side
Wrightstown Township	Undetermined	NA	Penns Park-Wrightstown Rd. Corner Rte. 232 And
Wrightstown Township	Undetermined	NA	Penns Park-Wrightstown Rd. North side of (T-369)
Wrightstown Township	Undetermined	NA	South side L.R. 09052, 452 E Neshaminy Creek
Wrightstown Township	Undetermined	NA	South side Rte. 413, 1879 Ft S 2nd St. Pike
Wrightstown Township	Undetermined	NA	Southeast Corner L.R. 09052 & Neshaminy Creek
Wrightstown Township	Undetermined	NA	Southwest Corner Cherry Ln. & Washington Ave.
Wrightstown Township	Undetermined	NA	Swamp Rd. And Rte. 232 Intersection
Wrightstown Township	Undetermined	NA	Swamp Rd. Near Rte. 232 Southeast Side
Wrightstown Township	Undetermined	NA	Swamp Rd. North side 483 Ft E Worthington Mill Rd.
Wrightstown Township	Undetermined	NA	West side Rte. 413, 1645 Ft South of 2nd St. Pike
Wrightstown Township	Undetermined	NA	West side Rte. 413, 709 Ft North of Rte. 232
Wrightstown Township	Undetermined	NA	West side Rte. 413, Opposite Pine Ln.
Wrightstown Township	Undetermined	NA	Worthington Mill Rd. East side
Wrightstown Township	Undetermined	NA	Worthington Mill Rd. East side 1990 Feet from No. 413

APPENDIX B

Detailed Grant Information

DCNR Grant Information for 2002 Grant Cycle

Community Conservation Partnerships Program (C_2P_2)
2002-2003 Grant Cycle - "Fact Sheet"

Open Application Period **July 15, 2002 - October 16, 2002**

The "Application Announcement Package", will be mailed the week of May 20, 2002 announcing the 2002-2003 (Round 9) grant round. The announcement for Round 9 will be officially announced in the Pennsylvania Bulletin on Saturday, May 25, 2002.

Application Deadline

All applications must be postmarked by October 16, 2002 or hand delivered to the Central Office by 5:00 p.m. on or before October 16, 2002.

Two (2) original copies of the grant application (both with original signatures) are to be mailed to the following address:

PA Department of Conservation and Natural Resources
Bureau of Recreation and Conservation
Rachel Carson State Office Building, 6th Floor
400 Market Street
P.O. Box 8475
Harrisburg, PA 17105-8475

Applications may not be submitted via fax or e-mail.

Application Announcement Package

The package will include an Announcement/Order Form, a pre-application workshop brochure, and a C2P2 grants fact sheet.

The package will be sent to: PA municipality; recreation and park boards and departments; county planning commissions; state legislators; trails and rivers groups; consultants; pre-qualified land trusts; heritage park managers; and PennDot LDDs and MPOs.

Application Manual Package

The C2P2 grant application manual and forms are available on the web at www.dcnr.state.pa.us/grants. Copies may also be obtained by e-mailing the Bureau at rec&con@state.pa.us, or by completing the order form included in the application announcement packet.

Regional Recreation and Park Advisors

We strongly recommend that all applicants for a Community Conservation Partnerships Program grant contact their Regional Recreation and Park Advisor to discuss their proposed project and the program application requirements prior to submitting an application.

Website

The Community Conservation Partnerships Program Grant manual and many related materials not printed in the manual, are available on the web at www.dcnr.state.pa.us/grants. The materials are available in both Microsoft Word and Adobe PDF formats. The forms may be completed on-line and then printed since they must be submitted by mail.

March 2002

DCNR

Bureau of Recreation and Conservation

Detailed Grant Information

Federal Programs

TEA21: Stemming from the 1991 Intermodel Surface Transportation Efficiency Act (ISTEA), massive funding was made available for highway and mass transportation projects; funding also was available for bike and pedestrian trails. TEA 21, the 1998 renewal of the program, provides another $198 billion to fund the program through 2003. Special program provisions include: The Transportation Enhancements Program (TE), Congestions Mitigation and Air quality Improvement Program (CMAQ), and the Recreational Trails Program (administered by PADCNR). See www.fhwa.dot.gov/tea21 for more information.

Transportation Enhancements: Up to 10 percent of the total state grant to each state is authorized for TE projects. These projects include 12 different categories, two of which fund bicycle and pedestrian trails. Funding is provided for new facilities for bicycles and pedestrian use and for improvements to existing trails, though excludes sidewalks and required curb ramps; funding is also provided for the planning, acquisition, rehabilitation, and development of active and abandoned railway corridors for public uses including pedestrian and bicycle trails. Funding is provided up to a maximum of 80 percent of total project costs and provided as a reimbursement, not a grant, after project completion. Contact the National Transportation Enhancement Clearinghouse at 888-388-6832 or www.railtrails.org/ntec for additional information. The Pennsylvania Department of Transportation administers the TE program, collaboratively with the Delaware Valley Regional Planning Commission (along with the Pennsylvania Transportation Enhancements Advisory Committee). Applicants may be any government or non-profit entity; applications usually are submitted in the Fall and can be complex, requiring considerable time and assistance from PennDOT. Contact PennDOT's Engineering District 6 Transportation Enhancements Coordinator at 610-964-6534 for more information.

Congestion Mitigation and Air Quality Improvements: Grants here fund projects which reduce harmful emission related to transportation. Like the TE program, the program is a competitive reimbursement with a maximum of 80 percent share of a project's total cost funded. The PennDOT/DVRPC institutional structure is similar to that of the TE Program, although in this case the Federal Highways Administration is also involved. Sixteen different categories of projects are defined, including public education campaigns and construction of park and ride lots and development of bicycle and pedestrian trails (this category may include designation of bike lanes on roadways as well as construction/reconstruction of paths, tracks, or areas for pedestrian or other non-motorized transportation modes.). Eligibility is similar to that of the TE Program, although special emphasis is placed on coordination with the respective county and municipal governments in which the project is located. See the DVRPC's Transportation Planning Division Director at 215-238-2863 for more information.

State Programs

State programs include several different agencies. PADCNR programs are described first and include the grants known as Keystone Grants in the 1990's and renamed the Community Conservation Partnership Program in 2000, using Growing Greener Funds provided by the Environmental Stewardship and Watershed Protection Act. The following funds and programs are included: Keystone Recreation, Park and Conservation Fund; Recreational Trails Program; and the Environmental Stewardship and Water-

shed Protection Act (Growing Greener Fund). Contact www.dcnr.pa.state.us or 717-787-7672 for additional grant program information. One grant manual provides details for all of the PADCNR programs; go to www.dcnr.state.pa/grants.htm. Contact should be made with the SE Pennsylvania PADCNR Recreation and Park Advisor at 215-644-0609 to discuss grant programs, their details, specific project needs, and so forth.

PADCNR's Community Recreation Grants: This annual municipal agency (also councils-of-government) grant program (mid-Fall deadline), established under the Keystone Recreation, Park and Conservation Funds (PA Act 1993-50), provides 50 percent matching grants for planning and technical assistance (comprehensive recreation and park planning, conservation plans, county natural areas inventories, feasibility studies, greenways and trails, master site development planning, circuit rider and peer-to-peer technical assistance grants), acquisition of land for park and recreation purposes, and development (rehabilitation and development of park and recreation facilities and grants for small communities with populations of 5,000 or below); small communities, circuit rider, and peer grants are not governed by the 50 percent limit.

Rails-to-Trails: This annual municipal and non-profit agency grant program (mid-Fall deadline), established under the Keystone Recreation, Park and Conservation Funds (PA Act 1993-50), provides 50 percent matching grants for planning and technical assistance (feasibility studies, master site development plans, special purpose studies of abandoned railroad right-of-way for trails and adjacent lands necessary for access and support facilities for trails), acquisition (acquisition of abandoned right-of-way for trails and adjacent land necessary for access and support facilities for trails), and renovation and development of abandoned railroad rights-of-way for trails.

Land Trust Grants: Pre-qualified non-profit land trusts and conservancies may receive up to 50 percent of a project cost for use in acquisition and planning of open space and natural areas facing development; lands must have public use/access and get priority if they are habitat for threatened/endangered species.

River Conservation Grants: Up to 50 percent matching grants are provided to municipal agencies of all types and non-profit groups for planning and technical assistance (River Conservation Plans, special purpose projects such as preparing zoning and subdivision ordinances, river area access studies, water quality monitoring, other projects), for land acquisition, and for development of river conservation projects.

Recreational Trails Fund: TEA21 funds the Pennsylvania Recreation Trails Grant program, awarded each year (mid-Fall deadline) to municipal agencies and private entities. Grants up to 80 percent of total project cost (acquisition projects limited to 50 percent) are to be used for acquisition, development, and maintenance of motorized and non-motorized trails.

Heritage Parks Fund: DCNR provides grants to eligible Heritage Park organizations and agencies on a competitive application basis. State Heritage Park grants can be obtained for feasibility studies, management action plans, special purpose studies, implementation projects and for the management of Heritage Parks. Studies and planning projects require a 50 percent match. Management grants

are provided on a year-to-year basis. Federally designated heritage commissions are also eligible applicants.

Other Programs

PADEP Grants: These Pennsylvania Department of Environmental Protection Growing Greener grants, funded under the Environmental Stewardship and Watershed Protection Act, include sewer and water infrastructure improvements, reclamation of abandoned mines and wells, and wetland and streambank restoration and protection. Applicants may include counties and municipalities, conservation districts, watershed organizations promoting watershed conservation efforts and recognized by PADEP, and other authorized organizations recognized by PADEP as promoting the protection, enhancement, conservation, preservation and/or enjoyment of Pennsylvania's environmental, conservation, recreation, and/or similar resources. Although a match is not required per se, applications, which have become much more competitive since recent funding cutbacks, are more likely to be funded if they include connection to other sources of funding or services and/or partnering in some manner with other agencies and programs. Contact www.dep.state.pa.us and the PADEP Grants Center at 717-705-5400 for more information, including grant manuals and updates on application deadlines. Locally contact the PADEP Southeastern Regional Office at 610-832-6259.

PADCED Grants: These Department of Community and Economic Development programs, including the Shared Municipal Service Program (funding regional recreation activities, public works operations, and municipal insurance pooling) and the Land Use Planning and Technical Assistance Program or LUPTAP (funding open space as part of a comprehensive plan with priority toward regional planning efforts), usually require a 50 percent match and are available throughout the year to counties, and municipalities (again with priority given to multi-municipal applications). Contact www.dced.state.pa.us or the Governor's Center for Local Government Services locally at 610-530-8223 or 215-560-2374.

County Grants

The two counties have substantially simlar funding programs available to watershed municipalities and other stakeholders, pursuant to their open space, recreation, and environmental resources programs; contacts should be made with the respective county program manager.

Other Grants

Some additional sources of funding for conservation, recreation, and open space are available, usually fairly small in size (i.e., mini-grants from $2,000 to $10,000). These include but are not limited to:

Pennsylvania Urban and Community Forestry Council Grants: Community Improvement Grants are given to plant and maintain trees; they are funded by the PA Bureau of Forestry, the PA Urban and Community Forestry Council, and the USDA Forest Service. Municipal Challenge Grants provide $1,000 to $5,000 for projects in public spaces and rights-of-way, as well as street tree projects. Community Improvement Grants provide $500 to $3,000 for projects in parks, greenbelts, schools, and community public spaces. Grants can be given to municipalities, authorities, schools, youth groups, church groups, local business, and other like organizations and are dispensed typically twice a

year. Contact the Pennsylvania Urban Forestry Coordinator at 717-783-0385 or the Southeast Urban Forester at 610-489-4315.

American Forest Global Releaf Grants: Projects here should include native tree planting on sites of 20 acres or more; the goal is planting diversity. Eligibility is broad, though projects must be located on land that is publicly owned or owned by a publicly assisted private entity. Applications are usually twice per year. Contact the American Forest website at www.amfor.org or 212-955-4500 for more information.

National Tree Trust Tree Planting Program: Created by the America the Beautiful Act of 1990 and endowed by a one-time grant from Congress, the National Tree Trust dispenses these grants to provide tree seedlings, tree planting materials, and a cash subsidy to cover cost of potting for projects that facilitate tree planting on public lands and along roadsides. Funds must be equally matched by the applicant with non-Federal funds. Volunteer organizations, school groups, municipal park and recreation departments, and other interested groups are eligible; the application process takes two years. Contact the National Tree Trust at 800-846-8733 or www.nationaltreetrust.org.

Kodak American Greenways Grants: Through a Kodak Corporation, Conservation Fund and National Geographic Society partnership, grants of up to $2,500 (most under $1,000) are awarded to develop and assist in the implementation of greenway projects. Grants may be used to map resources and greenways, undertake ecological assessments, perform design activities, hire consultants, plan bike paths, and perform other greenway tasks. Most awards have gone to local community, regional, and statewide non-profit organizations, although public agencies also may apply (e.g., recent awards have gone to the Wildlands Conservancy in Emmaus to construct a footbridge on a heavily used trail in Lehigh County; also to Delaware Greenways in Wilmington DE). Contact the American Greenways Programs at www.conservationfund.org or 703-525-6300 for more information.

Additionally a variety of private foundations provide grants for conservation and open space purposes. These grants often can be used for matching purposes.

APPENDIX C

Model Stormwater Ordinance

FEDERATION OF NORTHERN CHESTER COUNTY COMMUNITIES SUSTAINABLE WATERSHED MANAGEMENT PROGRAM

COMPREHENSIVE STORMWATER MANAGEMENT ORDINANCE

WITH

APPENDIX A COMNPREHENSIVE STORMWATER MANAGEMENT PROCEDURE

Prepared by

Cahill Associates
West Chester, PA

for

Green Valleys Association
Pottstown, PA

December, 2001

ARTICLE I
GENERAL PROVISIONS
Section 100. GOALS

The negative impacts of development with inadequately managed stormwater include, but are not limited to:

- **altered hydrology**
- **lowering of the groundwater table**
- **physical stream impacts**
- **biological impacts**
- **nonpoint source pollutants**

It is the goal of ___ Township to protect the health, safety, and general welfare of ___ Township residents by protecting the surface and groundwaters of the Township through effective stormwater management and control of sedimentation and erosion, as provided in this Ordinance.

Section 101. PURPOSE

The purpose of comprehensive stormwater management in ___ Township is:

1. To maintain the pre-development water balance in watersheds and sub-watersheds containing first-order and other especially sensitive streams in ___ Township, and to work to restore natural hydrologic regimes wherever possible throughout the stream system.

2. To maintain the pre-development volume of groundwater recharge.

3. To prevent significant increase in surface runoff volumes, pre-development to post-development, thereby worsening flooding downstream in the watershed, enlarging floodplains, eroding stream banks, and creating other flood-related health-welfare-property losses, and to work to reduce runoff volumes to natural levels

4. To maintain pre-development peak rates of discharge, site-by-site, so as not to worsen flooding at adjacent downstream sites, and to work to restore peak runoff rates to natural levels

5. To minimize nonpoint source pollutant loadings to ground and surface waters generally throughout ___ Township.

6. To minimize impacts on stream temperatures

7. To minimize aesthetic impacts

8. To manage stormwater through approaches and practices which require a minimum of structures and which rely on natural processes to the maximum.

Section 102. STATUTORY AUTHORITY

___ Township is empowered to regulate land use activities that affect stormwater runoff by the authority of the Pennsylvania Municipalities Planning Code, Act 247 of 1968, as amended by Act 170 of 1988, as further amended by Act 209 of 1990 and Act 131 of 1992, 53 P.S. Section 10101. Stormwater management is also enabled by Pennsylvania's Stormwater Management Act of 1978 (Act 167), as well as the Pennsylvania Environmental Amendment.

Section 103. APPLICABILITY

These regulations apply to:

- all activities governed by the ___ Township Subdivision and Land Development Ordinance (SLDO)
- construction of separate or additional impervious or semi-pervious surfaces (driveways, parking lots, additions to buildings, etc.)
- other earthmoving activities
- outdoor storage
- any other land disturbances.

No land or waterway shall be used or modified, no earth shall be disturbed, stripped, or moved, and no structure or other impervious surface shall be built or extended without full compliance with the terms of this Ordinance and other applicable regulations.

Section 104. REPEALER

An ordinance inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

Section 105. SEVERABILITY

Should any section or provision of this Ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any remaining provisions of this Ordinance.

Section 106. COMPATIBILITY WITH OTHER ORDINANCE REQUIREMENTS

Approvals issued/actions taken pursuant to this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. To the extent that this Ordinance is more rigorous in terms of the standards applied for stormwater management, the specific stormwater management standards and design criteria contained in this Ordinance are to be followed.

ARTICLE II
DEFINITIONS

(see Section ___)

ARTICLE III
COMPREHENSIVE STORMWATER MANAGEMENT STANDARDS

Section 301. STANDARDS FOR PERMANENT STORMWATER MANAGEMENT

All land disturbances as listed in Table 1 shall comply with provisions of this Section.

Table 1 LAND DISTURBANCES REQUIRED TO COMPLY WITH SECTION 301

1. All minor and major subdivisions and land developments where land disturbance exceeds 5,000 sq. ft.

2. An impervious cover addition to an existing developed property which exceeds 5 percent of lot area of 500 square feet, whichever is smaller.

3. A semi-impervious cover addition (gravel, lattice blocks) to an existing developed property which exceeds 800 square feet on slopes greater than 8 percent.

4. A temporary storage of impervious or pervious materials (rock, soil, etc.) on an existing developed property where ground contact coverage exceeds 5 percent of lot area of 4,000 square feet (whichever is less), where the material is placed either on slopes exceeding 8 percent or on alluvial soils or a drainage way.

(New)
(Please note that these limits are quite restrictive. GVA is flexible in establishing these standards so as not to impose excessive burdens, economic and other, on small property owners proposing modest projects with negligible cumulative watershed impacts. In some cases, these threshold limits could be increased substantially with little potential effect.
Limits should be determined by the respective municipality.)

A. Permanent Stormwater Management Standards

1. **Standard 1:** After installation of impervious cover, there shall be no increase in the **volume** of stormwater runoff being discharged for up to the 2-year frequency rainfall, pre-development to post-development, calculated using a methodology as described in this ordinance.

   Applicants may request a partial waiver, where a portion of the Standard 1 volume requirement is waived (i.e., volume control is achieved for a lesser storm such as the 1-year storm or 6-month storm). Or applicants may request a total waiver, where the entire Standard 1 volume requirement is set aside. The need for waivers of any type must be based on demonstration by the applicant that due to the existing soil, bedrock, water table, or other natural conditions and limitations at the site, the Standard 1

volume requirement cannot be satisfied through use of reasonable Best Management Practices, as defined in this ordinance. Waivers are discouraged by the Township and will be issued only after thorough scrutiny has been directed toward all possible stormwater management options.

(New)
If infiltration on site for the design storm is not feasible and either a partial or full waiver is issued by ___ Township, an applicant is strongly encouraged to provide off-site mitigation subject to the approval of ___ Township, prior to project commencement. Several off-site options may be approved.

(a) The acquisition of, and mitigation on privately owned lands, preferably adjacent to nearby open waters and within the same drainage sub-basin as defined by the Green Valleys Association in its Sustainable Watershed Management Plan, to be dedicated for preservation or re-forestation. Upon review of the ___ Township Engineer, this off-site mitigation may be deemed to be adequate to satisfy the requirements of Standards 1 and 3 (not 2 and 4).

(b) Mitigation on previously developed properties, public or private, and preferably nearby within the same drainage sub-basin (as above), that currently lack storm water management facilities designed and constructed in accordance with the purposes and standards of this Ordinance; upon review of the ___ Township Engineer, this off-site mitigation may be deemed to be adequate to satisfy the requirements of Standards 1 and 3 (not 2 and 4).

2. **Standard 2:** After installation of impervious cover and assuming full compliance with Standard 1, the peak rate of stormwater discharges from the site for all design storms up to and including a 100-year frequency rainfall shall not exceed the peak discharges from the site of the same storms before disturbance; design storms include:

- **2-year, 24-hour storm;**
- **5-year, 24-hour storm;**
- **10-year, 24-hour storm;**
- **25-year, 24-hour storm;**
- **50-year, 24-hour storm;**
- **100-year, 24-hour storm.**

If a partial waiver has been issued but at least 50 percent of the volume requirement specified under Standard 1 is being met, these Standard 2 provisions also apply.

3. **Standard 3:** In those cases where a total waiver from the Standard 1 volume requirement is issued or where a partial waiver is issued and less than 50 percent of the volume requirement specified under Standard 1 is being met, then the peak rate standards set forth under Standard 2 above are further modified, so that the post-development peak rate discharges from the site for 2-year storms and larger, up to the

10-year storm, must be equal to or less than the pre-development peak rate of discharge for the 2-year storm.

4. **Standard 4:** Significant loadings of nonpoint source pollutants shall not be discharged into either surface or groundwater. If the total volume and peak rate standards above are met as in Standards 1 and 2 (including if a partial waiver for volume control is approved by the Township, but at least 50 percent of the volume requirement specified in Standard 1 is met), then water quality impacts are assumed to be adequately controlled.

   If the requirements set forth in Standards 1 and 2 above cannot be achieved and a total waiver is issued or a partial waiver is issued where less than 50 percent of the volume requirement specified under Standard 1 is being met, then an additional water quality requirement must be met in order to guarantee that significant water quality impacts will not result from the proposed development action. A water quality-oriented Best Management Practice (BMP) designed to capture and treat stormwater generated for up to the 1-inch rainfall event for all site areas being disturbed must be employed. These BMPs include, but are not limited to:

- **Constructed wetlands/wetland forebays**
- **Retention ponds/extended detention ponds**
- **filters (sand-peat, underground sand, perimeter sand filter, organic sand, pocket sand filter, gravel)**
- **Grass channels'**
- **Dry swales**
- **Filter strips**
- **Other bioretention BMPs**

BMP selection, design and implementation shall be based upon appropriate reference materials such as the *Pennsylvania Handbook of Best Management Practices for Developing Areas, Design of Stormwater Filtering Systems,* and other manuals.

5. Special Provisions for "Hot Spot" Land Uses

   For all those projects involving land uses considered to be high pollutant producers or "hotspots" (vehicle service and maintenance facilities, vehicle salvage yards and recycling facilities, vehicle and equipment cleaning facilities, fleet storage areas for buses, trucks, etc., industrial/commercial or any hazardous waste storage areas or areas that generate such wastes, industrial sites, fast food businesses, any activity involving chemical mixing or loading/unloading, outdoor liquid container storage, public works storage areas, commercial container nurseries, and some high traffic retail uses), additional water quality requirements may be imposed by the ___ Township Engineer which supersede Standard 4 above.

6. Under certain conditions, the Township, upon recommendation by the Township Engineer, may impose the following additional restrictions on stormwater discharges:

(a) Peak discharge may be further restricted when it can be shown that a probable risk to downstream structures or unique natural areas exists or that existing severe flooding problems could be further aggravated.

(b) Measures shall be imposed to protect against ground or surface water pollution where the type of business activity may result in significant nonpoint source pollution (so called "hot spots") or the nature of the soils or bedrock underlying a stormwater management structure constitutes substantial risk of contamination, such as might be the case in limestone formations. Special provisions to be followed in these cases will be provided by the Township Engineer.

(c)

~~(c)~~ Where groundwater yields are very low or where a groundwater supply already is heavily used, the Township may require that the entire volume of the 2-year frequency rainfall (3.2 inches in 24 hours) be retained and infiltrated. If substantial irrigation needs are anticipated, portion of stored stormwater may be re-used for irrigation purposes.

B. Incentives for Environmentally Sensitive Conservation Design: Credits

Applicants are strongly encouraged in all cases to incorporate the principles further discussed in Appendix A, the Comprehensive Stormwater Management Procedure. To this end, a system of credits or incentives have been established. These credits can affect both quantity and quality stormwater calculations, as set forth above. Application of these credits is to be accomplished in addition to requirements and specifications set forth for Standards 1 through 6 above.

1. Credit 1 Conservation of Natural Areas

(a) Definition: natural areas include woodland areas, buffers of wetlands and riparian zones, steep slopes, wellhead protection areas, carbonate/sinkhole zones, and others

(b) Credit: subtract these natural areas from the total site area when calculating the 1-inch design volume requirement pursuant to Standards1 through 4 above

(c) Requirements: natural areas must not be disturbed during construction; limits of disturbance must be delineated on construction drawings and flagged in the field; the natural area must be protected in perpetuity, either through viable conservation easement or through enforceable regulation of some type; it must be properly inspected and managed.

2. Credit 2 Disconnection of Runoff

(a) Definition: disconnection of runoff relates to all rooftop areas or other impervious ground surface areas which are directed into pervious areas where it is either infiltrated into the soil or filtered through vegetation, accomplished typically by grading; these areas must either have adequate size and permeability

for adequate infiltration and/or extended detention with filtering; vegetated rooftops with storage also may be used

(b) Credit: disconnected areas may be subtracted from other areas on the site requiring water quality treatment pursuant to Standards 1 through 4 above; depending upon volume provisions, areas may also be subtracted from TR-55 calculations.

(c) Requirements: runoff should not be generated from "hotspot" uses (see above) to receive this credit; maximum contributing flow length shall be 100 feet; the flow length of disconnection shall not be less than 1.5 times the contributing flow length; the disconnection shall drain continuously through a vegetated channel, swale, forest buffer, or other filter strip to the property line or BMP; the disconnection shall consist of at least 50 percent of Hydrologic Soil Groups A and/or B with average slope not exceeding 4 percent (undisturbed group C with shrub or woodland vegetation may be counted as B with ____ Township approval).

3. Credit 3 "Environmentally Sensitive" Design

(a) Definition: when site design techniques from 1. and 2. are grouped and applied to residential developments, this credit is granted automatically.

(b) Credit: eliminates the need for additional BMPs to satisfy the Standard 3 (total suspended solids) and can significantly reduce stormwater volume as per Standards 1 and 2.

(c) Requirements: where total site impervious areas is less than 15 percent, where clustering is used, where roof and ground surface impervious areas are disconnected as per 2., where grass swales are used rather than conventional curbing with gutter, where at least 30 percent of the site is protected in natural areas as per 1., and where all runoff from the site is directed as sheet flow to filter strips or riparian buffers, the design is deemed to be "environmentally sensitive."

C. Stormwater Management Calculation Methods

1. In establishing the antecedent conditions for calculating runoff prior to land disturbance, the following assumptions shall apply:

   (a) Average antecedent moisture conditions;

   (b) A type II distribution storm;

   (c) Woodland shall be used as the prior condition for those portions of the site having trees of greater than 6 inches caliper DBH or where such trees existed within 3 years of application;

   (d) Meadow shall be used for all other areas including areas of existing cultivation or impervious surface.

   (e) In performing the TR-55 calculations, all those areas to be disturbed during construction will be assumed to be reduced one Hydrologic Soil Group category level during post-development runoff calculations (i.e., HSG B is reduced to HSG C, and so forth).

2. In all plans and designs for stormwater management system and facilities submitted to the Township Engineer for approval, stormwater peak discharge and runoff shall be determined through the use of the Soil Cover Complex Method as set forth in Urban Hydrology for Small Watersheds, Technical Release No. 55, with specific attention given to antecedent moisture conditions, flood routing, and peak discharge specifications included therein and in Hydrology National Engineering Handbook, Section 4, both by US Department of Agriculture, Natural Resources Conservation Service (Soil Conservation Service). Note that use of TR-55 with many of the natural system-based approaches and practices recommended by this Ordinance requires that calculations be performed on a detailed small sub-area basis. The Township Engineer may permit the use of the Rational Method for calculation of runoff on land developments of 10 acres or less and for the design of storm structures.

3. In calculating runoff after development, those areas covered by concrete lattice blocks on an appropriate base, porous pavement areas on an appropriate base, and roof areas which drain to properly designed and installed storage/groundwater infiltration beds, shall be considered adequate to infiltrate any increased runoff from a 2-year storm.

D. Specific Stormwater Management System Design Criteria

1. Infiltration devices shall be selected based on suitability of soils and site conditions. Measures may include porous pavement with underground infiltration beds, vegetated infiltration beds, swales and trenches, or other seepage structures as proposed in the Pennsylvania Handbook of Best Management Practices for Developing Areas (1998) and related references prepared by the USEPA, the Washington Metropolitan Council

of Governments, the Soil Conservation Service, the PA Dept. of Environmental Protection (PADEP), or other guidance documents.

2. Soil infiltration tests shall be performed for all proposed infiltration areas; these tests shall include evaluation of selected soil horizons by deep pits and percolation measurements. Testing should be reviewed and approved by the Township Engineer. The soil infiltration rate of discharge from the infiltration area being used in the proposed design shall be based on these measurements.

3. The lowest elevation of the infiltration area shall be at least two (2) feet above the Seasonal High Water Table (SHWT) and bedrock, except in the case of limestone formations, in which case the distance shall be three (3) feet.

4. All roof drains shall discharge to infiltration systems, with appropriate measures such as leaf traps and cleanouts taken to prevent clogging by vegetation.

5. All infiltration systems shall have appropriate positive overflow controls to prevent storage within one (1) foot of the finished surface or grade.

6. All infiltration systems shall have a setback of fifteen (15) from all residential structures. Care should be taken to prevent any seepage into sub-grade structures.

7. All infiltration systems shall be designed to infiltrate the stored volume within twenty-four (24) hours.

8. All surface inflows shall be treated to prevent the direct discharge of sediment into the infiltration system; accumulated sediment reduces stormwater storage capacity and ultimately clogs the infiltration mechanism. No sand or other particulate matter may be applied to a pervious surface for winter ice conditions.

Section 302. STANDARDS DURING LAND DISTURBANCE

A. During the period of land disturbance, when significant sediment can be contained in runoff, this runoff shall be controlled prior to entering any proposed infiltration area.

B. Peak discharges and discharge volumes from the site shall comply with the appropriate sections above, with the following additions:

1. For purposes of calculating required detention storage during land disturbance, peak discharges and discharge volumes shall be calculated based upon the runoff coefficients for bare soils during the maximum period and extent of disturbance. Controls shall insure that the difference in volumes and rates of peak discharge before disturbance and during shall not exceed those peak discharges and discharge volumes noted in Section 301 above. It should be understood that detention storage during the period of land disturbance and prior to establishment of permanent cover may require additional facilities on a temporary basis. Such measures shall be located so as to preserve the natural soil infiltration capacities of the planned infiltration bed areas.

2. Wherever soils, topography, cut and fill or grading requirements, or other conditions suggest substantial erosion potential during land disturbance, the Township, as recommended by the Township Engineer, may require that the entire volume of all storms up to a 2-year storm from the disturbed areas be retained on site and that special sediment trapping facilities (such as check dams, etc.) be installed.

3. Sediment in runoff water shall be trapped in accordance with criteria of the County Conservation District and PADEP and removed through means approved by the Township Engineer to assure proper functioning and adequate capacity in the basins or traps.

C. Procedures shall be established for protecting soils or geologic structures with water supply potential from contamination by surface water or other disruption by construction activity.

Section 303. RIPARIAN BUFFER ZONE (RBZ)

Areas immediately adjacent to the Township's perennial streams and waterways as mapped on US Geological Survey 1:24,000-scale quadrangle maps shall be defined as the Riparian Buffer Zone (RBZ). In the RBZ, special requirements as set forth in this section shall apply in order to maintain important natural functions. These RBZ requirements area based on both the heightened sensitivity of the RBZ zone and the potential to negatively impact the stream system when this RBZ zone is disturbed, as well as the potential of this RBZ zone to mitigate to the maximum extent the negative effects of development in areas adjacent to the stream system. The RBZ shall include three subzones, Zones 1 through 3, extending landward from the top of the streambank where different requirements are imposed:

A. Zone 1, a 15-foot setback zone, measured from the top of the bank of the waterbody, where no disturbance of vegetation and soil except for restoration shall occur, in order to shade the stream with natural vegetation, to provide a source of numerous other organic inputs to the aquatic system, to anchor the streambank and floodplain areas, and to consume and otherwise remove nitrogen, sediment, and other substances which can adversely affect stream systems.

B. Zone 2, a 60-foot managed buffer zone, extending outward from Zone 1, where disturbance of natural vegetative cover shall be limited to selective logging and other activities which minimally disrupt existing tree cover and soil mantle, in order to maximize filtering and overall physical removal of particulate-form pollutants from runoff generated upgradient and to promote subsurface vegetative uptake of nitrogen and other non-particulate elements from stormwater generated upgradient.

C. Zone 3, a zone of varying width extending outward from Zone 2; Zone 3 is defined in those cases where upslope areas adjacent to the RBZ are being disturbed during the land development process and where direct discharge of stormwater would otherwise occur; Zone 3 must include level spreading devices as necessary to ensure that any directly discharged stormwater flows are properly distributed as sheet flow and channelization and point source discharges are avoided.

D. The RBZ may be included in net density calculations with uses permitted in the Township Zoning Ordinance, unless this RBZ is required to be subtracted out as the result of other applicable Zoning Ordinance regulations, such as regulation of the floodplain.

E. AN RBZ adjacent to "High Quality Waters; and "Exceptional Value Waters; designated under the PADEP Chapter 93 Rules and Regulations shall be subject to the provisions of the PADEP "Special Protection Waters Implementation Handbook" and its amendments. To the extent that Pennsbury Township and PADEP requirements are not consistent, the more restrictive requirements shall apply.

Section 304. STEEP SLOPE PROTECTION ZONES

A. Definition of the Steep Slope Conservation District

The Steep Slope Conservation District consists of two specially designated areas defined below. Steep Slope Conservation District calculations are to be based on a site survey by a registered surveyor, on topographic information plotted from a verified aerial survey, or on analysis of US Geological Survey topographic maps where such the calculated slope category (i.e., greater than 25 percent or greater than 15 percent and less than or equal to 25 percent) exists for an area which spans five contiguous 10-foot contour intervals.

1. Prohibitive Slope: those slopes greater than 25 percent

2. Precautionary Slope: those slopes greater than 15 percent and less than or equal to 25 percent.

B. Steep Slope Conservation District Use Restrictions

1. General: The Steep Slope Conservation District shall be deemed to be an overlay on any zoning district now or hereinafter enacted by ___ Township.

(a) The Steep Slope Conservation District shall have no effect on the permitted uses in the underlying zoning district, except where said uses are intended to be located within the boundaries of the Steep Slope Conservation District and said uses are in conflict with the permitted uses set forth in this Ordinance. These regulations apply only to those portions of the tract or lot which fall within the Steep Slope Conservation District.

(b) The requirements of the Steep Slope Conservation District, as defined, shall supersede the requirements of the underlying zoning district.

2. Prohibitive Slope: On Prohibitive Slopes, no development, regrading or stripping of vegetation shall be permitted unless the disturbance is for roadway crossings or utility construction and unless it can be demonstrated that the roadway or utility improvements are necessary in the sloped area. The sloped area to be developed, regraded or stripped of vegetation shall be drawn on the development plans. Uses permitted as of right,

provided that they are consistent with requirements of the underlying zoning district and other applicable requirements, include:

(a) Parks and outdoor recreational uses, consistent with the goals of watershed protection. Site disturbance and impervious surfaces are to be minimized and/or avoided.
(b) Logging and woodcutting, where such activity is limited to highly selective removal of trees. Maximum precautions shall be taken to avoid destruction of or injury to understory brush and trees.
(c) Grading for the minimum portion of a driveway necessary to access the proposed building or land use, when it has been demonstrated that no other routing which avoids steep slopes is feasible.
(d) Yard area of any permitted building, so long as the building itself is not within the Prohibitive Slope area.

3. Precautionary Slope: Site design and grading on Precautionary Slopes shall provide the minimum disruption of view corridors and scenic vistas and shall preserve significant natural topographic features to the greatest extent possible. Uses permitted as of right, provided that they are consistent with requirements of the underlying zoning district and other applicable requirements, include:

(a) Parks and outdoor recreational uses, consistent with the goals of watershed protection. Site disturbance and impervious surfaces are to be minimized and/or avoided.

(b) Tree farming, forestry, and other agricultural uses when conducted in conformance with conservation practices, including minimum tillage methods, as approved by the Chester County Conservation District.

(c) Accessory uses excepting swimming pools necessary for the operation and maintenance of the above uses.

(d) Yard area of any permitted building or land use.

(e) Access roads for the passage of emergency vehicles.

C. Administration of the Steep Slope Conservation District

1. For all earth moving activities within the Steep Slope Conservation District, the Applicant shall submit a site plan prepared by a New Jersey-licensed engineer which includes at a minimum the following:

—Slopes in classes of 0 through 15%, greater than 15 through 25%, and greater than 25% based at minimum on ten foot (10') contour intervals
—Location of all waterbodies including but not limited to streams, lakes and wetlands
—Existing natural and topographic features
—Location of all proposed and existing buildings and

streets
—Location of all existing vegetation including meadow, forest, and scrub lands broken down by those areas of vegetation which will be removed as well as vegetation to be preserved; specifications for revegetation shall also be included
—Specific methods which will be utilized to control soil erosion and sedimentation, soil loss, and excessive stormwater runoff both during and after construction
—A statement and description of the stability of the soils on-site and the appropriateness of the construction method proposed
—Hydrology, drainage and flooding analysis to include a statement on the affect of the proposed development upon water bodies or wetlands in the vicinity of the project
—A statement describing the underlying geology attesting to the stability of the site
—Calculations of the area of proposed disturbance of each slope class on each proposed lot as well as within any proposed road right-of-way
—Grading plan for the construction site and all access routes

2. The site plan submitted shall be reviewed by the ___ Township Engineer. The ___ Township Engineer shall accept or reject the plan as submitted or may require that specific conditions be complied with in order for the plan to meet approval. In evaluating the site plan for developments where development encroaches up the Steep Slope Conservation District, the following criteria shall apply:

—Disturbance to especially sensitive features, including the most steeply sloping portions of the site, shall be minimized
—Disturbance to areas shall be minimized, where the length or area of steep slopes on the site and extending 200 feet into adjacent lands is extensive.
—Disturbance shall not cause runoff and/or related problems off of the site and onto adjacent properties.
—Disturbance shall be undertaken in such a way so as to minimize adverse effects on visual qualities of the site, to the maximum extent feasible, including hilltops, ridgelines, rock outcroppings, and the overall natural terrain.
—Disturbance shall be undertaken to minimize disturbance to and removal of natural vegetation at the site; vegetation removal shall be evaluated with particular regard to impacts on slope stability, transpiration and recharge of stormwater, existing drainage patterns, and the overall characteristics of the landscape. Special mitigation such as use of retaining walls to preserve the existing vegetation may be required.
—Innovative building approaches which adapt themselves to sloping terrain should be required, if disturbance to steeply

sloping areas is to be permitted.
—Road construction, if it is to be permitted on steeply sloping terrain, should be required to follow the natural topography to the extent feasible.

3. No building permit shall be issued and no grading or site clearing shall occur until a site plan including all of the above items has been reviewed and approved by the municipality.

D. Special Steep Slope Conservation District Requirements

All development proposals which propose development in the Steep Slope Conservation District shall conform to the following:

—Those lands to be undisturbed and preserved as open space due to the presence of steep slopes may be offered for dedication to the municipality, a private land trust or a non-profit agency in order to preserve and maintain the area in its natural state.
—The use of conservation easements on steep slopes shall be encouraged to preserve the area in perpetuity.

Section 305. WOODLAND PROTECTION ZONES

A. Purpose

The purpose of this regulation is to promote conservation of woodlands, hedgerows, specimen vegetation as well as non-specimen vegetation throughout _____ through establishment of management requirements restricting land development activities and specifying replacement requirements.

It has been determined that indiscriminate, uncontrolled and excessive destruction, removal and clear cutting of trees upon lots and tracts of land results in:

- increased drainage control costs
- increased soil erosion and sedimentation, especially on sloping areas
- decreased fertility of the soil
- degradation of water resources
- decreased groundwater recharge
- increased buildup of atmospheric carbon
- increased dust
- loss of natural cooling in the summer and wind protection in the winter
- adverse impacts on community aesthetics
- decreased habitat
- loss of natural noise buffering
- decreased property values
- all of which negatively affect the character of ___ Township.

Because the removal of trees adversely affects the health, safety and general welfare of its residents, ___ Township desires to minimize the indiscriminate and excessive cutting of trees by preserving the maximum possible number of trees in the course of development of a site, ensuring that the health of trees preserved on a site is maintained throughout the development process, protecting

larger, older specimens of trees as a first priority and encouraging innovative design and grading to promote the preservation of all existing trees. It is the purpose of this ordinance to modify the location of development in relations to woodlands, hedgerows, specimen trees, and other important vegetation but not to modify the overall density of development.

B. Applicability

With the exception of the exemptions set forth in this section, no tree shall be cut or otherwise removed from any lands in ___ Township without a tree removal permit. All applications for approval of a major subdivision, minor subdivision or site plan requiring tree removal shall include an application for a tree removal permit. Any residential, commercial, business or industrial lot owner wishing to remove trees upon said lot must comply with the appropriate sections of this ordinance. Applications for tree removal permits shall be submitted to _____ for review and approval**.** No tree planted or preserved as part of any landscape plan or in accordance with any street tree requirement approved in conjunction with a subdivision or site plan shall be removed, except for such trees directed to be removed pursuant to other sections of this ordinance.

The provisions of this ordinance apply to all land disturbances resulting from or in connection with any activity or use requiring approval of any of the following:

Building permit
Zoning variance
Special exception
Conditional use
Subdivision/land development

C. Definitions

(Include the following definitions unless the definition is already provided for in the adopted zoning ordinance)

Caliper - Standard measure of tree size for trees to be newly planted. The measurement is taken 6 inches above the ground for trees 4 inches in diameter or less and 12 inches above the ground for trees over 4 inches in diameter.

Clear Cutting - the removal of all standing trees on a lot or a portion of a lot.

Diameter at Breast Height - diameter of a tree measured four and one-half (4 2) feet (forestry method) above the ground level on the downhill side for existing trees. Diameter at Breast Height may appear as the abbreviation "DBH" (Diameter Breast Height).

Drip Line - a limiting line established by a series of perpendicular drop points marking the maximum radius of the crown of an existing tree, but not less than six (6) feet from the trunk, whichever is greater; and within which no construction or disturbance shall occur.

Replacement Tree - a nursery-grown certified tree, properly balled, marked with a durable label indicating genus, species and variety, and satisfying the standards established for nursery stock and installation thereof, set forth by the American Association of Nurserymen.

Selective Cutting - the removal of larger trees on an individual basis while leaving trees of lesser size.

Silviculture - the management of any wooded tract of land to insure its continued survival and welfare, whether for commercial or noncommercial purposes, pursuant to a plan approved by the Pennsylvania DEP's Bureau of Forestry.

Thinning - the removal of undesirable, competitive, diseased or damaged trees so as to cultivate and improve the development of remaining trees on the lot.

Tree - any self supporting woody plant which reaches a typical mature height of twelve (12) feet or more at maturity and has a typical DBH of four (4) inches or greater.

Tree Canopy - the top layer or crown of mature trees.

Wooded Acres Permitted for Development - means the wooded lands within a lot or tract which are not specifically excluded from development by any federal, state, county or municipal law or ordinance, deed restriction or covenant running with the lands. For purposes of this Ordinance, those lands specifically eliminated from consideration as wooded acres permitted for development include, but are not limited to, wetlands as defined by PADEP.

D. Tree Cutting or Removal Restrictions

1. With the exception of the exemptions set forth in this ordinance, no person shall cut or remove, or cause to be cut or removed, any existing tree with a diameter at breast height (DBH) of six (6) inches or greater upon any lands within ___ Township unless the cutting or removal can be accomplished in accordance with the provisions of this ordinance.

2. Applicants shall make all reasonable efforts to make subdivision and land development plans and all related development actions compatible with maximizing preservation of existing trees. Tree removal of all sizes is to be minimized. No portions of wooded areas, hedgerows, specimen trees, or any other trees with a diameter at breast height (DBH) of six (6) inches or greater shall be removed unless necessary to accomplish the proposed development.

3. No specimen trees shall be removed from any lot or tract except where the applicant demonstrates to ___ Township that such removal is essential to remove a hazardous condition(s) or otherwise is essential permit the lawful use of the lot or tract. Where permitted, this removal of specimen vegetation shall be minimized. Retention of specimen trees is to be double credited toward any tree replacement required under this ordinance.

4. Woodland replacement in accordance with provisions of this ordinance shall be required whenever permitted woodland disturbance on any lot or tract exceeds 20,000 square feet of wooded area or disturbance to more than twenty-five (25) percent of any wooded area, which is less. Extent of wooded area disturbance is to be measured to include the entire area within the drip line of any tree comprising a wooded area, where any portion of the drip line of such tree is subject to disturbance.

5. Where disturbance of wooded areas, hedgerows, specimen trees, or other trees with a diameter at breast height (DBH) of six (6) inches or greater is essential, the

applicant shall be guided by the following criteria in clearing and retaining vegetation:

(a) Location(s) and benefits of conservation of healthy mature tree stands

(b) Impacts in terms of functions and values to wildlife of separating, dividing, and/or encroaching on wildlife corridors and/or extensive wildlife habitat areas, especially when dealing with wooded areas of 10 acres or more.

(c) Impacts on views and scenic values, including autumn coloration, flower types and fruit, bark and crown characteristics, extent of dieback present, and so forth.

(d) Susceptibility to insect attack and/or disease.

(e) Species longevity.

(f) Wind firmness and capability of soil to hold trees.

(g) Existence of disease, rot, or other damage to trees (trees in poor health should be removed).

(h) Protection of buildings (dead or dying limbs hanging over buildings should be removed).

6. In areas of permitted tree disturbance, care shall be taken to protect remaining trees from damage in adjacent areas. The following measures shall be used:

(a) No change in existing grade shall be permitted within the drip line of trees. Appropriate fencing or other means of demarcation acceptable to ___ Township shall be placed for the duration of construction at the drip line of trees to being retained and which are adjacent to construction. Roots of trees being retained shall not be cut.

(b) Trees within 25 feet of a building or bordering entrances/exits to building sites shall be protected by temporary barriers to be maintained in place throughout the duration of construction activities.

(c) No boards or other materials shall be nailed or otherwise attached to trees during construction.

(d) Construction materials, equipment, soil and/or debris shall not be stored nor disposed of within the drip lines of trees being retained, except for mulched vegetative matter used to prevent soil compaction.

(e) Tree trunks, limbs, and exposed roots damaged during construction shall be protected from further damage by being treated immediately in accordance with accepted professional landscape procedures.

7. Exemptions

The following shall be exempt from this ordinance:

(a) Commercial nurseries and fruit orchards.

(b) Christmas tree farms.

(c) Residential lots that are less than two (2) times the minimum required lot size where removal is no more than three (3) trees with a six (6) inch DBH or less in any two (2) year period.

(d) Residential lots that are greater than two (2) times the required lot size and are removing no more than six (6) trees with a six (6) inch DBH or less in any two (2) year period.

(e) Any tree which is part of a cemetery.

(f) Trees directed to be removed by municipal, county, state or federal authority pursuant to law.

(g) Removal of trees which are dead, dying or diseased, or trees which have suffered damage, or any tree whose angle of growth makes them a hazard to structures, roads, or human life.

(h) Removal of trees which appear to cause structural damage to buildings or foundations.

(i) Any tree growing on or over a public right-of-way or public land.

(j) Pruning or removal of trees within the right-or-way by utility companies for maintenance of utility wires or pipelines and the pruning of trees within sight easements.

(k) Trees removed in conjunction with farmland greater than five (5) acres in size that will be actively devoted primarily to agricultural uses and that yield a minimum annual income of five hundred dollars ($500) from said farming activities except that where the owner desires to remove any trees for the purpose of expanding farmlands, an inventory of trees to be removed, identified by size and species, shall be prepared and filed with ___ Township prior to any tree removal. In the event the expanded farmlands are not actively devoted primarily to farming activities for a period of seven (7) years following tree removal, the tree replacement provisions contained in this ordinance shall apply.

(l) Those projects which have received major subdivision or site plan approval prior to the effective date of this Ordinance and amended major subdivision and site plans.

E. Tree Removal Permit and Planning Requirements for Major and Minor Subdivisions and Site Plans

Each application to ___ Township for approval of a major or minor subdivision or a site plan that requires the removal of trees as defined in this ordinance shall include an application for a Tree Removal Permit. The application for tree removal permit and development proposal shall conform to the following provisions:

1. Tree Removal Permit: The application form for a Tree Removal Permit may be obtained from _____ and shall include the following information:

   (a) Name and address (street, lot and block) of the owner of the lot or tract and legal status (individual, partnership, corporation of this or any other state, etc.)

   (b) Description of the lot or tract where removal is to take place, including lot and block numbers, street address as assigned

   (c) A list of all trees to be removed with a DBH equal to or greater than six (6) inches identified by size and species, including total number of each species to be removed;

   (d) Purpose for tree removal (new construction, street or roadway, driveway, utility easement, recreation areas, parking lot, etc);

   (e) Proof that there are no delinquent property taxes or assessments due on the property for which the application is submitted; and

   (f) Such other information as may be deemed necessary in order to effectively process and evaluate such a permit application.

2. Tree Protection Plan

   The following information shall be provided on a landscape plan prepared by a Registered Landscape Architect or Registered Professional Engineer and submitted with the application for a Tree Removal Permit. The tree protection plan must be submitted prior to Tree Removal Permit approval. If less than 10 percent of the existing tree mass is being disturbed, a Tree Protection Plan is not necessary.

   (a) Tree Protection Plan Base Information

   —Location of existing tree canopy within the property boundaries.
   —Location of individual trees with a DBH equal to or greater than
   six (6) inches identified by size and species within the area of development/limit of disturbance.
   —Location of individual trees with a DBH equal to or greater than six (6) inches identified by size and species beyond the area of development/limit of disturbance.
   —Location of individual existing trees and their drip lines noted for preservation within the area of development/limit of disturbance identified by size and species. Where clusters of trees exist on the site or are contiguous

with adjacent sites, fragmentation of the cluster shall be avoided where possible.
—Location of all required replacement trees.
—Clear labeling of the area(s) intended for tree/vegetation removal, both on the Plan and at the lot or tract (see provisions below).
—Tree protection material details and limit of disturbance line.
—Location of existing and proposed buildings/structures.
—All bodies of water and wetlands, including water retention and detention areas.
—Location of all existing driveways and parking areas.

(b) Tree Protection Plan Design Requirements

—As stipulated elsewhere in this ordinance, only those trees necessary to permit the construction of buildings, structures, streets, driveways, infrastructure and other authorized improvements shall be removed. Existing vegetation shall be preserved to the greatest extent feasible.
—No more than twenty-five (25) percent of the existing trees/tree masses within the lot or tract boundaries shall be removed, unless special approval is granted by ___ Township. The location of the remaining seventy-five (75) percent of the trees to be preserved shall be noted on the landscape plan. In all cases, tree replacement provisions of this ordinance apply. Steep slope limits of disturbance shall supersede this section when appropriate
—No more than fifteen (15) percent of existing trees with a DBH equal to or greater than ten (10) inches within the area of the lot or tract to be developed (i.e., the limit of disturbance) shall be removed, unless special approval is granted by ___ Township. In all cases, tree replacement provisions of this ordinance apply.
—For replacement trees, species and their locations shall be consistent with accepted landscape and horticultural practice with every effort to promote native species. Where necessary, ___ Township may approve location of replacement trees beyond the lot or tract, such as on public lands, where such placement furthers the objectives of this ordinance.
—Input from various subcommittees and groups of ___ Township shall be requested for recommended tree preservation areas.
—Trees and/or shrub masses that are relocated on the lot or tract may be given replacement tree value.
___ Township shall have the option of requiring imposition of a conservation easement to protect any or all trees or tree canopy areas to remain on site as part of the Tree Protection Plan.
—Applicant shall specify long-term management provisions for all those areas not being disturbed and subject to tree replacement. A statement of wooded area management objectives shall be included, demonstrating the feasibility and success of the proposed management practices, addressing viability of introduced plantings, deterrence of invasive species, and means to minimize future wooded area impact. These management provisions, to be specified either in narrative or graphic form, shall address:

-Retained wooded area ownership, management, and maintenance
-Conservation and land management techniques and practices to be used to protect such areas, as applicable

-Professional personnel requirements to maintain and manage the property

F. Protection of Trees during Construction

1. Tree protection measures and the limit of disturbance line shown on the Tree Protection Plan shall be provided at the lot or tract with snow fencing or other durable material and verified by a municipal officer from _____ prior to soil disturbance.

2. Protective barriers shall not be supported by the plants they are protecting, but shall be self-supporting. Barriers shall be a minimum of four (4) feet high and shall last until construction is complete.

3. Chain link fence may be required for tree protection if warranted by site conditions and relative rarity of the plant.

4. Snow fencing used for tree protection shall be firmly secured along the drip line, but shall be no less than six (6) feet from the trunk.

5. The grade of the land located within the drip line shall not be raised or lowered more than six (6) inches unless compensated by welling or retaining wall methods; and in no event shall welling or retaining wall methods be less than six (6) feet from the trunk of a tree.

6. No soil stockpiling, storage of building materials, construction equipment or vehicles shall be permitted within the drip line or within six (6) feet of any remaining trees, whichever is greater.

7. Any clearing within the drip line, or within six (6) feet of the trunk of a remaining tree, whichever is greater, shall be done by hand-operated equipment.

8. Where a tree designated for preservation is severely damaged and unable to survive, tree replacement shall occur as provided below.

G. Tree Replacement and Reforestation

1. The replacement of trees shall occur on the lot or tract and shall occur as prescribed in the table below.

2. Replacement tree(s) shall be of nursery grade quality, balled and burlapped. Where replacement trees are required but not suitable for the particular site prescribed due to the size of the site or other special limitations, the trees shall be utilized for planting on public lands as close to the lot or tract as possible.

3. The type of replacement tree(s) shall be the same as the species removed from the site or other as approved by ___ Township.

Tree Replacement Schedule **Caliper of Existing Tree Removed Trees (3" caliper)**	**Number of Replacement**
Less than 6 inches	1
Between 6 & 12 inches	3
Between 12 & 18 inches	4
Between 18 & 24 inches	5
Between 24 & 30 inches	7
Between 30 & 36 inches	10
36 inches or greater	The equivalent of 3" caliper trees or greater needed to equal the DBH of the removed tree

4. All specimen trees retained shall be credited toward the tree replacement requirement at a ratio of three trees credited for each one specimen tree retained.

5. All replacement trees shall have been grown within the same USDA hardiness zone as the lot or tract and shall be nursery grown, excepting those deemed by _____ to be acceptable for transplanting from other disturbed portions of the lot or tract (see above).

6. Species of replacement plantings shall reflect careful site evaluation, including.

   (a) Existing and proposed site conditions and their suitability for the tree species, based on geology, hydrology, soil, and microclimate.

   (b) Specific functional and design objectives, including replacement of the wooded area being removed, enhancement of existing wooded areas, reforestation of Stream Buffer Conservation Zones, landscape buffering, visual screening, noise abatement, energy conservation, wildlife habitats, and maximizing aesthetic values.

   (c) Maintenance considerations such as hardiness, resistance to insects and disease, longevity, and availability.

   (d) Because of the many benefits of native species (ease of maintenance, longevity, wildlife habitat, etc.), the use of nursery-grown free-fruiting native trees is strongly encouraged. Selection should reflect species diversity characteristic of the native deciduous landscape of Morris County.

7. The planting of all replacement trees shall be done by or supervised by a person with horticultural training in tree care and planting methods.

8. Newly planted replacement trees shall be monitored for a period of one year to ensure the health of the trees. If the replacement trees die within the one year period, the developer/applicant shall replace the dead tree.

H. Tree Removal Permit Time Limits

1 Where the Tree Removal Permit application is submitted as a part of an application for major subdivision, minor subdivision or site plan approval, the time for approval shall be governed by the timing requirements applicable to major subdivision, minor subdivision or site plans.

2. Where the application is made in connection with a residential, commercial, business or industrial lot that is not part of a major or minor subdivision or site plan, ___ Township shall act on the application within thirty (30**)** days of its receipt or within such additional time as is consented to by the applicant. Failure to act within thirty (30**)** days, or any extension thereof, shall be deemed to be an approval of the application.

3. Approval by default with regard to major subdivision, minor subdivision and site plan applications, shall not be deemed to be a waiver of a Tree Removal Permit.

I. Duration of Tree Removal Permits

Permits granted for the removal of trees under the terms and conditions of this ordinance shall run with the land and shall remain in force and effect for the following periods of time, and not thereafter. Once the Permit has expired, a new application must be submitted for review and a new Permit issued. Time limits are as follows:

1. If granted for a lot or tract of land for which no building permit is required, one year from the date of issuance.

2. If granted for a lot or parcel of land for which a building permit is required, but for which no site plan approval is required by the Planning Board, until expiration of the building permit granted with such Tree Removal Permit.

3. If granted for a lot or tract of land for which site plan approval from the Planning Board/Zoning Board is required as a condition precedent to obtaining a building permit, until expiration of the site plan approval, or expiration of the building permit issued after such site plan approval.

4. If granted for a lot or tract of land for which minor subdivision is sought, one year from the date of granting such minor subdivision.

5. If granted for a lot or tract of land for which preliminary approval of a major subdivision is sought, until expiration of such approval.

J. Inspections Related to Tree Removal Permits

1. Prior to taking final action upon any application for a Tree Removal Permit, an inspection of the site shall be made by ___ Township.

2. Prior to any tree removal, all trees must be marked and areas to be cleared identified, all of which in turn must be inspection by a municipal representative.

3. ___ Township shall periodically inspect the lot or tract throughout the duration of construction in order to ensure compliance with this ordinance. Such inspection shall be made of the lot or tract referred to in the Permit application, and of contiguous and adjoining lands, as well as of lands in the vicinity of the application, for the purpose of determining drainage conditions and physical conditions existing thereon.

K. Fees

A review fee of ___ dollars shall accompany the application for all Tree Removal Permits.

L. Penalties

When regulated trees are removed without a Tree Removal Permit, the affected areas shall be replanted, increasing replacement requirements by fifty (50) percent and planted to the satisfaction of the appropriate municipal authority.

Section 305. WELLHEAD PROTECTION ZONE

(Special wellhead protection management regulations apply to those areas which "feed" water directly and indirectly to public water supply system wells; historically, the wellhead protection program, begun by US EPA (out of the Safe Drinking Water Act) and now being implemented by PADEP, has focused on protection of water quality and prevention of contamination, there is also no reasons why the wellhead protection program also cannot address issues of recharge and water quantity.

Two points are important. First, there are relatively few public water supply wells in the Sustainable Watershed Management watersheds, though more may be developed in the future. Secondly, the technical realities of this regulation becomes extremely involved very quickly. In some cases regulated zones may be determined by elaborate groundwater modeling investigations. In short, we have opted to exclude wellhead protection regulations from this program for the moment and will be working to condense requirements into a more manageable array.)

Section 306. WETLANDS PROTECTION ZONE

(Wetlands in Pennsylvania are regulated by both Federal and State agencies, though perhaps not perfectly. When these Federal/State "jurisdictional" wetlands are being impacted by a proposed development, Fewderal/State permits are required. But there may exist uncertainty and dispute as to whether wetlands exist in the first place. There is also some room for additional regulation on the part of the municipality, both to facilitate wetlands permit administration and to expand with care the substance of the wetlands protection program, such as through establishment of buffers.)

A. Wetlands Definition

Wetlands are generally indicated by one or more of the following:

—the National Wetlands Inventory mapping as prepared by the US Fish and Wildlife Service of the Department of the Interior
—hydric soils, or soils with hydric inclusions as mapped in the *Soil Survey of Chester and Delaware Counties* (USDA-SCSC now NRCS)
—existence of hydrophytic vegetation, or wetland hydrology

Federal/State wetlands are formally defined in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January 19, 1989*, as amended. In most cases, Federal/State wetlands jurisdiction is indicated by the presence of hydric soils, hydrophytic vegetation, and wetland hydrology, in combination. Presence of hydric soil by itself does not establish a Federal/State wetland.

B. Applicants are required to determine all State and Federal jurisdictional wetlands present at each development site under review and to apply for and obtain all necessary State and Federal wetlands permits. Wetlands jurisdiction is established in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January 19, 1989*, as amended.

C. Applicants are encouraged to have a qualified wetlands professional examine the site and provide a report regarding the existence of wetlands at the site. If no wetlands are found to exist on the site, a note must appear on the preliminary and final plans indicating that "This site has been examined by (name and address with a statement of qualifications also submitted), and no wetlands, as defined by the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January 19, 1989,* were found to exist."

D. If applicants submits no wetlands report or if the wetlands report is disputed by ___ Township, the Township shall request, at its discretion, that either the US Army Corps of Engineers, US Fish and Wildlife Service, or Pennsylvania Department of Environmental Protection perform a wetlands jurisdictional analysis of the site; if these agencies are not able to provide this service in a timely manner, the Township may hire a qualified wetlands scientist to perform this wetlands mapping, with all costs passed on to the applicant. Lacking any wetlands mapping by the applicant, the Federal and/or State mapping of wetlands or the township mapping will be designated as the official mapping of wetlands, and the applicant will be required to secure any wetlands permits or waivers pursuant to this mapping, unless the applicant;'s proposed action in no way impacts these wetlands (i.e., there exists a separation distance of a minimum of 100 feet between proposed disturbance of any type and mapped wetlands).

E. If, as in C. above, wetlands are evaluated by the applicant's consultant but disagreement as to the presence of wetlands or to their location, then the Township and/or applicant may either directly petition the US Army Corps of Engineers, US Fish and Wildlife Service, or Pennsylvania Department of Environmental Protection to perform a wetlands jurisdictional analysis, either confirming or modifying the applicant's wetlands mapping, or the Township may hire a qualified wetlands scientist to perform its own wetlands mapping, with costs of this mapping to be negotiated. If Federal/State wetlands mapping is undertaken, the Federal/State mapping constitutes the official wetlands mapping. If the Township wetlands mapping is undertaken, then the applicant and Township may work together to resolve the wetlands mapping dispute, though no action by the Township in any way removes or limits legal responsibilities of the applicant pursuant to Federal/State wetlands requirements.

F. Where wetlands have been mapped at the site and the applicant's proposed action impacts these wetlands in some manner, requiring wetlands permits, waivers, and/or other agency actions, final plan approval from the Township shall not be granted until all of these outstanding wetlands actions are satisfactorily resolved and submitted to the Township.

G. As indicated in other sections of this ordinance, direct encroachment, including any sort of filling of wetlands or intrusion into wetlands by some form of land disturbance or development action, should be avoided whenever feasible. Impacts and the mitigations required to offset these impacts are developed in concert with Federal/State agencies and the permits which must be obtained by the applicant.

H. In Special Protection Waters (Exceptional Value and High Quality) watersheds, as designated by the State of Pennsylvania, applicants are strongly urged to establish a buffer zone of at least 100 feet around all mapped wetlands present at a site, wherein encroachment and other major development intrusions (structures, parking areas, roadways) should be minimized as well; in non-Special Protection Waters, this buffer should be at least 25 feet.

Section 307. FLOODPLAIN PROTECTION ZONE

(Virtually all municipalities have enacted minimum Federal emergency Management Act. FEMA, minimum requirements foir floodplain protection, pursuant to the National Flood Insurance Program. Although these minimum requirements have grown somewhat more rigorous in recent years, it is important to keep in mind that these requirements are focused on the overall goal of minimizing flood damage, both loss of life and limb as well as damage to property. FEMA minimum requirements are not designed to achieve environmental, either water quality or water quantity, objectives. In fact, under the FEMA program, tremendous manipulation of the natural floodplain is possible, including removal of existing vegetation and manipulation of the existing soil, provided that certain hydraulic and hydrologic limits are respective in the floodway and, to a far lesser extent, in the so-called flood fringe. If proper floodproofing is provided, even the critical floodway can be impacted by certain types of building construction.

In order to minimize "disruption" to existing ordinances, any changes to floodplain regulations must be carefully interjected. In the section below, language is offered, to be inserted in "uses permitted" and "uses prohibited" portions of the municipal ordinance which typically is located in the front section of the floodplain regulation. Each municipality should examine its respective sections and work to incorporate these changes, assuming they are necessary)

A. Uses Permitted in the Flood way and Flood Fringe

The objective of this ordinance is to minimize, if not prevent the removal of natural vegetation in the floodplain, as well as any manipulation, including compacting, of the natural soil mantle. Environmentally, the primary objective of floodplain management should be to maximize the porosity and overall permeability of the natural floodplain (below the surface), to maximize its quantitative flood carrying capacity (above the surface), to maximize its "roughness" and ability to slow flood flows through the retention of existing vegetative cover, and to provide maximum water quality filtering potential. Dense undisturbed wooded cover is the ideal cover. Possible compatible uses are not many but include:

1. Certain types of recreation, such as passive recreation;

development of facilities should be undertaken with extreme care; for example, trails should be naturally surfaced and constructed so as to minimize compaction.

2. Agriculture but only when undertaken in accord with an approved Conservation District farm plan.

3. Limited selective cutting of trees, provided that cutting is limited to removal of diseased, dying, dead, or damaged trees within 25 feet of the stream/river bank and minimized between 25 feet and 75 feet of the stream/river bank.

4. Sealed water supply wells and pipelines, provided that they are developed with Best Management Practices.

5. Road, railroad, utility crossings with no feasible alternative location, provided that they are developed with Best Management Practices to achieve minimum floodplain disruptiona nd impact.

B. Uses Prohibited

1. Clearcutting of trees and other vegetation

2. Any activity or facility which uses in some manner substances which are toxic or in any way injurious to human or ecological health

3. Hospitals, nursing homes, or any other type of health care facility

4. Prisons

5. Junkyards

‘ 6. Mobile home parks

7. Other uses deemed inappropriate by ___ Township.

C. Waivers

Where application of these requirements imposes an undue and excessive economic burden upon the applicant and/or property owner, preventing any reasonable economic use of the site and thus resulting in an economic taking of the entire value of the property in question, these requirements may be waived wholly or in part by ___ Township.

Section 308. SELECTION OF STORMWATER BEST MANAGEMENT APPROACHES AND PRACTICES

Optimal stormwater management that comprehensively achieves quantity and quality standards at least cost will vary from site to site and with different uses. Although stormwater plans themselves will be different, **the process or procedure for figuring out what to use where and under what conditions does have a structure.** This Comprehensive Stormwater Management Procedure has been defined; a guidance document (Appendix A The Comprehensive Stormwater Management Procedure) is available at ___ Township and through the Township Engineer. A Procedure Application Report must be submitted as part of the Comprehensive Stormwater Management Plan in order to demonstrate that the Procedure has been properly applied. Additional technical references and guidance documents also are available at ___Township and through the Township Engineer.

Note that the selection of a competent and creative design engineer by the applicant clearly is critical. In order to achieve the standards and construction and maintenance cost reductions which are intended in this regulation, additional time and money is required in the process in preliminary engineering and design. Review and approval of a Comprehensive Stormwater Management Plan will be heavily dependent on the technical review by the Township Engineer and compliance with this Ordinance.

ARTICLE IV
COMPREHENSIVE STORMWATER MANAGEMENT PROCEDURES

Section 401. COMPREHENSIVE STORMWATER MANAGEMENT PLAN REQUIREMENT

As part of all applications for preliminary subdivision or land development plans and building permits, except those exempted by Article III, a Comprehensive Stormwater Management Plan is required and must be reviewed and approved by the ___ Township Engineer. This Comprehensive Stormwater Management Plan shall include the documentation called for in Sections 402 and 403 of this Ordinance. This Plan shall be submitted to the Chester County Conservation District for its review and approval.

Section 402. COMPREHENSIVE STORMWATER MANAGEMENT PLAN RELATED TO SUBDIVISION OR LAND DEVELOPMENT

A. The Comprehensive Stormwater Management Plan shall demonstrate that all land disturbance activities related to the subdivision or land development comply with the performance standards set forth in Article III of this Ordinance.

B. The Comprehensive Stormwater Management Plan shall contain all of the information required by Section 404 below. The applicant and/or his engineer shall confer with the Township Engineer prior to the preparation of a Comprehensive Stormwater Management Plan.

C. The Comprehensive Stormwater Management Plan shall be reviewed by the Township Engineer, who shall submit a report thereon to the Township Planning Commission within 30 days of submission of the Plan.

D. If, in the Township Engineer's view, the Comprehensive Stormwater Management Plan as submitted satisfies all requirements of this Ordinance, he shall recommend its approval to the Planning Commission. That recommendation shall be considered by the Planning Commission

and Board of Supervisors, together with the results of their own reviews and the comments of any other reviewing body.

E. If the Township Engineer determines that the Comprehensive Stormwater Management Plan fails to satisfy all requirements of this Ordinance, he shall so indicate in his report to the Planning Commission and Board of Supervisors and shall specify those items not in compliance with the Ordinance. The Township shall communicate these items to the applicant and, should the applicant want to remedy the deficiencies, the Township shall confer with the applicant to mutually agree whether a resubmission would initiate a new 90-day review period, extend the existing review period, or occur within the existing review period. The applicant and Township shall agree in writing to the terms and conditions of any such resubmission schedule.

F. The Township may approve the Comprehensive Stormwater Management Plan with conditions to be addressed as part of the final subdivision or land development application. Such conditions will be agreed to by the applicant, in writing, prior to conditional approval. If these conditions are not accepted by the applicant, the Township may deny approval of the subdivision or land development application.

G. As part of any final subdivision or land development plan, the applicant shall submit:

1. All construction specifications for stormwater management facilities as outlined in this Ordinance and as further specified by the Township Engineer;

2. Proof of liability insurance over the term of the project, if required under Section 404(J);

3. A performance guarantee as outlined in Article VI;

4. Detailed documents necessary to comply with the maintenance requirements of Article V;

5. Such other information as is deemed necessary by the Township Engineer.

H. The applicant may request in writing the approval of the final subdivision or land development plan conditioned upon satisfactory submission of the above. No site work shall begin until all conditions are met.

I. Where the final Comprehensive Stormwater Management Plan submission does not comply with the performance standards set forth in Article III of this Ordinance, or other application requirements of this Ordinance, such failure to comply may be considered grounds for denial of the final subdivision or land development application.

Section 403. COMPREHENSIVE STORMWATER MANAGEMENT PLAN RELATED TO BUILDING CONSTRUCTION

A. Where individual on-lot land disturbance activities have been addressed, approved, and noted as such in an applicant's Comprehensive Stormwater Management Plan related to a subdivision or land development, applications for building permits for each individual lot shall reference such approval. In these cases, it shall not be necessary for the applicant to resubmit a Comprehensive Stormwater Management Plan concurrent with applications for building

permits, provided the proposed grading of the lot and the locations of houses, driveways, and stormwater management facilities of any type are not changed.

B. In all other cases, or in cases where an applicant in A, above, wishes to alter grading, building locations, or the on-lot stormwater management system, the applicant shall submit a Comprehensive Stormwater Management Plan. This Plan shall accompany the application for a building permit and shall demonstrate that all land disturbance activities related to the building construction shall comply with the performance standards in Article III and any other applicable provisions of this Ordinance.

C. The Township may require that the Comprehensive Stormwater Management Plan contain all of the information mandated by Section 404. The applicant and/or his engineer shall confer with the Township Engineer prior to the preparation of a Comprehensive Stormwater Management Plan to determine the scope and detail of the submission.

D. The applicant's Comprehensive Stormwater Management Plan shall be reviewed by the Township Engineer, who shall submit a report thereon to the applicant and the Zoning Officer (Zoning or Building Inspector or Codes Enforcement Officer) and a copy to the Board of Supervisors, within 30 days of submission of the Plan.

E. Where revisions to the Plan are necessary in order to meet the performance standards set forth in Article III, the applicant shall discuss the contents of the report with the Township Engineer. All necessary revisions shall be effected and submitted to the Township Engineer.

F. Within 10 days after receipt of the applicant's revisions, the Township Engineer shall review the revisions and issue a supplementary report to the applicant and the Zoning Officer, with a copy to the Board of Supervisors, recommending approval or disapproval of the Plan.

G. If the final Comprehensive Stormwater Management Plan is not in compliance with the performance standards set forth in Article III, failure to so comply may be considered grounds for denial of the building permit.

H. Approval of a building permit shall constitute approval of the accompanying Comprehensive Stormwater Management Plan; these approvals may be concurrent.

Section 404. STORMWATER MANAGEMENT PLAN CONTENT

Except as may be modified for activities in Section 403, the Comprehensive Stormwater Management Plan required by Section 401 of the ____ Township Subdivision and Land Development Ordinance, shall consist of two parts: (a) a map or maps describing the topography of the area, the proposed alteration to the area, the proposed erosion and sedimentation control measures and facilities, and the proposed permanent stormwater control measures and facilities; and (b) a narrative report describing the project and its compliance with applicable sections of Article III, giving the purpose and the engineering assumptions and calculations for control measures and facilities. The following elements shall be included in the map and narrative portions of the Plan (except where already prepared as part of the preliminary subdivision or land development plan required by Section V of the SLDO).

A. A narrative summary of the project, including:

- general description of the project;

- general description of accelerated erosion control;
- general description of sedimentation control; • general description of stormwater management, both during and after construction;
- date project is to begin and expected date final stabilization will be completed.

B. Mapping of various physical features of the project area at a scale of ___, both existing and proposed, including:

- the location of the project relative to highways, municipal boundaries, and other identifiable landmarks;
- property lines of proposed project area;
- contour lines at vertical intervals of not more than 2 feet for land with average natural slope of 4 percent or less, and at intervals of not more than 5 feet for land with average natural slope exceeding 4 percent (including location and elevation to which contour lines refer);
- acreage or square footage of the project;
- wetlands (both state and federal jurisdiction), streams, lakes, ponds, or other bodies of water within the subject property or within 50 feet of any boundary of the property; intermittent streams and natural drainageways also should be shown;
- other significant natural features, including existing drainage swales, tree masses, and areas of trees and shrubs to be protected during construction;
- proposed location of underground utilities, sewer and/or water lines;
- scale of map and north arrow;
- existing roads and easement.

C. Mapping of the soils and underlying geology of the project area, including:

- soil types, including depth, slope, texture, and structure
- Hydrologic Soil Group classifications and soil rated permeabilities in inches per hour
- Soil constraints including depth to bedrock, depth to Seasonal High Water Table
- geologic formations underlying the project area and extending 50 feet beyond all property boundaries;
- describe aquifer characteristics of formations; highlight special formations such as limestone.

D. A map of proposed alterations to the project area, including:

- changes to land surface and vegetative cover, including zones of disturbance, zones of non-disturbance
- areas of cuts;
- areas of fill;
- structures, roads, paved areas, and buildings;
- proposed stormwater control provisions, both nonstructural and structural facilities;
- finished contours at intervals as described in Section ___;

E. Calculations and description of the amount of runoff from the project area and the upstream watershed area, in accordance with the terms of Section 301 of this Ordinance, including:

- method of calculation and figures used (including square footages for impervious surfaces of buildings, driveways, parking areas, etc.);
- factors considered.

F. The time schedule for land disturbance activities including:

- cover removal, including all cuts and fills;
- installation of erosion and sediment control facilities and practices;
- installation of improvements, including streets, storm sewers, underground utilities, sewer and water lines, buildings, driveways, parking areas, recreational facilities, and other structures;
- program of operations to convert erosion and sedimentation controls to permanent stormwater management facilities, including a chart of the relative time sequence of activities.

G. Temporary control measures and facilities for use during land disturbance, in both map and narrative form including:

- purpose;
- temporary facilities or other soil stabilization measures to protect existing trees and shrubs from land disturbance activities;
- types, locations, and dimensioned details of erosion and sedimentation control measures and facilities;
- design considerations and calculations of control measures and facilities;
- facilities to prevent tracking of mud by construction vehicles onto existing roadways.

H. The Comprehensive Stormwater Management Procedure Report (the specific elements of this Report are defined in Appendix A and include responses to questions set out in the Procedure; additional guidance regarding application of the Procedure is available from the Township Engineer).

I. Permanent stormwater management program (indicating, as appropriate, measures for groundwater recharge) and facilities for site restoration and long-term protection, in both map and narrative form, including:

- Purpose and relationship to the objectives of this Ordinance;
- establishment of permanent vegetation or other soil stabilization measures;
- installation of infiltration facilities, roof-top storage, cisterns, seepage pits, french drains, etc., to serve individual buildings;
- use of semi-pervious materials for driveways, parking areas, etc.;
- types, locations, and dimensioned details of facilities for stormwater detention and conveyance and for groundwater recharge;
- design considerations and calculations supporting the stormwater management program;
- location of drainage easements.

J. A narrative description of the maintenance procedures for both temporary and permanent control facilities, and of ownership arrangements, including:

- the methods and frequency of removing and disposing of sedimentation and other materials collected in control facilities, both during and upon completion of the project;
- the methods and frequency of maintaining all other control facilities, as necessary
- the proposed ownership and financial responsibility for maintenance of the permanent control facilities, including drainage and other easements, deed restrictions, and other legally binding provisions.

This description will result in a Maintenance Plan, to be jointly co-signed by the applicant and Township Engineer (see Article V below).

K. At the determination of the Township Engineer, proof of liability insurance and other ameliorative measures as deemed necessary.

ARTICLE V
MAINTENANCE AND INSPECTION OF PERMANENT STORMWATER MANAGEMENT FACILITIES

Section 501. MAINTENANCE RESPONSIBILITIES

A. General Responsibilities

The owner of stormwater management facilities shall be responsible for their proper maintenance during and after development. A Maintenance Plan shall be prepared for review and approval by the Township Engineer and shall be executed and signed by the Township Engineer and applicant. Where appropriate, as described below, this Maintenance Plan also must be signed by the Homeowners Association. Where appropriate, maintenance responsibilities must be included as deed restrictions on individual lots. During all subsequent real estate transactions, maintenance responsibilities shall be pointed out to new owners. All deeds shall incorporate these specified maintenance responsibilities, making explicit individual owners responsibilities for stormwater management measures and for the common property.

On or before completion of subdivision or land development improvements, the permanent stormwater management system for a tract shall be fully installed and functional in accordance with the approved Comprehensive Stormwater Management Plan. Temporary sediment trapping facilities in detention basins, upon inspection and approval by the Township Engineer shall be converted into permanent stormwater management basins; additional facilities designed to serve more than an individual lot shall begin operation. All such work shall be as specified in the approved Plan.

B. Homeowners Association Ownership (Other than On-Lot Stormwater Facilities)

A single entity taking the form of a private corporation, partnership firm, estate or other legal entity empowered to own real estate exclusive of individual lot owners (i.e., Homeowners Association) shall be set up to manage stormwater management facilities that are suitable for such management, and perform other functions defined in this Ordinance. Responsibilities for ownership and management of facilities shall be defined in the Comprehensive Stormwater Management Plan.

C. Individual Lot Stormwater Facilities

1. Stormwater management facilities and systems that are located on an individual lot are the responsibility of that landowner to maintain. As with non-individual lot situations, a Comprehensive Stormwater Management Plan must be prepared, including a Maintenance Plan which shall include:

   a. Any obligations concerning perpetuation of natural drainage or infiltration facilities, and/or the maintenance of facilities constructed by the individual lot owner under terms of his building permit (e.g., berms, cisterns, downspout connections, seepage pits, etc.)

   b. Assurances that no action will be taken by the occupant to disrupt or in any way impair the effectiveness of any stormwater management system.

   c. A description of the facilities and systems on the lot, as called for above, setting forth in deed restrictions binding on the landowner's successors in interest.

D. Municipal Ownership

Where the Township has accepted an offer of dedication of the permanent stormwater management facilities, the Township shall be responsible for maintenance. Municipal ownership notwithstanding, the applicant is required to prepare a Comprehensive Stormwater Management Plan including a Maintenance Plan component, as defined above. Upon approval of the stormwater management facilities by the Township, the applicant shall provide a financial security, in a form approved by the Township Solicitor for maintenance guarantees, as follows:

1. Long-term Maintenance Bond - The long-term maintenance bond shall be in any amount equal to the present worth of maintenance of the facilities for a ten year period. The estimated annual maintenance cost for the facilities shall be based on a reasonable fee schedule provided by the Township Engineer and adopted by the Township Board of Supervisors.

2. Documentation - The terms of the maintenance guarantees shall be documented as part of the Comprehensive Stormwater Management Plan and the Maintenance Plan subpart.

E. Failure of any person, individual lot owner or private entity to properly maintain any stormwater management facility shall be construed to be a violation of this Ordinance and is declared to be a public nuisance.

Section 502. NEED FOR CORRECTIVE MEASURES.

If the Township determines at any time that stipulated permanent stormwater management facilities have been eliminated, altered, or improperly maintained, the owner shall be advised of corrective measures required within a period of time set by the Township Engineer. If such measures are not taken by the owner, the Township may cause the work to be done and lien all costs against the property.

Section 503. INSPECTIONS OF LAND DISTURBANCES RELATED TO SUBDIVISION OR LAND DEVELOPMENT

All land disturbance work shall be performed in accordance with an inspection and construction control schedule approved by the Township Engineer as part of the Comprehensive Stormwater Management Plan. The Township Engineer should be consulted for guidance regarding the timing and other details of necessary inspections. No work shall proceed to a subsequent phase, including the issuance of the Certificate of Occupancy, until inspected and approved by the Township Engineer or his designee, who shall then file a report thereon with the Township.

Section 504. LAND DISTURBANCES NOT RELATED TO SUBDIVISION OR LAND DEVELOPMENT.

The timing and frequency of inspections of land disturbance activities not related to the subdivision/land development process shall be a determined by the Township Engineer prior to final approval of the Comprehensive Stormwater Management Plan. Adherence to that schedule shall be a condition of Plan approval.

Section 505. FEES ASSOCIATED WITH INSPECTIONS.

Inspection fees for activities associated with Sections 503 and 504 shall be paid according to the provisions of the Township Subdivision and Land Development Ordinance.

ARTICLE VI
FEES AND PERFORMANCE GUARANTEES

Section 601. COMPREHENSIVE STORMWATER MANAGEMENT PLAN APPROVAL FEES.

A. Land Disturbance Related to Subdivision or Land Development.

All fees and escrow deposits incident to approval of a Comprehensive Stormwater Management Plan and conduct of the work approved thereunder, where the land disturbance activities are to be undertaken as part of a subdivision or land development, shall be established and submitted in accordance with Section _ of the Township SLDO.

B. Other Land Disturbance Activities.

1. All parties submitting a Comprehensive Stormwater Management Plan for land disturbances not related to Subdivision and Land Development shall agree, in writing, to reimburse the Township for all costs of administration and review of the Plan by the Township staff, Engineer, and Solicitor. Funds shall be deposited with the Township Secretary in an amount as specified by resolution of the Board of Supervisors.

2. Excluding fixed administrative costs, the applicant shall be charged only for time actually expended and detailed in bills from the Township Engineer and Solicitor. Any unexpended balance of the deposit shall be returned to the applicant following approval of the Plan.

3. If actual time required of either the Township Engineer or Solicitor will exceed the deposited amount, the Township shall render to the applicant a preliminary statement of time expended and shall require an additional deposit to complete reviews. Such required additional amounts must be deposited with the Township Secretary prior to approval of the Plan.

Section 602. PERFORMANCE GUARANTEES.

Where proposed land disturbance activities are related to a subdivision or land development, the applicant shall be subject to the requirements for a performance guarantee that are specified in Section _ of the Township SLDO. As stipulated in Section 501(D), a long-term maintenance bond and other requirements are imposed if stormwater management facilities are being conveyed to the municipality.

ARTICLE VII
VIOLATIONS AND PENALTIES

Section 701. NOTIFICATION OF NON-COMPLIANCE WITH COMPREHENSIVE STORMWATER MANAGEMENT PLAN.

Any activity conducted pursuant to a Comprehensive Stormwater Management Plan approved by Township shall be performed in strict compliance with the provisions of the Plan. Violations shall be treated in the following manner:

A. Any non-compliance with the provisions of the Plan that is identified by the Township Engineer or his designee in the course of inspections as specified in this Ordinance shall be remedied by the applicant/owner according to the terms in this Ordinance.

B. If at any time work does not conform to the Plan, including all conditions and specifications and modifications thereof, a written notice to comply shall be given to the applicant/owner. Such notice shall set forth the nature of corrections required and the time within which corrections shall be made. Upon failure to comply within the time specified, the applicant/owner shall be considered in violation of this Ordinance, and the Township shall issue a cease and desist order on all work on the site, including any building or other construction, until corrections are made. If corrections are not undertaken within a specified time or the applicant/owner violates the cease and desist order: (1) penalties shall be imposed and/or (2) the work shall be completed by the Township and the costs charged to the applicant/owner.

Section 702. PENALTIES.

Anyone violating the terms of this Ordinance shall be guilty of a summary offense and, upon conviction, shall be subject to a fine or penalty of not more than $300 for each and every violation. Each day that the violation continues after proper notification shall be a separate offense. In addition thereto, the Township may institute injunctive, mandamus, or any other appropriate action or proceeding at law or equity for the enforcement of this Ordinance or to correct violations of this Ordinance, and any court of competent jurisdiction, shall have the right to issue restraining orders, temporary or permanent injunctions, or mandamus or other appropriate forms of remedy or relief.

APPENDIX A

THE COMPREHENSIVE STORMWATER MANAGEMENT PROCEDURE

Introduction

A procedure for implementing stormwater management ordinance requirements (Comprehensive Stormwater Management Procedure; see figure) as set forth in Section ___ is described in this Appendix. This Procedure is intended to produce stormwater management "solutions" which achieve the standards set forth in a cost effective manner. The Procedure will not be fully applicable in all land development cases, especially in those cases where higher densities/intensities are proposed on the smallest of sites. In such cases, more highly engineered structural solutions may be necessary.

The Comprehensive Stormwater Management Procedure is designed to integrate the following underlying principles into the site design and stormwater management planning process:

- **Stormwater is a resource to be valued, not a waste for disposal.**
- **Prevent first, mitigate second.**
- **Integrate stormwater management early on into the site design process.**
- **Manage stormwater as close to the source as possible.**
- **Use natural systems, including the undisturbed soil mantle and natural/existing vegetation, for quality and quantity control.**
- **Disconnect and increase Time of Concentration, rather than pipe and accelerate.**
- **Achieve multiple stormwater objectives as simply as possible.**

This Comprehensive Stormwater Management Procedure consists of a series of questions, structured to provide an analysis of the site's natural features together with stormwater management needs of various development concepts. The initial questions in the Procedure focus on the more preventive aspects of stormwater management. Answers are to be recorded and compiled in the Comprehensive Stormwater Management Procedure Report, as stipulated in Section ___. If these Procedure questions are addressed thoroughly, the critical objective of managing stormwater comprehensively—both quantity and quality—will be achieved in a reasonably cost effective manner. The Procedure is largely common sense, but nevertheless approaches the engineering of stormwater solutions in ways which depart significantly from the conventional engineering approach.

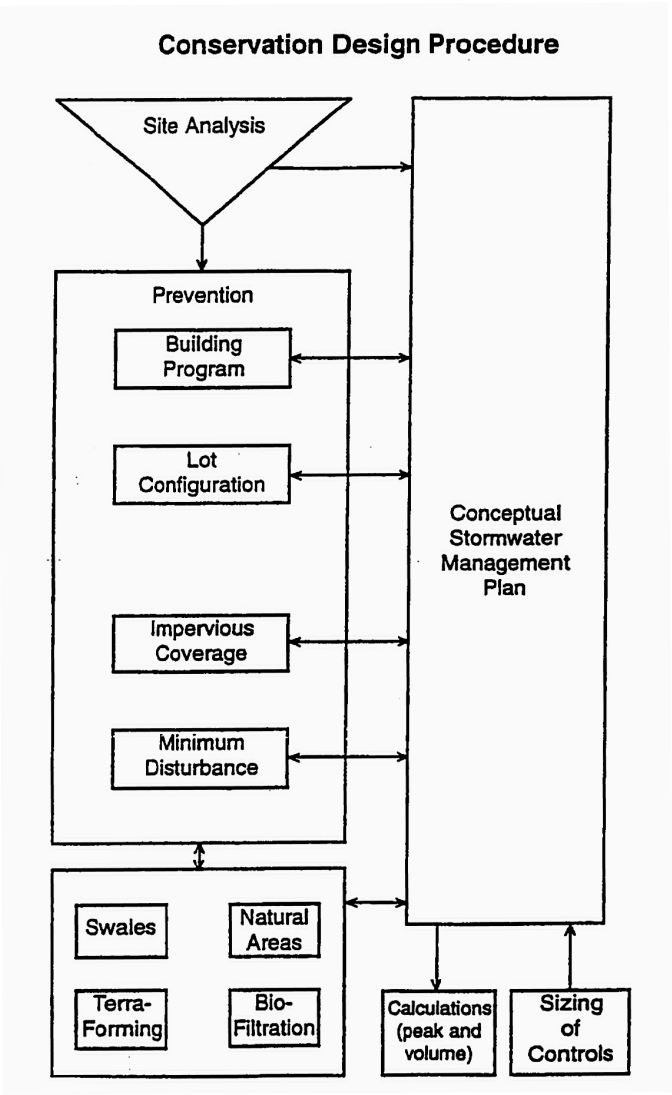
Prevention must be maximized. Then, natural system-based mitigative practices, together with more conventional structural practices, should be arrayed and evaluated, given that some amount of stormwater peaking and volume control will remain to be mitigated even with

successful prevention. These corrective or mitigative stormwater management needs should be met with an array of natural-system based Best Management Practices (Vegetated Swales, Vegetated Filter Strips, Berming/Terraforming), with the remaining stormwater management needs met with structural Best Management Practices (Infiltration Basins/Trenches/Wells, Porous Pavement, Wet Basins/Retention Ponds, Constructed Wetlands, Multi-Chamber Catch Basins, Sand/Peat Filters).

Finally, although this Procedure is presented as an integral part of stormwater management, the Procedure transcends the bounds of conventional stormwater management and involves the total site design process. That is exactly the objective. To this end, the Procedure extends beyond stormwater management requirements established in Section ___ and involves other sections of ___ Township's regulations.

In fact, much of the information relied on in this Procedure is information which already is required to satisfy other sections of ___ Township ordinances, such as the considerable requirements in Sections ___ Sedimentation and Erosion Control Plan, ___ Site Analysis, and ___ (as needed). The Procedure is intended to more effectively utilize this data and site knowledge in order to generate better stormwater management in the context of a markedly improved site plan.

The figure below provides a rough approximation of the process involved.



1.0 Site Assessment

Comprehensive Stormwater Management begins with Site Assessment—understanding the site. Site assessment includes inventorying and evaluating the various "systems" which define each site and which pose both problems as well as opportunities for site development. These systems include the full range of natural systems—water, soil, geology, vegetation, habitat, air quality—as well as cultural resources and even relevant socioeconomic factors. These systems range in scale from the very macro—resources of areawide importance—down to more micro-scale site-specific factors such as steep slopes, floodplains, wetlands, special geological/aquifer conditions, and so forth.

1.1 Background Site Factors:

Various site background factors are of interest due to their water quality importance.

—Does the site drain to special waterbodies with special water quality needs?

Determine State Stream classification.
Determine if the site ultimately flows into a reservoir or other type of impoundment where special water quality sensitivities exist, such as use as a water supply source.
Determine if other special fishery issues exist?
Determine if the site is linked to a special habitat system, such as delineated in the Pennsylvania Natural Diversity Inventory. For both water quality and temperature reasons, approaches and practices which achieve a higher order of protection may become especially important.

—Are there known downstream flooding problems?

Determine if stream system to which the site discharges is characterized already by flooding problems, especially important where urbanization already has occurred and where hydrology already has been impacted. Unfortunately the existing FEMA mapping and related studies don't adequately assess this issue. County agencies and possibly other sources may be able to indicate anecdotally the extent to which downstream flooding is already a problem or has potential to become a problem if substantial additional development is projected, in which case a cautionary flag should go up. If so, greater care should be taken in both floodplain management as well as stormwater management.

—Does the site discharge to 1st, 2nd, 3rd order streams?

Another important question relates to a site's location within its watershed. All else being equal, sites located near the base of watersheds have a lesser degree of potential hydrologic impact in the watershed system (i.e., the longer the route or routing of whatever additional stormwater is generated, the greater the potential problem this stormwater may cause). Sites located farther up in watersheds closer to headwaters are potentially more problematic when additional stormwater is generated. Conversely, and perhaps even more critical, sites located within headwaters must be managed most carefully in terms of stormwater so as to maintain pre-development infiltration and

groundwater recharge rates. In so doing, critical stream baseflow will be maintained and the aquatic community supported.

—Other

1.2 Site Factors Inventory:

Site physical factors powerfully influence Comprehensive Stormwater Management.

—How does site size and shape affect stormwater management?

Analyze how site size and shape influence Comprehensive Stormwater Management. As site size increases, ability to use different Comprehensive Stormwater Management approaches and practices increases. As size decreases, some aspects of approaches and practices may become more challenging to implement, although Comprehensive Stormwater Management can reduce site space requirements and therefore offers greater flexibility than the conventional site design approach (examples range from the clustering of dwellings in concentrated areas to elimination of conventional stormwater structural measures such as basins). Oddly shaped sites also usually can be better adapted with the approaches and practices set forth here.

—What are the important natural features characterizing the site?

Determine basic site hydrology, including perennial streams as well as intermittent swales.

Determine site soils.

Determine site vegetation. At the heart of the Comprehensive Stormwater Management procedure is an understanding of the natural areas (systems) characterizing each site. Existing vegetation and soil have tremendous importance and are key in so many different ways to understanding land development impacts on natural systems.

> *Careful accounting of existing vegetation is an important prerequisite for Comprehensive Stormwater Management, followed closely by soils mapping, including classification by permeability rating into Hydrologic Soil Group categories, followed closely by basic site hydrology in order to understand natural predevelopment surface flow patterns*.

Determine critical site features—wetlands, floodplains, riparian areas, natural drainageways (see above), special habitat areas, special geological formations (e.g.., carbonate), steep slopes, shallow depth to water table, shallow depth to bedrock, other limitations? Understanding critical natural areas is essential. Critical areas include: special value areas and sensitive areas. Special value areas include wetlands, floodplains, riparian buffers and naturally vegetated swales and drainageways, for example—all areas distinguished by special positive functions which can be translated into real economic value or benefit. Elimination of/reduction in these functions through the land development process creates real economic losses. These special value areas—including wetlands and floodplains and riparian areas—must be conserved and protected during land development.

Critical natural areas also include sensitive areas, such as steep slopes, shallow bedrock, high water table areas, and other constraining features, where encroachment by land development typically creates increased negative impacts of one sort or another. Both types of impacts should be avoided.

—What built/developed features characterize the site?

Determine if the site has centralized/public sewer? Centralized/public water? The most important elements for Comprehensive Stormwater Management are availability of centralized sewer and water service. With its focus on stormwater management, this Procedure does not include detailed discussion of statewide and county-municipal-wide requirements for wastewater treatment, ranging from onsite systems to various types of centralized systems. Specific regulations for wastewater treatment are dealt with in other sections of the ___ Subdivision and Land Development Ordinance. All of these requirements are critical. This Comprehensive Stormwater Management procedure must be able to coordinate and harmonize with these wastewater programs. In most cases, wastewater solutions are feasible; in fact, application of the approaches and practices advocated here enables a variety of wastewater treatment techniques which otherwise might not be feasible. In those rare cases where no centralized treatment systems exist, a variety of land-based treatment approaches are available, in addition to individual onsite septic systems.

Issues are similar for water supply, although wastewater tends to have greater significance for a variety of reasons.

1.3 Site Factors Analysis:

Given all of the above, what site factors constrain Comprehensive Stormwater Management and in what ways? What site factors can be viewed as opportunities?

—How is the site constrained?

Determine where buildings, roads, and other disturbance should be avoided, in terms of natural factors.

—Where are the zones of site "opportunity," in terms of stormwater management?

Determine where most recharge occurs in terms of vegetation, in terms of soils. Both constraints and opportunities are grounded in the natural systems present at the site. Constraints and opportunities are not necessarily simple converses of one another, although these relationships often do hold. For example, certain types of critical natural areas should be viewed as constraints in terms of direct land disturbance and building construction, yet also provide significant opportunity in terms of stormwater management, quantity and quality. Woodlands, which should be protected from direct land development, provide excellent opportunity for stormwater management, provided that the correct approaches and practices are used. Vegetated riparian buffers should

not be disturbed by building and road construction, yet can be used carefully with level spreading devices to receive diffuse stormwater runoff.

Similarly, soils with maximum permeabilities at the site should not be paved over with buildings and roads, but used for stormwater management where feasible. Conversely, buildings and other impervious areas should be located on those portions of a site with least permeable soils.

Defined in this way, site opportunities have major linkages to site stormwater recharge potential. The recharge requirements established in Section ___, if properly applied and enforced, are designed to achieve effective balance in the water cycle, pre-development to post-development. Site opportunities for recharge can be defined in terms of best vegetation types which minimize runoff as well as soil types with maximum permeabilities.

2.0 Use of Preventive Planning Approaches

With Site Analysis completed, the next step in the Comprehensive Stormwater Management Procedure is to address a series of questions, all of which focus on our ability to prevent the generation of stormwater from the outset.

2.1 Building Program:

—Can the proposed building program be reduced in terms of total number of units? What does the ___ Township Comprehensive Plan indicate for the site and adjacent areas? What is existing site zoning? Are zoning options allowed?

Determine if the development or building program itself can be modified. And if so, how, given current market realities? Pivotal here are the comprehensive plan and existing zoning requirements with maximum zoned densities. Not all sites can be developed at maximum zoned densities. The ___ Township Comprehensive Plan and Zoning Ordinance establish maximum or upper limit zoned density, which is expected to be adjusted site-by-site in accordance with a variety of other factors also set forth in the Plan and Ordinance. At the outset of the site planning and design process and as a part of this Comprehensive Stormwater Management procedure, it is vital to address the issue of adjusting the building program, particularly if the site is characterized by numerous critical features which are being impacted by conventional development concepts. In some cases, reducing the building program even moderately, may enable significant Comprehensive Stormwater Management approaches to be implemented and may result in cost reductions which balance the reduction in profit.

—Can the type of units be modified (e.g., from single-family to townhouse)? Are innovative development concepts (neo-traditional-, village-, hamlet-type?) been considered? Have building setbacks been reduced?

An alternative to reducing a site's building program can be a change in the type of development being proposed, such as substituting townhouses for single-family development. Moving from single-family dwellings to townhouses, holding the total number of dwelling units constant or even increasing total count of units, may enable more Comprehensive Stormwater Management concepts to be implemented. Achieving this same level of conservation of natural site features together with stormwater management needs might otherwise require a significant reduction in the total number of dwellings being proposed, assuming construction of single-family dwellings on approximately the same size of lot.

2.2 Lot Configuration/Clustering Design:

—Have lots been reduced in size to the maximum degree? Have lots/ uses been clustered/concentrated to the maximum degree?

Lot configuration, relating to both the sizing of lots and their arrangement, has more potential benefits than any other single Comprehensive Stormwater Management technique. Lot size reduction relates to the zoning requirements, to be satisfied by straightforward compliance or by successfully obtaining a waiver of some sort or special exception to these existing requirements. It should be kept in mind that the important question of gross density should not be confused with minimum lot size. In other words, reduction in lot size is allowed to decrease does not mean that densities should be allowed to increase.

Lot size also is related physically to structural type (i.e., there are minimum lot sizes which "fit" different types of structures and different sizes of structures). As lot size decreases, certain types of conventional structure types may be difficult to accommodate on the reduced size lot. With the proliferation of "village" and other clustered designs, there is ample documentation which demonstrates different designs for accommodating remarkably large homes on remarkably small lots. If properly designed, clustered configurations can take advantage of open space vistas and be far more successful in achieving a low density rural atmosphere—and even enhancing property values—than conventional large-lot design.

—Have lots been configured to avoid critical areas? Have lots been configured to take advantage of effective mitigative practices?

Careful configuring—clustering—of these reduced size lots also is critical, not only to minimize the total amount of site disturbance which is required, but also to avoid critical areas such as wetlands, steep slopes, and riparian and floodplain zones. This clustering further means that total road building and creation of other types of impervious cover can be minimized. Total site disturbance can be minimized.

Furthermore, clustering can also be designed to take advantage of stormwater opportunities, such as areas with the most permeable soils and with the best vegetation for stormwater management purposes. If

these areas are retained in open space adjacent to proposed development, such areas can provide excellent opportunities for receiving stormwater which is generated.

2.3 Impervious Coverage:

Although many of the Impervious Coverage issues addressed here relate directly to the Lot Configuration/Clustering Step above, the questions listed in this Step also stand alone. These questions relating to how and why imperviousness is created (roads, cul-de-sacs and turnarounds, parking lots, driveways, sidewalks, and even the structures themselves) are vital. We can do it just as well, just as safely and effectively, with much less imperviousness in many cases. Reducing imperviousness in all ways possible translates into a direct reduction in volume of stormwater runoff generated, in peak rate reduction, and in reduction of pollutants generated.

—Have road widths been reduced to the maximum? Have cul-de-sacs and turnarounds been designed to minimize imperviousness?

Questions are tiered, based typically on the potential imperviousness reduction which can be achieved. In other words, in most residential development cases, the first issue to be addressed ought to be road width. All else being equal, a reduction in road width from 30 feet to 20 feet (if feasible) means an immediate 33.3 percent imperviousness reduction in roadway imperviousness, which typically comprises a large fraction of total site imperviousness. Note that road length is not specifically dealt with here, simply because the Building Program and Lot Configuration/Clustering Steps will serve to minimize lengths of roads in most cases. Both cul-de-sacs and turnarounds can be designed to minimize imperviousness as well.

—Have driveway widths and lengths been minimized to the maximum?

Next comes driveways length and width. Length typically is dealt with under clustering and setback provisions. Reduction achieved here may or may not be substantial, depending upon the lots being created, their size, and building setback requirements (i.e., large-lot developments with substantial setbacks mean that total driveway length added up across the development will be great. If driveway width in such situation can be reduced by 20 percent, imperviousness reduction can be expected to be substantial.)

—Have parking ratios and parking sizes been reduced to the maximum? Has potential for shared parking been examined fully? Can porous surfaces be used for overflow parking, low impact shoulders, other applications?

Parking also is important, although the most interesting reduction in imperviousness to be achieved through parking strategies is with non-residential development, where the sizes of parking stalls themselves can be reduced, where ratios of parking stalls per size of structure being built possibly can be reduced, where sharing of parking spaces may be

possible. In residential applications, overflow or guest parking may be appropriately provided through use of porous pavement techniques.

—Have sidewalks been designed for single-side movement?

Sidewalk construction may afford opportunity to reduce imperviousness, though not in all cases. Sidewalks should be provided for any number of reasons, though usually provided only on one side of the street (for example, sidewalks are essential to the concentrated village development concepts which are advocated here). At the same time these sidewalks should be reasonably wide, oftentimes up to 5 feet in width. Of course the width and hoped for use of sidewalks will vary according to each development, its characteristics, nature of development in adjacent areas, and so forth.

2.4 Minimum Disturbance/Maintenance: Has Disturbance of Site Vegetation and Soils Been Minimized?

Undisturbed soil mantle and undisturbed vegetation offer tremendous stormwater potential, quantitatively and qualitatively. Minimum Disturbance/Maintenance offers double-sided benefits in that a negative impact is avoided and a positive opportunity is created. Even if a disturbed area remains pervious and is converted to lawn or some other form of artificial landscape, soils have been manipulated and compacted and all of the stormwater opportunity benefits of existing vegetation have been eliminated as well (i.e., post-development lawns can be expected to generate significantly more stormwater runoff than pre-development vegetation of most types, including meadow or scrub vegetation and certainly forests). At the same time, protected zones of vegetation and soil can be used actively for stormwater management purposes, offering areas where stormwater can be distributed and infiltrated, when used in conjunction with level spreading devices, berms, and other techniques.

—Has maximum <u>total site area</u>, including both soil and vegetation, been protected from clearing and any other type of development disturbance? Are zones of open space maximized? Do these open space zones make sense internally, externally?

Minimum Disturbance can be applied on several different levels. The approach is most effective when applied on the total site or development basis, when lots are concentrated into the most compact areas and the maximum proportion of site area can be protected, free of disturbance of any sort. The Minimum Disturbance concept in such cases becomes comparable to open space provisions in clustering designs, assuming that clustering provisions do not allow for disturbance of any type to occur in this open space. Furthermore, the Minimum Disturbance concept can and should be extended beyond the site level to take into account adjoining sites with their open space areas, ideally all integrated to create even larger blocks of open space, all of which has greater and greater positive ecological effect. If possible, these open space areas can ultimately form open space systems designed to protect stream valleys, important habitat, and other critical features.

—Have specially valuable and sensitive areas within the site been kept undisturbed? such as Riparian Corridors? such as the natural swales and drainageways system?

Even if a comprehensive approach to Minimum Disturbance cannot be undertaken, keeping special areas within the site undisturbed can have particular benefits. Of the utmost importance is making sure that areas buffering and bordering streams are kept undisturbed, the so-called riparian buffer. Various authorities now have recommended that a set of zones in the riparian buffer be established and managed rigorously, the zones customarily extending outward from the streambank about 100 feet or so (variable, depending upon topography and runoff flow being directed into it). These riparian areas are critical to water quality protection.

Similarly, the natural drainage system, including intermittent streams and swales, also is critical. If allowed to remain naturally vegetated, channelizing sheet flow is slowed and filtered. Some even is infiltrated. Careful addition of check dams and other devices can enhance performance significantly.

—In terms of <u>individual lots</u>, has maximum lot area, including both soil and vegetation, been protected from clearing and other development-related disturbance?

Unfortunately, such a macro-scale, total site perspective for the application of the Minimum Disturbance approach, however preferable, is not always achievable. In such cases, the Minimum Disturbance concept can be applied on the individual lot level, where, for example, larger lots of half-acre or more may be created and where through careful placement of structures, significant zones of existing vegetation can be preserved lot-by-lot, with undisturbed areas of adjoining lots forming larger open space massings. Zones of clearing—the required building footprint plus some modest apron needed for construction—can be designated and then flagged/fenced onsite, not unlike a wetlands mapping process. **Conceptually, the real difference here is that the basic approach to the site is "flipped," moving from the conventional approach which assumes that wholesale clearance/disturbance will automatically occur with some special critical areas flagged and protected. Versus Minimum Disturbance/Maintenance where the <u>entire site area</u> is considered important and disturbance zones are carefully defined—really the converse of how we typically go about land development.**

Minimum Disturbance/Maintenance can be used most effectively when applied in conjunction with critical features identified during the Site Analysis Step. For example, although the general Minimum Disturbance principle is to protect as much natural vegetation as possible, protection of existing vegetation which happens to be in riparian zones, which happens to be adjacent to existing wetlands, which happens to be on steep slopes, which happens to be in and along the natural system of drainageways will maximize the positive functions which Minimum

Disturbance provides. In other words, if Minimum Disturbance cannot be thoroughly and completely applied at a site, apply it with protection of these special value areas in mind. Special focus should be placed on mapping not only perennial streams at a site in question, but also the full drainage system, including all intermittent streams and swales which offer tremendous opportunity if kept undisturbed.

—Do structures correspond to site features such as slope, both in terms of type of structure, placement on lot, elevation, and so forth?

Minimum Disturbance/Maintenance also means that, if applied thoroughly and completely, types of structures themselves should be re-evaluated and may have to be modified (i.e., more vertical with less building footprint). The conventional sprawling colonial with 2 or 3-stall garage at grade set well back on the lot to provide a formal front yard should be re-evaluated. Types of building practices may need to be modified in order to effectively reduce needed site disturbance. Standard modes of excavation and top soil stockpiling result in large-scale if not total site clearing and disturbance, which is simply not necessary in order to provide 2,500 square feet of dwelling space, for example. The design of the structure, placement on the site in terms of elevation, all should reflect existing topography. Can the elevation of the dwelling be changed so that less excavation is required (i.e., less excavation means less site disturbance)? In sloping topography, can the dwelling design itself be modified to fit the slope, with driveways/garages properly fitted to minimize excavation and grading?

—Have re-vegetation opportunities been maximized throughout the site? Have re-vegetation opportunities been maximized in critical areas such as riparian buffer zones?

The most ambitious, but possibly most important aspect of Comprehensive Stormwater Management and Minimum Disturbance/Maintenance involves proactive re-forestation/re-vegetation as part of the stormwater management concept. Re-forestation can be cost-effective. It typically includes distributing (via level spreaders, swales, and so forth) stormwater onto areas where saplings with appropriate vegetative cover have been planted. Perhaps the most exciting aspect of re-forestation is that although the short-term stormwater performance must be assumed to be that of a modestly vegetated land cover (i.e., whatever cover crop has been included along with the sapling trees), nevertheless the long-term stormwater performance will improve year by year. For areas already cleared (though not necessarily developed as yet) and which are no longer naturally vegetated, incorporating re-forestation techniques into the land development process actually offers the potential to return watersheds to a more natural condition—even as development occurs! Related environmental benefits are very significant and, although rarely quantified as such, serve to make cost benefit ratios overwhelmingly positive.

Re-forestation done in conjunction with critical features such as riparian areas and natural swales is most important. If total zones cannot be re-forested, at minimum re-forestation of these most important zones should be undertaken.

3.0 Use of Mitigative "Nonstructural" Natural System-Based Practices

Having applied preventive Approaches to the maximum, nevertheless, stormwater still will be generated and must be managed or mitigated most effectively through a variety of mitigative "nonstructural natural system-based Best Management Practices, selection of which is part of this next Step. These Practices have been assigned to several groupings, although in many cases the lines of distinction are blurred. One technique blends into another. Although such Practices may be thought of as "nonstructural," virtually all of these techniques are actually structural in nature—they involve some building or construction of some type. At the same time, they also make use of vegetation and soil natural systems functions to a greater extent than the more conventional "structural" BMPs discussed below.

Terminology can be misleading. Vegetated Swales and Vegetated Filter Strips both can be considered to be Bioretention/Biofiltration devices, the increasingly popular name given to just about any type of device which utilizes vegetation and soil—existing natural areas—to manage stormwater flows. In most cases, the inspiration for Bioretention/Biofiltration has been water quality—using vegetation to remove nonpoint source pollutants in different ways. At the same time, however, quantity objectives such as reduction in stormwater volumes through infiltration can also be very important here, given the right applications and given reasonable permeabilities in the existing soils and avoidance of compaction problems during development. Furthermore, there are also variations on the Bioretention/Biofiltration theme itself, such as Prince George's County "rain garden" concept. These variations, although not exact fits of either the Swale or Filter Strip concept, nevertheless are quite similar in their overall functioning. With imagination the number of variations is almost limitless!

Also, it should be noted that although these Practices are defined and singled out, there is substantial overlap with the Minimum Disturbance/Maintenance approach. Obviously, the use of existing naturally vegetated areas at a site with a Vegetated Filter Strip of some sort is in fact predicated on not disturbing these particular vegetated zones. So in a sense any Vegetated Filter Strip concept is linked to Minimum Disturbance/Maintenance.

3.1 Vegetated Swales:

—Are vegetated swales with check dams being used?

In contrast to the tier of questions which has emerged for Preventive Approaches and which unfolds in a kind of sequence, the questions which relate to these mitigative Practices are less given to a particular sequence or order and must be addressed together in order to determine what to apply and where. Determine where **Vegetated Swales** can be incorporated into site design. What are the opportunities for existing Vegetated Swales? Can they be utilized for stormwater that will be generated? Can existing swales be enhanced in their performance with the addition of check dams and additional vegetation in order to effectively manage additional volumes of stormwater? Can new swales be created which will collect and convey increased stormwater? Can these new

swales be constructed in a broad and shallow configuration and then planted with vegetation that has maximum stem density in order to slow stormwater to the maximum and promote infiltration into the soil. Can check dams be used also to further slow flow rates and to maximize infiltration even as increased stormwater flows are conveyed?

Vegetated Swales do not perform well on steeply sloping sites, unless special provisions are made. Nor will Swales perform well in most cases if volumes of stormwater flow are large (i.e., swales can work nicely for residential applications, but are limited for higher density developments such as shopping centers where stormwater volumes are quite large). Specific engineering guidance is available for proper design of swales.

3.2 Vegetated Filter Strips:

—Are vegetated filter strips with level spreading devices being used?

Determine where vegetated filter strips can be used. Vegetated Filter Strips involve the collection of stormwater and direction into a level spreading device for distribution of collected stormwater onto some area of existing vegetation (level spreaders may not be necessary if topography is quite gentle and even). This vegetated area may take the form of a strip (such as the grassed filter strips which farmers use to separate cultivated fields). Or the vegetated area may be an irregularly shaped zone of existing woods or some other vegetation. The concept is probably most easily implemented in areas adjacent to group parking facilities, where runoff from a large relatively flat parking area drains to a level spreading device along the edge of the lot and then overflows evenly across some expanse of vegetation, ideally an existing wooded area (although a meadow or scrub vegetation can work as well). Or the concept can take the form of stormwater collected and even conveyed some distance to a riparian buffer area, distributed into a lineal level spreading device constructed parallel to the spine of the riparian corridor which then overflows evenly across the vegetated riparian buffer of some fixed width. Again the objective is certainly water quality protection, removal of nonpoint source pollutants accomplished through the physical and chemical and biological processes provided by the vegetation and soil. At the same time, Vegetated Filter Strips probably make infiltration and quantity reduction easier, than Vegetated Swales, for example. Filter Strips at least in theory should have more potential for infiltration than a swale, quite possibly serving to accommodate all required stormwater volumes, depending upon the proposed development.

3.3 Berms/Terraforming:

—Are berms and other terraforming techniques being used in conjunction with zones of natural vegetation?

Terraforming is a term loosely applied to any of several techniques such as use of berms, use of subtle depressions/negative drainage, and other practices to intercept and store stormwater. In these cases, both water quality and quantity are direct stormwater management objectives, with stormwater volume reduction actually able to be calculated. Important

here is that site soils be reasonably permeable and not heavily compacted during the construction process. Site slopes especially with berms should be moderate, with berms typically being placed along or parallel to the contour.

On the surface, Terraforming would appear to require soil clearing and disturbance and sometimes that is the case. At the same time this Practice can be used with other Approaches and Practices where disturbance is controlled carefully. The practice of berming can and should be used in conjunction with protecting existing vegetated zones such as wooded areas, where carefully developed berms of subtle height (2 feet) are threaded through wooded areas to provide the needed quantity control for the larger storm events. Here the objective is to minimize disruption of any type in the area behind the berm, so that infiltration rates are kept as high as possible.

On a small or micro scale, check dams placed in swales, as discussed above, can be thought of as a type of Terraforming. Along hilly roads, berms placed along the contours and integrated with fill placed for driveways may offer a mechanism whereby roadway runoff can be intercepted as driveways intersect the roadway lot by lot.

If lots are sufficiently large, lots also can be graded in subtle “saucer” fashion so as not to promote positive drainage and so as to retain stormwater volumes created lot by lot. Important here is to make sure that these depressions can be integrated into the overall site landscaping plan. As with any infiltration system, soil permeability must be sufficient. Also important here is to make sure that infiltrated stormwater is kept away from building foundations. If volumes provided by these depressions are basically reserved for the largest 100-year storm, then these depressions should not be frequently filled and should not interfere with lot usage. This approach should only be used where widespread clearance and disturbance is going to occur (i.e., if there is the chance that Minimum Disturbance/Maintenance can be employed, then a Terraforming Practice which involves extensive grading probably should be re-evaluated).

4.0 Use of Mitigative Best Management Practices That Are More Structural

If after all opportunities for use of the above approaches and practices have been investigated, stormwater quantities remain to be mitigated, then the following structural techniques can be used effectively. These different BMPs have different levels of success for different land uses as well as for different site conditions.

4.1 Recharge/Infiltration Devices:

—Are recharge-oriented structural devices, including infiltration trenches, basins, dutch drains, appropriate for the site?

Use infiltration devices if soil permeability is adequate. All types of infiltration devices, including porous pavement with recharge beds

(below), rely on soil permeability. To make infiltration devices work, soils typically should be rated as Hydrologic Soil Group C or better with drainage of at least 0.5 inches per hour (marginal soils with good undisturbed vegetation will infiltrate adequately). Devices should be designed to drain in 24 hours, lest anaerobic conditions develop.

Use infiltration devices if you can prevent soil compaction. Another critical factor is degree of soil disturbance, manipulation, and compaction occurring. Even reasonably good B soils, if heavily compacted during the construction process, will experience a tremendous loss in permeability which can last for extended periods (conversely, borderline C soils if covered with natural vegetation and reasonably well-devloped root systems can perform quite well in terms of permeability). Consequently care must be taken in order to prevent such compaction from occurring. A critical issue here relates to the soil layer which occurs at the base of the infiltration device. If exposing this base layer requires excavation, then the excavation process must be accomplished carefully, minimizing, if not preventing, heavy construction equipment from passing across the area. Related to this, detailed construction specifications should include necessary phasing/sequencing specifications, flagging, and any other requirements needed to enforce such provisions against compaction.

Use infiltration devices if you can maximize soil interface. Because infiltration occurs at the base of any particular device (it is true that in an infiltration trench or dutch drain, trench sides can also infiltrate). Infiltration will be facilitated if devices can be designed with broad and level infiltration bed bottoms, especially as the building program and extent of impervious area increases. It is critical that bed bottoms be level so that concentrated flows and channelization don't occur within the device. It is important to note that level bed bottoms does not mean that the site itself cannot be sloping, given the obvious ability to terrace properly constructed infiltration beds on slopes.

Use infiltration devices if pollutant loads are not expected to be great. Infiltration devices for proposed land uses which are pollutant intensive should be directed into an adequately designed filtration device prior to entering infiltration devices. Filtration devices include sand-peat filters, sand filters, multi-chamber catch basins, and so forth.

Design all infiltration devices so that general runoff from disturbed areas where sediment loads are great is not directed into the infiltration device or add adequate filtering devices.. Infiltration devices should receive runoff only from impervious areas. Sediment-laden runoff is apt to quickly clog the soil interface and prevent the infiltration device from functioning properly, if at all.

—Has the Porous Pavement over Infiltration Beds technique been used where appropriate?

An excellent stormwater solution ideally suited for group (congregate) parking areas is the combination of porous pavement placed on top of a stone-filled infiltration basin, all of which is paved over and then used for parking (i.e., cost effective multiple use). Note that the crushed stone can be replaced by prefabricated infiltrators of different types; selection is really a function of what seems to be most cost effective. Note that the paved surface doesn't have to be porous pavement, but can be conventionally paved with inlets into the infiltration bed below, although porous pavement is a more elegant solution. Use this approach where large parking areas are being created, such as office parks, institutional uses, possibly multi-family developments. Commercial uses and other more pollutant producing uses also can be adapted provided that filters of some sort are provided. All provisions defined for infiltration devices above should be respected. If porous pavement is used, use conventional pavement for service roads/ring roads, with roads draining into the infiltration beds. Roof drainage also should be directed into the infiltration beds. Infiltration beds can consist either of graded crushed stone, prefabricated infiltrators, other devices. Also, provide overflow inlets around parking area perimeter in order to provide an engineering redundancy in the case that the porous surface were ever to become clogged. Site design must be accomplished carefully so that runoff from non-impervious areas (i.e., general site runoff) is intercepted and kept from entering onto the porous pavement and/or infiltration bed in order to prevent clogging. This usually can be accomplished through careful attention to elevation of the porous surface/infiltration bed area together with use of intercepting swales and other techniques.

4.2 Water Quality Devices

—If infiltration has been deemed to be infeasible, has maximum reliance on water quality devices been made?

In those cases where infiltration is not practical (i.e., where soils have extremely poor permeability, where water table is high, and so forth), a various practices are available to remove nonpoint source pollutants. Keep in mind that these practices are designed to discharge stormwater quantities generated to receiving streams or other waterbodies. The BMPs are extremely variable in terms of their pollutant removal effectiveness.

Water quality devices consist of BMPs which function primarily to remove nonpoint source pollutants entrained in stormwater before this stormwater is discharged into a receiving waterbody. Practices include wet ponds (retention basins) where a permanent pool of water is maintained even in nonstorm periods. A variation on the wet pond practice is the constructed wetland, where wetland vegetation is added to the permanent pond in order to achieve greater pollutant removal potential. Extended detention basins also are sometimes offered as a water quality BMP, although their pollutant removal performance is questionable.

Note that site conditions are an important factor in determining if wet ponds and constructed wetlands can be workable solutions. Critical here is that the wet pond be able to function as a healthy wet pond system—as a viable ecosystem if its pollutant removal potential is to be achieved. All those factors relevant to successful pond development must be present. There must be, for example, an adequate water feed to maintain the permanent pool even in non-storm periods.

Constructed wetlands are even more challenging to make happen. Again, presence of the proper hydrologic conditions is essential. In most cases constructed wetlands, like natural wetlands, must be located in low and wet places, so that the wetland species being planted will be able to exist throughout the year. Design of the constructed wetlands must take into account species needs.

Multi-chamber catch basins and inlets of various designs are another option, particularly in high intensity developments such as malls and retail uses where pollutant loadings are expected to be high. Similarly, filters of different types, including sand filters and sand-peat filters, are gaining popularity, typically receiving parking lot runoff as well. These latter types of BMPS are costly to construct and maintain, yet they do offer the advantage that they can be periodically cleaned out and maintained. They are effective in removing particulate-form pollutants, though are far less successful if the pollutants are solubilized. Oftentimes percent removal is not as high as other BMPs; on the other hand, given the types of developments in which they are applied, there are not many alternatives.

Also, extended detention basins are a third variation, where stormwater is stored in the basin for longer periods of time in order to promote settling out of pollutants; extended detention basins are, however, considerably less effective in terms of pollutant removal than the wet pond and constructed wetland practices.

Different types of water quality inlets and catch basins have been used for some time, although these practices tend to be rated as having mediocre performance. Furthermore they are expensive to construct and expensive to maintain.

4.3 Peak rate devices

There are situations where, after applying appropriate approaches and practices as discussed above, additional management for peak rate control is required. In these cases devices provided detention volume are necessary.

5.0 The Conceptual Stormwater Management Plan:

Comprehensive Stormwater Management should be the very beginning of the Site Analysis process and then continues to evolve with constant iterations—back-and-forth testing of

different Approaches and Practices in order to develop the concepts which fit the site and fit the proposed development to the maximum extent.

—Can all preventive approaches and mitigative practices be integrated into an optimal Comprehensive Stormwater Management plan, maximizing both prevention and mitigation?

A Conceptual Stormwater Management Plan emerges (see beginning figure) as the result of this process. If the process of questioning has been honestly and rigorously followed and if the design engineers are familiar with Comprehensive Stormwater Management concepts, then a successful, hopefully close-to-optimal Comprehensive Stormwater Management plan should result, reflecting iterative testing of different approaches and practices. In many cases, different designers and engineers will produce different plans, which is to say that no one combination of approaches and practices is necessarily going to result.

—What other benefits are achieved through Comprehensive Stormwater Management (i.e., open space, enhanced marketability, cost reduction, habitat protection, stream water temperature, biota impacts, other stream impacts)?

Comprehensive Stormwater Management produces multiple benefits, including in many cases substantial reduction in costs. Nevertheless, the procedure is difficult to legislate directly and so must be reinforced with as many incentives as possible. From the developer's perspective, the Comprehensive Stormwater Management plan must be perceived to be favorable market-wise—more "green," more open space, better aesthetics—all translate into value for the developer. Additionally, of course there are a host of positive environmental features related to Comprehensive Stormwater Management which are important, although developers tend to be less motivated by such intangibles. To the extent that Comprehensive Stormwater Management actually saves developers money, that's undoubtedly the greatest incentive for its use. Additionally, this Ordinance provides incentives to promote Comprehensive Stormwater Management use.

6.0 Stormwater Calculations:

How does Comprehensive Stormwater Management affect stormwater calculations?

—How has impervious cover been reduced? What are the implications for Curve Numbers? How have total runoff volumes been affected? Has time of concentration been maximized? How has peak discharge rate been affected? How has recharge volume been affected?

This last Step in the procedure actually should appear both within the Conceptual Stormwater Management Plan box as well as after the Plan has been developed. In a sense, this calculation process has been occurring during the Conceptual Stormwater Management Plan formulation process from the start. Locating and sizing mitigative

practices ranging from berms to swales is grounded on such calculations.

Current regulations state that the peak runoff rate for the design storm (the 100 year storm) cannot increase pre to post development. The Comprehensive Stormwater Management Approaches and Practices are located and sized to meet these criteria.

Comprehensive Stormwater Management strives to achieve two basic goals:

- **minimize the Curve Number increase, pre to post development**
- **maintain and/or extend the predevelopment Time of Concentration within a site**

When these goals are achieved, Comprehensive Stormwater Management—when contrasted with conventional design—typically produces significantly reduced impervious cover with significantly lowered Curve Numbers and reduced total runoff volumes. Furthermore, because time of concentration of stormwater flow is extended (i.e., not reduced to the extent that it is with conventional design), peak discharge rates are not increased to the same extent as with conventional development. All of these results are benefits to the developer and translate into a lesser degree of management requirement at a lesser cost for the developer. In this sense, the use of Comprehensive Stormwater Management is self-perpetuating or rewarding.

In some instances, the application of the Curve Number Method and TR-55 runoff calculations is straightforward and resembles the steps used for a conventional site plan. However, in many other cases, the application is not as standard. Comprehensive Stormwater Management advocates alternative methods for the prevention and mitigation of stormwater runoff which often do not easily fit into the standard formulas and calculations. For example, Comprehensive Stormwater Management advocates treating stormwater as close to the source as possible. As a result, stormwater is managed in many smaller areas rather than concentrated in large areas such as detention basins. Evaluating these designs using TR-55 requires that the site be divided into numerous subareas — a separate subarea for each retention area. This often increases the complexity and number of computations. However, the money potentially saved by using the methods of Comprehensive Stormwater Management can outweigh the increased time and money spent during the computation phase.

Another problem is that many of these alternatives are designed to infiltrate stormwater. Because TR-55 does not fully account for this infiltration, the calculations performed for the case studies using these

techniques are conservative. The actual amount of stormwater generated on a site and the peak rates at the discharge point may be below the given figures. For example, stormwater level spread into a bermed area on good soils will significantly infiltrate. The current methodology has no way of accounting for this. TR-55 is more easily applied to sites with detention basins than it is to sites utilizing the Approaches and Practices advocated by this manual. However, until more accurate and flexible runoff models are designed and/or incorporated into regulations, the NRCS TR-55 runoff method will be used.

—Curve Number:

The Curve Number (NRCS method) is critical in determining how much runoff will occur from any given site. By minimizing the Curve Number (CN), runoff will be minimized. Curve Numbers are affected by both the Hydrologic Soil Group (A, B, C, or D) and the land cover type and condition (e.g., straight row crops with little residue, forest in good condition, open space/lawn). Development increases the CN by changing site conditions (i.e., compacting the soil and clearing the land) and most importantly by adding impervious surfaces. Many of the Comprehensive Stormwater Management Approaches and Practices discussed have the specific aim of reducing the Curve Number, and keeping it as close to the predevelopment number as possible. This is accomplished by reducing site imperviousness and site disturbance. These measures can considerably reduce the amount of runoff generated and thus reduce the mitigative/storage/detention need.

Techniques such as clustering and reduction in setbacks, road widths and driveway lengths can significantly reduce the amount of site imperviousness. Impervious surfaces have a very high CN (98) and generate a significant amount of runoff. Minimizing these areas helps keep the overall site Curve Number closer to the predevelopment condition. To take advantage of the reduction in imperviousness that occurs as a result of Comprehensive Stormwater Management, it is necessary to separate these surfaces when calculating the weighted Curve Number for a site. The assumptions used by NRCS in generating Curve Numbers and impervious percentages for developed areas may no longer hold true. For example, NRCS assumes 25 percent impervious coverage for 1/2 acre residential districts. If the building plan is altered or the setback and driveway length reduced, the impervious coverage may be less than 25 percent. For this reason, new categories (and new weighted Curve Numbers) must be generated based on the new conditions, or the amount of impervious surface for a site must be measured separately to get the most TR-55 benefit from Comprehensive Stormwater Management.

Site disturbance affects stormwater runoff as well. Some experts recommend that the Hydrologic Soil Group for all soils in disturbed areas should be lowered one category to reflect the compaction that occurs

during disturbance (e.g., an A soil becomes a B soil when disturbed). This practice would increase the Curve Number even if the land cover does not change (which it usually does in disturbed areas). Comprehensive Stormwater Management advocates minimizing these disturbed areas by setting strict limits of disturbance both for the entire site and on individual lots. Clustering lots, providing as much open space as possible, and retaining as much of the original site vegetation as possible, especially if woodlands and meadows are present, all significantly help reduce the impact of disturbance on any given site. When areas are left undisturbed with the original vegetation in place, Curve Numbers will invariably more closely approach the predevelopment condition.

Curve Numbers can also be reduced by re-forestation/re-vegetation. Open space areas and even portions of individual lots may be re-forested or re-vegetated as part of the site landscaping plan to both reduce the amount of stormwater generated and help mitigate the runoff that is created. Although it may take considerable time for re-forested areas to actually become forests, they will still provide stormwater reduction especially if care is taken to plant a hearty ground cover. In the case studies, any areas that were reforested were assigned the Curve Number associated with a poor woods land cover condition for all calculations. In some cases this may be a conservative approach depending on the size of the trees planted and the ground cover condition. If a thick ground cover exists or is allowed to develop quickly (such as a meadow condition), the actual Curve Number can be expected to be lower than that for poor woods.

Comprehensive Stormwater Management Approaches have the most significant impact on Curve Numbers. This is one of the main reasons stormwater calculations must be considered throughout the entire planning process. Decisions made early in the site planning process have significant effects on the final site Curve Number and thus the amount of stormwater generated.

—Time of Concentration:

The time of concentration relates directly to the peak stormflow rate. Many factors affect the time it takes water to move through a site to a point of discharge including the initial amount of water (determined by the Curve Number), routing of the stormwater, and the surface the water passes over (grass, meadow, woods, concrete). All of these factors are important considerations in the Procedure.

As discussed above, keeping the Curve Number as close to the predevelopment value as possible significantly aids in reducing the amount of stormwater generated. The less stormwater generated, the less need for mitigation.

The stormwater that is generated, however, must be routed through the site to avoid flooding roads, houses and other important features. The longer the route, the longer the time it takes water to reach a discharge point. Conventional development plans often shorten the water routes through a site with piping and curb and gutter systems. Shortening the route increases the peak discharge. In Comprehensive Stormwater Management these routes are kept as long as possible attempting to reflect the predevelopment flow paths. A longer path often will lower the peak rate of discharge.

Just as important as the route the water takes is the surface over which it flows. Vegetated surfaces slow water and may also infiltrate water and have water quality benefits, if designed properly. This is especially true during the smaller, most frequently occurring storms (such as the one year or less storms). The use of vegetated swales rather than paved channels can significantly increase the time of concentration, by both elongating the route and increasing the resistance of the surface (in channel flow this equates to increasing Manning's "n" value). Comprehensive Stormwater Management Practices such as swales, berms and filter strips can be used to increase the time of concentration for particular flow paths and thus reduce the overall site peak rates of discharge for given design storms.

Curve numbers and time of concentration are the two major factors in determining the peak rate of discharge from a site and thus compliance of a site plan with current regulation. The above discussion addresses the ways in which Comprehensive Stormwater Management Approaches and Practices can be used to meet the criteria. However, these calculations do not fully reflect all the environmental and ecological benefits provided by Comprehensive Stormwater Management. These benefits need to be considered in the greater context of regional planning and the effects of development on the watershed and the ecosystem. To fully understand and fully quantify all the benefits achieved in using Comprehensive Stormwater Management, better methods of stormwater runoff calculation are needed.

7.0 Selection of Additional Stormwater Controls:

—If Comprehensive Stormwater Management Has Not Fully Met All Stormwater Requirements, What Additional Requirements Must Be Provided to Manage Any Residual Stormwater Needs such as Peak Rate for Larger Storms <u>not</u> Mitigated by Comprehensive Stormwater Management?

This final Step (see figure) in the Comprehensive Stormwater Management procedure in the ideal should not be necessary. In most cases, the goal is to make any sort of conventional structure unnecessary, although this might not be feasible in all cases. In most cases, the unmet management need will focus on satisfying peak rate control requirements for the storms up to the 100-year, such that some

sort of detention facility would be necessary. However, these facilities will most likely be significantly smaller than with a conventional design and thus require less maintenance and land area. Certainly an option would be to go back and make infiltration devices larger, whatever they might be.

APPENDIX D

Draft Upper and Middle Neshaminy Creek River Conservation Plan

Response to Comments

Appendix D
Response Document - Public Comments Received for "Upper and Middle Neshaminy Creek Watershed Draft River Conservation Plan"

The Upper and Middle Neshaminy Draft RCP was released for public review on July 11, 2002. Copies of the Draft Plan were distributed to all study area municipalities, non-profit and community organizations, state and local agencies, public libraries and individual members of the public. There was a 30-day public comment period in accordance with DCNR guidelines.

Approximately 150 individual comments were received from various organizations, agencies and members of the public. These comments varied from simple typographical errors to detailed questions and comments about technical content. Every comment received was addressed by the RCP authors in the Final RCP or in this response document. If a comment was not addressed directly within the text of the Final RCP, a response to that comment is listed within this Appendix. The following is a list of individuals that submitted comments:

Terry Hough, DCNR
Terri Bentley, BCPC
Jessica Sanchez, DRBC
Rich Myers, NWA
Joe Miketta, HLA
Sean Greene, Heritage Conservancy
Ed Fell, NAABC
Art Friedman, Northampton Twp.
Susan Gross, Stakeholder
Beth Oughton Taylor, Stakeholder
Members of DRN Staff

In addition to the comments regarding the Draft Plan, many organizations and watershed stakeholders contributed to the Plan by recommending implementation projects that fit within the Plan Framework. A total of 97 projects were recommended by various organizations throughout the Middle and Upper Neshaminy Creek Watershed. Organization types included Municipalities, Non-profit Groups, Private Landowners and Community and Environmental Organizations. The following is a list of organizations that contributed project ideas.

Buckingham Township
Buckingham Civic Association (BCA)
Bucks County Conservation District (BCCD)
Bucks County Planning Commission (BCPC)
Central Bucks YMCA (YMCA)
Doylestown Hospital (DH)
Hatfield Borough
Hatfield Township

Hilltown Landowners Association (HLA)
Hilltown Township
Montgomery Township
Native American Alliance of Bucks County (NAABC)
Neshaminy Watershed Association (NWA)
New Britain Township
Newtown Borough
Newtown Township
Northampton Township
Peace Valley Nature Center (PVNC)
Pennswood Village Community (PVC)
Pine Run Watershed Initiative (PRWI)
Plumstead Township
Warrington Township
Warwick Township
Wrightstown Township

Comment Responses:
These comments and responses reflect only those comments that were not directly addressed within the Final RCP text. The comments are broken out by the Document Section to which they pertain. A response for each bulleted comment is given in a sub-bullet beneath it.

Section 1 – Introduction & Background

- Figure 1-2 would benefit from a gray-tone overlay of the area previously covered by an RCP.
    - Figure 1-3 shows the area previously covered by an RCP. The intention of Figure 1-2 is to show the location of the Upper and Middle Neshaminy in relation to the Greater Neshaminy Watershed
- **The public participation process developed for this Neshaminy Creek Watershed Plan has included a series of public meetings (evening) strategically located within the Watershed...** Representatives from the DRN did indeed meet with some local groups to discuss this RCP, including a meeting with the Hilltown Landowners Association (HLA) during the summer of 2001. However, the only input actively solicited during that particular meeting were project ideas for the watershed once money was obtained from the DCNR after the RCP was completed. While some of those suggestions have been included in the back of this draft RCP, none of the substantial comments and concerns raised by the HLA (over the objections of the DRN representatives) were incorporated as part of this report (buffer zone concerns, property rights, recognition of property owners who have been taking proper care of their part of the watershed, etc). These are real concerns for at least some watershed residents.
    - Concerns that were raised by some members of the HLA were addressed in the body of the Plan by providing adequate rationale for protecting the Creek through the employment of riparian buffers and other best management practices.
- Page 1-8, **DRN is committed to preparing a River Conservation Plan for the Upper and Middle Neshaminy Creek that provides a vision for the restoration and protection of the Upper and Middle Neshaminy Creek Watershed, one that considers all residents**

and interest groups, all neighborhoods, and all municipalities. As such this plan must be actualized through the cooperative efforts of the many diverse stakeholders in this Neshaminy Creek Watershed. In a watershed where resources are so often rigorously competed for, this cooperative vision is no simple matter. These are interesting words, but a look at the makeup of the steering committee on page 1-9 reveals a list of folks who have previous working relationships with the DRN, and/or who share the sometimes parochial views of the DRN. The Neshaminy Creek Watershed belongs to a myriad of stakeholders who have legitimate interests in its resources. What process was utilized to pick the steering committee members, and what efforts were undertaken to ensure that major stakeholders were somehow represented? How does someone go about being selected to serve on RCP advisory committees? Does DCNR have any procedures or guidelines in place to ensure RCP steering committee members are chosen so that State policies concerning diversity and non-discrimination are properly adhered to? The lack of diverse ideas sometimes can mean the difference between a good report, and a really great report.

- The steering committee was formed by Delaware Riverkeeper Network in an attempt to represent a variety of perspectives: Mike Coia, scientist and environmental remediation expert; Jeff Featherstone, senior planning expert from regional governmental agency; Ed Fell, representative of the area's very active Native American community; John Fowler, hydrogeologist and municipal Planning Board member who represents the municipality who first supported the formation of a Plan; Bernice Graeter-Reardon, historic expert and historic commission member referred by Bucks County Community College professor; Phil Margolis, local businessman, owner of wholesale food distributor; Rich Myers, watershed group activist; Betty Snyder and Ray Stepnoski, township supervisors. We also solicited technical advice from the Bucks County Planning Commission, township elected officials, writers and media experts. In addition, we had very strong input from the municipalities involved in the Plan, from various nonprofit and citizen groups and from individual members of the public, which further broadened input into the Plan and provided many valuable ideas. The result, we feel, is an excellent Plan.
- We appreciate all comments we received. However, we put together a Plan that is meant to protect and enhance the creek and its watershed, to encourage people to enjoy the creek's resources, and to expand appreciation of what the creek has to offer to the community. If sometimes this may seem to place more value on natural resources than on private rights, it may be because the overall goal of the Plan is aimed at river conservation. We do not feel there is an inherent contradiction in these interests and have attempted to craft a Plan that respects all.

Section 2 – Population & Land Use

- Table 2-8. Comparison of median household income to median housing costs could add some depth to the analysis.
  - Prefer not to go into greater detail here. This section is already very detailed and additional information may complicate the text without providing a great deal of information pertinent to the RCP Framework.
- P.2-29, The final sentence, misuses the term "reality" and states a condition that has not been established by citation or reference.

  - This statement, "..given the reality that virtually the entirety of the watershed was forested at some point many years ago in its predisturbance condition…", has been reported in various historical and planning documents and the planning team assumes this is common knowledge.
- P. 2-30, para. 1, Final sentence states a condition not represented by data. Why not relate the land use to employment categories?
  - This statement, "The land use category itself does not distinguish by type of industry, but clearly the bulk of this activity is light industrial in nature, often taking the form of high tech office parks in many cases" is based on 2001 Land Use data sheets provided by the Delaware Valley Regional Planning Commission.
- P. 2-34, Public & private ownership. Is there a citation that substantiates or recommends an acreage/person or per watershed for land in private conservation ownership?
  - No, there were no data sources found that provide this information.
- P. 2-35, para. 2, The result of the existing municipal code in PA is not "chaos". The result may be a duplication and the potential for the inappropriate use of landscapes – or the placement of inappropriate uses on landscapes. This statement also gives too little attention to the positive effect of regional planning agencies such as DVRPC, and the potential that the code presents for multi-municipal planning.
  - Changed the word, "chaotic," although there does appear to be basis for concluding that "the end result can be chaotic" as stated. Recent revisions to the MPC allow for better coordinated planning through the multi-municipal planning option. Application of the multi-municipal planning option in the study area would potentially remove the requirement that all municipalities provide for all land uses, municipality by municipality, regardless of their regional and watershed location, and therefore would allow for a better coordinated land use pattern and progression of uses.
- Have you included dumpsites that are within the study area but are not included on the Superfund or Toxic Release Inventory?
  - There are no regulated dumpsites (landfills, construction/demolition waste landfills, or waste-to-energy facilities) within the study area according to PA DEP. There are two sites outside the study area in the Lower Neshaminy Watershed.
- P. 2-26, Was any thought given to include the location of airports in Figure 2-2?
  - This information is not necessary to meet DCNR requirements and Plan resources do not allow for inclusion of this information.
- P. 2-32, **Because of the way in which stormwater had been managed (or mismanaged) in the vast bulk of the watershed for the vast bulk of this impervious cover, this imperviousness has translated into increased stormwater discharge of 14,650,529,793 gallons per year (539,552 ac-in), which in turn translates into a reduction in infiltration of 14,650,529,793 gallons with a related reduction in groundwater recharge of 4,529,577,307 gallons (166,816 ac-in).** To put all these numbers in perspective, it might be very helpful to the reader to compare them here with the amount of runoff (gallons per year) that would occur naturally in the watershed (7.5 inches according to Page 4-73 vs. 1.98 inches of increased runoff), or how much total infiltration occurs naturally in the watershed (15 inches according to Figure 4-9). Also, no mention is made anywhere in this RCP about the typically shallow depth to bedrock common throughout the study area. Even in areas where infiltration has not been curtailed by man-made impervious areas, water percolates down only to the first

layer of bedrock, in some cases just a foot or so deep. Some of this water percolates into the deeper aquifer system through faults, etc, but a lot of it runs laterally toward the nearest stream along the bedrock (interflow). This is readily seen on streamflow hydrographs from several gages in or near the watershed study area. These shallow soils could be a primary reason why the Neshaminy and Perkiomen Creeks are so prone to flash flooding, even before urban sprawl became an issue. It could very well be that the Neshaminy Creek Watershed, even in a natural state, is not efficient in converting precipitation into groundwater recharge. More elaboration on this topic would be helpful.

  - The average amount of runoff that would occur naturally in the watershed is stated in Table 2-11, but that statistic is more complex than any single value, differing by year and location within the basin. A more representative base flow value as a basin average is on the order of 12 inches, but previous research (CA, 1986) indicates a significant variability with wet and dry years. The more important constant in the Neshaminy watershed is the ration of immediate runoff to base flow, which does remain relatively constant, regardless of the total rainfall. The ratio is somewhat higher than other similar size watersheds in the Piedmont, and reflects the complex aquifer system created by the Triassic formations that are situated beneath much of the upper watershed.
  - The soils that have weathered from these formations vary greatly in depth and permeability, from the Lockatong argillite to the Stockton sandstone. It is true that shallow soils are characteristic of the Lockatong (and even more so the igneous intrusions such as Buckingham ridge), but the shales and sandstones do allow the infiltration estimated as base flow in the water balance illustration. Where the soil mantle is thin and the bedrock shallow and dense, infiltrating rainfall will move down-gradient in the unsaturated zone, but that dynamic is not well defined in any of the hydrographic data for the Langhorne gage, which tends to mask local variations in hydrologic response. The long term flow record for the watershed does not suggest that more rapid "interflow" movement of rainfall in the soil mantle is responsible for historic flooding, and in fact the hydrograph simulations performed during previous modeling efforts indicate a relatively slow response during major events.

- P. 2-38, The section titled "Critical Areas of the Watershed" refers mainly to documented Superfund sites and Toxic Release Inventory sites in the Study area. However, there are many non-documented dump sites scattered throughout the study area. The location of some of these sites are known to the municipalities (at least three exist in the West Branch drainage). These dump sites could be producing harmful drainage into the ground and surface water supplies. Was any attempt made to identify these sites in this RCP?
  - There is no agency tracking these sites and so there is no source of information that is documented and proven. See comment regarding landfills above.

Section 3 – Earth Resources

- Page 3-49, Figure 3-5, To put the Hillshade image into perspective, perhaps it might be beneficial to identify the actual elevation (MSL) of some of the hills by placing actual numbers on the figure in a color that won't overwhelm it.
  - Acknowledge the point, but the idea of this map is to simply convey the general relief of the watershed, not to examine actual elevations.

Section 4 – Water Resources

- In the last sentence of the first paragraph of Page 4-60, it is not clear why mapping of historical first order streams would show more channels. The increased runoff from development may increase the number of channels.
    - Often, it is the small headwater streams that are easily encroached upon by development. When historic maps are compared with current maps, it is often observed that there is a loss of small headwater streams. Typically in developed watersheds, it is found that many have been piped and buried to make way for homes, businesses and roads.
- In the second paragraph of Page 4-69, a reduction in evaporation could occur simultaneously with a reduction in infiltration, reducing the impact on the ground water reservoir.
    - If the reduction in infiltration is the result of new impervious cover, it most certainly will also result in a reduction in ET, because the surface vegetation will have been removed. It also will result in a reduction in base flow, as infiltration deep into the soil mantle and aquifer is reduced.
- With reference to the analysis in the second paragraph of page 4-70, it has not been demonstrated anywhere in the Neshaminy or Delaware River Basins that observed ground water levels have been impacted by impervious cover. USGS studies on Long Island have shown that sanitary and storm sewers intercept ground water and impact ground water recharge.
    - There are many references that have found a direct correlation between increased impervious surfaces and reduced groundwater levels. Citations have been added to clarify this point.
- The first sentence in the second paragraph of Page 4-73 is not correct. When rainfall occurs on any landscape, precipitation is intercepted by the land cover or soaks into the soil until the rate of precipitation exceeds the rate of infiltration, at which time surface runoff begins. This is true for all land surfaces. The key to better stormwater management is to promote as much interception and infiltration as possible.
    - The point of the paragraph is that most rainfall initially infiltrates the vegetated land surface, with a significant amount returned from the upper soil mantle by the vegetation through transpiration. Evaporation also takes place from biomass surfaces and surface depressions, in highly variable rates. A relatively small fraction (+/- 20%) actually occurs on saturated surfaces, producing direct runoff. Sustaining the natural processes by retaining vegetation and providing infiltration opportunities is certainly the best stormwater management.
- In Figure 4-12, again, there have not been documented observations that increases in impervious surfaces in the Neshaminy Basin have impacted ground water levels.
    - See comment above regarding impervious surfaces and groundwater levels.
- In the last paragraph of Page 4-63, what aspects of FEMA's minimum floodplain standards as they affect location of structures in the floodplain were made more rigorous in the mid-90's?
    - A variety of specific provisions, mostly procedural, were modified in the mid-90's, in an effort to make the FEMA flood insurance program more effective; these modifications required member municipalities to change their respective municipal floodplain

management programs as well. In most cases, these changes were not environmentally-oriented, but focused on other aspects of the program.

- P. 4-66, The first paragraph on this page contains the sentence; "In any case, a cursory review of the municipal ordinances requested from and made available by the municipalities for this RCP indicates that most municipalities have not gone beyond FEMA minimum requirements, although they are constitutionally enable to enact more rigorous floodplain and riparian zone controls." This information is misleading and appears to imply that municipalities have not been interested in attempting stronger protection of floodplain areas. Municipalities that have tried to enact floodplain regulations, to prevent floodplain development, have been uniformly defeated in this effort. The sentence should be modified or deleted.
    - Sentence has been modified slightly. The commenter should provide specific instances/ cases (legal and other) of municipalities being legally defeated in their attempt to make floodplain management more rigorous. In order to protect the health safety and general welfare of residents, municipalities have the right, if not the responsibility, to properly manage highly sensitive environmental zones such as floodplains (as well as wetlands and a host of other environmental values). To protect the health, safety and general welfare, floodplains should be kept undisturbed and uncompacted and naturally vegetated in order to maximize their multiple environmental benefits, including flood reduction and maintenance of water quality. Effective floodplain management ordinances can be made flexible, avoiding legal "takings" challenges through addition of waivers. Additionally, floodplain zones can be defined as "sending zones" in transfer of development rights programs, further guarding against legal takings" challenges.
- P. 4-73, Under the heading Stormwater and the Groundwater Reservoir/Stream Baseflow on this page, text is provided that describes how rainfall in natural conditions affects the landscape as, "When rainfall occurs on a natural landscape, most of the incident precipitation soaks into the soil mantle. Only 7 or 8 inches actually runs from the surface in a given year. Evaporations can occur from depression storage, consisting of small 'nooks and crannies' that cover the natural surface." Is this statement, "most of the incident precipitation soaks into the soil mantle," accurate? The water balance table shows a fairly significant portion of precipitation is captured by vegetation, therefore a good segment is evaporated back into the atmosphere and captured in the biosystem, not soaking in the soil mantle. Does vegetation create more infiltration or transpiration?
    - The text following the statement above clearly states that the larger amount of precipitation that soaks into the soil mantle is taken up by vegetation and used during evapotranspiration. A much smaller portion of the rainfall that soaks into the soil mantle actually recharges the groundwater aquifer.
- P. 4-89, Table 4-3 indicates that significant pollution from municipal point sources are impairing the tributaries of Cook's Run, the Lower Neshaminy Creek, and the West Branch Neshaminy Creek. Are these sources in violation of permit DEP discharge allowances? It also refers to surface mining?
    - According to the PA DEP, a stream segment not meeting its attained use due to a point source would not be listed on the 303(d) list, if this condition was caused by a permit violation. There was no detailed information regarding specific mining operations that

caused impairment, however there are several quarries in the watershed that may be impacting the stream system.

- Page 4-58, In Figure 4-58, was any thought given to include the location of levee systems which were built on various tributaries of the Neshaminy system? Perhaps another figure could be added to avoid clutter.
    - This information is not tracked by any agency and is not required by DCNR.
- Page 4-72, **In southeastern PA, average annual precipitation does vary to some extent from location to location, but long-term rain gauge data generally indicates average annual precipitation to be about 45 inches.** 45 inches is very good estimate. Actually, the best estimate of average annual precipitation in the study area is 45.17 inches (National Weather Service, 50 year average). This estimate does not include the rain gauge at Neshaminy Falls, which is outside the study area, and where average annual precipitation estimates are skewed by the "fall-line" effect. Was any thought given to include an isohyetal map of average annual precipitation over Pennsylvania, New Jersey, and Delaware just to give the reader some perspective of how precipitation varies in and around the study area? Also, perhaps some mention of average annual snowfall should be mentioned, and the benefits of snow to the hydrologic cycle.
    - Showing an isohyetal map of average annual precipitation in Pennsylvania may be of interest to some readers, and is illustrated in several references and publications. It is not included in the final RCP document because we did not wish to write a detailed hydrology report, but rather a planning guide to land management that will restore and sustain water resources. For the same reason, the annual snowfall is included in average annual precipitation, without a detailed discussion of moisture storage and seasonal variability.
- Page 4-78 and Figure 4-15, **Real-world examples of such development show that even if detention basins are employed to only limit the peak rate of runoff, flooding has worsened nonetheless.** Some examples would be very helpful in illustrating this concept. A bit of interesting information: Although the impervious area in the watershed may have increased during the past 20 years, the unit hydrograph for the Neshaminy Creek at Langhorne (just outside the study area) shows only a minute increase in peak discharge over the same 20 year period. This would seem to suggest that the statement above is false. Since Figure 4-15 and the above statement provide a foundation for recommendations later in the RCP, this discrepancy should be investigated and resolved. Also, why not use a real hydrograph from the Neshaminy system to illustrate this point rather than a hypothetical one?
    - The best current example of the overall watershed impact of multiple detention basins is Valley Creek in Chester County, where the increasing impervious cover has not been mitigated by almost two hundred detention basins built during the past twenty-five years in the small (23 SM) watershed. Previous research in the hydrology of the Neshaminy Creek (CA, 1986) indicates a great deal of variability in unit hydrographs among and between sub-basins, suggesting that the impact of development must be evaluated on a smaller scale than the gage at the bottom of the basin. This data, however, has not been analyzed thus far. Again, this report was never intended to be a hydrologic research paper, but rather a land management guide to local government. A study is not required, however, to confirm that impervious surfaces turn all rainfall into immediate and direct runoff.

- Page 4-80, **If we eliminate runoff quantitatively, erosion by definition will be eliminated. Once in the stream, increased volumes and rates of runoff mean streambank erosion, undercutting, flattening and straightening of the channel, re-suspension of sediment, all of which become serious quality problems.** Runoff will never be eliminated quantitatively. Perhaps a better way to say this would be as follows: "If we reduce runoff quantitatively, erosion by definition will be reduced." Erosion occurs naturally in the stream channel, with or without human activity, as a result of basin response to varying amounts of precipitation. The Creek itself was formed by erosion. Ice is another erosive agent...some readers might remember the winter of 1994. Perhaps man shouldn't be blamed for *every* problem. Perhaps this sentence could be re-written to more realistically access the situation.
    - Sentence suggestion was used and has been changed in the report. Although erosion occurs naturally in the stream, the intensity and frequency of erosion has been exacerbated by increased runoff in this watershed. For example, in the Pine Run Sub-watershed, first order streams have been observed with 6'-8' under cut and eroded banks. This is a direct result of increased runoff that is conveyed to the stream from a detention basin which controls stormwater runoff from a single family development adjacent to the stream. This condition is typical in streams that receive increased runoff volumes from development.

Section 6 – Recreational and Cultural Resources

- **Unfortunately, European settlement disrupted this peoples' way of life and the Lenape people were forced to move northward and westward as more and more Europeans arrived in the region**. Weren't many Lenape killed by diseases after exposure to Europeans? The Lenape faced many hardships from European settlement, and we need to paint the picture as accurately as possible. Hopefully the Native American Alliance of Bucks County can make sure the correct information gets in the final version of this RCP.
    - Plan authors did not find any factual source of information to support this notion.