Pennsylvania Coastal Zone Management Program
FINAL REPORT

"Little Neshaminy Creek River Conservation Plan"
Final Report
September 2007

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The views expressed herein are those of the author(s) and do not necessarily reflect those of the U.S. Department of Commerce, NOAA, the PA DEP nor any of their sub-agencies.

Magidson Property – Forks of the Neshaminy

Little Neshaminy Creek River Conservation Plan

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The following individuals and organizations have contributed to the completion of this plan. We would like to thank all of them for their time and expertise

Steering Committee

Fred Achenbach, Warrington Water and Sewer Authority
Terri Bentley – Bucks County Planning Commission
Tina Boor, Manager – Horsham Water and Sewer Authority
John Carbone - Montgomery Township Environmental Advisory Council
Larry Comunale - Manager – Lower Gwynedd Township
Karen Czarny – Hatboro-Horsham School District*
Arthur Friedman - Northampton Township Environmental Advisory Council
Annette Glemser – Horsham Water and Sewer Authority
Susan Harris – Montgomery County Conservation District
Katrina Harding – Warwick Township
William Heil - Environmental Specialist – Naval Air Station, Joint Reserve Base Willow Grove
Stuart Hughes – Park Creek Watershed Association
Craig Marleton – Aqua Pennsylvania
Richard Myers, President – Neshaminy Watershed Association
Carl Meixsell – Park Creek Watershed Association
Ed Molesky, President – Aqua-link, Inc.
Marc Newell – Horsham Township Environmental Advisory Board
William Pav – Park Creek Watershed Association
Charles Ritter, Mayor – Ivyland Borough
Stanley Ropski – Upper Dublin Township Environmental Advisory Board
Gretchen Schatschneider – Bucks County Conservation District
J. Drew Shaw, Section Chief: Environmental Planning – Montgomery County Planning Commission
Fred Suffian – Warrington Environmental Advisory Council
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The views expressed herein are those of the author(s) and do not necessarily reflect those of the U.S. Department of Commerce, NOAA, the PA DEP nor any of their sub-agencies.

Heritage Conservancy Project Team

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I. River Conservation Plans

The Pennsylvania Rivers Conservation Program was developed to conserve and enhance river resources through preparation and accomplishment of locally initiated plans. The program, funded through the Community Conservation Partnership Program of the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) provides technical and financial assistance to municipalities and river support groups to carry out planning, implementation, acquisition and development activities.

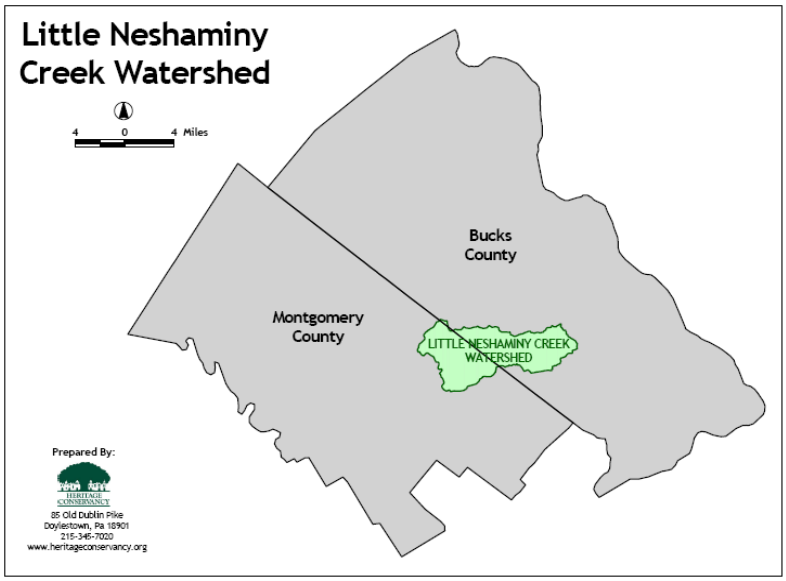
A River Conservation Plan (RCP) identifies significant natural, recreational and cultural resources. Issues, concerns and threats to river resources and values are determined locally as part of planning, as well as recommended methods to conserve, enhance and restore Pennsylvania's many streams and rivers. Aspects of the RCP are the implementation, development and acquisition projects that take place within the planning areas. These projects can include but are not limited to:

- Greenways
- Rails to Trails
- Riparian Buffers
- Water Trails, and
- Wildlife Areas

Study Area Location

This plan focuses on the Little Neshaminy Creek, the 43-square mile sub-watershed of the Neshaminy Creek situated in southwest Bucks County and southeast Montgomery County, as shown on Figure 1, Regional Context.

Figure 1 – Regional Context



The study area includes the main stem Little Neshaminy and Park Creek, its major tributary. The Little Neshaminy Creek flows in an easterly direction for

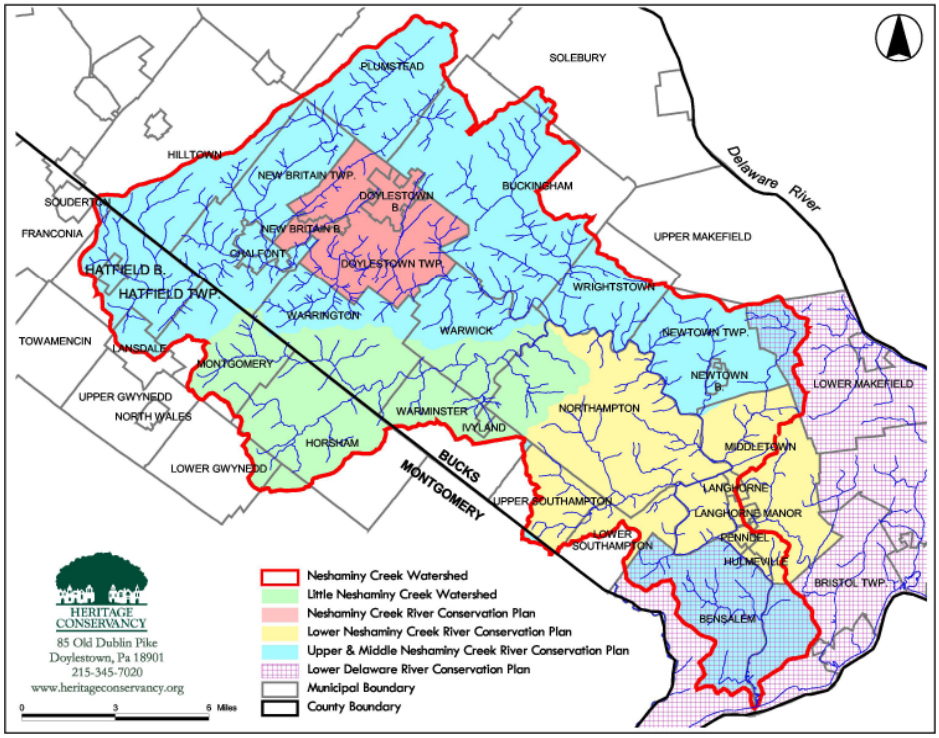
approximately 16 miles to its confluence with the main stem of the Neshaminy Creek in Wrightstown, Warwick and Northampton Townships. Park Creek flows in an easterly direction from its headwaters in both Lower Gwynedd and Upper Dublin Townships through Horsham Township approximately 6 miles where it joins the Little Neshaminy just over the county line in Warrington Township. The Little Neshaminy represents the largest tributary to the 232 square mile Neshaminy Creek Watershed. The watershed area is shown on Map 1, *Base Map*.

Planning History

The Little Neshaminy Creek Watershed is the last remaining section of the 232 square mile Neshaminy Creek Watershed that has not been included in a river conservation or watershed management plan.

Figure 2 shows the Little Neshaminy in relation to the surrounding Neshaminy Creek sub-watersheds which have previously been studied under PA DCNR's River Conservation Program.

Figure 2 – River Conservation Plans within the Neshaminy Creek



In 2005, Heritage Conservancy completed the *Lower Neshaminy Creek Rivers Conservation Plan* and has completed two other Rivers Conservation Plans (RCP) for portions of the Neshaminy Creek Watershed. The *Lower Delaware River Conservation Plan* Included the 4.5 mile portion of the Neshaminy Creek from the Bristol\Bensalem border to the Delaware River. The *Neshaminy Creek River Conservation Plan* focused on the portion of the Neshaminy Creek

in the vicinity of Doylestown Township. In 2003, the Delaware Riverkeeper Network completed the River Conservation Plan for the Middle and Upper Neshaminy Creek.

The headwaters of the Little Neshaminy Creek Watershed are the most highly developed lands in the upper sub-basin of the Neshaminy Creek watershed. Many state and local have efforts have been brought to focus on improving and protecting the resources of the Little Neshaminy and Park Creek. A number of these studies were reviewed and summarized in this RCP and include:

- PA DEP, Total Maximum Daily Load (TMDL) Assessment of Little Neshaminy Creek Watershed, December 2003.
- PA DEP, Watershed Restoration Action Strategy (WRAS) State Water Plan Subbasin 02F Neshaminy Creek Watershed Bucks and Montgomery Counties. Updated May, 2004.
- Delaware River Keeper Network, Little Neshaminy Watershed – Watershed Assessment and Restoration. February 2003.
- Aqua Link, Inc., Little Neshaminy Creek & Bradford Lake Watershed Assessment, Prepared for PA DEP and Bucks County Conservation District, June 2005.

A full listing of studies and plans reviewed as part of this RCP are referenced in the bibliography.

II. The Planning Process

Steering Committee

A steering committee for the Little Neshaminy Creek River Conservation Plan was established in October 2004, and is comprised of watershed stakeholders, local, county and state governmental agencies, environmental groups and utilities. The purpose of the steering committee is to identify the important river related values and issues of concern to be included in the RCP, as well as proposing management options for the watershed.

A total of 5 steering committee meetings were held at different intervals throughout the project to work on the goals and objectives, management options and other aspects of the plan. Representatives provided critical assistance in the development of the plan. Its members are:

- Fred Achenbach, Warrington Water and Sewer Authority
- Terri Bentley – Bucks County Planning Commission
- Tina Boor, Manager – Horsham Water and Sewer Authority
- John Carbone, EAC – Montgomery Township
- Larry Comunale, Manager – Lower Gwynedd Township
- Karen Czarny – Hatboro-Horsham School District
- Arthur Friedman, EAC – Northampton Township
- Annette Glemser – Horsham Water and Sewer Authority
- Susan Harris – Montgomery County Conservation District
- Katrina Harding – Warwick Township
- William Heil, Environmental Specialist – NAS JRB Willow Grove
- Stuart Hughes – Park Creek Watershed Assoc.
- Craig Marleton – Aqua Pennsylvania
- Richard Myers, President – Neshaminy Watershed Association
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- Marc Newell, EAB – Horsham Township
- William Pav – Park Creek Watershed Association
- Charles Ritter, Mayor – Ivyland Borough
- Stanley Ropski, EAB – Upper Dublin Township
- Gretchen Schatscheider, Watershed Specialist – Bucks County Conservation District
- J. Drew Shaw, Section Chief: Environmental Planning – Montgomery County Planning Commission
- Fred Suffian, – Warrington EAC
- William Walker, Assistant Manager – Horsham Township
- Karen Whitney, Director – Warminster Township Parks and Recreation Dept.

Community Participation

Community participation is a key component of the RCP process. Through several outreach events and meetings, the RCP sought input from residents

to identify important resources and issues in this watershed. This information helped guide the RCP's planning team to develop a range of management options to benefit the watershed stakeholders. The following meetings or events were held during the development of the plan:

Public Meeting 1 – Warrington Township March 10, 2005

Public Meeting 1 – On March 10, 2005 the residents of the Little Neshaminy Creek Watershed were invited to a public meeting in Warrington Township to introduce the plan and seek input on issues and concerns of the watershed. Participants viewed numerous maps, had the opportunity to ask questions and participated in an exercise to identify issues and concerns on a variety of topics.

Public Meeting 2 – Warminster Township May 29, 2007

Public Meeting 2 – On May 29, 2007, a second public meeting was held at the Warminster Township municipal building. The purpose of the meeting was to share the draft RCP via presentations by the planning team and municipal representatives. The draft management options were presented and participants were asked to review and provide comment. All participants were provided with a copy of the draft executive summary and draft management options. Prior to the meeting all steering committee members were provided with full copies of the entire draft plan. The full plan was posted on the Heritage Conservancy website and websites of several of the watershed municipalities. Hard copies of the draft were also provided to both county planning commission offices for review.

This meeting initiated the 30-day formal public review period. Copies of written comments received at the meeting are included in Appendix C. Other comments, received either by phone or e-mail have been included in this final draft.

Public Meeting 3 - A final public meeting will be held to present the final plan and will include an event to highlight a current restoration project in progress.

Other Outreach Events

June 2005 - Riparian Buffer Restoration in Park Creek in Kohler Park with local students.

In June 2005, Heritage Conservancy in cooperation with Horsham Township conducted a Riparian Buffer Restoration activity with over 65 middle-school students along the Park Creek in Kohler Park. Students were educated on the benefits of riparian buffers and were given the opportunity to help plant trees, shrubs and herbaceous plantings along the stream.

In February 2006, watershed stakeholders were invited to a meeting of the Neshaminy Alliance to discuss broad issues impacting watershed residents throughout the two-county area. Discussions included the state of the watershed, the proposed Act 167 stormwater management plan update and flood mitigation.

A short public survey was developed and distributed to watershed municipalities in 2006. Municipalities and organizations were asked to distribute the paper copies and provide links on their websites for the on-line version of the survey. The survey was posted on the Heritage Conservancy website. A special website page was also developed to provide information on the watershed and planning activities.

In addition to these events, HC staff made presentations to the Park Creek Watershed Association and the Warrington Township Environmental Advisory Committee meetings to gain input on implementation projects.

Regional Implementation and Listing on the PA Rivers Registry

Once the river conservation plan is approved, the municipalities and other partners will be responsible for prioritizing and implementing projects. One of the final requirements of the planning process is to have municipalities endorse the plan and commit to implementing the recommendations. The last official responsibility of the steering committee is to see that the plan is presented to their municipal governing bodies and request endorsement of the plan and its recommendations.

III. Plan Goals and Objectives

The initial RCP goals and objectives were identified by the steering committee during the planning process. These goals and objectives were further refined throughout the course of the project. Goals, objectives and actions reflecting the needs and desires of the local stakeholders and communities were developed through facilitated discussion and consensus building and are described below.

Goal 1 - Protect and improve the surface and ground water quality in the Little Neshaminy Creek Watershed to improve recreational opportunities, wildlife habitat, and sources of drinking water.

Objective – *Improve in-stream habitat.*

Actions:

- Increase streamside vegetation to increase canopy cover and moderate stream temperature.
- Promote sustainable land use practices to reduce impervious cover and increase infiltration of stormwater.
- Improve protection of headwaters.
- Reduce nutrient and sediment loadings to watershed.
- Develop and distribute educational materials to all landowners related to the proper care and management of streamside properties.

Objective – *Protect existing riparian areas and improve those lacking sufficient riparian corridors.*

Actions:

- Increase riparian protection in areas lacking sufficient vegetated buffers (50% canopy cover and 50 foot width forest buffer).
- Develop and adopt riparian corridor protection ordinances, in all watershed municipalities if one has not been adopted.
- Improve land management practices for streamside properties.
- Purchase land or conservation easements in riparian zones to limit development and restrict uses.

Objective – *Improve Water Quality in Bradford Lake Reservoir.*

Actions:

- Implement in-lake management practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment:
  - Sediment dredging
  - Aeration
  - Algal control using algaecides
  - Aquatic plant control methods
  - Aquatic herbicides (if dredging not performed)
  - Annual mechanical harvesting of water chestnut if lake is not dredged and aquatic herbicides are not applied to lake.

- Implement Bradford Lake restoration activities to eliminate sources of taste and odor compounds impacting downstream drinking water treatment plants.
- Design and construct forebay/constructed wetland structure to improve water quality of Bradford Lake.
- Implement watershed best management practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment:
  - Bank Stabilization and Protection
  - Streambank Stabilization
  - Riparian buffers
  - Stormwater retrofits
  - Conservation and nutrient management plans for all farms located within watershed.
- Implement institutional practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment.
  - Establish a Watershed Association.
  - Develop and adopt a municipal lawn fertilizer ordinance for all municipalities within the watershed.
  - Increase landowner education and continue annual water quality monitoring

Objective – *Protect drinking water sources.*

Actions:

- Institute wellhead protection programs.
- Reduce demand on drinking water sources through residential water conservation programs.
- Support efforts of local watershed groups to improve and protect water quality in the watershed.

Objective – *Support water quality recommendations of the Little Neshaminy Watershed Assessment and Restoration.*

Actions:

- Initiate cooperative projects to fulfill plan recommendations.
- Increase water quality monitoring through establishment of small network of channel reference sites.
- Explore alternative management of grass or turf areas of publicly owned lands.
- Explore stormwater retrofits within suburban campus and industrial lands.
- Initiate projects to restore Stage V streams and priority reaches. Priority reaches are:
  - Kemper Park, Warminster – Valley Road to Bristol Road
  - Downstream of Meetinghouse Road – Warwick – Bristol Road Bridge to below downstream bend.
  - Park Creek along Keith Valley Road – Horsham – Horsham Park to County Line Road.

Objective – *Prioritize water quality projects for implementation.*

Actions:

- Support efforts of local watershed groups to improve and protect water quality in the watershed.
- Convene meeting of watershed municipalities, water utilities, wastewater utilities and DEP to explore cooperation meeting federal mandates.

Objective – *Increase water quality monitoring in Park Creek and Little Neshaminy Creek.*

Actions:

- Train, recruit and educate volunteer water quality monitors.
- Collect and analyze lake and stream samples for nitrogen, phosphorus, total suspended solids, and oil/grease.

Objective – *Encourage programs to increase vegetative cover throughout watershed.*

Actions:

- Develop and implement residential, municipal and public education programs that address the benefits of naturalized land for water management and air quality.
- Initiate reforestation projects on certain public lands.
- Educate and encourage homeowners, businesses, religious and non-profit organizations to plant as much soil-retaining, water holding vegetation on land presently in turf or lawn.
- Increase the number of street trees in developed areas of the watershed.
- Increase forested riparian buffers adjacent to stream tributaries.

Goal 2 - Improve the way stormwater is managed in the watershed to reduce flooding, protect stream baseflow and maintain the hydrologic balance.

Objective – *Reduce stormwater runoff volume.*

Actions:

- Increase infiltration through use of appropriate BMPs.
- Reduce impervious cover of new development through conservation design practices which increase opportunities for infiltration of stormwater runoff.
- Encourage use of conservation design in redevelopment projects.

Objective - Improve water quality of stormwater.

Actions:

- Perform stormwater basin assessments to determine candidate sites for retrofits or naturalization.
- Retrofit and/or naturalize BMPs where possible to promote infiltration and improvements in water quality.

- Utilize treatment wetlands and innovative BMPs as educational tools for the public, municipalities and agencies, including:
  - Rain gardens
  - Disconnect rooftop drains from stormwater collection system.
- Install innovative BMPs on public and school district lands to be used as demonstration sites.
- Provide incentives for developers to utilize pervious paving, bio-retention islands, green roofs and other low impact development technologies in new and redeveloped sites.
- Encourage the use of stormwater BMPs in all types of development as recommended in the Pennsylvania Stormwater BMP Manual.
- Adopt and enforce water quality standards and criteria within the updated Neshaminy Creek Act 167 plan (when approved).
- Prepare conservation and nutrient management plans for active farms.

Objective – *Update land use practices and ordinances to include water quality standards and criteria.*

Actions:

- Update natural resource protection ordinances to support better stormwater management.
- Review and update Subdivision and Land Development Ordinances to support low-impact development techniques to reduce impervious cover in new and infill developments.
- Require installation of naturalized stormwater BMPs to improve water quality in all new developments.
- Eventually adopt the stormwater management model ordinances of the updated Act 167 Stormwater Management Plan for the Little Neshaminy Creek in all watershed municipalities.

Objective – *Improve stormwater management programming and financing.*

Actions:

- Support efforts to research requirements of establishing stormwater utility.
- Coordinate stormwater management, conservation and preservation efforts between organizations and municipalities throughout the Neshaminy Creek watershed.
- Implement and fund programs to identify and retrofit existing stormwater detention basins to improve water quality function.

Goal 3 – Mitigate impacts from Floods.

Objective – *Reduce impacts from flooding on economic, historic and natural resources.*

Actions:

- Sponsor study to remap the 100-year floodplain to account for upstream development as in Pennypack Creek.

- Strengthen existing ordinances to place more restrictive controls on 100-year flood zone and flood fringe areas.
- Reduce exceptions to existing ordinances allowing encroachment and building in floodplains and wetlands.
- Regulate alluvial soils.
- Purchase flood prone properties for conversion to public open space.
- Provide training to zoning hearing boards regarding the cumulative effects of exceptions and increased impervious surface on the hydrologic cycle of watershed.
- Improve existing stormwater infrastructure.
- Encourage protection of existing wetlands and natural floodplain areas through conservation easements.

Objective: *Determine procedures for removal of debris and obstructions in the stream.*

Action:

- Establish dialog with Penn DOT, DEP, NRCS and Army Corps of Engineers to determine and coordinate procedures for removal of obstructions and debris in streams, including obstructions upstream and downstream from existing bridges.

Objective: *Improve management of flood prone properties.*

Actions:

- Purchase flood prone properties for conversion to public open space.
- Ensure proper management of acquired land through property management plans.
- Support park department staff person to address property management.

- **Objective:** Reduce zoning and building exceptions in sensitive areas.
- Actions:
- Provide training to zoning hearing boards regarding the cumulative effects of exceptions and increased impervious surface on the hydrologic cycle of the watershed.
- Develop handbook for ZHBs educating them about cumulative impacts of impervious surfaces and offer recommendations of measures that can mitigate environmental damage.

Goal 4 – Protect Cultural Resources of the Watershed.

Objective - *Identify and protect archaeological and historical resources of the watershed.*

Actions:

- Identify significant historic and archaeological properties to be protected.

- Conduct a comprehensive municipal survey of historic properties, if a survey has not been conducted.
- Nominate historic resources that have been determined eligible for the National Register of Historic Places to the National Register.
- Protect and maintain historic and archaeological resources.
- Adopt or strengthen historic preservation ordinances.
- Promote adaptive re-use of historic structures.
- Strengthen financial and operational support of local historic preservation and Native American organizations.

Objective – *Preserve significant scenic views and view sheds.*

Actions:

- Identify scenic views to be maintained.
- Adopt or strengthen scenic preservation ordinances.

Objective – *Link important cultural and natural resources*

Actions:

- Implement BCPC and MCPC proposed greenway networks.
- Develop trails, bike paths and greenways linking important natural and historic resources.

Goal 5 – Protect the Natural Resources of the Watershed

Objective – *Identify and conserve sensitive natural resources of the watershed.*

Actions:

- Conduct or update municipal environmental resources inventories (ERI) to identify and prioritize natural areas.
- Review and strengthen natural resource protection ordinances for wetlands, floodplain, groundwater recharge areas, priority natural areas, woodlands and forests, ponds, lakes, hydric and alluvial soils.
- Protect most sensitive areas through acquisition or conservation easement.
- Restore and protect riparian vegetation along streams in the watershed.
- Restore and protect aquatic communities, habitats and stream channels.
- Restore and protect natural floodplains.
- Remove references to invasive species in zoning and subdivision ordinances.
- Review examples of ordinances that include the removal of non-native species such as in Upper Makefield Township.

Objective – *Protect groundwater resources and stream base flow.*

Action:

- Identify important groundwater recharge areas and protect as open space.

Objective – *Reduce damage to natural areas.*

Actions:

- Control invasive and exotic plants and animals.
- Institute measures to reduce damage from Canada Geese and White Tailed deer.
- Control illegal ATV use on open spaces.

Objective – *Implement riparian and stream restoration projects where effective.*

Actions:

- Restore streambanks and riparian buffers along priority reaches in the watershed as identified in Little Neshaminy Creek Watershed Assessment and Restoration Plan.
    - Kemper Park, Warminster – Valley Road to Bristol Road
    - Downstream of Meetinghouse Road – Warwick – Bristol Road Bridge to below downstream bend.
    - Park Creek along Keith Valley Road – Horsham – Horsham Park to County Line Road.
- Continue to monitor and assess streambank conditions for additional riparian and restoration sites

- **Objective** – *Support sustainable land management practices on community open spaces.*

Actions:

- Promote invasive plant and animal control, reduced mowing schedules, and other environmentally sound management practices for community held open spaces and common areas.
- Address illegal ATV in community open spaces.
- Promote use of vegetated buffers around BMPs and ponds to discourage use by Canada Geese.

Objective – *Protect prioritized NAI and ERI sites and identified sensitive lands.*

Actions:

- Enact stricter resource protection regulations in designated NAI, ERI and conservation areas.
- Protect NAI areas, ERI sites and sensitive lands through acquisition or conservation easements.
- Sponsor training sessions on the use of conservation easements for open space protection.

Objective – *Link important cultural and natural resources.*

Actions:

- Implement BCPC and MCPC proposed greenway networks.
- Develop trails, bike paths and greenways linking important cultural and natural resources.

Goal 6 – Maintain and Enhance Recreational Opportunities, and the Parks and Open Space Resources of the Watershed.

Objective – *Improve connectiveness and management of open spaces throughout watershed.*

Actions:

- Link greenways throughout the watershed.
- Support implementation of BCPC and MCPC proposed greenway networks.
- Develop trails, bike paths and greenways linking important natural and historic resources.
- Encourage multi-municipal trail linkages among existing park systems.

Objective – *Implement parks, recreation and open space plans.*

Actions:

- Prioritize large parcels for open space acquisition or conservation easement.
- Update existing municipal parks, recreation and open space plans.
- Implement recommendations of existing municipal and county parks, recreation and open space plans.
- Specify and implement stewardship plans on existing community open space areas.

Objective – *Increase and improve municipal passive and active recreational facilities.*

Actions:

- Maintain and improve playground and recreational facilities.
- Increase passive recreation opportunities for residents through acquisition and management of natural open spaces.
- Improve bike path and bike trail network throughout the watershed and park systems.

Objective – *Improve access points to the creek for recreation.*

Actions:

- ID potential public access points.
- Identify and install canoe and kayak access points to the Little Neshaminy Creek.
- Develop access points utilizing sound environmental design practices to serve as educational sites.

Objective – *Promote sustainable land management practices on community open spaces.*

Actions:

- Specify and implement stewardship plans for public open spaces and all park land.
- Encourage naturalization of open spaces.

- Create fund for purchase of trees, shrubs, and meadows grasses to be used by municipalities, schools and organizations for re-vegetating or naturalizing open spaces.
- Promote invasive plant and animal control, reduced mowing schedules, and other environmentally sound management practices for community held open spaces and common areas.
- Address illegal ATV in community open spaces.
- Promote use of vegetated buffers around BMPs and ponds to discourage use by Canada Geese.
- Promote participation in the Audubon Cooperative Sanctuary Program for existing golf courses and other types of property in watershed.

Goal 7 – Increase participation in Education and Conservation Activities.

Objective - *Promote and enhance the understanding of the historic, cultural, spiritual, economic, and natural resources of the watershed among residents and business owners, religious and non-profit organizations.*

Actions:

- Develop programs and materials to educate homeowners, business owners, religious and non-profit organizations on water quality practices at home and land management techniques for those with property along riparian areas.
- Educate and encourage homeowners, businesses, religious and non-profit organizations to plant as much soil-retaining, water holding vegetation on land presently in turf or lawn.
- Coordinate outreach and education with municipal NPDES II program requirements.
- Promote hands-on environmental education to residents, business community, religious and non-profit organizations via programs such as tree planting, stream clean-ups, and stream visual assessments.
- Educate farmers on preparing conservation and nutrient management plans for active farms.
- Post educational signage at stream crossings, naturalized areas, public open spaces and historical sites.

Objective - *Promote and enhance the understanding of the historic, cultural, economic, and natural resources of the watershed to municipal officials.*

Actions:

- Promote educational programs for municipal officials, staff, boards and commissions on the link between land use practices and natural resource protection.
- Evaluate alternatives to low-density, sprawl forms of residential development. Research, distribute and implement model ordinances for consideration by the municipalities.

- Create Environmental Advisory Boards in all watershed municipalities that do not currently have them.
- Provide information, such as maps and fact sheets for the use of key decision-makers.
- Create resource materials for use by municipalities regarding the benefits of using native vegetation in landscaping and residential gardens.
- Encourage municipalities and school districts to adopt policy to use native vegetation in facility landscaping.

Objective - *Promote and enhance the understanding of the historic, cultural, economic, and natural resources of the watershed among elementary and secondary school students.*

Actions:

- Promote service learning programs at Elementary and Secondary schools to teach students about basic stream ecology.
- Identify or provide access to the creek for school groups.
- Work with school districts to coordinate, in partnership with non-profit organizations, curricula on the creek's resources.
- Promote service learning programs and coordinate curricula on the creek's resources for youth education at religious & non-profit organizations with property along riparian areas.

Objective - *Promote and enhance the understanding of the historic, cultural, economic, and natural resources of the watershed to the development community.*

Action:

- Educate development community on the economic and environmental benefits of conservation design and low-impact development techniques.

Goal 8: Encourage Sustainable Economic Development Practices.

Objective - *Promote Conservation Design and sustainable land use practices in new development within watershed communities.*

Actions:

- Promote the use of conservation design and low-impact development techniques to reduce impervious surfaces.
- Encourage the use of stormwater best management practices as recommended in Pennsylvania's Stormwater Best Management Practices Manual.

Objective - *Promote Conservation Design and sustainable land use practices in redevelopment and/or infill development activities within the watershed communities*

Actions:

- Work cooperatively to identify economically viable adaptive reuse options for the NASJRB Willow Grove facility which incorporate conservation design principles.
- Encourage reduction in imperious surfaces in redevelopment projects
- Promote adaptive re-use of existing underutilized or vacant facilities.
- Promote the use of green roofs and rain gardens in highly developed areas.
- Promote use of stormwater BMPs as recommended in Pennsylvania's Stormwater Best Management Practices Manual.

Goal 9: Improve Watershed-Wide Plan Coordination and Integration.

Objective – *Integrate Little Neshaminy RCP recommendations with the management options and recommendations of the adjacent River Conservation Plans and other studies and assessments completed or underway for the entire Neshaminy Creek Basin.*

Actions:

- Establish plan clearinghouse to provide single repository and database for previous Neshaminy Creek plans, studies and assessments.
- Review and integrate all RCP goals and actions.
- Coordinate watershed-wide activities through Neshaminy Alliance to avoid duplicative efforts.
- Review status of previous and ongoing studies within the watershed.

Objective - *Improve coordination among watershed organizations and stakeholders to prioritize and implement recommendations of RCPs, and other watershed studies.*

Actions:

- Coordinate efforts between municipalities, water and wastewater utilities to cooperatively address Safe Drinking Water Act, Act 167, NPDES Phase II and TMDL for Little Neshaminy Creek Watershed to capitalize on efforts.
- Support efforts of local watershed groups to improve and protect water quality in watershed.
- Implement water quality recommendations of Little Neshaminy Watershed Assessment & Restoration.

Objective – *Integrate goals of RCP with municipal plans and land use ordinances.*

Actions:

- Promote integration of RCP goals with comprehensive plans, open space and recreation plans, zoning and subdivision ordinances of municipalities within the watershed.
- Encourage multi-municipal planning among the municipalities.
- Investigate funding and other incentives.

Goal 10: Improve Neshaminy Creek River Conservation Plan Implementation Resources.

Objective – *Establish a structure, mechanism or information system for continued cooperation and securing funding for projects and programs to maintain and enhance the historic, cultural, economic, and natural resources of watershed.*

Actions:

- Organize working group to encourage plan project implementation.
- Identify leadership and establish a structure or information system to facilitate the implementation of the river conservation plan.
- Provide copies of the river conservation management plan to each municipality and the legislators whose districts encompass the corridor along with a summary of funding needs.
- Promote public support for conservation funding.
- Sponsor public information sessions on municipal funding initiatives for open space and watershed initiatives.
- Build the capacity (volunteers, staff, resources, etc.) to implement the river conservation plan.
- One year after the adoption and approval of the river conservation plan, hold a meeting of the advisory committee and other interested parties to evaluate progress on the implementation projects. After five years, meet to evaluate progress on the priority projects and activities and conduct update if warranted.

IV. Issues Concerns and Constraints

The Neshaminy Creek is a Category I FY 99/2000 priority watershed under PA DEP's Unified Watershed Assessment, which identifies priority watersheds needing restoration. The 43-square miles of the Little Neshaminy Creek watershed are on the Section 303d[1] list of impaired waters due to water and flow variability and siltation from urban stormwater runoff as well as nutrient inputs from municipal point source discharges[2].

The lands in the headwaters of the Little Neshaminy Creek Watershed are the most developed in the Neshaminy Creek basin. The Montgomery County communities of Montgomery, Horsham and Lower Gwynedd townships are among the fastest growing communities in the state. Over the past decade the municipalities within the Little Neshaminy have added 11,400 new housing units and 28,500 people. Rapid urbanization and conversion of farmland to residential and other forms of development both upstream and in the area has led to several emerging problems. Flooding, both downstream and within the study area, is an on-going issue for the watershed.

In 2003, nutrient inputs into Bradford Reservoir, a flood control lake located in Warrington Township, led to an algae bloom that caused widespread taste and odor complaints from customers of Aqua PA (formerly the Philadelphia Suburban Water Company), which operates a drinking water treatment plant on the main stem Neshaminy.

Also in 2003, the Delaware Riverkeeper completed a study that identified stream morphology changes within the watershed that have been caused by increased stormwater flows. Recent storm events have resulted in damage to the natural environment and may require long-term measures to restore the affected resources. Streams have changed courses and have highly eroded banks, exposed soil and native vegetation damaged, leaving the watercourses in overall poor health. Heritage Conservancy received PA DEP funding to conduct an aerial survey of the riparian buffers along the Neshaminy Creek. Results of this study indicated that approximately 87 linear miles of the Neshaminy Creek are lacking a forested buffer on one or both banks.[3]

PA DEP identifies municipal point source discharges as a source of impairment for this basin[4]. These discharges are regulated by the state administered, federal NPDES program, but large municipal discharges can overwhelm small streams ability to assimilate treated effluent during periods of low base flow. Base flows are adversely affected by the regions dependence on groundwater for a large percentage of its drinking water sources.

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1 Section 303(d) of the US Clean Water Act

2 (PA DEP draft Watershed Restoration Action Strategy – WRAS 7/31/01) (Exhibit B: Watershed Assessment Map).

3 Heritage Conservancy, Riparian Buffer Assessment of Southeastern Pennsylvania, 2002.

4 WRAS, 2001

A variety of non-point source pollution (NPS) affects the Little Neshaminy Creek sub-basin, consistent with a variety of land uses. Siltation has resulted from land construction and impairment by stream flow variability from stormwater runoff. Construction activities associated with rapid urbanization are a major source of high sediment loads during storm events. Erosion and stormwater runoff continue to carry sediments and nutrients to the stream and Bradford Reservoir. In-stream erosion from high velocity storm flows is another significant source of sediment entering the stream.

Stream degradation associated with excess nutrients, phosphates, nitrates, sludge, fecal coliform bacteria, copper, chlorine and bacteria from sewage treatment plants have been reported in all the branches of the Neshaminy Creek and its tributaries. These discharges have significantly limited aquatic life in several of these watersheds.[5] These conditions also have degraded the quality of recreation along these once-scenic greenways.

Groundwater depletion is also a problem due to water well withdrawals to serve the new housing developments. With these new developments come new problems of runoff from fertilized lawns, increased impervious surfaces and water withdrawal not returning to groundwater but to surface streams. Runoff is rapid during storm events with rain having little time to infiltrate and replenish groundwater.[6] There is a strong need to develop educational strategies to inform landowners of alternative ways to manage their properties in more sustainable ways.

The economic climate within the watershed has increased the demand for all forms of development. Some types of development can contribute to diminishing the riparian buffers and other natural vegetative areas traditionally used by nature to filter pollutants. With this also comes a decrease in the aesthetic appeal of the stream valleys and loss of habitat as undeveloped land becomes more scarce and expensive. Although Bucks and Montgomery Counties and individual municipalities have developed programs to provide money to protect open space, it is often difficult to keep pace with development in the region.

Community Input on Issues

As part of the initial public meeting in March 2005, attendees were asked to provide written input on issues of concern on a series of large format pads. Attendees were also asked to indicate areas of concern on maps provided by Heritage Conservancy. Specific areas of concern are shown on Map 2 – *Issues and Concerns.*

A summary of the comments, issues and concerns are listed below:

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5 WRAS, 2001

6 WRAS, 2001

Budget/Funding/Legislation

- Need funds to implement plan recommendations and projects
- Need more Federal, State, County funding support
- Promote grant information

Economic Development

- Impact of Wegmans' development (Warrington Township)
- Work with developers to set up BMPs of stormwater management using more innovative and environmentally sound practices.
- Closing of Willow Grove Naval Air Station
- Traffic

Education, Outreach Coordination

- Use of pesticides, herbicides and fertilizers near streams
- Label storm drains
- Increase education signage and brochures.
- Educate public to plant trees and native vegetation instead of lawn especially on sloped lands.
- Set-up examples using current detention/retention basins using natural plantings and conservation practices
- Educate the public on treating stormwater runoff problem at source and ways to do it (example – reduce impervious surfaces.)

Historical/Cultural Resources

- Protect home at Mearns and Almshouse Roads.

Land Use/Sprawl

- Closing of Willow Grove Naval Air Station
- Traffic

Parks and Recreation

- Establish a regional trail system
- Improve creek access at bridges
- Consider Creek Road/Walton Road as park area
- Preserve college settlement in Horsham
- Provide better access/facilities to reservoir (dam)
- Evaluate walking trails in Warwick Township along creek, how to cross Almshouse Road under bridge.
- Walking/bike trails along creek.
- Greenway along Little Neshaminy – Warrington
- Trail along Park Creek from Lower State Road to Cedar Hill Road to Horsham Road.
- Restore pond in Kohler Park, Horsham Township
- Connecting Trails

- Recreational use of County flood control dams.

Stormwater/Flooding

- Streambed restoration
- Repeated house flooding below Neshaminy Warwick Church
- Stream erosion (bad) below Neshaminy Warwick Church
- Develop a program to mitigate flooding of the Little Neshaminy in Warrington Township in the Neshaminy Village area.
- Upgrade storm retention basins.
- Prevent mowing up to edge of streams
- Better stormwater ordinances
- Better enforcement of ordinances
- Encourage private owners to re-grade sloping/and (lawn) to BMPs.
- Flooding of Kansas Road, Warrington Township (Park Creek intersection w/Little Neshaminy)
- Flooding on Keith Valley Road between Davis Grove Road and County Line road in Horsham.
- Dam removal along Park Creek
- Controlling problem of stormwater run-off at source

Water Quality

- Bradford Dam water pool and flood control
- Establish Maintenance Program for Bradford Dam
- Restore riparian corridor along Park Creek
- Golf course is being built on Creek Road (Warwick Township). Concerned about pesticides/herbicides going into ground water. Who monitors this?
- Preserve and re-vegetate riparian corridors
- Current Wetlands areas could be/should be maintained to clean waters, rather than increasing the flood plains as wetlands.
- Identify wetlands properly utilized and those that need work
- Reduce pollution from paved areas.
- Retrofit detention basins – Cedar Hill Road Park basin in Horsham Township as educational model.
- Improve stream buffers – discourage lawns and parking lots right up to stream banks.

Wildlife/Habitat Protection

- Reforesting stream corridors and preserved open space
- Inventory of wildlife, especially in wetlands – protect nesting sites
- Jarrett Nature Center
- Establish wildlife nature preserves – Bradford Dam
- Removal of invasive species in natural areas
- Reforest municipal lands

Closing of the Naval Air Station Joint Reserve Base Willow Grove

During the course of the project, the U.S. Department of Defense (DoD) recommended to close Naval Air Station Joint Reserve Base (NAS JRB) Willow Grove. The base is currently a major source of employment in the region with 865 military and 362 civilian personnel assigned there. This announcement in November 2005 sparked numerous debates over the future use of the 1,100 acre base and 8,000 foot runway located partially within the Little Neshaminy Watershed in Horsham Township. Park Creek flows through the base itself and contamination from decades of use as a military airbase are central to site remediation. The base is currently listed on the Final National Priorities List (NPL)[7] and the US EPA is working to determine whether, under current conditions, there are any potential or actual human exposure to contaminants at this site. According to the Superfund Information System, EPA is still working to determine whether contaminated groundwater migration is under control. A final remedy has not been selected.[8] Various options are being considered including its reuse as a civilian airport. Additional information regarding the history of the base is included in Chapter V of this Plan.

7 The National Priorities List (NPL) is the list of the most hazardous sites, also known as Superfund sites, across the United States.

8 See full site status report at: http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0303820

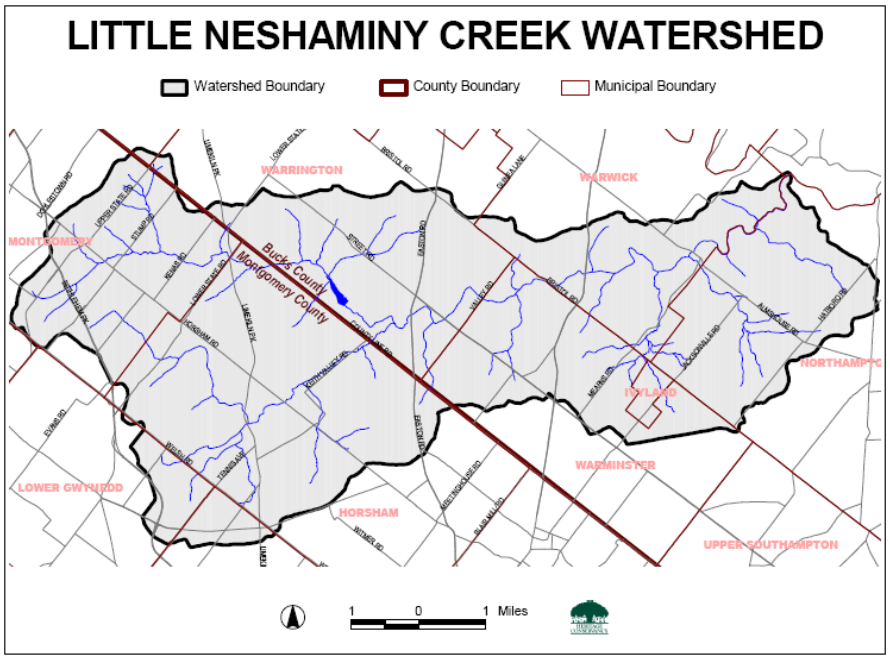
V. Project Area Characteristics

Location

The Little Neshaminy Creek Study Area is the 43 square mile sub-watershed of the Neshaminy Creek situated in southwest Bucks County and southeast Montgomery County. The project area encompasses the twenty-two linear miles of the Little Neshaminy and Park Creeks from the headwaters area in Montgomery Township, Montgomery County to the Little Neshaminy Creek's confluence with the main stem Neshaminy Creek in Warwick, Wrightstown and Northampton Townships, Bucks County.

As shown in Figure 3, Little Neshaminy Creek Location Map, the watershed flows through the following municipalities Horsham, Lower Gwynedd, Montgomery and Upper Dublin Townships in Montgomery County and Ivyland Borough, Northampton, Warminster, Warrington and Warwick Townships in Bucks County.

Figure 3 – Location Map

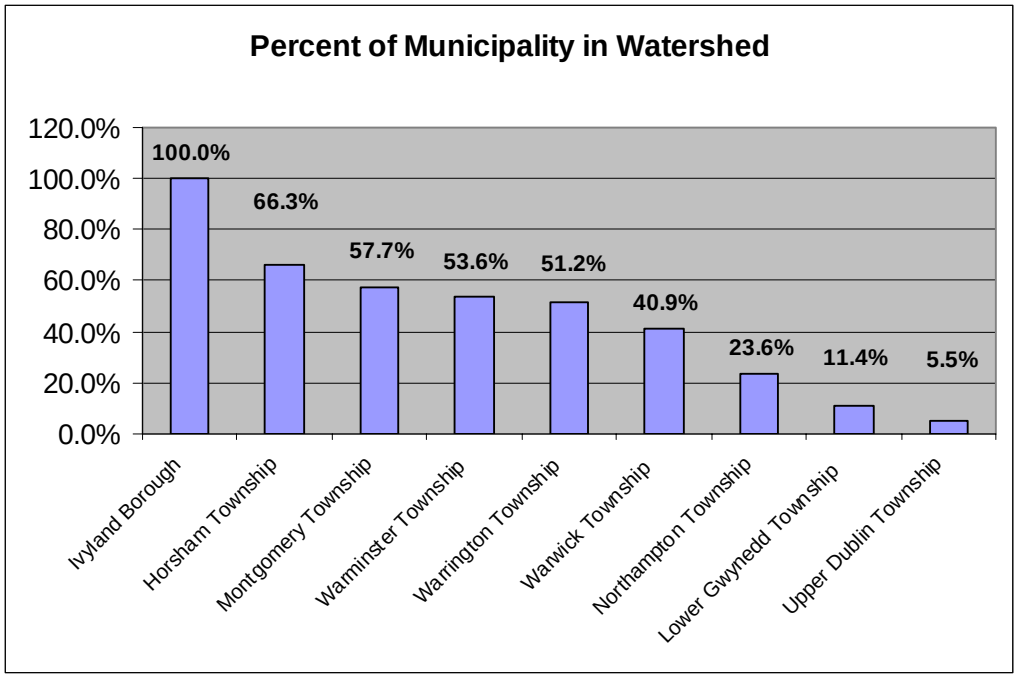


Size

For purposes of this study, the Little Neshaminy Creek Watershed drainage area encompasses 43 square miles or 27,514 acres including all or portions of nine municipalities in Bucks and Montgomery Counties. The distribution of the project area among the nine municipalities is detailed in the Table 1. All of Ivyland Borough is within the watershed, while over 50% of the municipalities of Horsham, Montgomery, Warminster and Warrington are within the watershed boundaries. The relative spatial distribution among the municipalities is shown in Figure 4.

Table 1 – Distribution of Municipal Acreage - Little Neshaminy Creek Study Area			
Name	Acreage within Study Area	% of total Study Area	% of Municipality in Study Area
Bucks County	15,118.39	54.9%	
Montgomery County	12,430.88	45.1%	
Ivyland Borough	225.20	0.8%	100.0%
Northampton Township	3,951.74	14.3%	23.6%
Warminster Township	3,500.89	12.7%	53.6%
Warrington Township	4,515.18	16.4%	51.2%
Warwick Township	2,893.84	10.5%	40.9%
Horsham Township	7,349.89	26.7%	66.3%
Lower Gwynedd Township	679.59	2.5%	11.4%
Montgomery Township	3,928.86	14.3%	57.7%
Upper Dublin Township	468.54	1.7%	5.5%
Total	**27,513.73**	**99.90%**	

Figure 4 – Percent of Municipality in Watershed



Major Tributaries

The Little Neshaminy Creek includes the 16 linear stream miles of the main stem Little Neshaminy and 6 linear miles of the Park Creek, its major tributary. The Little Neshaminy represents the largest tributary to the 232 square mile Neshaminy Creek Watershed. The watershed area is shown on Map 1, *Base Map*.

Social/Economic Profile

Population Centers

The watershed is located in a highly urbanized region within the Philadelphia Metropolitan Area. Population densities within the watershed range from 1,079 persons per square mile in Warwick Township to 3,047 persons per square mile in Warminster Township. Northampton Township has the highest population among the watershed municipalities (39,384), while Ivyland Borough has the smallest (492).

Transportation Facilities

The project study area is located in Suburban Philadelphia and accessible via a number of major state roads and mass transportation lines. It is traversed by several east/west arterial roadways such as PA Route 463 (Horsham Road), County Line Road, PA Route 63 (Welsh Road), PA Route 132, (Street Road), Bristol Road and Almshouse Road. Major north/south roadways include PA Route 309 (Ft. Washington Expressway), PA Route 611 (Easton Road), PA Route 152, (Limekiln Pike), PA Route 263 (Old York Road). The project area is accessible to the Southeastern Pennsylvania Transportation Authority's (SEPTA) commuter rail lines, which provide direct links to Center City Philadelphia to the south and to Doylestown in the north. Rail lines include SEPTA's R5 Doylestown and R2 Warminster lines. The Warminster Regional Rail Train Station is located within the project area.

Major Sources of Employment

The Little Neshaminy Creek Watershed Area includes a number of municipalities with major employment centers, The Horsham area is considered one of the five largest employment centers in Montgomery County with an estimated 20-30,000 employees[9] In addition, Horsham Township includes one of the leading public sector employers, the Willow Grove Naval Air Station. Montgomery Township is also home to one of the region's largest retail facilities, Montgomery Mall. On the Bucks County side of the watershed, several major employers are located in the Township of Warminster such as Tenet Health Systems and PECO Energy. Numerous retail centers are located along the major transportation routes such as Easton Road (PA Route 611), Street Road (PA Route 132), Horsham Road (PA Route 463) and York Road (PA Route 263).

Outstanding or Unique Features

The watershed contains a variety of outstanding natural and cultural resources including Graeme Park, a National Historic Landmark and pristine farmlands located where the Little Neshaminy and main stem Neshaminy converge. The watershed also contains two aviation sites closely tied to the regions historic and economic development. Examples of these and other unique features of the watershed are described below:

9 Montgomery County Vision 2025 based on data from the 1999 County Business Patterns zip Code Data.

Figure 5 – Forks of the Neshaminy

The Forks of the Neshaminy is so called because of the narrow, winding stream valleys formed by the juncture of the Neshaminy and Little Neshaminy Creeks.

The Forks of the Neshaminy

This area is home to a concentration of historic farmlands and properties and contains some of the most pristine areas of the watershed. The concentration of resources within this area led to its designation by Heritage Conservancy as a Lasting Landscape Area. The Forks of the Neshaminy is so called because of the narrow, winding stream valleys formed by the juncture of the Neshaminy and Little Neshaminy Creeks. This watershed, located in the Pennsylvania municipalities of Warwick; Wrightstown; Buckingham; and Northampton, is approximately 5,600 acres and was recently recognized in the Natural Areas Inventory of Bucks County (1999) as an area containing significant natural features, which should receive priority for protection. The natural area includes the forested slopes and floodplain along the Little Neshaminy and Neshaminy Creeks near Rushland. This region is also made up of a group of farms united by Neshaminy Creek, and due to topography, form a visually distinct area that still reflects its agricultural heritage.

In addition to county and municipal preserved lands, Heritage Conservancy owns or has easements on 413 acres of land and has facilitated the preservation of an additional 165 acres within this area. Preserved properties include the Lindsay Barn, and the Ross Mill Farmstead among others.

Figure 6 – The Keith House at Graeme Park

Keith House is the only remaining colonial governor's residence in the Commonwealth

Graeme Park

Located on 42 acres in Horsham Township, Graeme Park is a state-owned historic site maintained by the Pennsylvania Historical and Museum Commission (PHMC). The site includes Keith House, built by Provincial Governor William Keith in 1721-22. Keith House is the only remaining colonial governor's residence in the Commonwealth. The site, and the adjacent historic Penrose/Strawbridge Property, (owned by Horsham Township), protects a regionally historic landscape for heritage tourism and natural resource preservation. The site is considered a National Historic Landmark Property by the National Register of Historic Places. National Historic Landmarks (NHLs) are cultural properties designated by the Secretary of the Interior as being nationally significant. NHL sites possess exceptional value or quality in illustrating or interpreting the heritage of the United States in history, architecture, archeology, engineering and culture.

Figure 7 – The Moland House – Warwick Township[10]

The Moland House[11]

John Moland, a prominent Philadelphia and Bucks County lawyer in the region, built Moland House in Warwick Township in the mid-18th century. In August of 1777, the American Army of 11,000 men camped for 13 days in and around the "Cross Roads" as Hartsville was known. The encampment stretched along both sides of Old York Road, on the slope of Carr's hill to the north; on both sides of Bristol Road from Mearns Road to Meetinghouse Road.

Moland House is reputed to be the location where Washington was joined in the war effort by the Marquis de Lafayette and Count Casimir Pulaski

General Washington's Headquarters was located in the Moland House not far from the intersection of York and Bristol Roads. During his stay at the Moland House, also referred to as the Neshaminy encampment, the Continental Army kept watch for British Army scouts and prepared for battle. . The next battles being the Battles of Brandywine and Germantown. The Old York Road played a major roll in the American Revolution easing the movement of the American Army during the northern campaigns.

Moland House is reputed to be the location where Washington was joined in the war effort by the Marquis de Lafayette and Count Casimir Pulaski. Lafayette was a mere nineteen years old. Washington was very impressed with the young man and their friendship grew to be more like father and son. Lafayette used his power and money to support the fledgling country. It is also alleged to be the site where the American Flag with stars and stripes was flown for the first time.

Among Washington's officers were some of the future leaders of America, such as Alexander Hamilton, John Marshall, Henry Knox, Anthony Wayne and Charles Cotesworth Pinckney. A Council of War was held in the Moland House,

10 Source: www.warwick-bucks.org/historical/moland_house.htm

11 Historical information from http://moland.org/ and http://www.warwick-bucks.org/historical/moland_house.htm

consisting of the Commander-in-Chief, four Major Generals, and six Brigadier Generals General Green's Headquarters' was across the street from Washington's quarters, Lord Sterling's Headquarters was located on Jamison Street and is now a Bed and Breakfast, Lt. James Monroe was his Aid-de-Camp. The Cross Roads Tavern is now stained a glass studio. The Neshaminy Church served as both hospital and a place for court-martials such as the one held for Major Light Horse Harry Lee, the father of Robert E. Lee. Interred in the church graveyard are the remains of several soldiers who died during the two-week period.

The Moland House, which is owned by Warwick Township and maintained by the Warwick Township Historical Society, is listed on the National Register of Historical Places

Bradford Lake – Bradford Reservoir

Bradford Lake, also known as Warrington Lake and Floodwater Retarding Dam PL-566, is a 22-acre impoundment located off County Line Road in Warrington Township. The reservoir and surrounding lands are owned by the Bucks County Department of Parks and Recreation and leased to the township. The impoundment was created in 1975 by constructing an earthen dam across the Little Neshaminy Creek. Bradford Lake was primarily built to alleviate flooding along the Little Neshaminy and the Neshaminy Creeks. Secondary uses of this lake include fishing and aesthetics. In addition, visitors use the surrounding 280-acre parkland for walking, hiking and nature watching.

In 2005, Aqua Link Inc. completed a comprehensive assessment of the Bradford Lake watershed[12]. The study included Bradford Lake and its major tributaries. The lake receives stream flow via the Little Neshaminy Creek and two unnamed tributaries. Aqua Link, Inc. prepared the assessment for the Bucks County Conservation District. As reported in the assessment, Bradford Lake is classified as a very shallow, hypereutrophic impoundment or reservoir, and contains very dense stands of aquatic vegetation that are adversely impairing its recreational uses. The assessment is further described in Chapter 10 of this Plan.

Warminster Community Park (Former Naval Air Warfare Center/Johnsville Air Base)[13]

Brewster Aeronautical Corporation bought 730 acres of farmland and constructed an aircraft assembly plant in 1938. Brewster developed two successful types of aircraft for the Navy, a scout dive-bomber and a fighter (the buffalo) the Navy's first single wing all-metal fighter plane. In 1941, Brewster aeronautical corporation with $125 million in orders for the Buffaloes announced plans to construct a 5 million dollar aircraft plant in Bucks County. With Loans from federal agencies Brewster purchased an additional 367 acres of land in

12 Aqua Link, Inc., Little Neshaminy Creek & Bradford Lake Watershed Assessment, Prepared for PA DEP and Bucks County Conservation District, June 2005.

13 History and Park information compiled from http://www.crompton.com/nadc/index.html and Schoor DePalma, Master Site Plan for a New Recreational Complex on the Former Naval Air Warfare Center Site., Warminster Township PA, July 2002.

Warminster Township, which later became the core site of the NAWCAD (Naval Air Warfare Center Air Division).

Brewster opened the plant on December 19, 1941 and advertised that up to 5000 people would be employed at the plant, creating the largest industrial boom to the area in its history.

Brewster opened the plant on December 19, 1941 and advertised that up to 5000 people would be employed at the plant, creating the largest industrial boom to the area in its history. Skilled workers were trained through an aircraft assembly -training program taught at the Hatboro high School. The buildings and runways were completed in January 1942. All flight tests were performed at the Johnsville plant.

On April 18th, 1942, the Navy, concerned over lack of production and poor management, took over all three of the Brewster Aeronautical Corporation's plants.

In July 1944, as the war was winding down, the Navy took over Brewster's lease from the Defense Plant Corporation. The facility came under the command of the Naval Air Material Center and was designated the Naval Air Modification Unit. The NAMU also modified helicopters for air-sea rescue.

The end of World War II meant that Aircraft modification was no longer needed on a large scale and the NAMU was renamed the Naval Air Development Station (NADS). The mission of the NADS was modified several times in the late 1940's, beginning with the construction of a new medical laboratory and human centrifuge and the Aviation Medical Acceleration Laboratory. The station was renamed the Naval Air Development Center (NADC) in June 1950. The NADC expanded in early 1951. The Navy purchased more land to extend the ease-west runway 8000 feet making it necessary to close parts of Kirk and Newtown roads.

The NADC was also involved with the space program using the centrifuge and a simulator for the X-15, which resulted in work on project Mercury and Gemini. By 1970, NADC employed a workforce of approximately 1,000 scientists, 2,200 civilians and 450 Navy personnel.

On April 12, 1991 the NADC, which had been renamed The Naval Air Warfare Center Aircraft Division (NAWCAD), was included on the list of base closure realignments, as a result of the base Closure and Realignment Act (BRAC) of 1988.

The buildings on the West side of Jacksonville road, the former main complex of NADC, were remodeled by a private developer and are leased as office and warehouse space. In 2001, Warminster Township received 243 acres of parkland from the Department of Interior. The acquisition of the property was lead by a coalition of community leaders including representatives of local civic and athletic associations, members of the Warminster Park and Recreation Department and interested residents. A committee was established to participate in the selection of a consultant to prepare a master plan for the park. The master plan was completed in July 2002. The Warminster Community Park had its Grand Opening and Warminster Day on Saturday, October 18th, 2003.

The parkland is located at the East end of the runway, along Kirk and Bristol roads. Ann's Choice, a retirement community is building on the West end of the runway bordered by Newtown and Street roads. New Victorian style homes are being built near the corner of Jacksonville and Kirk roads and behind the old barracks and enlisted club site.

Figure 8 – Aerial View of NAWC Warminster, looking North.
Photograph by the NAWC Photo Lab. Taken prior to redevelopment.

Source: www.crompton.com/nadc/Pix/aerial.html

Naval Air Station Joint Reserve Base Willow Grove[14]

In 1926, when many considered flying a daredevil sport, aviation pioneer Harold F. Pitcairn, outgrew his flying field in Bryn Athyn and purchased 191 acres of farmland north of Philadelphia along Easton Road in the vicinity of Graeme Park. From 1926 until 1942, Pitcairn developed built, tested and flew many different aircraft – most notably the Mailwing and Autogiro. In 1927, when Pitcairn won the U.S. Postal Service contract to carry the overnight mail between New York and Atlanta, he designed a safe, efficient and fast aircraft known as the Mailwing. This aircraft was bought as standard equipment by many other airlines. In 1929, Pitcairn formed a partnership with a Spanish Inventor Juan de la Cierva to develop rotary wing aircraft technology, coined by Mr. de la Cierva as an Autogiro, in the United States. That same year Pitcairn made the first successful rotary-wing flight in America at the Willow Grove Field. Throughout the 1930s, the Pitcairn team would develop and manufacture many different models of Autogiros at Willow Grove, a technology that would later be used in the development of the modern helicopter. Mr. Pitcairn was the 14th recipient of the highest award in American Aviation, the Collier Trophy. Three of his aircraft are

In 1929, aviation pioneer Harold F. Pitcairn made the first successful rotary-wing flight in America at the Willow Grove Field.

14 History compiled from http://www.globalsecurity.org/military/facility/willow-grove.htm

on display at the Smithsonian Institution's National Air and Space Museum in Washington D.C.

In 1942, Pitcairn reluctantly sold his air field to the United States Navy to support the war effort. In January 1943, the field was officially commissioned the United States Naval Air Station Willow Grove.

Figure 9 – The Autogiro

Following World War II, NAS Willow Grove was designated a Naval Air Reserve Training Station. Training and operation support activities increased during the Korean War. In 1957, the Navy purchased additional land, bringing the air station to its present total of 1,100 acres. Later, the Vietnam conflict and Gulf War would also significantly increase air station operations. All three conflicts saw many Willow Grove Reservists recalled to support both flight and ground missions. In 1994, the air station's name was again changed to Naval Air Station Joint Reserve Base (NAS JRB) Willow Grove, to more accurately depict the joint composition and mission of the Reservists serving here. Today, NAS JRB Willow Grove's 8000 foot runway is shared by Navy, Marine Corps, Air Force and Army Reservists, as well as the Pennsylvania Air National Guard. A total of 865 military and 362 civilian personnel are assigned to the base.

The Base Realignment and Closure 2005 Recommendations

The US. Department of Defense (DoD) recommended closing NAS JRB Willow Grove in November of 2005. This recommendation included the recommendation that all Navy and Marine Corps squadrons, their aircraft and necessary personnel, equipment and support be relocated to McGuire Air Force Base, Cookstown, NJ. The DoD also recommended deactivating the 111th Fighter Wing (Air National Guard or ANG) and relocating its assigned A-10 aircraft to several air stations in Idaho, Maryland and Missouri.

Although Willow Grove would be closed, an enclave would be established for the Army Reserve units remaining on or relocating to Willow Grove and the Air

National Guard 270th Engineering Installation Squadron. If the Commonwealth of Pennsylvania decides to change the organization, composition and location of the 111th Fighter Wing (ANG) to integrate the unit into the Future Total Force, all personnel allotted to the 111th Fighter Wing (ANG), including the unit's Expeditionary Combat Support (ECS) elements, will remain in place and assume a mission relevant to the security interests of the Commonwealth of Pennsylvania

Figure 10 – Aerial View of NAS JRB - Willow Grove

VI. Land Resources

Geology and Topography

Geology and topography exert great influence on the land uses and natural communities in a region. Regions with similar geologic and topographic characteristics are generally grouped into eco-regions or physiographic regions. This study area is located within the Northern Piedmont physiographic region.

The topography of a region is the configuration of a surface in relation to man-made and natural features. Topography is typically described in terms of differences in elevation and slope. The majority of the Little Neshaminy Creek Study Area's topography is characterized by undulating valleys and hills of the Triassic Lowland section of the Piedmont Province. Natural slopes may be gentle, moderately steep, or steep, but stable. As illustrated on Map 3 – Digital Elevation/Topography, this section's rolling terrain lies between altitudes of about 34 feet to 512 feet above sea level. Ridge tops, illustrated locally in Montgomery Township and along the border of Warwick and Warrington Township rise to elevations of 512 feet and 469 feet respectively.

As shown on Map 4 – *Geology*, the surface geology of the watershed consists primarily of Stockton Formation (18,945 acres) and Lockatong Formation (8,581 acres). There is also a small area (23 acres) of Brunswick Formation in the eastern-most section of the study area.

Stockton Formation has good surface drainage and high to moderate effective porosity and permeability. It contains light-colored, coarse-grained, arkosic sandstone and can include red sandstone, shale and siltstone. Groundwater yield from this geology is 130-gal/min of good quality groundwater from arkosic sandstone and 20-gal/min from shale. Stockton Formation creates topography featuring valleys of low relief with stable natural slopes.

Lockatong Formation is the second most prevalent geology in the study area. It consists of dark gray or black argillite with some zones of black shale and thin layers of calcareous shale. It has good surface drainage, low porosity and low permeability. The topography associated with this formation is rolling hills of medium relief with moderately steep and stable slopes. The Lockatong Formation has an average yield of 35-gal/min, making it a poor source for water extraction and recharge.[15]

Brunswick Formation consists mainly of reddish-brown shale, mudstone and siltstone. It has topography of undulating hills of low relief with moderately steep and stable slopes. This formation also exhibits good surface drainage and an average groundwater yield of 60-gal/min.

15 Geyer, Alan & Wilshusen, Peter. Environmental Geology Report 1 Engineering Characteristics of the Rocks of Pennsylvania, Harrisburg 1982

Steep Slopes

Development on moderate slopes in the range of 8 to 15 percent or greater accelerates erosion by removing or disturbing the established groundcover and topsoil. Slopes of 15 to 25 percent are considered steep and disturbed areas will yield heavy sediment loads, while very steep slopes over 25 percent produce heavy erosion and sediment loading when disturbed. Great care should be taken in disturbing areas within these steep slopes. Most municipalities within the study area have restrictive ordinances to protect these natural features. Removal of the vegetation destroys the groundcover, which absorbs rainwater, anchors soil and buffers or dissipates the impact of rainfall on topsoil. Without established vegetative cover, steep slopes yield greater volumes and more rapid rates of storm water runoff. This increased run-off contributes to more frequent and severe localized flooding in adjacent stream valleys during heavy rains and spring thaw. Erosion produces sediment that pollutes surface water. Over time, accumulated sediments narrow stream channels and fill ponds. This process restricts the capacity of waterways to handle flood flows and increases the incidence and severity of flooding.

The amount of steep slopes throughout the Little Neshaminy watershed is greatly varied from the headwaters to its confluence with the Neshaminy Creek main stem. As illustrated on Map 3 –Digital Elevation Model, there is an area of steep slope terrain along the Little Neshaminy Creek just above Park Creek. The elevation drops about 212 feet from Upper State Road to Lower State Road. Other key areas of steep slope exist along the north side of the Little Neshaminy Creek where Warminster, Warrington and Warwick Township meet to Almshouse Road. In this area, the elevation decreases approximately 217 feet over a 1,500 distance, a slope of approximately 15%. Overall, the watershed is not a steep slope prone area. However, areas in excess of 15% should be regulated to minimize disturbance from land development.

Soil Types

Soil characteristics have a direct impact on the way land is used and developed. They help determine an area's suitability for farming and building, as well as answer questions regarding potential drainage problems and erosion. The most common soil types in the study area are Urban Land-Penn complex (1,955 acres), Penn channery silt loam (1,613 acres), and Chalfont silt loam (1,496 acres).

The Penn series are moderately deep to shallow silt loams. They are formed from red shale, siltstone and fine-grained sandstone, and have moderately rapid permeability. These soils are important for agriculture and are often used for fruit, vegetables, hay and pasture. They have limitations for residential developments.

The Chalfont series of soils are deep, somewhat poorly drained, and nearly level or gently sloping. They are slowly permeable and have a thick layer of subsoil that restricts the downward flow of water and growth of roots. This series is suited to hay and pasture and have severe limitations for use as developments.

The majority of land in the study area is classified as Urban Land (5,685 acres). Urban Land is created when native soils are disturbed or destroyed by the construction process of homes, industry or active recreation facilities. Soil characteristics of Urban Land are highly variable due to the disturbed nature of these soils.

Hydrologic Soil Groups

Hydrologic soil groups (HSG) are used by soil scientists to indicate the minimum rate of infiltration of bare soil after prolonged wetting. The rate of infiltration is the speed at which water enters the soil at its surface. Soils with low runoff potential and high infiltration rates are classified as Group A. These soils tend to be deep, well-drained sand or gravel. The rate of water transmission is greater than 0.30 in/hr. Group B consists of soils with moderate infiltration rates. They are moderately deep or deep and moderately well-drained to well-drained. They also have moderately fine to moderately coarse textures. The rate of water transmission is 0.15-0.30 in/hr. Lower infiltration rates (0.05-0.15 in/hr) indicate Group C soils. Group C soils typically have a layer of soil that restricts the downward movement of water. Its texture is moderately fine to fine. The final HSG is Group D. This type of soil has high runoff potential with a very low infiltration rate (0-0.05 in/hr). Typically, Group D soils consist of one or more of the following: clay with high swelling potential, soil with a very high, permanent water table, soil with a layer of clay near the surface, shallow soil over nearly impervious material. The infiltration rates of the HSGs are shown on Table 2.

The majority of soils within the Little Neshaminy (52%) are classified as Hydrologic Group C,

Table 2 – Hydrologic Soil Type Definitions

Type	USDA Soil Texture	Infiltration Transmission Rate (in/hr)
A	Sand, loamy sand, sandy loam	> 0.30
B	Silty loam, loam	0.15–-0.30
C	Sandy clay loam	0.05–-0.15
D	Clay	0.00–-0.05

Source: National Engineering Handbook, Section 4, Hydrology, Chapter 7 Hydrologic Soil Groups, Victor Mockus, 1972

Table 3 describes the hydrologic soil group classification of soils within the study area and Figure 11 shows the distribution of these soil types. The majority of soils within the Little Neshaminy (52%) are classified as Hydrologic Group C, followed by soils that are not classified (23.82%). The soils are shown on Map 5 – *Hydrologic Soil Groups*. Unclassified soils are those that have been so altered that the United States Department of Agriculture, Natural Resource Conservation Service (NRCS) can not determine HSG values. Approximately 83% of those with an unclassified HSG are Urban Land soils.

The abundance of soils with low infiltration and moderate to high runoff rates can lead to increased stormwater runoff, based on land cover and also contribute to the watershed's characteristic of being flashy during storm events. This means that stream levels can rise quickly in response to rainfall events and fall very quickly, once the rain stops.

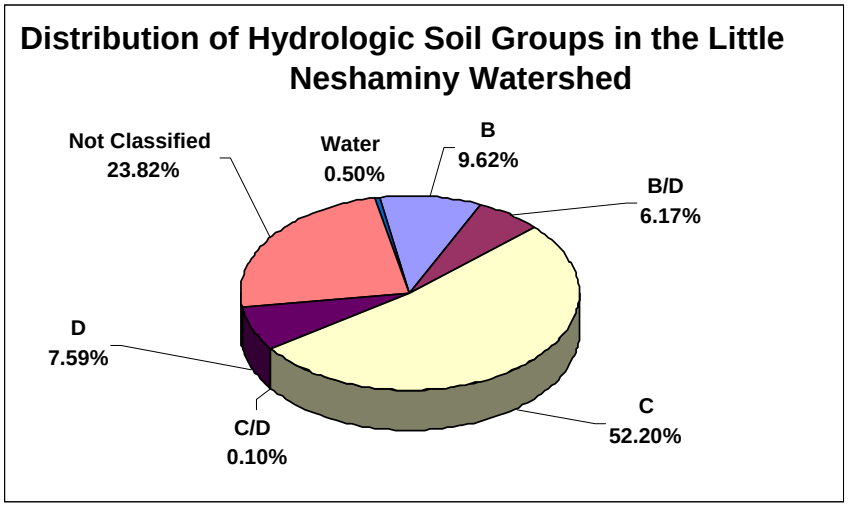
Table 3 Hydrologic Soil Groups within Little Neshaminy Creek Watershed		
Hydrologic Group	Total Acres	% of total
B	2,649.88	9.62%
B/D*	1,698.90	6.17%
C	14,381.70	52.20%
C/D*	26.79	0.10%
D	2,091.07	7.59%
Not Classified**	6,563.21	23.82%
Water	137.90	0.50%
Grand Total	27,549.45	100.00%

Source: Heritage Conservancy, NRCS

* Some soils are in Group D because of a high water table that creates a drainage problem. Once theses soils are effectively drained, they are placed in a different group. For example, Soils classified as B/D indicates that the drained soil is in Group B and the undrained in group D.

** These soils have been altered so that NRCS can no longer determine their hydrologic characteristics.

Figure 11 – Distribution of Hydrologic Soil Groups in Little Neshaminy



Floodplain and Hydric Soils

Floodplain (alluvial) and hydric soils exhibit characteristics of both land and aquatic environments. Due to their unique properties, areas within the land/water interface such as floodplains and wetlands are particularly susceptible to adverse environmental impacts. Hydric soils are one of the primary indicators of the existence of a wetland area. A hydric soil is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of wetlands vegetation. Hydric soils are shown along with hydrologic soil groups on Map 5 – *Hydrologic Soil Groups*.

Floodplain or alluvial soils are rich in nutrients and easily support plant growth. This provides an environment that typically supports many different species of plants, animals and birds. Vegetation within floodplains can help reduce the

velocity of stormwater and lowers erosive capacity. Floodplains also trap sediments, a process which helps improve water quality following rainfall events. Floodplains located within the study area are shown on Map 6 – *Water Resources*.

Floodplain (alluvial) soils are important in areas where the National Flood Insurance Program has not identified and calculated the floodway and flood fringe areas. In these unmapped areas, the floodplain or alluvial soils indicate where flooding had occurred in the past. Unless a hydrological study is undertaken to prove that flooding has not occurred in recent times, these floodplain soils should be considered part of the floodplain and regulated as a floodway. (See further discussion on floodplains and flooding in Chapter X – *Water Resources.)*

Land Cover

The following information describes current land cover within the watershed. Land cover, instead of land use information is presented to give a more precise view of the type and intensity of coverage actually occupying a given area. "Land cover" refers to what is on the land, such as crops, lawns or woodlands. "Land use" describes what the land is currently designated to be used for economic or development purposes. (i.e., commercial, residential, or industrial). Land use is typically portrayed for future planning purposes, while land cover is used to describe current conditions. [16] Land cover information was obtained from the USGS Land Cover Data and 2000 DVRPC land cover. As summarized in Table 4, and illustrated in Figure 12, the highest single land cover type in the watershed is Low Intensity Residential at 34.0%, followed by Woodland at 16.7% and Agriculture at 16.2%. Map 7 – *Land Cover* provides an overview of the watershed.

...the highest single land cover type in the watershed is Low Intensity Residential at 34.0%

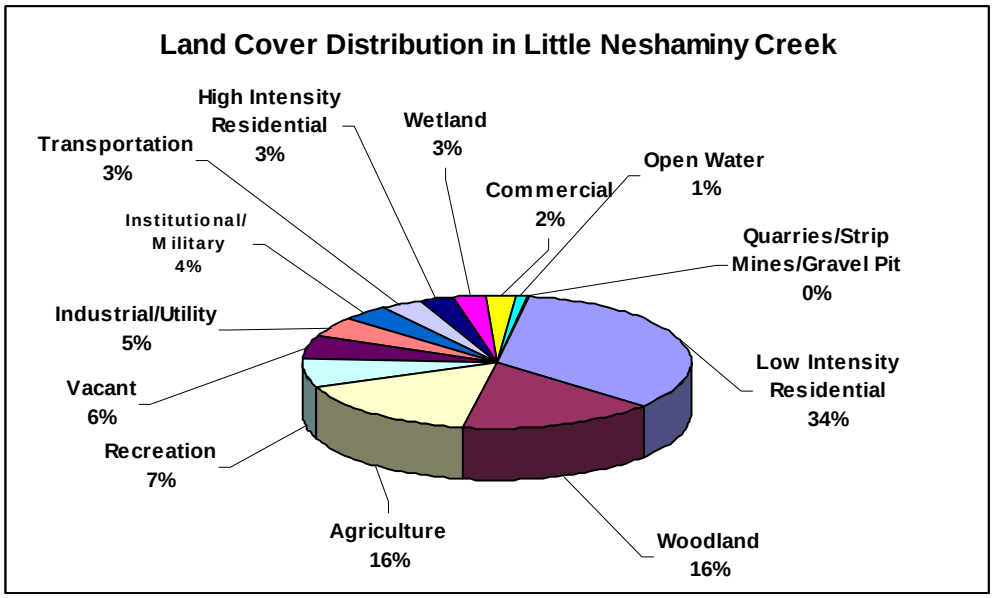
Table 4 – Land Cover Statistics for Study Area

Land Cover Type	Acres	% Study Area
Low Intensity Residential	9,363.05	34.0%
Woodland	4,596.33	16.7%
Agriculture	4,453.71	16.2%
Recreation	1,933.48	7.0%
Vacant	1,536.29	5.6%
Industrial/Utility	1,334.40	4.8%
Institution/Military	1,124.10	4.1%
Parking/Transportation	955.12	3.5%
High Intensity Residential	813.16	3.0%
Wetland	763.65	2.8%
Commercial	701.09	2.5%
Open Water	220.77	0.8%
Quarries	90.85	0.3%
Totals	27886.00	101.3%

Source: Pennsylvania Spatial Data Access based on United States Geological Survey Land Cover data. DVRPC, 2000 Land Cover

16 http://www.cara.psu.edu/land/lu-primer/luprimer01.asp Consortium for Atlantic Regional Assessment

Figure 12 – Land Cover Distribution - DVRPC, 2000



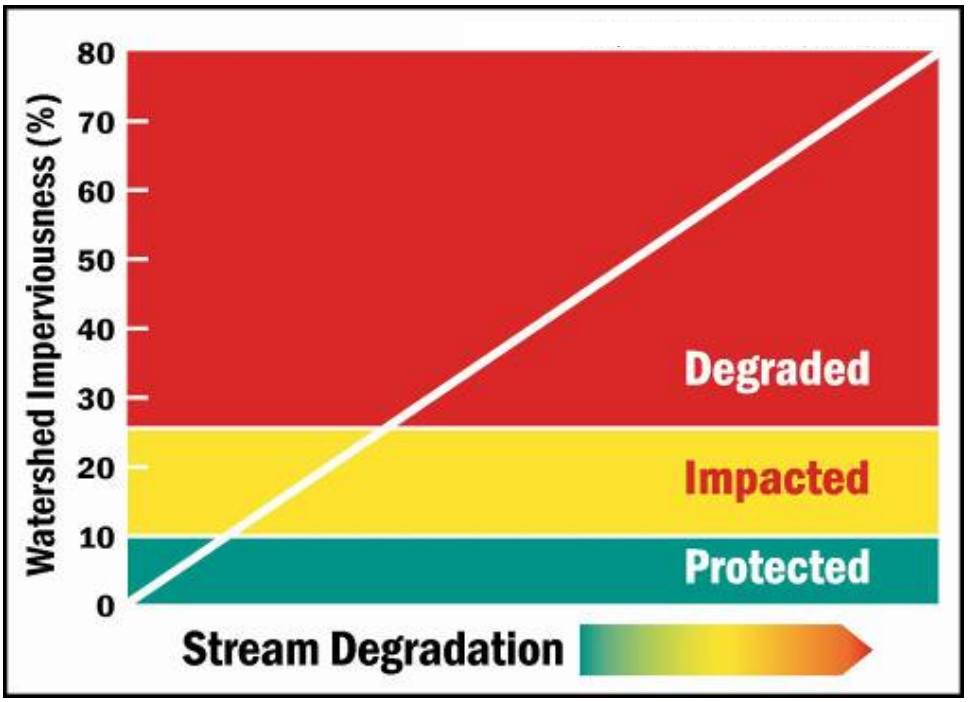
Impervious Cover and Stream Health

The amount of imperviousness directly relates to the amount and type of development in a watershed.

Land cover is a valuable tool in assessing stream quality health because it provides an indicator of the intensity of development. As the intensity of development increases, (i.e. from woodland to residential); so does the generation of nonpoint source water pollution, or polluted runoff. A good indicator of the intensity of development in a given area is the amount of impervious surface. Impervious surfaces like asphalt, concrete and roofing increase the volume and velocity of the runoff. In addition, by blocking the infiltration of water and its associated pollutants into the soil, impervious surfaces interfere with natural processing of nutrients, sediment, pathogens and other contaminants, resulting in degradation of surface water quality.

Impervious surfaces do not allow rainfall to infiltrate back into the soils and thus increased impervious cover leads to increased stormwater runoff volume discharging directly into our streams and rivers. The amount of imperviousness directly relates to the amount and type of development in a watershed and the relationship between impervious cover and stream degradation has been verified in numerous studies. Perhaps the most well-know illustration showing the relationship between percent impervious cover and water quality is the "Impervious Cover Model" developed by Tom Schueler et al., at the Center for Watershed Protection. Figure 13 illustrates that when watershed imperviousness reaches about 10%, stream quality indicators are impacted, and when impervious cover reaches about 25%, stream degradation occurs. These percentages can vary depending upon the sensitivity of the stream.

Figure 13 –The Impervious Cover Model



Watershed Impervious cover was estimated through an evaluation conducted by the Delaware Riverkeeper Network as part of their *Little Neshaminy Watershed Assessment and Restoration* study completed in 2003. Through analysis of aerial photographs and land use information, the average percent impervious cover was determined by individual aerial photo units. These figures were then averaged to determine the overall watershed impervious cover for 2000. This process was also repeated with information from 1970 as a basis for comparison. Impervious cover percentages by aerial photo unit for 2000 and 1970 are shown on Figure 14.

Overall watershed impervious cover in the Little Neshaminy was estimated to be 24% in 2000.

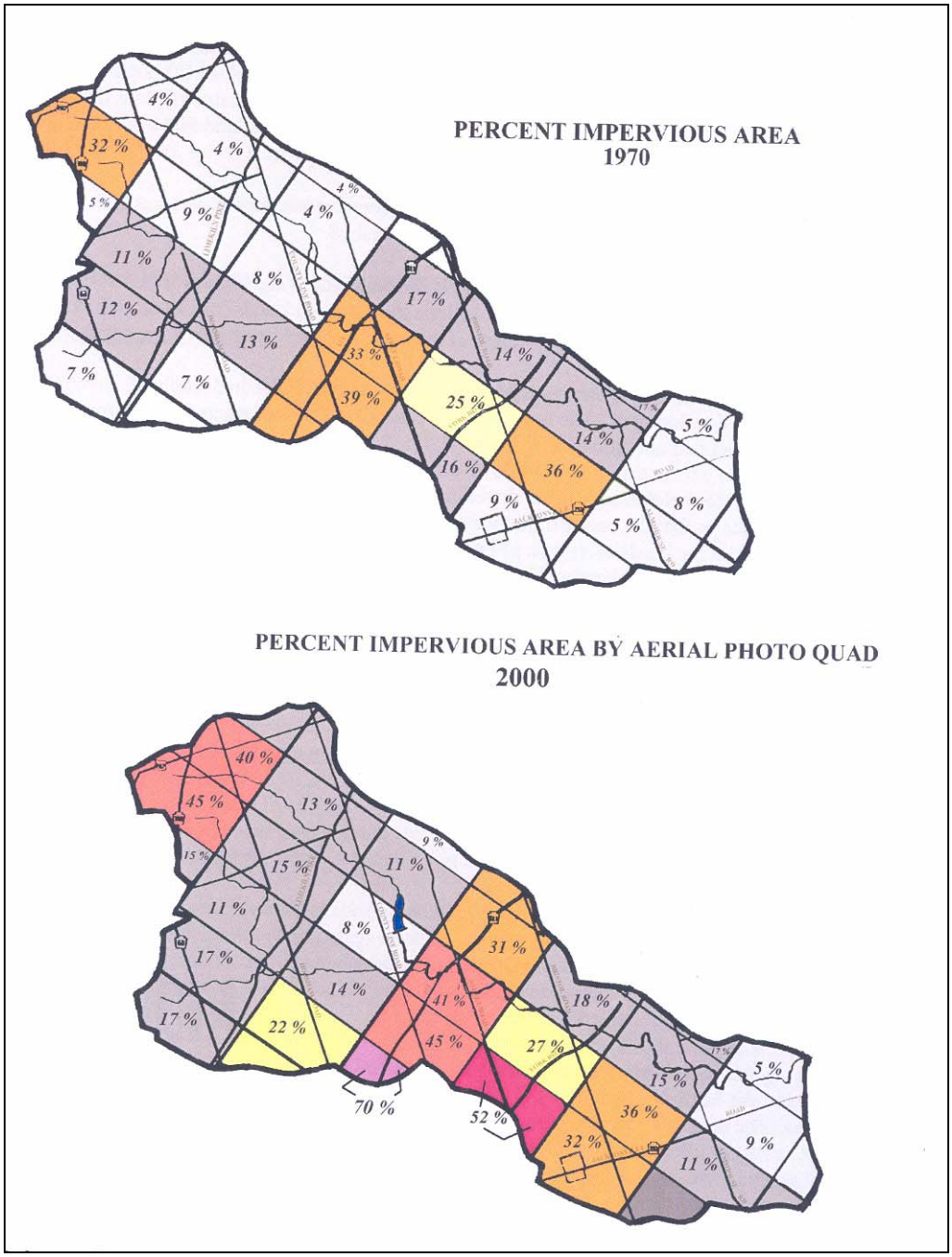
Overall watershed impervious cover in the Little Neshaminy was estimated to be 24% in 2000. In comparison, impervious cover in 1970 was estimated to be about 15%. The study notes that agricultural lands decreased dramatically over the 30 year period due to development of residential, commercial and industrial properties.[17]

While this number represents an average across the Little Neshaminy watershed, there are still areas within the watershed that maintain impervious cover percentages lower than 10%. As shown on Figure 14 areas of lower impervious cover include the vicinity of the Forks of Neshaminy, where there are still a number of rural, agricultural properties. This area has also been a focus of concentrated land preservation which has contributed to keeping lands free from development and thus minimal increases in impervious cover.

17 Delaware Riverkeeper Network, Little Neshaminy Watershed Assessment and Restoration, February 2003.

This information is useful in determining preservation priorities for locations within the watershed. Areas that are below or near the 10% impervious cover should be carefully evaluated for possible conservation or use of low-impact development techniques which stress the importance of minimizing impervious cover in new and redeveloping areas.

Figure 14 – Percent Impervious Cover - !970 and 2000



Source: Delaware Riverkeeper Network, Little Neshaminy Watershed Assessment and Restoration, February 2003.

Woodlands

Large parcels of wooded land provide contiguous habitat for wildlife and educational opportunities to learn about flora and fauna of forest communities. These areas are important in replenishing groundwater resources and absorbing and filtering stormwater runoff. Woodlands and forest areas, especially those along stream corridors provide cover to the creek's tributary waters, which helps cool and moderated temperature fluctuations. Wooded areas, especially those with public access, are an important but diminishing resource and most are typically found in state and local parklands in the region. According to the land cover information from 2000, woodlands represent about 17% of the land cover in the Little Neshaminy Creek or 4,600 acres. Most of the existing woodlands in the watershed are located along the main stem of the Little Neshaminy within Warwick and Northampton Townships and along the Bradford Reservoir in Warrington. Other contiguous areas can be found in Horsham Township along the Park Creek and its tributaries. These areas are shown in Map 7 – Land Cover. Since land cover data is from 2000, this percentage will most likely decline in the region due to the amount of development occurring in some parts of the watershed area.

Quarries

There are two quarries within the study area. Both are operated by Glasgow, Inc. in Montgomery Township. The quarry located on Upper State Road between Bethlehem Pike and Horsham Road is a clean fill reclamation location. The second location is a quarry and asphalt plant located at the intersection of Bethlehem Pike and Hartman Road.

There are no quarries located within the Bucks County portion of the Little Neshaminy Creek Watershed. Table 4a provides additional detail on the Glasgow Spring House Quarry.

Table 4a – Quarries in the Little Neshaminy Watershed

Municipality Name	Quarry Name	Permit I.D. #	Type	Company	Tonnage	Geology	Employees
Montgomery Township	Glasgow Spring House Quarry	8074SM1	Surface Mine	Glasgow, Inc.	586,025	Argillite	14

Source: Montgomery County Open Space Plan, Chapter 2 - Natural Features "Quarries in Montgomery County", 2000

Municipal Planning & Zoning

As noted in the table below, all of the municipalities within the watershed have adopted comprehensive plans, although a number of these are outdated. In addition, all municipalities have open space plans. As a result of the Montgomery County Green Fields/Green Towns program, all of the Montgomery County municipalities have updated their open space plans within the last 2 years.

Table 4b - Status of Comprehensive and Open Space Plans for Little Neshaminy Creek Municipalities			
Municipality	Comprehensive Plan	Open Space Plan	Environmental Advisory Board or Council
Horsham	1989	2005*	yes
Lower Gwynedd	1987	2006	no
Montgomery	1999	2006	yes
Upper Dublin	outdated	2005	yes
Ivyland Borough	1968	1999	no
Northampton	1999	1999	yes
Warminster	outdated	2001**	no
Warrington	2006	1998	yes
Warwick	1998	1999	no
*updated parks and recreation plan in 2003			
** includes parks and recreation plan			

A general review of the municipal natural resource protection ordinances was undertaken to determine the type of protection measures currently in place within the watershed municipalities. This review utilized information compiled by the Bucks County Planning Commission (updated in 2005) and through review by Heritage Conservancy. A summary matrix is included in Appendix A. The majority of municipalities have ordinances which restrict development in natural areas such as steep slopes, floodplains, wetlands, lakes, and ponds, and woodlands.

Although each municipality restricts development in wetlands and the 100-year floodplain, some do not provide the same level of protection for wetland buffer, flood fringe areas or floodplain soils. Municipalities should review ordinances to strengthen protection of 100-year floodplains, flood fringe, wetlands and wetland margin areas and to assure that protection measures for significant natural areas are in place. Municipalities should also consider regulating the uses within alluvial and hydric soils, which are generally associated with floodplains and wetlands

Four municipalities have specific riparian buffer ordinances which delineate specific zone widths, permitted uses and management measures. These include Horsham Township, Ivyland Borough Lower Gwynedd Township and Warwick Township. All of the municipalities include stormwater volume control, while only two (Horsham and Upper Dublin) require groundwater recharge. The Bucks County Planning Commission is currently completing an update to the Neshaminy Creek Watershed Act 167 Stormwater Management Plan, which includes the Little Neshaminy. This plan will include specific water quality standards and criteria and recommended stormwater Best Management Practices which will need to be adopted by the Neshaminy Creek Watershed municipalities.

Three municipalities currently have ordinances in place to protect historic resources, (Horsham, Montgomery and Warwick Townships) and two, (Lower

Gwynedd and Upper Dublin Townships) are currently drafting historic preservation language.

Analysis

According to the Little Neshaminy TMDL report[18], the watershed experienced a 20% increase in development from 1992 to 2000. Land cover in 1992 was 34% agricultural, 33% forested and 33% developed. In comparison, 2000 land cover information revealed a reduction in agricultural land cover to 16% and woodlands to 17%. In the same period developed areas increased to 51% (combination of residential, commercial, institutional, industrial and transportation). These statistics are important due to the relationship between local land use practices and protection of natural resources, as noted in the discussion of watershed impervious cover.

Although the watershed is not characterized by steep topography, the underlying geologic formations and hydrologic soil characteristics lead to high runoff potential and low infiltration during storm events. This coupled with the increases in impervious surfaces from development contributes to increased volume of stormwater runoff during storm events and increases in non-point source pollution. Consequently, the Little Neshaminy has had a history of flooding and many of its stream tributaries are experiencing water quality degradation.

There is a continuing need for all the municipalities to review their comprehensive plans, zoning and subdivision ordinances to be consistent with conservation values.

Municipalities are encouraged to review and update, if necessary their natural resource protection ordinances to assure that the most sensitive features such as wetlands, floodplains and riparian areas are properly protected and managed. Natural resource based planning to assure protection and conservation of sensitive natural areas is an important method to guide the type and intensity of new development in a community. It also provides an opportunity to collectively identify the most valuable resources for preservation efforts and utilize this information to update and revise comprehensive plans, which help guide future land use decisions.

There are a variety of model ordinances available for Pennsylvania municipalities which cover a wide range of resources including steep slopes, groundwater recharge areas, wetlands and wetland buffers, hydric and alluvial soils, riparian corridors and stormwater. Municipalities within the Little Neshaminy such as Horsham Township have adopted innovative ordinances for stream corridor protection and stormwater management. Model ordinances, which can be used as a template for developing specific ordinances, can be obtained from the Bucks County Planning Commission and Montgomery County Planning Commission.

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18 PA Department of Environmental Protection, TMDL Assessment of Little Neshaminy Creek Watershed, December 2003.

In addition, the Delaware Valley Regional Planning Commission (DVRPC) maintains samples of municipal ordinances from this region which they feel are outstanding resource protection examples. This list can be accessed via their website at:
http://www.dvrpc.org/planning/community/ProtectionTools/ordinances.htm

Proper environmental review of development plans to encourage conservation design and the use of stormwater Best Management Practices are also recommended so that new and redevelopment can be accommodated in a sustainable manner, including designs which minimize the amount of impervious cover. This requires continuing education and technical assistance to municipal officials and staff involved in land use management issues on the link between land use practices and water quality.

In addition, the recently published Pennsylvania Stormwater Best Management Practices Manual would be an excellent reference for reviewing appropriate structural and non structural BMPs. The involvement of an Environmental Advisory Committee or Board is also a valuable tool in the design review process. Those municipalities who do not have Environmental Advisory Boards are encouraged to form them if possible to assist in the review of development and redevelopment plans.

VII. Demographic Trends

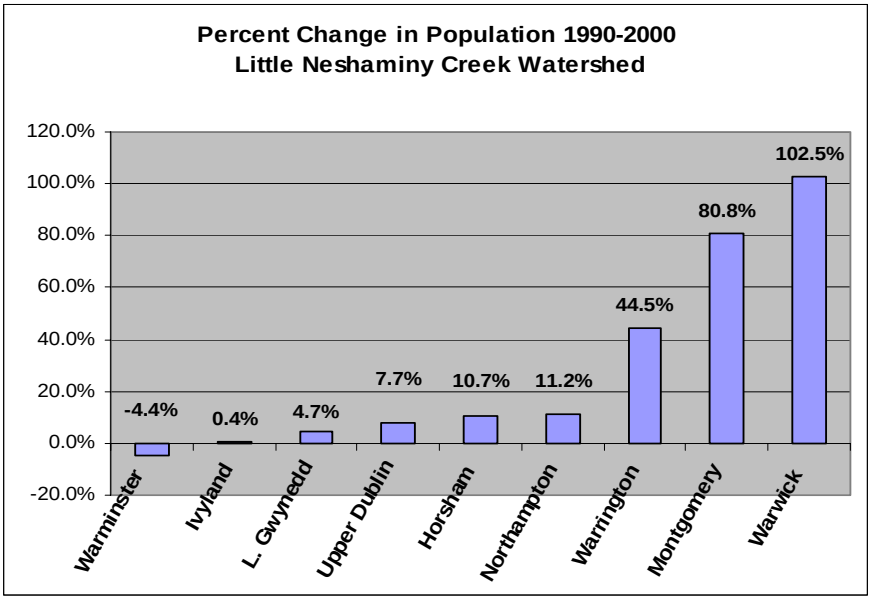
Methodology

The following review of demographic data has been generated based on analysis of several demographic sources including the US Census Bureau and the Delaware Valley Regional Planning Commission. As noted in Chapter 5, some of the municipalities are only partially located within the Little Neshaminy Creek Watershed area[19]. However, the statistics for the entire municipality are presented in this chapter. In addition, we have provided reference data for the two counties as well as the state of Pennsylvania.

Population Growth Trends: 1990 - 2000

A review of U.S. Census data from both 1990 and 2000 show that overall, the municipalities within the Little Neshaminy Creek Watershed have experienced varying degrees of growth within the last decades. Figures 14 and 15 portray both the percent increase as well as absolute increases in population within the watershed municipalities. These increases are particularly evident in the headwaters community of Montgomery Township and within the more rural municipality of Warwick Township in central Bucks County. Over the past decade the municipalities have had an increase of 28,500 people and 11,400 new housing units.

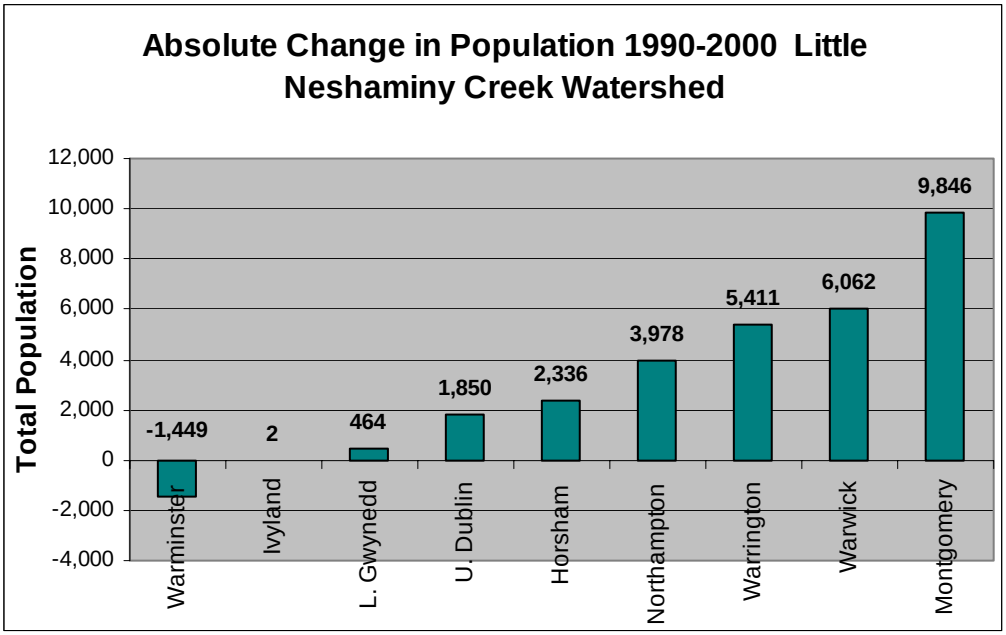
Figure 14 – Percent Change in Population



Source: US Census Data, 2000.

19 Note: Based on an analysis of block group data, Heritage Conservancy estimated that the population of the watershed in 2000 was approximately 90,500. This figure was developed to try and approximate the population of the municipalities only within the boundaries of the watershed area. All other data presented is based on the entire municipality regardless of the amount of land area located in the watershed boundary.

Figure 15 – Absolute Change in Population - 1990 – 2000.



Source: US Census Data, 2000.

Population Estimates 2005

Estimates for 2005 prepared by the US Census Bureau were reviewed to provide additional information on trends since the 2000 census. The estimates show that the growth trends evident since 1990 are continuing. Estimated population of the Little Neshaminy Creek municipalities has continued to increase steadily since 2000, with an average rate of 3.1%. As summarized in Table 5, it is estimated that the communities of Ivyland, Warrington and Warwick have experienced the most gains in terms of percent growth, while the communities of Warrington and Warwick are estimated to have the most numeric gains over the past 5 years.

Table 5 – 2005 Population Estimates

Area	Current Population	Population Estimates *	Numeric Change	Percent Change
	2000	2005	2000-2005	2000-2005
Pennsylvania	12,281,054	11,957,883	-323,171	-2.70%
Bucks County	597,635	608,486	10,851	1.78%
Montgomery County	750,097	751,097	1,000	0.13%
Planning Area Municipalities	183,373	189,208	5,835	3.08%
Ivyland Borough	492	804	312	38.81%
Northampton Township	39,384	41,018	1,634	3.98%
Warminster Township	31,383	32,980	1,597	4.84%
Warrington Township	17,580	22,020	4,440	20.16%
Warwick Township	11,977	14,538	2,561	17.62%
Horsham Township	24,232	25,071	839	3.35%
Lower Gwynedd Township	10,422	11,175	753	6.74%
Montgomery Township	22,025	24,213	2,188	9.04%
Upper Dublin Township	25,878	26,389	511	1.94%

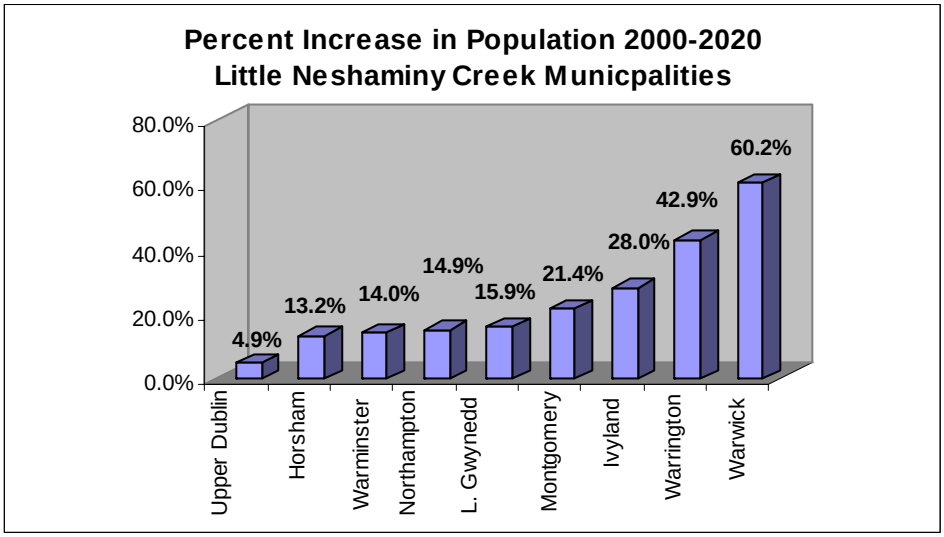
*Source: US Census Bureau, Population Estimates Program.

As summarized in Table 5, all of the Little Neshaminy Creek municipalities are estimated to have experienced an increase in population since 2000, most at rates higher than the two counties and the state. Montgomery Township's growth rates are estimated to be tapering off as compared to the 1990's.

Forecasted Population Change 2000-2020

Forecasts developed by the Delaware Valley Regional Planning Commission and updated in March, 2005 indicate that collectively the population of the municipalities within the Little Neshaminy Creek Watershed are forecasted to increase by 40,446 people or 22% overall growth from 2000 to 2020. As detailed in Table 6, and illustrated in Figure 16, Warrington and Warwick Townships are forecasted to increase population by 43% and 60% by 2020. With the exception of Upper Dublin, all of the watershed municipalities are predicted to grow at rates exceeding their respective county rates of 11.4% for Montgomery and 18% for Bucks County.

Figure 16 – Projected Increase in Population 2000-2020



Sources: US Census Data, 1990 and 2000. Forecasts by Delaware Valley Regional Planning Commission (Population and Employment Forecasts, 2000-2030, Regional Data Bulletin, Revised No. 73, March 2005)

Table 6 – Population Projections for the Little Neshaminy Creek Watershed Planning Area 2000-2020									
Area	Current Population	Projections*		Numeric Change			% Change		
	2000	2010	2020	2000 - 2010	2010-2020	2000 - 2020	2000 - 2010	2010 - 2020	2000 - 2020
Bucks County	597,635	652,800	709,150	55,165	56,350	111,515	9.2%	8.6%	18.7%
Montgomery County	750,097	797,990	838,700	47,893	40,710	88,603	6.4%	5.1%	11.8%
Planning Area Municipalities	183,373	203,820	223,650	20,447	19,900	40,446	11.2%	9.7%	22.0%
Ivyland Borough	492	560	630	68	70	138	13.8%	12.5%	28.0%
Northampton Township	39,384	42,430	45,260	3,046	2,830	5,876	7.7%	6.7%	14.9%
Warminster Township	31,383	33,680	35,790	2,297	2,110	4,407	7.3%	6.3%	14.0%
Warrington Township	17,580	21,120	25,120	3,540	4,000	7,540	20.1%	18.9%	42.9%
Warwick Township	11,977	15,230	19,190	3,253	3,960	7,213	27.2%	26.0%	60.2%
Horsham Township	24,232	25,840	27,420	1,608	1,580	3,188	6.6%	6.1%	13.2%
Lower Gwynedd Township	10,422	11,410	12,080	988	670	1,658	9.5%	5.9%	15.9%
Montgomery Township	22,025	24,870	26,740	2,845	1,870	4,715	12.9%	7.5%	21.4%
Upper Dublin Township	25,878	26,730	27,150	852	420	1,272	3.3%	1.6%	4.9%

*Sources: Delaware Valley Regional Planning Commission, Population and Employment Forecasts, 2000-2030. No. 73, March 2005.

Family and Household Characteristics

A review of family and household characteristics reveal that the municipalities with the highest percentage of population change tend to have corresponding increases, both in percent change and in absolute change, in the numbers of new households and also in the number of new family households. Households are defined as, "One or more people occupying a housing unit as their usual place of residence. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated people who share living arrangements."[20] Family households include a householder and one or more other people living in the same household who are related to the householder by birth, marriage or adoption. All people in a household who are related to the householder are regarded as members of his or her family. A household can contain only one family for purposes of census tabulations. Not all households contain families since a household may be a group of unrelated people or one person living alone.

As shown on Tables 7 and 8, the municipalities of Warwick, Montgomery, and Warrington all showed corresponding increases in new household formations and new family household formations.

20 US Census Bureau

Table 7 – Household Characteristics 1990 to 2000 Little Neshaminy Creek Planning Area						
Area	Total Households		Numeric Change	Percent Change	Average HH Size	
	1990	2000	1990-2000	1990-2000	1990	2000
Pennsylvania	4,495,966	4,777,003	281,037	6.3%	2.57	2.48
Bucks County	190,507	218,725	28,218	14.8%	2.8	2.69
Montgomery County	254,995	286,098	31,103	12.2%	2.58	2.54
Planning Area Municipalities	52,998	64,974	11,976	22.6%	2.81	2.75
Ivyland Borough	186	194	8	4.3%	2.63	2.52
Northampton Township	11,105	13,014	1,909	17.2%	3.17	3.01
Warminster Township	10,846	11,350	504	4.6%	2.99	2.74
Warrington Township	4,204	6,124	1,920	45.7%	2.89	2.86
Warwick Township	1,914	3,933	2,019	105.5%	3.09	3.04
Horsham Township	8,279	9,082	803	9.7%	2.6	2.64
Lower Gwynedd Township	3,679	4,177	498	13.5%	2.46	2.39
Montgomery Township	4,579	7,926	3,347	73.1%	2.64	2.74
Upper Dublin Township	8,206	9,174	968	11.8%	2.86	2.78

Source: US Census Bureau, Census 2000, 1990

Table 8 – Change in Family Households 1990 to 2000 Little Neshaminy Creek Planning Area						
Area	Family Households		Numeric Change	Percent Change	Average Family Size	
	1990	2000	1990-2000	1990-2000	1990	2000
Pennsylvania	3,155,989	3,208,388	52,399	1.7%	3.1	3.04
Bucks County	145,924	160,946	15,022	10.3%	3.24	3.17
Montgomery County	181,075	197,640	16,565	9.1%	3.11	3.09
Planning Area Municipalities	41,906	50,342	8,436	20.1%	3.22	3.17
Ivyland Borough	140	152	12	8.6%	3.06	2.83
Northampton Township	9,487	10,964	1,477	15.6%	3.48	3.33
Warminster Township	8,758	8,625	-133	-1.5%	3.37	3.16
Warrington Township	3,316	4,805	1,489	44.9%	3.27	3.26
Warwick Township	1,644	3,267	1,623	98.7%	3.36	3.38
Horsham Township	5,883	6,447	564	9.6%	3.11	3.18
Lower Gwynedd Township	2,474	2,754	280	11.3%	3.08	3.03
Montgomery Township	3,565	6,055	2,490	69.8%	3.02	3.2
Upper Dublin Township	6,639	7,273	634	9.5%	3.23	3.18

Source: US Census Bureau, Census 2000, 1990

Age Characteristics

Household increases, especially family households, usually show a close correlation with age statistics and the number of children. Typically, those with increased family households show corresponding increases in the number of children below 18 and typically have younger median ages. This trend is evident in the Little Neshaminy municipalities.

As summarized in Table 9, Warwick, Montgomery and Warrington have the highest percentage of population under 18 and all three also have shown either increased or steady family size between 1990 and 2000. In addition, Warwick and Warrington have the youngest median age of the study area municipalities. Lower Gwynedd and Warminster Townships and Ivyland Borough had the highest percentage of population over 65 and both Lower Gwynedd and Ivyland had corresponding high median ages. It is also interesting to note that seven of the nine study area municipalities showed an increase in the percentage of population over 65.

Table 9 – Age Characteristics in the Little Neshaminy Planning Area
1990 to 2000

Area	2000 Census	Percent of Population 2000 Census		Percent of Population1990 Census	
	Median Age	Under 18 Years	65 Years and Over	Under 18	65 years and over
Pennsylvania	38.0	23.8	15.6	23.5%	15.4%
Bucks County	37.7	25.7	12.4	25.7%	10.9%
Montgomery County	38.2	24.1	14.9	22.5%	15.0%
Planning Area Municipalities	38.2	26.9	12.4	25.3	10.8
Ivyland Borough	39.3	21.1	14.8	23.3%	10.4%
Northampton Township	38.9	28.2	10.0	28.6%	7.3%
Warminster Township	37.9	24.5	15.2	25.5%	9.6%
Warrington Township	35.4	29.1	8.5	27.3%	7.8%
Warrick Township	34.0	33.1	5.8	31.6%	5.4%
Horsham Township	35.7	27.0	9.8	23.3%	8.7%
Lower Gwynedd	44.6	23.1	22.6	19.8%	24.3%
Montgomery Township	36.8	28.4	11.3	24.0%	12.6%
Upper Dublin Township	40.9	27.4	13.7	24.4%	11.2%

Source: U.S. Census Bureau, Census 1990, 2000

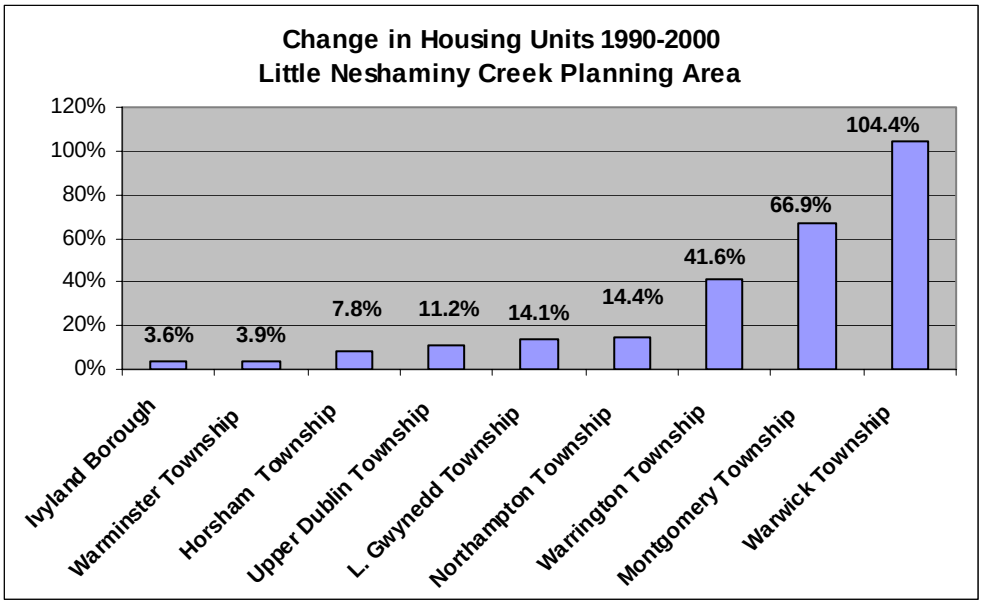
Housing Unit Characteristics

Another indicator of development trends are housing unit statistics. The US Census tracks the number of new housing units constructed and also provides key data on housing unit characteristics. This data, in conjunction with other economic indicators helps us understand the characteristics of the housing stock and the development status (i.e. growing, stable and declining) of the various communities. As shown in Figures 17 and 18 and summarized in Table 10, the municipalities with higher rates of population and household growth are also those with high percentage of new housing units.

Table 10 – Change in Housing Units 1990-2000				
Little Neshaminy Creek Planning Area				
Area	Housing Units		Numeric Change	Percent Change
	1990	2000	1990-2000	1990-2000
Pennsylvania	4,938,140	5,249,750	311,610	6.3%
Bucks County	199,934	225,498	25,564	12.8%
Montgomery County	265,856	297,434	31,578	11.9%
Planning Area Municipalities	54,971	66,371	11,400	20.7%
Ivyland	192	199	7	3.6%
Northampton	11,486	13,138	1,652	14.4%
Warminster	11,207	11,644	437	3.9%
Warrington	4,458	6,314	1,856	41.6%
Warwick	1,981	4,050	2,069	104.4%
Horsham	8,599	9,269	670	7.8%
Lower Gwynedd	3,820	4,360	540	14.1%
Montgomery	4,825	8,053	3,228	66.9%
Upper Dublin	8,403	9,344	941	11.2%

Source: U.S. Census Bureau, Census 1990, 2000

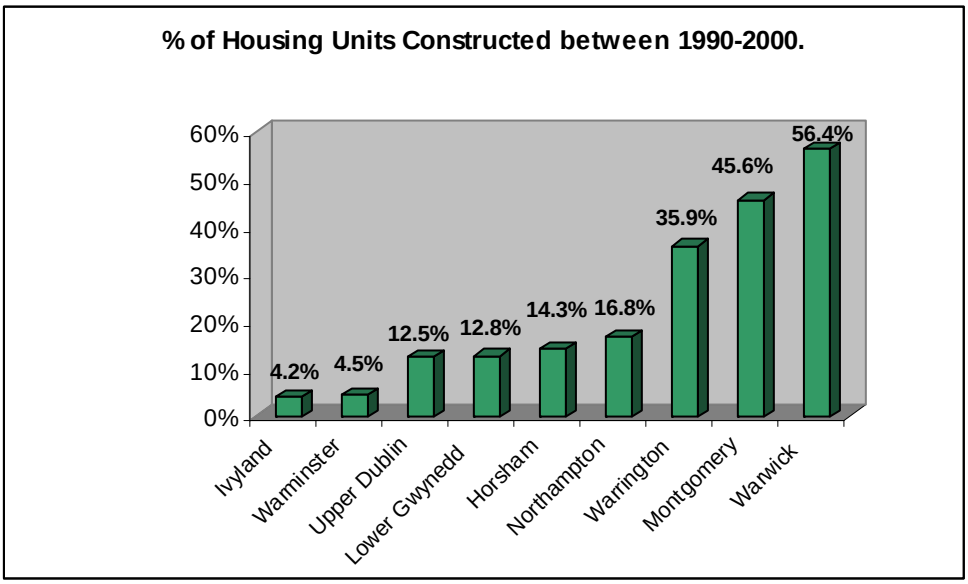
Figure 17 – Change in Housing Units 1990-2000



Source: U.S. Census Bureau, Census 1990, 2000

Again, the municipalities of Warwick, Montgomery and Warrington ranked highest in the percentage of new housing units constructed between 1990 and 2000. In absolute numbers, Montgomery added over 3,200 units while Warwick added over 2,000 units. In terms of the age of the municipality's housing stock, these same municipalities also had a large percentage of newer housing stock.

Figure 18 – Percent of Housing Units Constructed 1990-2000



Source: U.S. Census Bureau, Census 2000

Economic and Employment Information

Several economic indicators were reviewed for the study area municipalities including median household income and median housing values. As summarized in Table 11, the municipalities within the watershed have higher median household incomes and housing values than the than the State and higher or similar values in comparison to the county figures. Unemployment rates as well as poverty rates are also below the state figures.

Table 11 – Little Neshaminy Creek Planning Area- Economic Characteristics

Area	% Unemployed	Median HH Income	Median Housing Values	% Families Below Poverty Level
Pennsylvania	3.5%	$40,106.0	$97,000.0	7.8%
Bucks County	2.4%	$59,727.0	$163,200.0	3.1%
Montgomery County	3.1%	$60,829.0	$160,700.0	2.8%
Ivyland Borough	3.3%	$58,958.0	$157,400.0	2.1%
Northampton Township	2.0%	$82,655.0	$219,000.0	1.4%
Warminster Township	1.9%	$54,375.0	$160,500.0	4.1%
Warrington Township	2.9%	$66,364.0	$199,900.0	1.8%
Warwick Township	1.7%	$81,711.0	$203,400.0	1.2%
Horsham Township	2.3%	$61,998.0	$167,700.0	1.4%
Lower Gwynedd Township	1.4%	$74,351.0	$252,500.0	1.2%
Montgomery Township	2.3%	$78,953.0	$188,400.0	1.5%
Upper Dublin Township	1.5%	$80,093.0	$224,200.0	2.7%

Source: US Census Bureau, Census 2000

Analysis

The demographic information reveals that the watershed municipalities have experienced varying degrees of growth over the past decade. These communities are generally affluent and located within close proximity to major transportation routes and employment centers, making them attractive places to live. Much of the growth that has occurred over the past decade has been in the most sensitive areas of the watershed such as in Montgomery Township within the creek's headwaters and in Warwick Township located in the rural and relatively undeveloped "Forks of Neshaminy" area.

To varying degrees over time, home-buying has been more attractive in this area, and thus municipalities continue to be faced with development pressure and the desire to accommodate reasonable growth, but in a sustainable manner. The demographic data notes that those municipalities who are growing rapidly tend to have a greater percentage of children under 18, which has implications for school districts across the watershed. With the increased population growth, additional land is utilized for housing, institutional and commercial development which, as noted in the previous chapter, places additional stress on the watershed health by reducing woodland and open space areas and increasing impervious surfaces.

VIII. Parks, Recreation and Open Space

State and County Parks

There is one County–owned park within the study area, (Bradford Dam Park) located in Warrington Township and one State Park, (Graeme Park) located in Horsham Township. Bradford Dam Park is a 280-acre park that includes the 22-acre Bradford Lake Reservoir. The lake and surrounding parkland are owned by the Bucks County Department of Parks and Recreation and leased to Warrington Township. Both the County and Township maintain the park. Graeme Park is owned and operated by the Pennsylvania Historical and Museum Commission and supported by the Friends of Graeme Park. The 44-acre park includes the Keith House, constructed in 1722, which was the summer home of the Provincial Governor Sir William Keith and the only remaining residence of a colonial Pennsylvania Governor. The park also offers nature trails, picnic tables, a visitor center and special events throughout the year.

Municipal Parks and Open Space

The majority of parks located within the study area are municipally owned. There are 45 municipal parks that make many recreational resources available for public use, including playing fields, hiking trails, picnic areas, tennis and volleyball courts, and playground equipment. A description of the resources available at many parks is included in Table 12 and Map 8 – *Parks and Open Spaces*.

Table 12 – Municipal Open Space, Park, and Recreation Areas
Little Neshaminy Creek Watershed

Name	Municipality	Acreage	Special Features
Kohler Park	Horsham	71.42	fishing pond, picnic tables, 2 playgrounds, paved walking trail, lighted street hockey court, 6 lighted soccer fields, 2 restrooms, 1 concession stand/clubhouse, gazebo
Deep Meadow Park	Horsham	51.88	11 baseball fields, concession stand, restrooms, 1-mile walking/jogging trail, playground, outdoor exercise center, picnic tables, storage garage, batting cage, picnic pavilion
Samuel Carpenter Park	Horsham	30.98	3 basketball courts, 3 tennis courts, 1 softball field, 1 baseball field, 1 football field, 1 pavilion, picnic tables, 3/4 mile walking /jogging trail, restrooms, 2 multipurpose fields
Chestnut Creek Park	Horsham	80.00	3 football fields, 2 half-sized football fields, concession stand, restrooms
Cedar Hill Road Park	Horsham	87.00	playground, walking trail, softball field, open field, 2 grass volleyball courts, nature trail with 3 blinds, outdoor classroom
Maple Park	Horsham	7.46	playground, 1 basketball court, swing set, asphalt path
Hideaway Hills Park	Horsham	2.86	playground, picnic tables and grills
Jarrett Road Park	Horsham	2.31	neighborhood park

Table 12 – Municipal Open Space, Park, and Recreation Areas Little Neshaminy Creek Watershed			
Name	Municipality	Acreage	Special Features
Strawbridge Park	Horsham	102.90	open space
Keith Valley Road Park	Horsham	29.20	open space
Lakeview Park	Horsham	16.00	open space, fishing pond
Wichard Property	Horsham	12.16	open space
Kingswood Estates	Horsham	14.83	open space
Squires Knoll	Horsham	30.70	open space
Hearne Property	Horsham	78.40	open space
Park Ridge	Horsham	14.29	open space adjacent to STP
Highgate Open Space (Bauer Tract)	Horsham	30.52	open space to be dedicated
Commonwealth National Country Club (ACSP)	Horsham	250.00	Private Golf Club – Certified as a member of the Audubon Cooperative Sanctuary Program for Golf Courses. (ACSP)
Horsham Valley Golf Club	Horsham	75.00	Public Golf Course
Limekiln Golf Club	Horsham	164.00	Public Golf Course
Oak Terrace Country Club	Horsham	190.00	Private Golf Club
Squires Golf Club	Horsham	130.00	Private Golf Club
Old York Road Golf Club	Lower Gwynedd	124.00	Private Country Club
Cedar Hill Trail	Lower Gwynedd		1.25 mile trail originates along Peterman Lane, near Welsh Rd (Rte. 63)
Red Stone Trail	Lower Gwynedd		Mile long trail across from Peterman Lane along Cedar Hill Road. Provides link to Wooded Pond Trail and Cedar Hill Trail.
Wooded Pond Trail	Lower Gwynedd		2/5 mile trail located off of Wooded Pond Drive and McKean Road - some permanent open space
Bark Park	Montgomery	1.00	fenced in park designed for dogs
Hourglass Park	Montgomery	9.00	large open space parcel in development
Municipal Building Park	Montgomery	24.00	gazebo and walking trails
Spring Valley Park	Montgomery	63.70	2 tot lots, baseball fields, 2 soccer fields, picnic pavilion, jogging/biking path, tennis courts, basketball courts, street hockey court, volleyball court
Whispering Pines Park	Montgomery	5.00	tot lot, basketball court, street hockey court
Windlestrae Park	Montgomery	172.00	soccer fields, golf driving net, baseball fields, Zehr Fields, community garden, hiking/horseback riding trails
Three Tuns Park	Upper Dublin	5.20	Picnic areas, playground, playing fields, 2 tennis courts

Table 12 – Municipal Open Space, Park, and Recreation Areas Little Neshaminy Creek Watershed			
Name	Municipality	Acreage	Special Features
The Old Fire Dam Park	Ivyland		Adjacent to Ivyland Creek
The Playground	Ivyland		Pennsylvania & Wilson Ave.
Ivyland Common	Ivyland		Adjacent to playground
The Village Green	Ivyland		Along Valentine Rd.
Eddowes Drive Park	Ivyland		Eddowes and Valentine Rd.
Spring Mill Country Club	Northampton	140.00 (est.)	Private Golf Club
Barness Park	Warminster	14.00	Walking trails, nature area
Christ Home	Warminster	14.00	Undeveloped natural area
Devonshire Court	Warminster	6.80	Undeveloped natural area
Five Ponds Golf Course	Warminster	130.00	Public Golf Course
Ivy Woods	Warminster	12.00	Natural area with trail
Kemper Park	Warminster	30.00	Walking trail, picnic area, pavilions, playground, softball field and parking
Log College Park	Warminster	26.60	Basketball court, tennis court, nature area, playground, grass volleyball courts
Munro Park	Warminster	36.00	Baseball, softball & soccer fields, tennis court, picnic areas & pavilions, playground, parking, refreshment stand and restrooms.
Warminster Community Park	Warminster	243.00	Multipurpose trails, playground, pavilion, restrooms, parking
Warminster Recreation Center	Warminster	13.00	Basketball courts, softball field, parking, playground, grass volleyball court
Werner Park	Warminster	6.80	Football field, picnic area, parking, playground, refreshment stand, restrooms, softball field.
Palomino Park	Warrington	5.00	playground, tennis court, baseball field, basketball court
Alou Tot Lot	Warrington	3.00	tot lot
Bradford Dam Park (Leased to Township)	Warrington	280.00	fishing, walking trail
Dapple Tot Lot	Warrington	0.70	tot lot
Warrington Village Tot Lot	Warrington	5.00	tot lot, tennis court, basketball court
Shank Tot Lot	Warrington	0.80	tot lot
Valley Glen Park	Warrington	2.90	tot lot, basketball court
Mary Barness Tennis and Swim Club	Warrington	11.30	2 swimming pools, tennis courts, volleyball court, playground, snack stand
Igoe Porter	Warrington	16.80	7 soccer fields, walking path, picnic tables

Table 12 – Municipal Open Space, Park, and Recreation Areas Little Neshaminy Creek Watershed			
Name	Municipality	Acreage	Special Features
Wellings (Upper Nike)			
Lower Nike Park	Warrington	23.70	basketball court, volleyball court, hockey rink, skating rink
Twin Oaks Day Camp	Warrington	47.00	Township Day Camp
Willow Knoll Park	Warrington	0.80	playground, pavilion, basketball court
Penns Wood Tot Lot	Warrington	1.00	tot lot
The Fairways Golf and Country Club	Warrington	46.50	Public Golf Course
Special Equestrian Center	Warrington	40.00	Therapeutic
Hidden Pond Park	Warwick	10.00	Tot lot, basketball court, baseball field, pond
Neshaminy Valley Golf Course	Warwick	92.00	Public Golf Course
Total Acreage of Parks/Open Space		**3,050.01**	

Source: HC analysis, 2006. (Municipal Open Space Plans, websites, county planning commissions data)

Preserved lands within the study area include parks and recreational facilities, open space, and private preserved lands (including lands under conservation easement). These areas are summarized in Table 13 – Preserved Lands. Approximately 1,400 acres within the study area are preserved as parks and open space and 1,346 acres are in use as public and private golf courses. An additional 330 acres are preserved by Heritage Conservancy. Ten golf courses (five public and five private) are located within the study area, with the majority located in Horsham Township.

Warrington Township Open Space includes a therapeutic riding facility on Street Road. This 40-acre property is leased to the Special Equestrians organization and features a 27-stall barn, turnout areas and pastures. It is currently used for the rehabilitation of mentally and physically impaired individuals.

At 280 acres, Bradford Dam Park is the largest tract of preserved open space in the study area. The park includes the 22-acre Bradford Lake (Warrington Lake) reservoir. The park, owned by the Bucks County Department of Parks and Recreation and leased to Warrington Township allows fishing from the dam and features a walking trail. The site is also well known locally for its bird watching. The site provides many recreational uses throughout the year.

Table 13 – Preserved Lands within Little Neshaminy Creek Watershed			
Municipality	Parks/Open Space (Acres)	Golf Courses (Acres)	HC Preserved (Acres)
Horsham	599.5	771.1	
Lower Gwynedd	10.3	124.0	
Montgomery	236.9	0	
Warrington	356.2	46.5	
Warwick	10.0	92.0	191.1
Upper Dublin	3.1	0	
Northampton	0	182.4	129.8
Warminster	197.1	130.4	8.6
Ivyland	1.2	0	
Totals	**1,414.7**	**1,346.2**	**329.5**

Source: HC analysis, 2007.

At 280 acres, Bradford Dam Park is the largest tract of preserved open space in the study area.

Greenways & Trails

Greenways and trails are crucial keys to help promote open space, parks, and recreation, and to link all of these resources together, in an environmentally and healthy manner. Connecting open space is more effective for wildlife habitat and for recreation then open space fragmented by developed areas. A Greenway can serve many regional and local needs. The benefits of greenways are described in the Conservation Fund's 1993 publication, *A Guide to Planning, Design and Development*[21]:

- Offer protection for important habitat corridors and help promote plant and animal species diversity. The area can also act as a filtering zone helping absorb surface runoff, and the vegetation can help cleanse and replenish the air.
- Provide much needed space for recreation in an ever more urbanized world, and an alternative to a traditional park
- Provide healthier, safer and more eco-friendly non-motorized commuting routes from one community, park or other cultural resource to another.
- Offer visual relief and protection of visual interest by protecting ridgelines, river ways and scenic resources.
- Provide strong economic value. Greenways enhance the quality of life, and can increase property value in communities. They have been known to be the backbone of revitalization of former town centers, and been instrumental in helping draw tourist.

Greenways can be implemented by a municipality by utilizing existing corridors such as stream corridors, old railways, and utility corridors; these corridors then become the spokes in a green infrastructure framework, serving to connect other natural amenities and recreational resources.

21 Flink, Chuck. Schwarz, Loring. Searns, Robert. Guide to Planning, Design & Development. The Conservation Fund. 1993

Trails located within greenways and those that connect greenways provide a tremendous resource of recreational use. According to public surveys conducted as part of the Montgomery Open Space Plan, trails are in the high demand. The Bucks County Open Space Task Force listed preserving and creating greenways and trails as a top priority. Trails need not only serve a recreational role, but as a means of transportation as well. They can link high-density areas with surrounding neighborhoods, and cultural resources. Trails are part of a well-balanced transportation system. Backed by the Inter-modal Surface Transportation Efficiency Act, and locally by Penn DOT, trails are now looked upon as a legitimate means for transportation through biking, walking and other methods of active transportation.

Many of the municipal parks throughout the study area include trail systems. These include: Municipal Building Park, Spring Valley Park, and Windlestrae Park all in Montgomery Township; Kohler Park, Deep Meadow Park, Samuel Carpenter Park, Cedar Hill Road Park, and Maple Park all in Horsham Township.

Warminster Community Park provides over 5 miles of multipurpose trails, which provide trail connections to Munro Park, Werner Park and Szymanek Park (just south of the Little Neshaminy Watershed boundary). Kemper Park has a ½ mile paved trail, which begins at Valley Road and runs the length of the park then connects to a nature trail which extends another ¼ mile along the stream towards Bristol Road.

However, although some inter-municipal connections exist, there are few contiguous greenways within the watershed. The potential of connecting these paths to create greenways throughout the watershed would provide additional opportunities for recreation and possible alternative transportation corridors.

For example, Montgomery Township's Open Space Plan proposes a number of prioritized trail segments within the Little Neshaminy Creek watershed. These include an off road township feeder and connector trail from the proposed County Powerline Trail along the Little Neshaminy to Windlestrae Park, an off-road township feeder trail along the Little Neshaminy Creek from Windlestrae Park to Lower State Road connecting to the Horsham Township trail network and a new pedestrian and bike crossing along Kenas Road over the Little Neshaminy Creek.

County and Municipal Funding for the Conservation of Open Space, Farmland and Natural Areas

Over the years, both counties and several of the municipalities have raised money for the protection of important land resources. In 1993, the Montgomery County Board of Commissioners budgeted $100 million over a ten year period for these purposes. Many municipalities appropriate their own funds for financing parks and recreation programs. Others utilize funds from

the county open space programs for open space protection. All of the other funding programs were approved by voter referenda.

The list of county and municipal funding initiatives within the Little Neshaminy Creek watershed includes the following:

Table 13a - Open Space Bond Referenda in Little Neshaminy Creek Municipalities		
Municipal Referenda	Amount Raised*	Year
Lower Gwynedd Township	2.0 million	1994
Northampton Township	5.0 million	1998
Upper Dublin Township	30.0 million	2006
Warrington Township	2.1 million	1995
Warwick Township	1.5 million	2000
	5.0 million	2003
	7.0 million	2006
County Referenda	Amount Raised*	Year
Bucks County	3.5 million	1994
	59.0 million	1996
Montgomery County	150.0 million	2003

Source: HC analysis

*Amount raised is not limited to Little Neshaminy Creek Watershed.

Analysis

There are a wide range of parks, recreational and open space opportunities within the Little Neshaminy Creek Watershed ranging from small local playgrounds to larger regional park facilities. The majority of these areas are owned, operated and maintained by the individual municipalities. County parkland is limited to the Bradford Reservoir and the State's Historical and Museum Commission owns and operates Graeme Park in Horsham Township.

In addition to the municipal-owned parkland, there are 10 golf courses (five private and five public) totally approximately 1, 300 acres. Although golf courses provide recreational and open space, the manicured and mowed lawn areas typically contain non-native grasses and are not the most effective land cover for wildlife habitat, managing stormwater runoff and promoting groundwater infiltration. Environmental management practices should be promoted within all established golf courses, including water conservation and water quality management, wildlife and habitat enhancement and chemical use reduction and safety.

Public and private golf courses should be encouraged to participate and become certified in the Audubon Cooperative Sanctuary Program for Golf Courses (ACSP). This program, initiated in 1992 by Audubon International, is an educational and certification program that promotes ecologically sound land management and the conservation of natural resources on *established golf courses*.

By implementing and documenting a full complement of environmental management practices, a course earns designation as a Certified Audubon Cooperative Sanctuary. Only one golf course within the watershed, Commonwealth National Country Club, in Horsham Township, is currently ACSP certified.

In addition to the ACSP, Audubon's Signature Programs are education and certification programs that provide comprehensive environmental planning assistance to *new developments*, including golf courses. Audubon International is involved from the planning phase through construction and ongoing management once the course is opened.

There may be potential for creating multi-municipal trail linkages among the individual trail and greenways in place within the watershed. Municipalities could consider developing these linkages through their existing open space and land use planning.

Although the enactment of sound regulatory techniques will help provide open space and protect sensitive natural resources, these ordinance methods should be used in conjunction with the purchase of land or development rights in certain circumstances. For example, the assembly of some links along a community trail might be acquired through required dedications of land during the development process. However, it might be necessary to purchase other links or easements across properties to complete the trail system. It is often necessary to purchase a sizeable property in an appropriate location with adequate access for community athletic fields. A smaller piece of dedicated land surrounded by new houses would not be as suitable. Municipal officials should use both appropriate ordinance methods and capital investments to achieve their community's land and natural resource protection goals.

IX. Biological Resources

The Little Neshaminy Creek Watershed is located in a cool climate region with relatively high rainfall (42 inches per year), and moderate temperatures. The watershed's biological resources are significant and the combination of good soils, adequate rainfall and moderate temperatures has permitted both agriculture and natural biological resources to flourish. The Little Neshaminy crosses two physiographic regions – the Piedmont and the Atlantic Coastal Plain.

In 1973, the Federal government moved to provide protection to endangered and threatened species and habitats with the Endangered Species Act. This act allowed the US Fish and Wildlife Service to assign various levels of importance to a species to indicate its rareness and threat of extinction. There were no federally listed species in the Neshaminy study area; however, species of state importance were identified.

The current responsibilities for biological protection at the state level reside within three agencies. The Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry (BOF) maintains responsibility for plant species. The Pennsylvania Game Commission (PGC) administers to birds and mammals and the Pennsylvania Fish and Boat Commission (FBC) had jurisdiction over fish, reptiles and amphibians.

Pennsylvania Natural Diversity Inventory (PNDI)

The Bureau of Forestry, in partnership with the Western Pennsylvania Conservancy and The Nature Conservancy, maintains a list of species and habitats for a number of watersheds in Pennsylvania and is accessible via the web at www.naturalheritage.state.pa.us. The following tables present a summary of the PNDI information. In table 14, the key to the state ranking system is provided. In Table 15, the habitats (or ecological communities) present in the watershed are listed. Finally, in Table 16, the species indicated as present in the Neshaminy Watershed are listed by scientific name.

Table 14 – PNDI Key to State Ranking of Habitats.

State Element Ranks	Implication	State Status	Implication
S1	Critically imperiled in the state (<5 occurrences)	PE	PA Endangered
S2	Imperiled in the state (6-20 occurrences)	PR	PA Rare
S3	Rare or uncommon in the state (21 – 100 occurrences)	PT	PA Threatened
S4	Apparently secure in the state	PX	PA Extirpated
S5	Demonstrably secure in the state	CA	Candidate at risk
A	Accidental in the state	N	No current legal status
B	Breeding population in the state		
N	Non-breeding population in the state		
X	Believed to be extirpated in the state		
?	Uncertain status		

Source: PA DCNR

Table 15 – Listing of Ecological Communities within the Study Area			
Scientific Name	Common Name	State Rank	State Status
Coastal plain forest	Coastal Plain Forest	S1	
Freshwater intertidal marsh	Freshwater Intertidal Marsh	S1	
Freshwater intertidal mudflat	Freshwater Intertidal Mudflat	S1	
Herbaceous vernal pond		S3S4	
Highbush blueberry - sphagnum wetland		S5	
Northern Appalachian shale cliff community	Northern Appalachian Shale Cliff Community	S2	
Prairie sedge - spotted joe-pye-weed marsh		S1S2	
Robust emergent marsh	Robust Emergent Marsh	S2	
Tuliptree- beech -maple forest		S4	

Source: PA DCNR

Table 16 – PNDI Species found in Neshaminy Creek Watershed.			
Scientific Name	Common Name	State Rank	State Status
Acantharchus pomotis	Mud Sunfish	SX	
Acipenser brevirostrum	Shortnose Sturgeon	S1	PE
Acipenser oxyrinchus	Atlantic Sturgeon	S1	PE
Agalinis auriculata	Eared False-foxglove	S1	PE
Alasmidonta heterodon	Dwarf Wedgemussel	S1	LE
Alasmidonta varicosa	Brook Floater	S2	
Alopecurus aequalis	Short-awn Foxtail	S3	N
Amaranthus cannabinus	Water hemp Ragweed	S3	PR
Amelanchier canadensis	Serviceberry	SNR	N
Amelanchier humilis	Serviceberry	S1	TU
Amelanchier obovalis	Coastal Juneberry	S1	TU
Ammannia coccinea	Scarlet Ammannia	S2	PE
Andropogon glomeratus	Bushy Bluestem	S3	TU
Andropogon gyrans	Elliott's Beardgrass	S3	N
Aphredoderus sayanus	Pirate Perch	SX	
Arabis patens	Spreading Rockcress	S2	N
Ardea herodias	Great Blue Heron	S3S4B,S4N	
Asclepias rubra	Red Milkweed	SX	PX
Asclepias variegata	White Milkweed	S1	TU
Atrytone arogos	Arogos Skipper	SX	
Baccharis halimifolia	Eastern Baccharis	S3	PR
Bartonia paniculata	Screw-stem	S3	N
Bartramia longicauda	Upland Sandpiper	S1S2B	PT
Bidens bidentoides	Swamp Beggar-ticks	S1	PT
Bidens discoidea	Small Beggar-ticks	S3	N
Bidens laevis	Beggar-ticks	S3	N
Bromus kalmii	Brome Grass	S3	N
Carex alata	Broad-winged Sedge	S2	PT
Carex bicknellii	Bicknell's Sedge	S1	PE
Carex bullata	Bull Sedge	S1	PE
Carex crinita var. brevicrinis	Short Hair Sedge	S1	PE
Carex longii	Long's Sedge	SU	TU
Carex lupuliformis	False Hop Sedge	S1	TU
Carex tetanica	A Sedge	S2	PT
Carex typhina	Cattail Sedge	S2	PE
Chasmanthium laxum	Slender Sea-oats	S1	PE

Table 16 – PNDI Species found in Neshaminy Creek Watershed.			
Scientific Name	Common Name	State Rank	State Status
Chenopodium capitatum	Strawberry Goosefoot	SH	TU
Chionanthus virginicus	Fringe-tree	S3	N
Chrysopsis mariana	Maryland Golden-aster	S1	PT
Cistothorus platensis	Sedge Wren	S1B	PT
Clemmys muhlenbergii	Bog Turtle	S1S2	PE
Coastal plain forest	Coastal Plain Forest	S1	
Coreopsis rosea	Pink Tickseed	SX	PX
Crotonopsis elliptica	Elliptical Rushfoil	SX	PX
Cuscuta campestris	Dodder	S2	N
Cuscuta compacta	Dodder	S3	N
Cuscuta pentagona	Field Dodder	S3	N
Cuscuta polygonorum	Smartweed Dodder	SU	TU
Cyperus diandrus	Umbrella Flat sedge	S2	PE
Desmodium laevigatum	Smooth Tick-trefoil	SU	N
Desmodium nuttallii	Nuttalls' Tick-trefoil	S2	TU
Echinochloa walteri	Walter's Barnyard-grass	S1	PE
Eleocharis obtusa var. peasei	Wrights Spike Rush	S1	PE
Eleocharis olivacea	Capitate Spike-rush	S4	PR
Eleocharis parvula	Little-spike Spike-rush	S1	PE
Ellisia nyctelea	Ellisia	S2	PT
Enneacanthus chaetodon	Blackbanded Sunfish	SX	
Enneacanthus obesus	Banded Sunfish	S1	PE
Eriocaulon parkeri	Parker's Pipewort	SX	PX
Eryngium aquaticum	Marsh Eryngo	SX	PX
Etheostoma fusiforme	Swamp Darter	SX	
Eupatorium album	White Thoroughwort	SH	PX
Eupatorium rotundifolium	A Eupatorium	S3	TU
Euphorbia ipecacuanhae	Wild Ipecac	S1	PE
Euphyes conspicuus	Black Dash	S3	
Eurybia spectabilis	Low Showy Aster	S1	PE
Euthamia tenuifolia	Grass-leaved Goldenrod	S1	PT
Falco peregrinus	Peregrine Falcon	S1B,S1N	PE
Freshwater intertidal marsh	Freshwater Intertidal Marsh	S1	
Freshwater intertidal mudflat	Freshwater Intertidal Mudflat	S1	
Gentiana saponaria	Soapwort Gentian	S1S2	TU
Gomphus abbreviatus	Spine-crowned Clubtail	S2	
Gratiola aurea	Golden Hedge-hyssop	S1	TU
Helianthemum propinquum	Low Rockrose	SU	N
Helianthus angustifolius	Swamp Sunflower	SX	PX
Herbaceous vernal pond		S3S4	
Heteranthera multiflora	Multiflowered Mud-plantain	S1	PE
Hottonia inflata	American Featherfoil	SX	PX
Hydrocotyle umbellata	Many-flowered Pennywort	SH	PX
Hypericum adpressum	Creeping St. John's-wort	SX	PX
Hypericum crux-andreae	St Peter's-wort	SX	PX
Hypericum denticulatum	Coppery St. John's-wort	SX	PX
Hypericum gymnanthum	Clasping-leaved St. John's-wort	S1	PX
Hypericum stragulum	St Andrew's-cross	S2	N
Ilex glabra	Ink-berry	SX	PX
Ilex opaca	American Holly	S2	PT
Iris prismatica	Slender Blue Iris	S1	PE

Table 16 – PNDI Species found in Neshaminy Creek Watershed.			
Scientific Name	Common Name	State Rank	State Status
Itea virginica	Virginia Willow	S1	PX
Juncus biflorus	Grass-leaved Rush	S2	TU
Juncus debilis	Weak Rush	S3	N
Juncus dichotomus	Forked Rush	S1	PE
Juncus scirpoides	Scirpus-like Rush	S1	PE
Juniperus communis	Common Juniper	S2	N
Kinosternon subrubrum	Eastern Mud Turtle	SH	
Lathyrus palustris	Vetchling	S1	TU
Lechea minor	Thyme-leaved Pinweed	SU	N
Lemna perpusilla	Minute Duckweed	SU	N
Lemna valdiviana	Pale Duckweed	SH	PX
Lepomis megalotis	Longear Sunfish	S1	PE
Lespedeza stuevei	Tall Bush Clover	SX	PX
Leucothoe racemosa	Swamp Dog-hobble	S2S3	TU
Linum intercursum	Sandplain Wild Flax	S1	PE
Lobelia nuttallii	Nuttall's Lobelia	SX	PX
Ludwigia sphaerocarpa	Spherical-fruited Seedbox	SX	PX
Lupinus perennis	Lupine	S3	PR
Luzula bulbosa	Southern Wood-rush	S1	TU
Lycaena hyllus	Bronze Copper	SU	
Lycopodiella alopecuroides	Foxtail Clubmoss	S1	PE
Lycopodiella appressa	Southern Bog Clubmoss	S2	PT
Lycopus rubellus	Bugleweed	S1	PE
Lyonia mariana	Stagger-bush	S1	PE
Lysimachia hybrida	Lance-leaf Loosestrife	S1	N
Lythrum alatum	Winged-loosestrife	S1	TU
Magnolia tripetala	Umbrella Magnolia	S2	PT
Magnolia virginiana	Sweet Bay Magnolia	S2	PT
Melanthium virginicum	Virginia Bunchflower	SU	N
Micranthemum micranthemoides	Nuttall's Mud-flower	SX	PX
Myriophyllum farwellii	Farwell's Water-milfoil	S1	PE
Myriophyllum heterophyllum	Broad-leaved Water-milfoil	S1	PE
Notropis chalybaeus	Ironcolor Shiner	S1	PE
Nuphar microphylla	Yellow Cowlily	S1	TU
Nycticeius humeralis	Evening Bat	SUB,SUN	
Nymphoides cordata	Floating-heart	S2	PT
Orontium aquaticum	Golden Club	S4	PR
Oxypolis rigidior	Stiff Cowbane	S2	TU
Pandion haliaetus	Osprey	S2B	PT
Panicum longifolium	Long-leaf Panic-grass	SH	TU
Panicum lucidum	Shining Panic-grass	S1	TU
Panicum scoparium	Velvety Panic-grass	S1	PE
Panicum spretum	Eaton's Witchgrass	SH	PX
Pedicularis lanceolata	Swamp Lousewort	S1S2	N
Phlox pilosa	Downy Phlox	S1S2	TU
Pluchea odorata	Shrubby Camphor-weed	S1	TU
Poa autumnalis	Autumn Bluegrass	S1	PE
Polygala cruciata	Cross-leaved Milkwort	S1	PE
Polygala lutea	Yellow Milkwort	SX	PX
Polygala nuttallii	Nuttall's Milkwort	S3	N
Polygonella articulata	Eastern Jointweed	S1	TU

Table 16 – PNDI Species found in Neshaminy Creek Watershed.			
Scientific Name	Common Name	State Rank	State Status
Polystichum braunii	Braun's Holly Fern	S1	PE
Potamogeton pulcher	Spotted Pondweed	S1	PE
Potamogeton zosteriformis	Flat-stem Pondweed	S2S3	PR
Prenanthes serpentaria	Lion's-foot	S3	N
Proserpinaca pectinata	Comb-leaved Mermaid-weed	SX	PX
Prunus maritima	Beach Plum	S1	PE
Pseudacris triseriata kalmi	New Jersey Chorus Frog	S1	PE
Pseudemys rubriventris	Redbelly Turtle	S2	PT
Ptilimnium capillaceum	Mock Bishop-weed	SX	PE
Pycnanthemum torrei	Torrey's Mountain-mint	SU	PE
Quercus falcata	Southern Red Oak	S1	PE
Quercus phellos	Willow Oak	S2	PE
Rana sphenocephala	Coastal Plain Leopard Frog	S1	PE
Ranunculus aquatilis var. diffusus	White Water-crowfoot	S3	
Ranunculus pusillus	Spearwort	S1	N
Rhexia mariana	Maryland Meadow-beauty	S1	PE
Rhynchospora capillacea	Capillary Beaked-rush	S1	PE
Rhynchospora recognita	Small Globe Beaked-rush	S1	TU
Rotala ramosior	Tooth-cup	S3	PR
Rubus cuneifolius	Sand Blackberry	S1	TU
Rudbeckia fulgida	Eastern Coneflower	S3	N
Sabatia campanulata	Slender Marsh Pink	SX	PX
Sagittaria calycina var. spongiosa	Long-lobed Arrow-head	S1	PE
Sagittaria filiformis	An Arrow-head	SX	PX
Sagittaria subulata	Subulate Arrowhead	S3	PR
Salix x subsericea	Meadow Willow	S1	TU
Schoenoplectus fluviatilis	River Bulrush	S3	PR
Schoenoplectus smithii	Smith's Bulrush	S1	PE
Senecio anonymus	Plain Ragwort	S2	PR
Sericocarpus linifolius	Narrow-leaved White-topped Aster	S1	PE
Sisyrinchium atlanticum	Eastern Blue-eyed Grass	S1	PE
Sparganium androcladum	Branching Bur-reed	SH	PE
Speyeria idalia	Regal Fritillary	S1	
Spiranthes lucida	Shining Ladies'-tresses	S3	N
Spiranthes tuberosa	Little Ladies'-tresses	S1	TU
Stachys hyssopifolia	Hyssop Hedge-nettle	SH	TU
Strophostyles umbellata	Wild Bean	S2	N
Symphyotrichum dumosum	Bushy Aster	S2	TU
Symphyotrichum novi-belgii	New York Aster	S2	PT
Tipularia discolor	Cranefly Orchid	S3	PR
Triplasis purpurea	Purple Sandgrass	S1	PE
Tyto alba	Barn-owl	S3B,S3N	
Utricularia intermedia	Flat-leaved Bladderwort	S2	PT
Utricularia radiata	Small Swollen Bladderwort	SX	PE
Viburnum nudum	Possum-haw	S1	PE
Viola brittoniana	Coast Violet	S1	PE
Woodwardia areolata	Netted Chainfern	S2	N
Xyris torta	Twisted Yellow-eyed Grass	S1	N
Zizania aquatica	Indian Wild Rice	S3	PR

Source: PA DCNR

The Natural Areas Inventory (NAI) is as list of priority areas that hold crucial biological, ecological and hydrological resources

County Natural Areas Inventories

The Natural Areas Inventory (NAI) is as list of priority areas that hold crucial biological, ecological and hydrological resources. These inventories present a comprehensive picture of Bucks and Montgomery's natural diversity. In 1999, Bucks County engaged the Morris Arboretum to inventory these natural features of the county, and 240 individual sites were surveyed. The resulting document listed 115 sites prioritized into four different levels of importance ranging from Level 1 (highest, statewide importance) to Level 4 (Lowest – local importance). [22]

The Montgomery County NAI was prepared by scientists at The Nature Conservancy employing a systematic search for lands within Montgomery County that contain the best and most unique natural habitats.[23] The study was completed in October 1995. As part of the inventory, 28 sites of statewide significance were identified. The inventory was developed in four phases: Site Identification, Aerial Survey, Fieldwork, and Prioritization and Documentation of Natural Areas. This inventory can be a tool to help locate and categorize priorities for protection within the county. The sites found within the Little Neshaminy Creek Watershed study area are noted below and are located on the Map 6 – Water Resources.

Priority Areas in Bucks County

a) Warrington Township:
Site # 93 Bradford Reservoir: Priority 4

This site contains the Bradford Reservoir created by a dam used to control flooding along the Little Neshaminy Creek. The lake (impoundment) is 22 acres in extent and provides habitat for many water fowl including Great blue herons and cormorants. The site is surrounded by primarily disturbed forest and has extensive amounts of non-native species of plants in the area. The area is used primarily for recreational uses including: fishing, walking and ATV riding.

b) Warwick Township:
Site # 33 Forks of Neshaminy: Priority 2

This site is on the northern fringe of the township and includes forested slopes and floodplains along the Little Neshaminy and Neshaminy Creek where the two come together near Rushland. The north facing wooded talus slope along Neshaminy Creek below Dark Hollow Road is of particular interest as are he extensive wooded slopes and floodplains along the Little Neshaminy Creek between the mouth and Almshouse Road. The site is rather undisturbed, which is unusual in this area, and should remain as undisturbed as possible.

Priority Areas in Montgomery County

a) Horsham Township:

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22 Rhoads, Ann and Timothy Block. *Natural Areas Inventory of Bucks County*. Morris Arboretum of the Univ. of Penn 1999.

23 The Nature Conservancy, *Natural Areas Inventory of Montgomery County (1995,)* as summarized in *Montgomery County Visions 2025*, Natural Features. Pg. 37-44.

Willow Grove Naval Air Station: Site of State Significance

A small population of grass species of special concern was found in seasonal wet fields at the Willow Grove Naval Air Station. Annual mowing, preferably after seed set, will help maintain open habitat used by this species.

b) Keith Valley Road: Site of Local Significance

Located just west of County Line Road on Keith Valley Road is locally significant forest that includes hardwoods of mixed ages and a well-developed sub-canopy and shrub strata. Site needs further investigation. This site should be left undisturbed to provide a good example of this community type.

"Watershed protection is vitally important to the ecological health of the county."
From Bucks County Natural Areas Inventory

Analysis

Identification and Management of Important Resource Areas

Various studies have stressed the importance of identifying and protecting key natural resource areas in order to maintain biological diversity of watershed areas. As stated in Bucks County's Natural Areas Inventory, "Watershed protection is vitally important to the ecological health of the county. Many species of rare plants and animals are dependent on wetland habitats. Hydrological aspects of habitat protection must be addressed if these species and habitats are to be protected." [24]

The Natural Features section of Montgomery County's Comprehensive Plan, notes that, "While the relationships between the natural system components occur throughout the county, the interconnections are most apparent within a stream corridor."[25]

Sites included in the County Natural Areas Inventories should be viewed as an integral part of land use planning. Sites of the highest significance should be preserved and protected by either outright purchase or easements or through regulatory measures such as resource protection zoning. Municipalities should consider preparing or updating local environmental resource inventories (ERI), which can then be used in guiding land development decisions and in prioritizing lands for open space preservation. As noted in Chapter VI, municipalities should also review and strengthen natural resource protection ordinances for areas such as wetlands, floodplains, groundwater recharge areas, woodlands and forests, ponds, lakes, hydric and alluvial soils. These areas often contain habitat for numerous terrestrial and aquatic species. Restoring and protecting natural floodplains and identifying and protecting important groundwater recharge areas are an important component of natural resource planning.

24 Natural Areas Inventory of Bucks County, pg 4.

25 Montgomery County Planning Commission 2005. *Shaping our Future, A Comprehensive Plan for Montgomery County,* Open Space, Natural Features and Cultural Resources Plan,. Pg. 40.

Properties identified in the Natural Areas Inventory should not only be priorities for preservation but also for land management programs. Non-native invasive species are a chronic problem in disturbed natural areas, and require long-term management and stewardship strategies. These strategies include protection and restoration of riparian vegetation along streams, proper removal of invasive species and planting of native vegetation, and linking of natural areas to promote corridors for wildlife. In addition, municipalities should review their landscaping provisions within their ordinances to remove references to non-native or invasive vegetation. A number of priority reaches have been identified in the Little Neshaminy and should be targeted for restoration efforts as a starting point.. These sites are detailed in Chapter XII and include:

- Kemper Park, Warminster from Valley Road to Bristol Road
- Downstream of Meetinghouse Road, Warwick Township, from Bristol Road Bridge to below downstream bend.
- Park Creek along Keith Valley Road, Horsham Township, from Horsham Park to County Line Road.

Goose and deer damage to newly planted vegetation must be reduced to ensure the success of newly planted areas. Multiflora rose, bush honeysuckles, Oriental bittersweet, Norway maple, lesser celandine, Japanese stilt grass, garlic mustard, invasive privets and Japanese knotweed are the most persistent non-native invaders of this region.

Stewardship plans which specify land management practices for these areas need to be developed in coordination with land managers (both public and private) to control invasive species and minimize illegal uses (dumping and use by all terrain vehicles (ATV).

Education and Coordination

Volunteers, school children, residents, municipal officials and municipal staff should be educated about invasive plants and enrolled in their removal. These groups can also be enlisted to help in monitoring water quality and assessing the condition of streambanks for additional restoration sites. Local land trusts and watershed organizations should provide training and technical assistance in the use of conservation easements for open space protection and other land protection measures to local officials, institutional land owners (i.e., schools, hospitals, and places of worship), and land-owners and business-owners in the watershed..

X. Water Resources

This chapter will provide an overview of the various water resources found within the Little Neshaminy, including Lakes, Reservoirs, Wetlands, Floodplains, and Riparian Buffers. The chapter begins with an overview of the hydrologic water cycle and how disruptions of the water cycle can change the way water is transported and stored, resulting in impacts to stream form, function and water quality. This chapter also reviews the historic and current water quality conditions of the Little Neshaminy Creek and various sources of impairments that have occurred and continue to occur in the watersheds resulting from point and non-point sources of pollution. A summary of local, state, and federal regulatory programs addressing these issues is also included.

Water resources, including Lakes/Reservoirs, National Wetlands Inventory (NWI) wetlands, Federal Emergency Management Agency (FEMA) 100-year floodplains, sub-watershed basins and point source discharges are indicted on Map 6 – Water Resources map that accompanies this report.

Summary of Water Cycle

To understand the relationship of ground and surface water within a watershed, it is important to be familiar with the process by which water moves through the earth. This process, known as the Natural Water Cycle or Hydrologic Cycle is basic to understanding how our activities impact the water cycle. Essentially the water cycle involves five basic processes, precipitation (rainfall), infiltration (and percolation), surface runoff, evaporation and transpiration. As illustrated in Figure 19, the hydrologic cycle is continuous as water changes from liquid to vapor to ice.

Essentially the water cycle involves five basic processes, precipitation (rainfall), infiltration (and percolation), surface runoff, evaporation and transpiration.

Water falls to the land and water surfaces through precipitation in the form of rain and snow. This precipitation can return water directly to a body of water or can fall on pavement, rocks, soils, etc. The water will then travel downhill as runoff to the nearest body of water. Water can also fall on permeable surfaces such as some soils and sands and be absorbed into the ground and eventually into saturated zones. The saturated zone is the groundwater portion of the water cycle. The rocks and soils that hold and transmit this groundwater are known as aquifers. This water is eventually moved upward back into the atmosphere through evapotranspiration. This process of evapotranspiration is a combination of evaporation from land and water and transpiration from the leaves of plants.

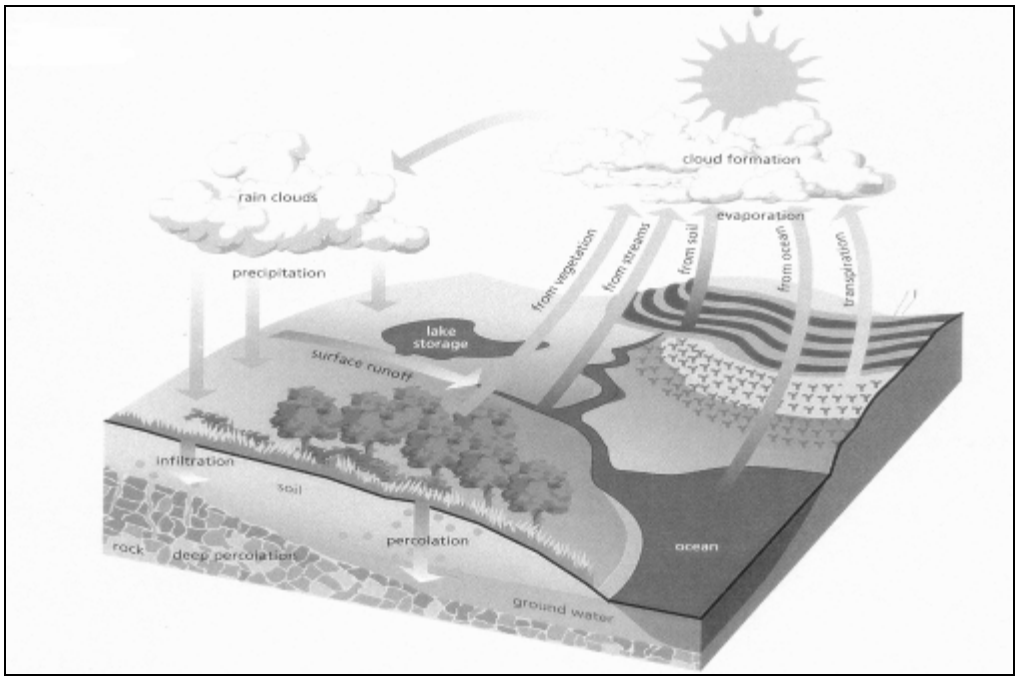


Figure 19 – The Hydrologic Cycle

The transfer of water from precipitation to surface water and ground water, to storage and runoff, and eventually back to the atmosphere is an ongoing cycle.[26]

Disruption of the Water Cycle[27]

When development occurs, the resultant alteration to the land can lead to dramatic changes to the hydrology, or the way water is transported and stored. Impervious man-made surfaces (asphalt, concrete, rooftops) and compacted earth associated with development create a barrier to the percolation of rainfall into the soil, increasing surface runoff and decreasing groundwater infiltration. This disruption of the natural water cycle leads to a number of changes, including:

- increased volume and velocity of runoff;
- increased frequency and severity of flooding;
- peak (storm) flows many times greater than in natural basins;
- loss of natural runoff storage capacity in vegetation, wetland and soil;
- reduced groundwater recharge; and
- decreased base flow, the groundwater contribution to stream flow. (This can result in streams becoming intermittent or dry, and also affects water temperature.)

26 PA DEP, Watershed Stewardship A Planning and Resource Guide, Draft 2005.

27 Text from, "Impacts of Development on Waterways", NEMO Program Fact Sheet #3. © 1994 The University of Connecticut. Used with permission of the University of Connecticut Cooperative Extension System. Heritage Conservancy is a charter member of the National NEMO Network.

Impacts on Stream Form and Function[28]

Impacts associated with development typically go well beyond flooding. The greater volume and intensity of runoff leads to increased erosion from construction sites, downstream areas and stream banks. Because a stream's shape evolves over time in response to the water and sediment loads that it receives, development-generated runoff and sediment cause significant changes in stream form. To facilitate increased flow, streams in urbanized areas tend to become deeper and straighter than wooded streams, and as they become clogged with eroded sediment, the ecologically important "pool and riffle" pattern of the stream bed is usually destroyed.

These readily apparent physical changes result in damage to the ecological function of the stream. Bank erosion and sever flooding destroy valuable streamside, or riparian, habitat. Loss of tree cover leads to greater water temperature fluctuations, making the water warmer in the summer and colder in the winter. Most importantly, there is substantial loss of aquatic habitat as the varied natural streambed of pebbles, rock ledges and deep pools is covered by a uniform blanket of eroded sand and silt.

Water Quality in the Little Neshaminy Creek

A stream's ability to support aquatic life, provide drinking water and to function as a recreational resource is all dependent on its water quality. Scientists who assess water quality study both its chemistry (what is dissolved in water) and biology (what is alive in the water). Chemical monitoring provides a "snap shot" of the water condition at the time the sample is collected. Common chemical indicators of water quality are the following[29]:

Alkalinity – is a total measure of the substances in water that have "acid-neutralizing ability. Alkalinity indicates a solution's power to react with acid and buffer its pH (which measures acids and bases). Thus, streams with high alkalinity can better buffer against pH changes.

Carbon Dioxide – is an odorless, colorless gas produced during the respiration cycle of animals, plants and bacteria and through the burning of materials that contain carbon. When carbon dioxide levels are high and oxygen levels low, fish have trouble respiring and their problems become worse as water temperature rises.

Conductivity – is a measure of the ability of water to pass an electrical current. Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity. Significant changes in

28 Text from, "Impacts of Development on Waterways", NEMO Program Fact Sheet #3. © 1994 The University of Connecticut. Used with permission of the University of Connecticut Cooperative Extension System. Heritage Conservancy is a charter member of the National NEMO Network.

29 From DRBC Water Quality Terminology, http://www.state.nj.us/drbc/snapshot_terms.htm

conductivity could be used as an indicator that a discharge or some other source of pollution has entered a stream.

Dissolved Oxygen (DO) – is oxygen that is dissolved in water. Its gets there by diffusion from the surrounding air; aeration of water that has tumbled over falls and rapids and as a product of photosynthesis. The amount of DO is affected by temperature. Cold water generally contains more DO than warm water.

Oxygen levels can be reduced through over fertilization of water plants by run-off from farm fields containing phosphates and nitrates (the ingredients in fertilizers). Under these conditions the size of water plants increase a great deal. Respiring plants will use much of the available DO. When these plants die, they become food for bacteria, which in turn multiply and use large amounts of oxygen.

Numerous scientific studies suggest that 4-5 parts per million of DO is the minimum amount that will support a large, diverse, fish population.

Nitrate and Phosphate – are necessary for aquatic plant growth, which supports the rest of the aquatic food chain. Both of these nutrients are derived from a variety of natural and artificial sources, including decomposition of plant and animal materials, man-made fertilizers, and sewage. While excessive nutrients might cause undesirable plant growth, an appropriate level of nutrients is one of the driving forces of the aquatic ecosystem.

Natural nitrate concentrations rarely exceed 10 milligrams per liter (mg/l). Most are less than 1 mg/l. Concentrations greater than 20 mg/l may pose health hazard to small mammals. In natural unpolluted water, phosphate levels are generally very low. Phosphorus, which combines with oxygen to form phosphate, is most often the limiting factor for plant production in streams.

pH – is a measure of the acid/alkaline relationship in a water body. pH values range on a scale of zero to 17, with 7 being neutral. A pH of about 6-9 is generally favored by aquatic life, especially fish. In-stream pH levels can also be impacted by acid and alkaline chemicals from industry, mining, acid rain and other man-made sources, as well as by natural sources such as limestone deposits.

Turbidity – refers to the optical property of a water sample, (i.e. whether or not it is cloudy). Any substance that makes water cloudy will cause turbidity. The most frequent cause of turbidity in lakes and rivers are plankton and soil erosion from storm water runoff.

Macroinvertebrates are an important indicator of stream health.

Water Temperature – is an important environmental factor for fish and other aquatic life, with many species needing specific temperature ranges to thrive. Temperature affects concentrations of dissolved oxygen in water, with higher concentrations occurring with colder temperatures.

In contrast to the chemical parameters noted above, the biological indicators or living organisms show what is happening in the stream over a period of time.

Certain types of plants and animals are more tolerant than others to changes in habitat and water quality. For example, many species of trout are extremely sensitive to water temperature changes and require water temperatures less than 70 degrees to grow and reproduce. Common indicators of biological health are fish, algae and macro-invertebrates. Macroinvertebrates are a group of animals without a backbone that can be seen by the naked eye. These bottom dwelling animals include crustaceans and worms but most are aquatic insects. Beetles, caddisflies, stoneflies, mayflies and dragonflies are among the groups of insects represented in streams. Macroinvertebrates are an important link in the food web between the producers (leaves and algae) and higher consumers such as fish.

Historical Water Quality Conditions in the Watershed

A detailed history of water quality conditions is included in the Delaware Riverkeeper Network's Little Neshaminy Watershed Assessment & Restoration Study completed in February 2003[30]. Studies dating from the mid 1940s to present are reviewed and summarized. As noted in the DRN study, comprehensive investigations of water quality in the entire Delaware River Basin were conducted in 1957 by the United States Geological Survey (USGS), which found that the Neshaminy Basin had sedimentation more intense than any other stream surveyed. Specific studies which included the Little Neshaminy were conducted from the 1960s to 2000 by various entities such as the Bucks County Planning Commission, and PA Department of Environmental Protection and Pennsylvania Fish and Boat Commission. From 1967-1977, for example, the Bucks County Planning Commission established a county wide water monitoring program which included five sampling sites in the Little Neshaminy. Sites were monitored for water quality, stream flow, fish, aquatic life and macroinvertebrates.

Two of the Little Neshaminy sites exhibited high percentages of rooted and floating plants covering the streambed. The existence of the plant beds were attributed to high nutrient levels, exposure to sunlight, shallow channels and silt deposits.

During studies conducted in the mid 1970s, the Little Neshaminy was cited as having the worst pollution problems in the Neshaminy Creek Basin, primarily due to point source discharges from wastewater treatment facilities.

Beginning in the mid-1970s, the Pennsylvania Department of Environmental Resources (now known as Pennsylvania Department of Environmental Protection) began looking at the impacts of specific wastewater treatment plants in the Little Neshaminy. In 1982, a study of the whole watershed found fair to poor water quality. In 1985, degraded macroinvertebrate communities and dense algal growths were observed during a PA DEP Priority Water Body Survey. By this time, water standards in the Neshaminy Creek Basin were upgraded to require phosphorus treatment for wastewater treatment plants.

30 See, Delaware Riverkeeper Network, Little Neshaminy Watershed Assessment & Restoration, February 2003, pages 47 – 73.

In the summer of 1987, the PA DEP conducted the Neshaminy Creek-Use Impairment Survey to examine nutrient-related impairments to designated uses. A second purpose of the study was to examine non-point source contributions to phosphorus loads. The overall conclusion of the study was that phosphorus controls were justified. The findings and observations specific to the Little Neshaminy included the following:

- The Little Neshaminy Watershed exhibited severe nutrient and organic enrichment on the same order as observed by the Bucks County Planning Commission a decade ago.
- In general the data in 1987 were worse than observed in 1984.
- Phosphorus loads in the stream were almost totally accounted for by point source loads.
- Like all Neshaminy basin streams, the Little Neshaminy was in the high risk category for stream enrichment based on alkalinity, degree of shading, stream velocity, scouring and substrate composition.

In 1992, the PA DEP and PA Fish and Boat Commission conducted biological surveys of the Little Neshaminy and Park Creeks. Six sites along the Little Neshaminy and Park Creek were evaluated for water quality, macroinvertebrates and fish. The following table summarizes the results of the 1992 analysis.

Table 17 – 1992 Rankings By PA DEP

	Water Quality	Macroinvertebrates	Fish
Little Neshaminy			
Headwaters	Good	Poor	Poor
Limekiln Rd.	Good	Fair	Fair
Kansas Rd.	Fair	Poor	Good
Bristol Rd.	Fair	Poor	Good
Grenoble Rd.	Fair	Fair	Fair
Mouth	Fair	Fair	Good
Park Creek			
Hartman Rd. (U)	Good	Poor	---
Hartman Rd. (D)	Fair	Poor	---
Lower State Rd	Good	Good	Fair
Horsham STP (U)	Good	Fair	Fair
County Line Rd. (U)	Fair	Good	Good
Tributary from Graeme Park	Fair	Poor	---
Mouth	Poor	Poor	Fair

Source: Delaware Riverkeeper Network - *Little Neshaminy Watershed Assessment and Restoration* – February 2003 from PA DEP 1992 biological survey. U= upstream, D = downstream

In March 2001, a monthly water quality monitoring program was initiated by the Delaware Riverkeeper Network (DRKN). The program established 11 baseline monitoring sites and operated between March and August of 2001. A comprehensive set of parameters were measured including: temperature, dissolved oxygen, pH, nitrate nitrogen, phosphate, ammonia, total dissolved solids and specific conductivity. Each site was also evaluated for fecal coliform.

The DRKN study evaluated each parameter and provided a summary of water quality trends based on data from 1968 to 2001. As noted in the report, the trends can be summarized as follows[31]:

- No apparent decreased aquatic plant activity in spite of PA DEP phosphorus removal requirements.
- No significant increase in phosphate (PO_4-P) in spite of an increased amount of treated effluent in the watershed with a significant decrease in phosphate downstream of the Warminster Township wastewater treatment plant.
- Increased nitrates NO_3-N, conductivity and TDS due presumably to larger amounts of treated wastewater effluent and possibly other human activities in the watershed.

In addition to the chemical parameters noted above, a biological assessment was conducted in the Fall of 2002 to assess the biological health of the Little Neshaminy and Park Creeks. The assessment examined benthic macroinvertebrates collected at nine locations and followed the EPA's Rapid Bioassessment Protocol.

Results indicated sub-optimal conditions for habitat at all locations analyzed. The report notes, "Overall, the quality of the macroinvertebrate community in the Little Neshaminy and Park Creeks suggests slight to moderate impairment. This is consistent with the findings published in a number of reports by PA DEP. Considering the number of sewage treatment plants and degree of urbanization in the watershed; the degree of impairment is not unexpected."[32]

Current Water Quality Designations and Impairments

Pennsylvania sets forth water quality standards for surface waters of the Commonwealth. These standards are important indicators of the biological health of the waterway as well as its recreational potential and aquatic life diversity. The standards are based upon water uses, which are to be protected and considered by the Pennsylvania Department of Environmental Protection (PA DEP) in its regulation of discharges such as those from wastewater treatment plants or industry.

The designated use for the Little Neshaminy Creek and its main tributary, Park Creek and several unnamed tributaries are Warm Water Fisheries (WWF) and Migratory Fisheries supporting such fish as the American eel.

Section 303(d) of the Clean Water Act requires that states assess the quality of surface waters biannually. Streams considered impaired or not meeting their designated use are included on the "303d list". States must then prepare Total Maximum Daily Load (TMDL) plans for those streams' watersheds. The TMDL is designed to reduce the sources of impairments in the watershed by identifying

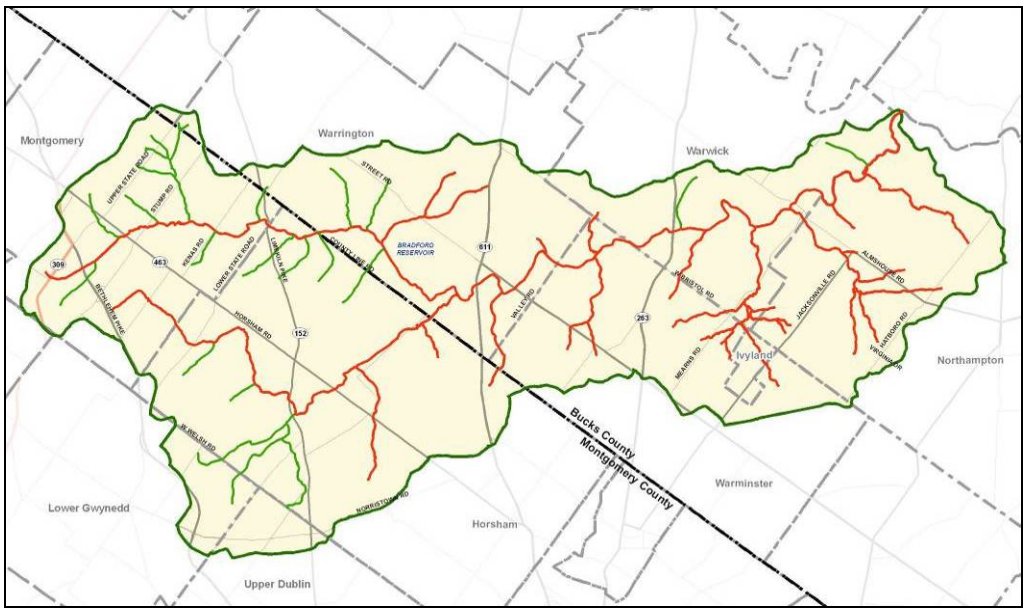
31 Delaware Riverkeeper Network, Little Neshaminy Creek Watershed Assessment & Restoration, February 2003, p. 68.

32 Delaware Riverkeeper Network, p. 73.

specific causes of impairment and setting targets for the reduction of those inputs to the stream system.

The Little Neshaminy Creek Watershed is listed as a Category I Priority Watershed under the state's Unified Watershed Assessment program. Assessment results are based on biological and habitat surveys conducted by the PA DEP as noted above. The entire main stem of the Little Neshaminy Creek is considered impaired. These results reflect that the aquatic life present does not meet criteria established for expected species diversity and abundance. The Park Creek Watershed located in Horsham and Montgomery Townships is also listed as impaired. Figure 20 shows the streams and tributaries to the Little Neshaminy Creek that are impaired. Table 17 identifies the miles of impaired streams in the study area and the causes for impairment.

Figure 20 – Portion of Little Neshaminy Creek having point & non-point source related impairments



Source: TMDL Assessment for Neshaminy Creek Watershed 303(d) list of impaired streams. (PA DEP -December 2003) Red = impaired

Total Maximum Daily Loads were developed for the Little Neshaminy Creek watershed to address the impairments noted on Pennsylvania's 1996, 1998 and 2002 Clean Water Act Section 303(d) Lists (see Table 17a below). The 1996 303(d) List reported 15.7 miles of the Little Neshaminy and 6.2 miles of Park Creek to be impaired by nutrients and DO/BOD[33]. The 1998 303(d) List added 5.5 miles to the Little Neshaminy as being impaired by water/flow variability and siltation, and the 2002 303(d) List added still more impaired segments. The 2002 list reports a total of 37.9 miles of Little Neshaminy Creek (plus several unnamed

33 DO – Dissolved Oxygen is the amount of oxygen that is dissolved in water and is essential to healthy streams. BOD – Biological Oxygen Demand is a measure of the oxygen used by microorganisms to decompose waste. If there is lots of organic waste in the water, there will be a lot of bacteria present. When BOD levels are high, DO levels decrease because the oxygen available in the water is being consumed by the bacteria. Since less DO is available, fish and other aquatic organisms may not survive.

tributaries) and 9.3 miles of Park Creek (and its two unnamed tributaries) to be impaired by nutrients and DO/BOD from municipal point sources, and by siltation and water/flow variability as a result of urban runoff/storm sewers.

Table 17a – Streams in Little Neshaminy Creek: 303d/305/b Listings

Stream	Stream Code	Drainage Basin (square miles)	Miles Attained	Miles Impaired	Impairment Causes/Sources/Comments
Little Neshaminy Creek	02638	43.0	12.65 miles of 19 UNTs	15.78 of main stem & 22.24 of 3 UNTs; 15.78 of main stem; 34.98 of 43 UNTs	Water/flow variability & siltation from urban runoff/storm sewers; Fish consumption advisory for PCB
Park Creek	02661	11.8	5.24 of 5 UNTs	7.37 of main stem & 1.7 of one UNT 6.84 of main stem & of 7 UNTs	Nutrients, pathogens, organic enrichment/low DO; other from municipal point sources; Water & flow variability & nutrients from Urban runoff, storm sewers; Fish consumption advisory for PCB

Source: PA DEP Watershed Restoration Action Strategy - Subbasin 02f - Neshaminy Creek Watershed - Updated May, 2004
UNT: Unnamed Tributary

Stream segments of Little Neshaminy Creek and its tributaries are impacted by siltation as a result of "new land development" in the watershed. New land development is defined here as disturbed land at construction sites, or at new development. Siltation presently observed in the Little Neshaminy is believed to be the result of years of sediment build-up in the channel bottom that started in the early 1990s. This sediment originated from disturbed and unprotected soils at construction sites and increased channel bank erosion during periods of intense storm events. Water/flow variability, also listed as a cause of impairment by DEP, was not explicitly addressed because it was believed that the implementation of BMPs in the developed (and developing) areas to reduce sediment losses due to upland and streambank erosion would also decrease water flow and volume to the stream and therefore stabilize stream flow.

The goals are to help reduce the important problems in the watershed that have increased significantly due to urbanization and suburbanization especially in the construction process. The implementation of best management practices (BMP) in the affected areas to increase infiltration and sediment control should achieve the loading reduction goals stated in the TMDL.

The TMDL can be viewed at http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/tmdl/neshaminy_2.pdf on the PA DEP website.

Lakes/Ponds/Reservoirs/Impoundments

Lakes and ponds provide habitat for aquatic life as well as water sources for wildlife. These landscape features are scenic amenities and have aesthetic value. Several dams are located within the Little Neshaminy watershed including Bradford Reservoir in Warrington Township, which is the largest. Two other older impoundments are located upstream of Street Road and on the lower reach of Park Creek.

Although popular as landscape features, man-made lakes and ponds may become problematic if not properly designed or maintained. These problems include eutrophication (the process by which a body of water becomes rich in dissolved nutrients (as phosphates) and shallow, either naturally or by pollution, with a seasonal deficiency in dissolved oxygen, increased water temperature and attractiveness to geese. This latter problem has been the focus of much debate. Geese are attracted to well-mown lawns, particularly those adjacent to water bodies. These types of areas provide a safe environment for the birds. However, many locations are being overrun by geese and their associated droppings.

Bradford Lake is a 22-acre impoundment made from a Floodwater Retarding Dam along the Little Neshaminy Creek in the township of Warrington. Bradford Lake is the only man-made lake in the study area. The dam was created in 1975 by constructing an earthen dam across the creek. The dam was built primarily to alleviate flooding downstream from its location. The lake is classified as a very shallow, hypereutrophic[34] impoundment or reservoir. The lake provides habitat for aquatic life as well as water sources for wildlife. Bradford Lake is shown on Map 6 – Water Resources. Additional information regarding the reservoir is included in the following paragraphs.

Bradford Lake and Little Neshaminy Creek Watershed Assessment

A study prepared by Aqua Link, Inc. in June of 2005, analyzed Bradford Lake and the associated drainage area of the Little Neshaminy Creek.[35] The study determined that the lake had an excess of nutrients, particularly phosphorus. This condition promotes blooms of blue green algae and has caused significant taste and odor problems at the Neshaminy Falls Water Treatment plant. A more in-depth discussion of this topic can be found in the "Impacts to Drinking Water" Segment.

The Lake has a high density of aquatic vegetation that is adversely affecting its recreational uses. The most dominant of these vegetations is the water chestnut. Water chestnut (*Trapa natans*) is a highly aggressive plant that is spreading from New England north and south. Furthermore, this invasive exotic plant has little

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34 Hypereutrophic lakes are very nutrient rich lakes characterized by frequent and severe nuisance algal blooms and low transparency. In hyper-eutrophic (highly eutrophic) lakes, aquatic productivity is extremely high and is dominated by very large numbers of a few, undesirable species.

35 Aqua Link, Inc., Little Neshaminy Creek & Bradford Lake Watershed Assessment, Prepared for PA. Department of Environmental Protection and Bucks County Conservation District. June 2005.

value as a food source and habitat for native wildlife. These dense beds of water chestnut were intertwined with dense mats of filamentous algae. According to the study, water chestnut covers about 70% of the lake's surface in the summer months, thereby severely restricting anglers from using this water resource during the summer recreational season and greatly reducing habitat for native plants and animals. By fall, the decomposing chestnut dangerously reduces dissolved oxygen levels. Figure 21 shows and example of the Water chestnut observed at the lake during the assessment.

The largest source of pollution to the lake according to the study is non-point source pollution (polluted runoff from a variety of sources). Most of the nutrients and sediments that are entering the lake are coming from urban lands such as residential housing, commercial districts and industrial zones. The study reports that the most serious threat to the lake's quality is land development (active and post construction). With a lack of erosion controls during the construction process around the lake's watershed there is a high increase in nutrients being brought into the lake during and after construction from stormwater runoff.

The largest source of pollution to the lake according to the study is non-point source pollution

The surrounding area has a very impervious landscape. The most dominant land cover feature is residential land cover, and the watershed has a relatively high agricultural land cover area as well, mostly used for crop production. The primary goal for the watershed management plan is to reduce non-point source pollutants, namely nutrients and sediments, to the streams in the lake's watershed and as a result into the lake. The study recommends that action be taken towards in-lake restoration including the following techniques: sediment dredging, diffused-air aeration, the use of aquatic algaecides and herbicides, and mechanical weed harvesting.

Figure 21 Bradford Lake - Dense Strands of Water Chestnut

Source: Bradford Lake & Little Neshaminy Creek Watershed Assessment, 2005

The study also notes that the watershed in its entirety needs restoration including streambank stabilization; establishing riparian buffers; performing stormwater retrofit assessment; and preparing conservation and nutrient management plans for active farms. Finally, the establishment of a watershed organization for the

lake would be very beneficial to the people living in the watershed, and for the health of the watershed.

Bradford Lake and Impacts to Drinking Water

As indicated above, studies of the lake indicate that Bradford Lake has excessive nutrient levels, particularly phosphorus. This condition promotes blooms of certain cyanobacteria (blue-green algae) that produce two notorious natural taste and odor compounds: methyl isoborneol (MIB) and geosim. These compounds can cause "musty" and "earthy" tastes and odors in tap water at concentrations as low as 5 parts per trillion. They are very difficult to remove with conventional water treatment processes. Impacts to drinking water sources were first documented in 2003 at a water treatment plant in Neshaminy Falls, after heavy rains followed a prolonged period of drought in 2001 and 2002, and have continued to affect water quality at this facility seasonally to varying degrees.

Neshaminy Creek flows into the Delaware River upstream of Philadelphia's Baxter WTP intake. Despite tremendous dilution in the Delaware River, impacts on the source water for the city of Philadelphia may have occurred in the past, and could occur in the future. Measures should be taken to address conditions in the lake that contribute to these impacts on drinking water sources downstream, particularly phosphorus.

Wetlands

Wetlands are areas that are seasonally or perennially wet, due to replenishment of water from a groundwater source or the pooling of water due to poorly drained soils. They are often characterized by soil types, the presence of standing water for parts of the year, and the plant communities that they support.

There are approximately 763 acres of wetlands located within the study area.

A unique landform, wetlands are often called bogs, swamps, marshes, seeps or springs. They provide specialized habitats for wildlife, often serving as breeding areas for amphibians and fish, and can serve as important passive recreational areas for bird and wildlife viewing. Wetlands provide an additional benefit of improving water quality by filtering nutrients and other pollutants from the water such as nitrogen and phosphorus. Wetlands can serve as a storage area for floodwaters and reduce the velocity of stormwater run-off.

There are approximately 763 acres of wetlands located within the study area. These were identified by the National Wetlands Inventory (NWI) which is a service provided by the U.S. Fish and Wildlife Service. The NWI identifies wetlands from aerial photographs and is not field verified. As a result, data may be inaccurate or incomplete, and more formal verification is required for regulatory purposes. There are still several small wetlands, found along the creek corridor, remaining in the Little Neshaminy Creek Watershed. These areas are very low-lying areas, where the water table is just below the surface. Wetlands along the Neshaminy Creek tend to lie within a floodplain, if not set back from the creek. The wetland areas are shown on Map 6.

The federal and state permitting process for disturbances within wetlands is regulatory, rather than protective. If the proper information is provided and the permit conditions satisfied, the permit is issued. Thus, the municipality's role becomes more important in terms of protecting these resources.

At the local level, wetland areas can be protected through the use of wetland protection ordinances and wetland buffer zone ordinances. Most municipalities within the study area prohibit development in wetland areas. However, protection measures are only effective if the wetland areas are properly identified through wetland delineation as described above. Municipalities should require that applicants delineate wetlands on their property prior to development or provide evidence that no wetlands exist. In addition to wetlands, some municipalities in the study area regulate the intensity of development in wetland buffer areas. Local wetland buffer ordinances are very important, because the protection of wetland buffers is not mandated at the state level. The Bucks County Planning Commission recommends a buffer zone to extend 100 feet from the wetland boundary or to the limit of the delineated hydric soils whichever is less. Within this area, 80% of the buffer area must be protected from development.

Floodplains

Floodplains are the land areas adjacent to a stream channel that are susceptible to periodic inundation, are usually categorized by the frequency of this inundation. A key term used in floodplains, especially in ordinances, is the 100-year floodplain. This is an area that has a one percent chance of being flooded in any given year. (Recent storm events have exceeded this statistical average and caused property damage.) These areas are typically restricted for new development or disturbance. Floodplains consist of two primary components: Floodway and flood fringe. A floodway is the portion of the 100-year floodplain that serves as a flood channel to pass deep, fast moving waters. It includes both the watercourse channel and the adjacent land area which must be reserved to carry the base flood without cumulatively increasing the 100-year flood elevation more than one foot. The flood fringe is the portion of the floodplain outside of the floodway, which contains the shallow, slower moving floodwater. The 100-year floodplains are delineated on Map 6 – *Water Resources*. Floodplains were identified in the studies associated with the National Flood Insurance Program (NFIP). Floodplain areas are based on elevation data and hydrologic modeling. The modeling determines the volume of water that will occur during and after a rainfall event. The volume of water is directly proportional to the amount of impervious surface in the watershed. Due to development, there may be more impervious cover than was estimated when the original modeling was conducted.

In addition, filling and construction in floodplain areas may have occurred since the modeling, thereby reducing the storage volume of the currently delineated floodplain. The Federal Emergency Management Agency or FEMA has recognized that the increase of impervious surface and reduced storage volume in the floodplain have resulted in some flood hazard areas being more extensive

than currently shown on flood insurance rate maps. Activities are currently underway to examine existing flood hazard areas and update flood insurance rate maps.

Floodplains serve as ideal areas for managed aesthetic and recreational activities.

Floodplains serve as ideal areas for managed aesthetic and recreational activities. The natural flat, lush characteristics of floodplains as well as their waterfront view make them ideal areas for outdoor recreational activities. Floodplain areas often contain other resources such as historic heritage and archaeological sites. As noted in Chapter 10 Biological Resources, relatively undisturbed floodplains are found along the Little Neshaminy Creek within the Forks of Neshaminy Natural Areas Inventory site in Warwick and Northampton Townships.

The natural function of floodplains is to accommodate floodwater. The natural vegetation supported by moist floodplains helps trap sediment from upland surface runoff, stabilizes stream banks for erosion control and provides shelter for wildlife and proper stream conditions for aquatic life.

These floodplain limitations do not preclude all development. Agricultural uses, private and public recreation uses (e.g. golf courses, ball fields, golf driving ranges, picnic grounds, wildlife and nature preserves, swimming areas, passive open space, hunting and fishing areas, hiking trails) and uses incidental to residential structures (e.g. lawns, gardens, play areas) are typically permitted.

Due to their unique characteristics, ecological significance and susceptibility for adverse impacts, development within floodplains is regulated at the local, state and Federal levels. Regulations seek to minimize damage to life and property for existing development, control future development and protect water quality. Regulatory agencies include the FEMA and the PA DEP.

There are also numerous state legislative programs directly or indirectly related to floodplain development and protection including the 1978 Stormwater Management Act (Act 167), the 1978 Dam Safety and Encroachment Act (Act 325), and the 1978 Pennsylvania Floodplain Management Act (Act 166) and its amendments of 1986, and 1989. Floodplains are also under local protection in many municipalities through the establishment of floodplain conservation districts or overlay zones. Each municipality within the study area restricts development within identified 100-year floodplain areas and most place restrictions on flood fringe areas.

In 1978, the Pennsylvania Floodplain Management Act (Act 166 of 1978) was enacted. This required local governments to exclude hospitals, nursing homes, jails, new or substantially expanded mobile home parks and subdivisions, and storage of specified hazardous material from floodplain areas. This act also required municipalities with flood prone areas to participate in the NFIP.

In order for a community to qualify for the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program, the local municipality must

enact ordinances that regulate construction and certain human activities in flood plains in order to prevent loss of life and property due to flooding.

Riparian Buffers

Riparian buffers act as a natural filter of stormwater and stabilizer of stream banks to help reduce erosion usually through areas of vegetation that grow along the stream banks. Riparian buffers may be forested, wetlands or meadows. Proper riparian vegetation can hold the soil intact and remove excess nutrients and pollutants before they reach the water. In addition, riparian buffers slow the velocity of stormwater. The vegetation helps shade the streams allowing for more sustainable aquatic life, as well as supporting habitat and cover for wild life. These buffers are often overlooked by landowners but are key to providing a healthy and stabilized stream environment. However, this can change with the continued use of ordinances and the enforcement of these ordinances.

Warminster Township has been working over the past 3 years with the Delaware Riverkeeper Network to improve riparian buffers in Kemper Park.

A number of riparian buffer restoration projects have been initiated or completed in the watershed municipalities. Examples include Kohler Park in Horsham and Kemper Park in Warminster Township. Warminster Township has been working over the past 3 years with the Delaware Riverkeeper Network to improve riparian buffers in Kemper Park funded via a grant from the PA DEP's Growing Greener Program. The township planted over 300 trees of all sizes, put in wildflower matting, removed the fish dam and completed an evergreen revetment project to reduce erosion. Results have been improved water quality, increased buffer and a huge reduction of geese at this site because they no longer have direct access. Future activities include tree planting to replace those lost in storms, planting of more native species, educational signage about streamside parks and the watershed, installation of a bio-swale to increase filtration off the parking lot.

In 2002, Heritage Conservancy completed a pilot study for the Pennsylvania Department of Environmental Protection entitled, *Riparian Buffer Assessment of Southeastern Pennsylvania.* The study analyzed the Riparian Buffer Status of four watersheds in Southeastern Pennsylvania, including the Neshaminy Creek Watershed. The goals of the project, consistent with Pennsylvania's Stream ReLeaf goals, were to promote non-point source (NPS) pollution prevention and mitigation. Forested Buffers can provide reduction of suspended soils, and other contaminants in run-off.

During the study, a set of benchmarks were established as a guide to interpretation of the maps produced during the ground and fly-over process in early April 2000. It should be noted that only forested buffers were indicated in this study and that meadow or wetland buffers were not included in the analysis

The following key terms were used to categorize the data:

- **Forested Buffer** – defined as a band of forest extending 50 feet from the streambank, with a minimum 50% canopy closure.
- **Lacking Forest Buffer** – defined as a streambank lacking 50-foot wide forest and less than 50% canopy closure with little or no apparent buffering

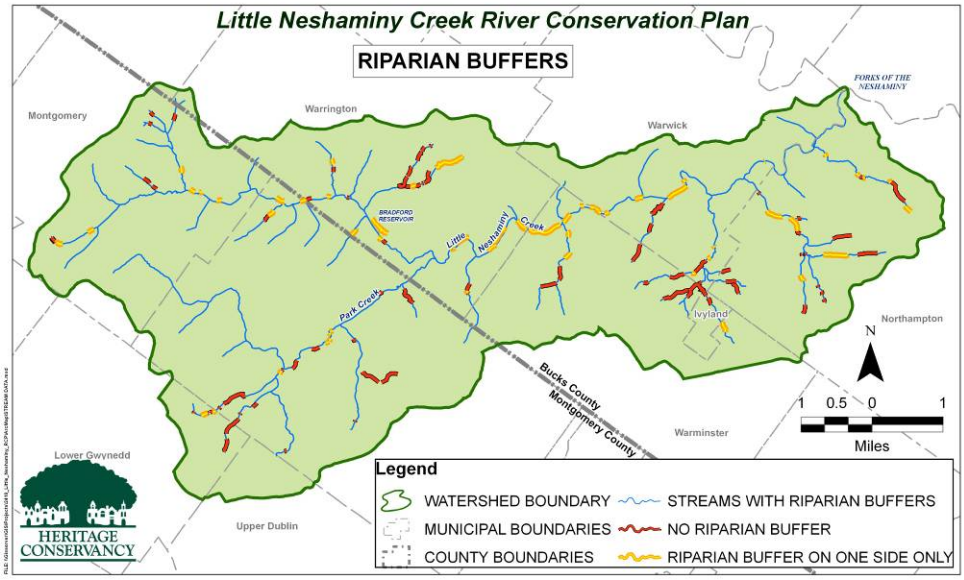
capacity from shrubs, tree seedlings, non canopy trees or widely spaced canopy trees.

- **Partial Forest Buffer** –defined as a streambank lacking 50-foot width or 50% canopy closure but with some buffering capacity from shrubs, tree seedlings, non-canopy trees, or widely spaced canopy trees.

Data was collected as stated above from ground and flyover photographs. The flyover was done before leaf-out. Then ground data was collected via automobile along the route with still photography. These images were then compared with each other to determine the accuracy of interpretation. Each stream bank was assessed separately during the study. Large water bodies along the creeks in the watershed had their banks assessed as well. In some cases, streams lacked buffers on only one side, while others lacked buffers on both sides.

Numerous stream segments lack buffers on one or both sides of the stream.

Figure 22 – Riparian Buffer Status in Little Neshaminy Watershed



As shown on Figure 22, numerous stream segments lack buffers on one or both sides of the stream. These areas are shown as yellow lines, (one side lacking) or red lines, (both sides lacking).

Flooding

The Little Neshaminy Creek has a long history of flooding. Large-scale floods were recorded in 1865, 1931, 1955, 1960, 1967, 1971, 1972, 1996 and 2001. The floods of 1865 and 1955 are noted as the most significant over the years.[36] As noted above, Bradford Lake was created in 1975 by an earthen dam to primarily alleviate flooding downstream. A preliminary bathymetric survey conducted in November, 2004 as part of the Little Neshaminy Creek and Bradford Lake

36 Bucks County Planning Commission By Corps. Of Engineers U.S. Army. Flood Plain Information: Little Neshaminy Creek Bucks County. November 1973. pg. 10

Watershed Assessment indicated that due to accumulated sediments in the reservoir over the past 30 years, the lake's storage volume is less than its original floodwater retarding storage volume.[37] This could affect its functionality in storm events. Bucks County is considering lowering the water levels in the lake, when major storm events are predicted.

The Little Neshaminy Creek has a long history of flooding.

In June of 2006, the region experienced another major storm event which resulted in additional flooding along the Little Neshaminy and Park Creeks. Figures 23 and 24 show the creek's high, turbid, waters on the morning following this storm event.

Figure 23 – Little Neshaminy meander at Street Road Embankment after June 28, 2006 flood.

Some of the areas which are typically inundated during major rainfalls were identified by the public during the project including:

- Houses located below Neshaminy Warwick Church
- Neshaminy Village Area in Warrington Township
- Kansas Road Flooding (where Little Neshaminy and Park Creek merge) in Horsham Township
- Keith Valley Road between Davis Grove and County Line Ave. in Horsham Township
- BuxMont Unitarian Universalist Fellowship property along Little Neshaminy (2040 Street Road), just east of Route 611.
- Grace Church, Street Road in Warminster Township
- Bridge over the Little Neshaminy on Old York Road, Warwick Township

These areas are shown on Map 2, Issues and Concerns.

Man-made obstructions to flood-flows are the primary reason for more extensive flooding than would normally occur. Man made encroachments on or over the streams include dams, bridges and culverts. These obstructions can create more

37 Aqua Link, Inc. Little Neshaminy & Bradford Lake Watershed Assessment, Pg 10.

extensive flooding due to backwater.[38] Obstructions can also come in the form of natural obstructions such as trees, brush and other vegetation along the stream banks.

Understanding the soils in the Little Neshaminy Creek Watershed can be one of the keys to understanding the flashy nature of flooding in the watershed. Soil Groups C and D make up most of the watershed. These soils have "moderate to high" and "high" runoff rates respectively, meaning that water is very slow to infiltrate. This causes rapid increases in stream levels during storm events. This situation is perpetuated by human activity in the form of impervious land cover, which increases the rate at which runoff is discharged into the streams. The percent impervious cover in the watershed (a measure of the amount of paved surfaces) has also increased dramatically since 1950 from 5% to over 24% as land uses shifted from rural to urban/suburban.[39] The increased imperious cover from 1970 to 2000 is illustrated on Figure 14, located in Chapter VI.

Figure 24 – Park Creek looking downstream from Kansas Road Bridge – following major storm of June 28, 2006.

Property damages resulting from flooding is exacerbated by development within areas prone to flooding.

Property damages resulting from flooding is exacerbated by development within areas prone to flooding. Many communities were developed prior to the implementation of more restrictive floodplain regulations and before mapping were developed to specify these flood prone areas. The Neshaminy Creek Watershed as a whole ranks fifth out of the 30 main watersheds in the Delaware River Basin in total amount of flood claims filed. The Neshaminy Creek ranks 3rd out of the same 30 watersheds in total amount of claims cost.[40]

Water Supply

The majority of residents and businesses are served by public water and sewer utilities, although private wells and septic systems may still be in use in some

38 Bucks County Planning Commission By Corps. Of Engineers U.S. Army. Flood Plain Information: Little Neshaminy Creek Bucks County. November 1973. pg 7-9

39 Delaware Riverkeeper Network, Little Neshaminy Watershed Assessment and Restoration, February 2003, pg 1.

40 Delaware River Basin Commission, FEMA Flood Insurance Claim Data For Period of Record. Past 25 years.

areas. The public water utilities that service the area are local or county municipal authorities that rely on both groundwater and purchased surface water for supply.

North Wales Water Authority and the North Penn Water Authority have permits to extract 40 million gallons a day from the Forest Park Water Treatment Facility. In addition, the Horsham Township Water Authority relies on groundwater within the watershed. [41] The Northampton Township Water Authority relies on the Bucks County Water & Sewer Authority (BCWSA) who is reselling their water from the Philadelphia Water Department's Baxter Water Treatment Plant in northeast Philadelphia. Ivyland Borough receives their water supply from the Warminster Water Authority who purchases their water from the North Wales Authority. Warwick Township Water & Sewer Authority purchases their water through Aqua PA in multiple interconnections from surface water.

Warrington Township purchases their water from the North Wales Water Authority at the Forest Park Water Treatment Facility; the township also serves the eastern part of its township through nine wells drilled at depths of 360 to 900 feet deep in the Stockton geological formation along the Rt. 611 corridor. In Montgomery County, Montgomery Township receives their water from both the North Wales Water Authority and the North Penn Water Authority.

The study area lies within the Delaware River Basin Commission's Groundwater Protection Area of Southeastern Pennsylvania. This protection act serves to protect water resources in the Triassic Lowland region of the Delaware River Basin with regulations on water withdrawals, and to promote water conservation.[42] Increased development has led to increased groundwater withdrawals while at the same time decreased infiltration into the water table; all of this has led to reduced stream base flow into the creek and its headwater tributaries. This reduction in base flow negatively impacts aquatic life and reduces the ability for streams to filter and assimilate pollutants and treated municipal waste.

Municipal Dischargers

There are four municipal wastewater discharge facilities in the Little Neshaminy watershed. Two are located in Montgomery County and two in Bucks County. Montgomery County's facilities include Horsham Township Water and Sewer Authority's Park Creek Sewage Treatment Plant and the Montgomery Township Municipal Authority's Eureka Wastewater Treatment Plant. In Bucks County, facilities include the Warminster Sewage Treatment Plant in Warminster, PA near Kemper Park along the main stem of the Little Neshaminy Creek and the Warminster NAWC Wastewater Treatment Plant along Jacksonville Road. These municipal major discharges are one of the sources of impairment for the Little Neshaminy Creek. The discharge coming from these sites can result in excess nutrients and sediments in the creek.

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41 Montgomery County Open Space Plan Chapter 3

42 Delaware River Basin Commission. Ground Water Protected Areas in Southeastern PA. October 29, 1961 Amendments include 1999

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System, otherwise known as NPDES is a federal permitting program designed to track and reduce the number of pollutants that are being discharged directly into the nation's waterways. The goal of this program is to restore waterways to state of historical recreational uses such as fishing and swimming. There are 12 facilities with NPDES permits in the study area including the four municipal dischargers noted above. Table 18 details the name of the discharging facility, its permit identification number, the county, the Standard Industrial Code (SIC) description and the receiving waters.

Table 18 – NPDES Permitted Dischargers within the Study Area

NPDES ID Number	Facility Name	County	SIC Description	Receiving Waters
PA0050059	English Village Service Co.	Montgomery	Sewerage System	Park Creek
PA0051985	Park Creek STP (Horsham Twp. Water & Sewer Auth.)	Montgomery	Sewerage System	Park Creek
PA0011011	Plymouth Tube	Montgomery	Steel Pipe and Tubes	Unnamed tributary to Park Creek
PAG050051	Exxon Station Maple Glen	Montgomery	Gasoline Service Station	Unnamed tributary to Park Creek via storm sewer
PA0053180	Eureka WWTP (Montgomery Twp. Mun. Auth)	Montgomery	Sewage Systems	Little Neshaminy Creek
PAR700013	Dryden Oil Co.	Bucks	Lubricating oil and greases	Little Neshaminy Creek
PAR700003	Castrol Ind.	Bucks	Gasoline Service Station	Little Neshaminy Creek
PAR2000017	Greif Containers	Bucks	Metal Shipping Barrels, Drums, Kegs, and Pails	Little Neshaminy Creek
PAR110038	Milton Roy Mfg.	Bucks	Industrial Instruments	Little Neshaminy Creek
PAG040001	Wagner SRSTP	Bucks	Operators of Dwellings other than Apt. Bldgs.	Little Neshaminy Creek
PA0058742	Warminster NAWC WWTP (Warminster Municipal Authority)	Bucks	Sewerage Systems	Unnamed tributary to Little Neshaminy Creek
PA0026166	Warminster Twp. Log College STP (Warminster Municipal Authority)	Bucks	Sewerage Systems	Little Neshaminy Creek

Source: http://cfpub.epa.gov/npdes Updated 9-15-06

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Hazardous Waste Sites

The United States Environmental Protection Agency (EPA) administers the Superfund program to identify and mitigate sites that pose a great present danger to public health and the environment do to past land uses. When a potential contaminated site is presented to the EPA, it is put on the CERCLIS system list. This listing means that through investigation by the EPA the site could be placed on the National Priorities List (NPL). The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants or contaminants throughout the United States. A site is proposed for inclusion on the NPL based on a Hazard Ranking System score of 28.5 or higher. A site that has been proposed to NPL is "final" when it has been formally added to the NPL. Once a site is on the NPL, it becomes eligible for Superfund financing to aid in clean up activities.

Table 19 – Sites on the CERCLIS List - Little Neshaminy Creek Watershed

CERCLIS Sites	Address	NPL Status	EPA ID	County	Federal Facility	Cleanup Progress Summary
Merit Medal Products Corp.	242 Valley Road Warrington, PA 18976	Not on NPL	PAD004006839	Bucks	No	
ABAR Corp.	82 Richard Road 18974	Not on NPL	PAD077060358	Bucks	No	
Castrol Industrial Inc.	775 Louis Drive Warminster PA, 18974	Not on NPL	PA0000766923	Bucks	No	
Creek Road Sand Blasting	871 Creek Road Hartsville, PA, 18974	Not on NPL	PASFN0305402	Bucks	No	
Fischer & Porter Co.	Jacksonville & Street Road Warminster, PA, 18974	Final – 1983	PAD002345817	Bucks	No	Construction Complete
Naval Air Development Center (now includes Warminster Community Park) (8 waste areas)	Street and Jacksonville Roads, 18974	Final – 1989	PA6170024545	Bucks	Yes	Construction Complete
Warwick Twp. Real Estate	960 Creek Road Warwick, PA, 18974	Not on NPL	PA0000585901	Bucks	No	
Willow Grove Naval Air & Air Reserve Station	RT. 611 and County Line Road Horsham PA	Final – 1995	PAD987277837	Montgomery	Yes	Study Underway, Early Action Initiated

Source: http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm

Last Updated 11/06

As listed on Table 19, there are eight sites on the CERCLIS located in the Little Neshaminy Creek Watershed. Seven are located in Bucks County, one in Montgomery County. Three of the eight CERLIS sites are currently listed on the Final NPL: Fischer & Porter Company, at the intersection of Jacksonville and Street Roads in Warminster, the former Naval Air Development Center (Johnsville Air Base), also at Street and Jacksonville Roads in Warminster and the Willow Grove Naval Air Station in Horsham. [43] The other sites are not on the NPL and are not Federal Facilities. Sites on final NPL undergo a series of cleanup milestones. Both the former Naval Air Development Center and Fisher and Porter Company are categorized as "Construction Complete." A site is categorized as Construction Complete by meeting one of the following criteria: any necessary construction is complete, whether or not final levels or other requirements have been achieved; EPA has determined the response action should be limited to measures that do not involve construction; or the site qualifies for deletion from the NPL. For both sites, EPA notes that under current conditions at this site, potential or actual human exposures are under control.[44]

Clean up at the former Naval Air Warfare Center was initiated in 1993 and construction was completed in 2000. Over 2,700 cubic yards of soil have been treated, stabilized, or removed and over 153 million gallons of water have been treated, stabilized or removed. Contaminated groundwater migration at the site is also under control. Monitoring activities continue at the former Naval Air Warfare Center/Johnsville Air Base through a series of twenty monitoring wells situated in Werner Park, Munro Park and Warminster Community Park.

At the Willow Grove NAS, the first clean-up action was initiated in 1999. Over 8,000 cubic yards of soil or other solid-based media have been treated, stabilized or removed. According to the Superfund Information System, EPA is working to determine whether under current conditions, there are any potential or actual human exposures to contaminants at the site. In addition, EPA is still working to determined whether contaminated groundwater migration is under control. The final remedy for the site has not been selected.[45]

Stormwater Planning and Regulations in the Watershed

The focus of water pollution problems has traditionally been on point sources of pollution--direct discharges from industrial facilities, sewage treatment plants and the like. In the last 25 years or so, however, these point sources have been cleaned up considerably due to legislation such as the Clean Water Act and many additional state and local efforts. Despite this, pollution problems have not gone

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43 EPA: CERCLIS http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm 05/08/06

44 US EPA Superfund Information Systems http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0300585

45 US EPA Superfund Information Systems http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0303820

away. The Environmental Protection Agency (EPA) estimates that non-point source pollution is now the single largest cause of the deterioration of our nation's waterways. Non-point source pollution or polluted runoff is created when water washes over the land and picks up all sorts of diffuse (not concentrated or localized) pollutants along the way. These pollutants include soils from erosion, excess nutrients from lawn and crop fertilizers and chemicals and heavy metals from roadways and parking lots. Every time it rains, these pollutants are transported directly into our waterways by stormwater runoff. The increased volume and velocity of stormwater runoff creates problems for stream system morphology. High velocity stormwater runoff scours stream channels and erodes stream banks often times stripping vegetation from stream banks. This eroded sediment is then deposited downstream when the water levels recede leaving sediment islands and debris blockages of bridges and culverts.

Concern over polluted runoff has resulted in an increasing number of state and federal laws enacted over the last five years. These programs supplemented existing laws enacted earlier, which mainly focused on controlling the volume and velocity of stormwater. The following paragraphs describe the current state and federal regulatory programs, which are intended to address both stormwater quantity and quality issues.

Pennsylvania Act 167 Stormwater Management Plan

In order to mitigate some of the effects of stormwater run-off, the Pennsylvania state legislature passed the Stormwater Management Act of 1978. Under this legislation, the Bucks County Planning Commission completed the Neshaminy Creek Stormwater Management Plan in 1992. This plan, however, excluded the Little Neshaminy Creek sub-basin. The Little Neshaminy Creek Act 167 Plan was later completed in 1996. While both plans addressed issues of groundwater recharge and water quality impacts, they emphasized the problem of peak stormwater flows. A "peak" discharge is that point in time where the maximum speed and volume of runoff discharging occurs during the entire storm event. The Act 167 Plan for the Little Neshaminy Creek resulted in municipalities within the watershed adopting the model stormwater ordinance set forth in the plan. The Act 167 plan set a standard for on-site stormwater run-off for new construction in the watershed and identified reaches of the watershed where reduced stormwater flows would be required.

In short, post-construction stormwater flows could be no greater than the flows from the site before it was developed. The model ordinance recommended Best Management Practices (BMPs) that benefited water quality and groundwater recharge as well as peak flow attenuation. The Bucks County Planning Commission is currently updating the Act 167 plan for the entire Neshaminy Creek Watershed, including the Little Neshaminy Creek. The updated plan, due to be completed in 2007, will address water quality aspects and groundwater recharge issues associated with stormwater management.

National Pollutant Discharge Elimination System (NPDES) and Phase II Stormwater Regulations

In 1972, the Clean Water Act prohibited the discharge of any pollutant into a waterbody of the United States without a permit. The NPDES program was designed to track the point sources of pollution and required the implementation of controls designed to reduce this pollution.

In 1987, the U.S. Congress amended the Clean Water Act to establish a national program for addressing stormwater discharges. The program was to be implemented in two phases. Phase I required NPDES permits for municipal separate stormwater systems (MS4s) for municipalities serving populations of 100,000 people or more. Phase I also regulated discharges from industrial point sources.

As of 2003, designated MS4s with populations of less than 100,000, within an urbanized area and meeting population density criteria (> 1,000 persons per square mile), were required to apply for NPDES permits to cover municipal separate stormwater systems. Each municipality in this study area is a designated MS4 and they are required to submit plans to address six minimum control measures set forth by the state DEP. These minimum measures include:

- Public education and outreach
- Public participation and involvement
- Elicit discharge detection and elimination.
- Construction site runoff control
- Pollution prevention
- Good housekeeping for municipal operations

At this time, the state is in the process of finalizing a model stormwater ordinance for municipalities to adopt to help meet the new permitting requirements. The State has also finalized a new Stormwater Best Management Practices Manual. These documents can be viewed at the following websites:

BMP Handbook:
http://164.156.71.80/WXOD.aspx?fs=2087d8407c0e00008000071900000719&ft=1

Model Ordinance:
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/stormwatermanagement/Stormwater%20Draft%20Ordinance/STORMWATER%20DRAFT%20Ordinance.htm

General Information on Stormwater Management Program:
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/stormwatermanagement/default.htm

Analysis

General Water Quality Issues

The ground and surface water resources of the Little Neshaminy are under stress from increased development, lack of effective stormwater management practices, and in some cases ineffective land use policies and practices. Stream impairments have been documented along the entire main stem of the Little Neshaminy and the entire main stem of Park Creek. Heritage Conservancy's Riparian Buffer Analysis showed that numerous tributaries lacked forested buffers on one or both sides of the stream.

Much of the impairment is caused by siltation and water flow variability resulting from urban runoff and storm sewers. These issues have become increasingly important as communities struggle with growth management issues.

Within the last few years, since the NPDES, Phase II regulations have taken effect, stormwater issues have become an important topic of discussion at the municipal level and technical information has become more available. However, it will take time to reduce the impairments that have resulted over many years. The increased incidences of major storm events have also increased the frequency of damaging flood events in the region. However, there is optimism that with increased diligence of municipal officials and oversight by planning commissions and EACs, future development and redevelopment will include effective stormwater BMPs and more attention to the non-structural aspects of good design and planning.

Substantial reductions in the amount of sediments reaching the streams can be done through BMP practices of drainage controls including detention ponds, sediment ponds, infiltration pits, dikes and ditches. These practices have a sediment reduction range of 20%-70% in efficiency. These new BMP practices will be initiated in the DEP's Comprehensive Stormwater Management Policy. This new policy will require affected communities to implement BMPs to address stormwater control that will "reduce pollutant loadings to streams, recharge groundwater tables, enhance stream base flow during times of drought and reduce the threat of flooding and stream bank erosion resulting from storm events."[46]

The updated Act 167 Plan for the Neshaminy Creek will include water quality standards and criteria that will help address some of the degradation occurring in the watershed.

Bradford Lake Water Quality

In the lake, the primary actions necessary include removing the excess biotic material to help alleviate the impacts on BOD (biological dissolved oxygen). In addition, removing excess sediment will improve both the ecological habitat of

46 Watershed Restoration Action Strategy (WRAS) State Water Plan Subbasin 02F Neshaminy Creek Watershed Bucks and Montgomery Counties Updated 5/2004

the lake as well as restore some of the reservoir's capacity for flood control. Specific actions may include:

1. sediment dredging
2. diffused-air aeration
3. aquatic algaecides and herbicides
4. mechanical weed harvesting (primarily the invasive species water chestnut)

Since most of the impacts to the lake occur as a result of upstream activities, implementing improved best management practices there will help prevent significant impacts to the lake. Since the largest impact stems from NPS, largely from land development and construction, steps should be taken to ensure that adequate erosion controls are in place or reducing development itself through land protection. Concurrently, steps should be taken to reduce runoff impacts through streambank stabilization and improving riparian buffers.

Finally, increased monitoring and advocacy efforts for maintaining good water quality and habitat at Bradford Lake can be improved through a watershed organization. In addition, Warrington Township and other upstream municipalities in the watershed should improve their water protection ordinances.

Regulating Uses in Water Resource Areas

A review of the natural resource ordinances for the municipalities within the watershed indicated that only four have specific riparian buffer ordinances. Although each municipality restricts development in wetlands and the 100-year floodplain, some do not provide the same level of protection for wetland buffer, flood fringe areas or floodplain soils. Municipalities should review ordinances to strengthen protection of 100-year floodplains, flood fringe, wetlands and wetland margin areas and to assure that protection measures for significant natural areas are in place.

Municipalities should also consider regulating the uses within alluvial and hydric soils, which are generally associated with floodplains and wetlands. Actually, alluvial and hydric soils are critical and integrated parts of the hydrologic system. In 1978, the Pennsylvania Flood Plain Management Act (Act 166 of 1988) was enacted and gave broad powers for municipal protection of flood prone areas. If there are areas within a municipality that are subject to flooding, the municipality must adopt flood plain management regulation to comply with at least the minimum standards of the National Flood Insurance Program. Act 166 does not limit a municipality's power to adopt more restrictive regulations than the minimum required. In addition, a number of sections of the MPC require that municipalities protect flood plain areas and areas subject to flooding (flood prone areas that may not have been mapped under the federal insurance program). Although Sections 301(6) and 603(b) of the MPC requires that municipal regulations must be consistent with and may not exceed certain requirements imposed by a number of other federal and state enactments, these sections do not preclude municipalities from enacting flood plain protection standards stronger than the minimum standards of those specified in federal and state laws. Appendix A includes a review matrix, which summarizes the natural resource

ordinance provisions for the study area municipalities. Model ordinance references for specific resources are also included in the Appendix.

The basis for the protection of natural features is found in the commonwealth's constitution, in judicial decisions, and in the MPC. In 1968, the constitution was amended by a vote of the people of Pennsylvania to state in Article I, Section 27:

> *The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and aesthetic values of the environment. Pennsylvania's public natural resources are common property of all people, including generations yet to come.*

As would be expected, the courts have had to evaluate how this constitutional provision would be applied and who would assume the role of protector of these rights of the people. The Commonwealth Court has stated that, although various state departments have certain responsibilities, the local governments of the commonwealth have been delegated authority for land use planning and preservation of open space and natural features under the MPC. The constitutional mandate must rely on various statutes of the Commonwealth for implementation. The state laws specify responsibility for different aspects of natural resource protection. The court has also stated that, in exercising this responsibility, municipalities must permit reasonable development of property as well as managing the public natural resources. The court emphasized that controlled development, rather than no development, should be the focus and is the responsibility of local governments.

XI. Archeological and Historic Resources

Pre-Historic Era

Before European settlement, in prehistoric times, the Little Neshaminy Watershed was occupied by indigenous people. The earliest of these were the Paleo-Indians who came to North America from Asia beginning around 12,000 B.C. At that time, the Ice Age was ending and the continental glaciers were receding. The climate was tundra-like with open plains and scattered wooded areas along with herds of wooly mammoths and other mammals that are now extinct. Paleo-Indians hunted these mammals using straight wooden spears with a distinctive fluted spear point. Around 8000 B.C. the landscape began to change and the mammals that inhabited the area began to look similar to what we know today. Humans evolved as well and became more sophisticated in their hunting and gathering techniques. Tools began to be used, including a distinctive spear-throwing device. Spear points from this period are notched and are similar to the typical arrowheads used by Native Americans. This period, which lasted until 1000 B.C., is known as the Archaic period. Beginning around 1000 B.C. is the Woodland period, which is characterized by even greater technological advances by Native Americans including farming, pottery making, and hunting with bow and arrow. The Woodland period is divided into three sub-periods: Early, Middle and Late. It was during the Late Woodland Period, starting around 1550 A.D., which Europeans began to explore and eventually settle in North America.

The predominant tribe of Native Americans at the time of European settlement was the Lenni Lenape. In 1681, King Charles II of England granted William Penn 40,000 acres of land, which became known as Pennsylvania. William Penn envisioned a new colony that held religious tolerance as its main virtue and subsequently English Quakers, who were persecuted for their beliefs in Europe, began to settle in Pennsylvania. The Quakers were followed closely by the Mennonites and other German Anabaptist settlers. William Penn provided just compensation to the Lenni Lenape for their lands, but upon his death in 1718, the Lenni Lenape were not treated nearly as well and eventually they were driven out of Pennsylvania.

The impact of Native Americans on the area remains in the form of numerous archaeological sites from prehistoric times and the name Neshaminy is a Native American word that means the place where we drink twice. The period from the beginning of European settlement is referred to in archaeological terms as the Historic Period. Some archaeological sites in the watershed contain materials from the Historic Period. The European settlers began constructing mills, establishing farms, building roads and rail lines, and started towns and village.

There are numerous historic resources, many of which are eligible for, or listed on, the National Register of Historic Places within the Little Neshaminy watershed. Today, the area has been greatly impacted by urban and suburban development.

"Much of the history of any region is intimately connected with the streams that pass through it."

The Rev. D.K. Turner, Hartsville, PA - "The Little Neshaminy", presented at Galloway's Ford Meeting, June 20, 1897.

Archaeological Resources

The Pennsylvania Historical and Museum Commission (PHMC) maintain the list of Sites recorded in the Pennsylvania Archaeological Site Survey (PASS) files. There are 21 archaeological sites recorded in the PASS files within the Bucks County Portion of the Little Neshaminy Creek Watershed and 14 archaeological sites recorded for the Montgomery County portion of the study area. Table 120identifies PASS numbers and the historic period of significance of the sites. In order to protect the sites, site names and locations will not be identified. According to the PHMC, other archaeological sites, which have not been either identified or recorded at this time, exist in the study area. This rich archaeological record attests to the region's breadth and depth in natural resources through historic and prehistoric times.

Table 20 – PASS Sites Recorded in the Little Neshaminy Creek Watershed

PASS#	Historic Period	Artifacts of Significance
Bucks County		
36 Bu 46	Archaic through Woodland Periods (8000BC – AD 1550)	Temporally Diagnostic Projectile Points
36 Bu 47	Archaic Period (8000 BC – 1000 BC)	Temporally Diagnostic Projectile Points
36 Bu 81	Paleo-Indian Period (13,000 BC – 8000 BC)	Temporally Diagnostic Projectile Points
36 Bu 100	Archaic Period	Temporally Diagnostic Projectile Points
36 Bu 106	Unknown Prehistoric	No Temporally Diagnostic Artifacts
36 Bu 133	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Bu 197	Archaic Period	Temporally Diagnostic Projectile Points
36 Bu 208	Late Archaic through Late Woodland Periods (3000 BC – AD 1550)	Temporally Diagnostic Projectile Points
36 Bu 222	Archaic through Woodland Periods	Temporally Diagnostic Projectile Points
36 Bu 223	Paleo-Indian, Archaic and Historic Periods (13,000 BC – 1000 BC and AD 1,700 –1,900)	Temporally Diagnostic Projectile Points
36 Bu 224	Middle Archaic through Middle Woodland Periods (6500 BC – AD 1000)	Temporally Diagnostic Projectile Points
36 Bu 225	Late Archaic Period (3000 BC – 1000 BC)	Temporally Diagnostic Projectile Points
36 Bu 226	Paleo-Indian Period and Historic Period (13,000 BC – BC and AD 1700 –1990)	Temporally Diagnostic Projectile Points
36 Bu 227	Archaic Period	Temporally Diagnostic Projectile Points
36 Bu 228	Late Archaic Period	Temporally Diagnostic Projectile Points
36 Bu 252	Historic Period	Temporally Diagnostic Projectile Points
36 Bu 253	Historic Period	Temporally Diagnostic Projectile Points
36 Bu 281	Archaic and Woodland Periods (8000 BC – AD 1550)	Temporally Diagnostic Projectile Points
36 Bu 301	Historic Period	Temporally Diagnostic Projectile Points
36 Bu 316	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Bu 374	Archaic Period	Temporally Diagnostic Projectile Points
Montgomery County		
36 Mg 72	Archaic Period	Temporally Diagnostic Projectile Points
36 Mg	Historic Period	Temporally Diagnostic Projectile Points

Table 20 – PASS Sites Recorded in the Little Neshaminy Creek Watershed		
PASS#	Historic Period	Artifacts of Significance
167		
36 Mg 189	Historic Period	Temporally Diagnostic Projectile Points
36 Mg 254	Archaic Period	Temporally Diagnostic Projectile Points
36 Mg 266	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Mg 267	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Mg 268	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Mg 295	Archaic and Woodland Periods	Temporally Diagnostic Projectile Points
36 Mg 296	Archaic Period	Temporally Diagnostic Projectile Points
36 Mg 297	Archaic and Woodland Periods	Temporally Diagnostic Projectile Points
36 Mg 298	Archaic Period	Temporally Diagnostic Projectile Points
36 Mg 299	Unknown Prehistoric	Temporally Diagnostic Projectile Points
36 Mg 300	Historic Period	Temporally Diagnostic Projectile Points
36 Mg 307	Historic Period	Temporally Diagnostic Projectile Points

Source: PHMC, 2006

Historic Resources

In 1966, Congress authorized the creation of the National Register of Historic Places to serve as the nation's official list of cultural resources worthy of protection. The National Register of Historic Places (National Register) is maintained by the National Park Service. The Pennsylvania Historical and Museum Commission's (PHMC) Bureau for Historic Preservation manages the National Register of Historic Places for Pennsylvania. Properties listed in the Register include districts, sites, buildings, structures and objects that are significant in American history, architecture, archeology, engineering and culture. National Register properties are distinguished by having been documented and evaluated according to uniform standards. These criteria recognize the accomplishments of all peoples who have contributed to the history and heritage of the United States and are designed to help state and local governments, federal agencies, and others identify significant historic and archeological properties worthy of preservation and of consideration in planning and development decisions. Listing in the National Register, however, does not interfere with a private property owner's right to alter, manage or dispose of property. It often changes the way communities perceive their historic resources and gives credibility to efforts to preserve these resources as irreplaceable parts of our communities[47.]

47 Introduction to National Register from: http://www.phmc.state.pa.us/bhp/nr/overview.asp?secid=25

The Little Neshaminy Creek Watershed contains numerous historic properties and structures that have met criteria for listing on the National Register as well as many that have been determined eligible for listing on the registry. Map 9 illustrates the locations of historical resources on or eligible for the National Register. Table 21 contains a list of eligible and listed sites, along with their locations keyed to Map 9. These resources were identified based on PHMC's Bureau for Historic Preservation National Register Listed- Eligible Properties as of 12/2004. Many communities within the watershed have established local historic commissions and maintain lists of locally significant historical sites, which may not have been evaluated for listing on the National Register. Although not listed in this plan specifically, these resources were determined to have historical significance to the local community and efforts to preserve and maintain these local resources should also be considered, either via historic preservation ordinances or through recognition from local historic commissions. Communities should also consider having locally significant sites evaluated for National Register eligibility.

The study area contains one National Historic Landmark (Graeme Park) , six (6) National Register Listed sites, one listed historic district- Ivyland Borough Historic District (described below), and 36 National Register eligible resources.

National Historic Landmarks

National Historic Landmarks (NHLs) are cultural properties designated by the Secretary of the Interior as being nationally significant. Acknowledged as among the nation's most significant historic places, these buildings, sites, districts, structures, and objects possess exceptional value or quality in illustrating or interpreting the heritage of the United States in history, architecture, archeology, engineering, and culture. NHL designation is an official recognition by the federal government of the national significance of historic properties. By 1999, almost 2,300 properties had been designated as National Historic Landmarks. Authorized by the Historic Sites Act of 1935 (Public Law 74-292) and administered by the National Park Service, the NHL program focuses attention on places of exceptional value to the nation as a whole, by recognizing and promoting the preservation efforts of private organizations, individuals, and government agencies. [48]

The National Historic Landmark site and the sites listed on the National Register are further described below:

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48 NHL definition from: http://www.cr.nps.gov/NR/publications/bulletins/nhl/index.htm

National Historic Landmark:

Graeme Park (Keith House) – Horsham Township, Map I.D. #17: Graeme Park is a 42-acre historical park owned and operated by the Pennsylvania Historical and Museum Commission. The park includes Keith House, which was constructed around 1722. Keith House served mainly as the summer home of Sir William Keith, Provincial Governor of Pennsylvania from 1717-15. The stone house is the last remaining residence of a colonial Pennsylvania Governor. It is located within Graeme Park, named for Dr. Thomas Graeme who purchased the property in 1739.

Keith House – Graeme Park, Horsham Township

Sites Listed on the National Register:

Kenderdine Mill Complex – Horsham Township, Map I.D. #34: The Kenderdine Mill Complex contains an original fieldstone mill building and raceways, an owner's home dating to the early 19th century, and a stable and carriage house built in the mid-19th century. An earlier fieldstone house exists nearby, which was the original home of the Kenderdine family.

Kenderdine Mill, Horsham Township

Horsham/ Montgomery Bridge – Horsham Township, Map I.D. #14: The Horsham/Montgomery Bridge crosses Little Neshaminy Creek at Lower State Road. It was built in 1839, an excellent example of a 19th century stone highway bridge. The bridge consists of two small arches with long flanking approach walls.

Jacob Kastner Loghouse – Lower Gwynedd Township, Map I.D. #37: The original log house was built between 1712 and 1754 on Norristown Road in Lower Gwynedd Township. It is a locally significant and intact example of log house construction. It is the only house of its kind in Lower Gwynedd Township, and one of only a few remaining in Montgomery County.

Knapp Farm – Montgomery Township, Map I.D. #9: The Knapp Farm property contains a main house and several surrounding buildings, including a barn. John Roberts, Jr. was most likely the builder of the house, which has stood since before the Revolutionary War. It is believed the George Washington stayed there in October 1777.

Bridge Valley Bridge – Warwick Township, Map I.D. #21: Bridge Valley Bridge, also known as Pettit's Bridge, is located over Neshaminy Creek on an abandoned stretch of Old York Road in Warwick Township. It is an example of traditional bridge building from the early 19th century. Featuring eight-arch construction, Bridge Valley Bridge is the only bridge remaining in Pennsylvania with more than seven arches.

Moland House Painting, Warwick Township

Moland House – Warwick Township, Map I.D. #20: John Moland, a prominent lawyer in the region, built Moland House in Warwick Township in the mid-18th century. The House served as George Washington's headquarters from August 10 to August 23, 1777 while the Continental Army was camped nearby. It is reputed to be the location where Washington was joined in the war effort by

the Marquis de Lafayette and Count Casimir Pulaski. It is also alleged to be the site where the American Flag with stars and stripes was flown for the first time.

Ivyland Historic District, Ivyland Borough and Map I.D. #28: Ivyland Historic District is significant for its architecture. It has excellent examples of Queen Anne, Second Empire and Italianate and early 20th century revival architecture. The district developed around a hotel specifically constructed to attract visitors attending the Philadelphia Centennial Exposition of 1876.

The Archeological and Historic Resources of this watershed help define the area's character and provide a great source of pride and tradition for the community.

Analysis

The Archeological and Historic Resources of this watershed help define the area's character and provide a great source of pride and tradition for the community. From early Indian settlements to colonial homesteads to aviation centers, these properties and lands are valuable for the information they provide now, and will continue to provide to future generations. It is therefore important to continue to preserve and protect these resources utilizing the tools available to us, including Federal and State programs and through stewardship provided by residents who volunteer on historic commissions, boards and friends groups.

Historic resources that have been determined eligible for the National Register of Historic Places should be nominated to the National Register. Only six of the 44 properties noted in Table 21 have been listed on the Register. Several properties that were listed have subsequently been demolished or destroyed by fire.

A review of municipal ordinances in the watershed found that Horsham, Montgomery and Warwick Townships do have ordinances in place to preserve or protect historic resources. Both Lower Gwynedd and Upper Dublin Townships are currently drafting historic preservation ordinance language.

In order to identify additional historic resources that may exist, but not studied, each municipality should conduct a comprehensive survey of historic properties, if a survey has not been conducted.

The four municipalities in the Little Neshaminy Watershed who do not currently have preservation ordinances should consider adopting historic preservation ordinances to protect historic resources, including ordinances to protect existing and potential archaeological sites.

Ivyland Historic District

Table 21 – Properties Listed or Determined Eligible for Listing on the National Register Little Neshaminy Creek Watershed[49]					
Map I.D. #	Township	Site Name	Site Address	Listed/ Eligible	Date Listed or Determined Eligible
33	Horsham Township	H. Pratt McKean House (Pine Ridge)	Welsh Road and McKean Road	Eligible	12/4/1986
35	Horsham Township	Quee/Shay Farm	950 Limekiln Pike	Eligible	5/2/2003
13	Horsham Township	T.H. Rowe Property	736 Lower State Road	Eligible	7/17/1995
16	Horsham Township	William and Hanna Penrose House	County Line Road and Keith Valley Road	Eligible	6/11/1990
40	Horsham Township	Richard Lewis Homestead	Lower State Road	Eligible	11/19/1984
17	Horsham Township	Graeme Park (Keith House)	County Line Road and Keith Valley Road	National Historic Landmark	10/9/1960
34	Horsham Township	Kenderdine Mill Complex	Keith Valley Road and Davis Grove Road	Listed	1/22/1992
14	Horsham Township	Horsham/Montgomery Bridge	Lower State Road	Listed	6/22/1988
27	Ivyland Borough	Barton Hall	88 Wilson Avenue	Eligible	4/22/1985
28	Ivyland Borough	Ivyland Historic District	Jacksonville, Wilson, Greely, Chase Roads	Listed	3/20/2002
37	Lower Gwynedd Township	Jacob Kastner Loghouse	416 Norristown Road	Listed	12/13/1984
2	Montgomery Township	Baker House	1616 Upper State Road	Eligible	2/17/1994
12	Montgomery Township	C.E. Coulston Farmstead	300 Stump Road	Eligible	2/17/1994
3	Montgomery Township	J. Baker Farmstead	Horseshoe Lane, Lot 24	Eligible	2/17/1994
5	Montgomery Township	J. Zane House	1214 Upper State Street	Eligible	2/17/1994
11	Montgomery Township	John Roberts House	143 Hartman Road	Eligible	6/9/1994
8	Montgomery Township	Joseph Amber Farmstead	1005 Horsham Road	Eligible	2/17/1994
6	Montgomery Township	Levi Jenkins Farmstead	1124-1126 Upper State Road	Eligible	2/17/1994
4	Montgomery Township	Samuel Delp House	1301 Stump Road	Eligible	2/17/1994
1	Montgomery Township	Silas Walton House	300 Claremont Drive	Eligible	2/17/1994
10	Montgomery Township	Swartley Farm	455 Stump Road	Eligible	7/23/1986
7	Montgomery Township	John Ambler Farmstead	953 Horsham Road	Eligible	2/17/1994
9	Montgomery	Knapp Farm	Dekalb Pike and	Listed	10/22/1976

49 Table Source: Pennsylvania Historical & Museum Commission, Bureau for Historic Preservation. National Register Listed/Eligible Properties, 12/7/2004.

Table 21 – Properties Listed or Determined Eligible for Listing on the National Register Little Neshaminy Creek Watershed[49]					
Map I.D. #	Township	Site Name	Site Address	Listed/ Eligible	Date Listed or Determined Eligible
	Township		Knapp Road		
30	Northampton Township	Recklitis Farm	492 Jacksonville Road	Eligible	12/1/2000
31	Northampton Township	Van Artsdalen Farm	290 Foxcroft Drive	Eligible	5/14/1984
38	Upper Dublin Township	North View	1650 East Butler Pike	Eligible	5/2/2002
39	Upper Dublin Township	Samuel Mann Farmstead	600 Limekiln Pike	Eligible	5/2/2003
36	Upper Dublin Township	Spring Lake Farm (Property demolished)	239 Welsh Road	Eligible	10/13/1987
25	Warminster Township	Christ's Home For Children	800 Old York Road	Eligible	11/13/2003
23	Warminster/ Warwick Townships	Hartsville Village Historic District	Vicinity of Bristol Road and Old York Road	Eligible	3/10/1993
15	Warrington Township	French/Lee Farm	Kansas Road and County Line Road	Eligible	4/6/1998
26	Warwick Township	Francis Baird Estate	1530 Mearns Road	Eligible	1/13/1995
22	Warwick Township	Hartsville Mill Complex	1559-1570 Old York Road	Eligible	3/24/1988
24	Warwick Township	Little Neshaminy Rural Historic District	Bristol Road and Old York Road	Eligible	3/10/1993
29	Warwick Township	Lower Mearns Mill	Walton Road at Grenoble Road	Eligible	1/25/1980
32	Warwick Township	Mearns Farmstead	545 Almshouse Road	Eligible	8/22/2001
19	Warwick Township	Neshaminy Warwick Presbyterian Church	Bristol Road and Meetinghouse Road	Eligible	5/31/1984
18	Warwick Township	Samuel Long House	1720 Meetinghouse Road	Eligible	12/4/1986
19	Warwick Township	Warwick Presbyterian Church and Education	Bristol Road and Meetinghouse Road	Eligible	12/4/1986
41	Warwick Township	Stony Road House	Stony Road	Eligible	8/8/1994
21	Warwick Township	Bridge Valley Bridge	Old York Road	Listed	5/10/1984
20	Warwick Township	Moland House	1641 York Road	Listed	5/19/1989

XII. Stream Visual Assessments: Summary of Restoration Priorities

In February of 2003, the Delaware Riverkeeper Network (DRKN) completed a comprehensive study focusing on Watershed Assessment and Restoration in the Little Neshaminy Creek Watershed. This study was to help pinpoint problems in the watershed and provide viable solutions to those problems discovered. The data was collected from trained volunteers and professionals. The data is extensive covering the broad topics of Stream Channel Assessment and Water Quality Assessment. The summary below describes the key findings and solutions presented in the study.

The Little Neshaminy Watershed has been impacted by human development since the areas first settlements in the 1700's. However, that impact took a dramatic change in the 1950's, when development boomed in the watershed and throughout Southeastern Pennsylvania. According to analysis, overall impervious land cover grew from less then 5% to over 24% today in the watershed. This change has had negative and positive results on the watershed. The negative is the increased impact by humans and all of our waste and development; the positive is the great reduction in excess nutrients washing into the streams from agriculture lands.

Due to development along the creek and its tributaries, natural stream channels are rare in the watershed.

Due to development along the creek and its tributaries, natural stream channels are rare in the watershed. The watershed is constantly being modified through channel enlargement via down cutting and widening, bank erosion, decreased sinuosity (measurement of the amount of meandering), aggradation and the disappearance of small tributaries that are being turned into storm sewers, and channelization.[50] Despite this and all of the development over the last 50, years the creek has seen some increase in sinuosity, because of improved width-to-depth ratios in the lower reaches of the Park Creek. However, more can be done to bring back a more natural stream pattern in the area.

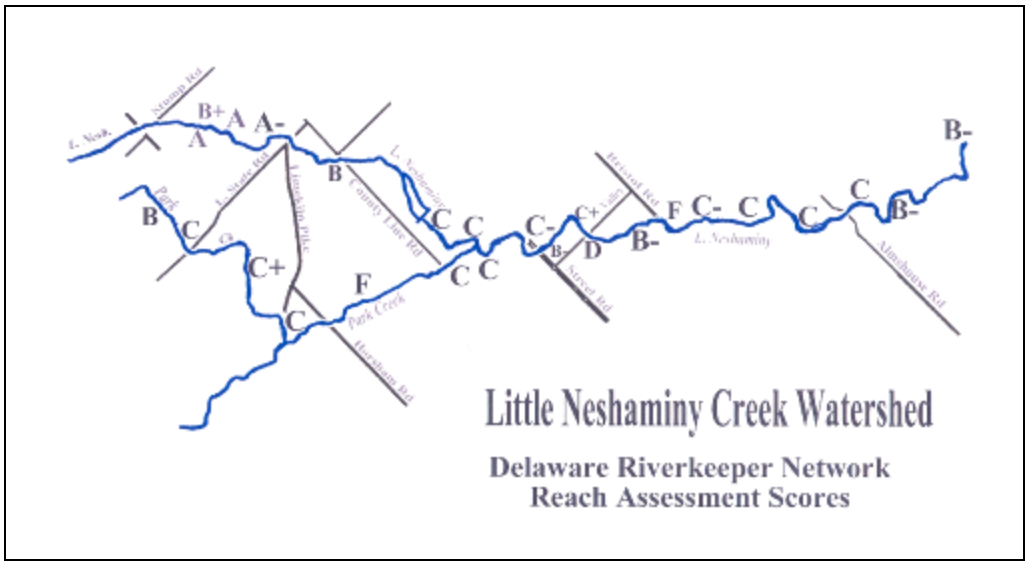
Reach Assessment

The DRKN study calculated a formula based on (1) US EPA Habitat Assessment; (2) Pfankuch Channel Stability Evaluation; (3) USDA Stream Visualization Method, and 15 parameters that were broken into four main categories; Human Impacts, Habitat, Stream bank, and Stream Bottom. From this formula, they were able to give grades to every section of the streams in the watershed. The grades were given in an A (excellent) to F (poor/failing) grading scale much like in grade school.[51] Figure 20 shows the results of the reach assessment and the grades assigned to each stream segment.

50 Delaware Riverkeeper Network: Little Neshaminy Watershed, Watershed Assessment & Restoration Feb.2003 pg.1 Paragraph 4

51 Delaware Riverkeeper Network: Little Neshaminy Watershed, Watershed Assessment & Restoration Feb.2003 pgs. 40-41

Figure 24 – Results of Reach Assessment – Little Neshaminy Creek



Source: Delaware Riverkeeper Network, Little Neshaminy Watershed, Watershed Assessment and Restoration, February 2003.

Three high priority restoration areas were identified: Kemper Park, Little Neshaminy downstream of Meetinghouse Road, and Park Creek Dam

According to the ranking system, three high priority restoration areas (those with scores of F or D) were identified: Kemper Park, Little Neshaminy downstream of Meetinghouse Road, and Park Creek Dam. The problems and potential solutions for each site are summarized below:

- Problem Area 1: Kemper Park (Warminster Township), Valley Road to Bristol Road

Issues: Riparian width; fish barrier and embeddedness.

Solutions: Remove rock dam built by unknown parties, increase riparian buffer width, use rock vanes if needed and provide educational opportunities.[52]

Note: Following reports of poor water quality in Kemper Park, Warminster Township partnered with the Delaware Riverkeeper Network, received a Growing Greener grant and has been working for the past three years to expand the riparian buffer, move the walking trail away from the stream, remove the fish dams and install tree revetment to prevent erosion in the stream. Educational signage has been posted during this project and permanent signs will be posted at the end of the project.

- Problem Area 2: Little Neshaminy Creek (Warwick Township), downstream of Meetinghouse Road & Bristol Road Bridge

Issues: Riparian width; habitat cover; velocity/depth; pool variability; leaning trees; and embeddedness.

52 Delaware Riverkeeper Network: Little Neshaminy Watershed, Watershed Assessment & Restoration Feb.2003 pgs. 44 Priority Reaches

Solutions: Use natural channel design methods to restore channel width, provide aquatic habitat and to remove pressure on streambanks. Where feasible increase riparian buffer width along Bristol Road and on church property.[53]

- Problem Area 3: Park Creek Dam (Horsham Township), Park Creek along Keith Valley Road & Horsham Road to County Line Road

Issues: Fish barrier; pool variability; bank erosion; bank vegetation; and embeddedness.

Solutions: remove dam and evaluate stream and riparian responses before undertaking subsequent restoration efforts.[54]

The study indicates that the Neshaminy Creek Watershed as a whole has several top priorities that will better the environment of the watershed, and the surrounding developed areas. The rewards for improving the problems found in this study will benefit all concerned parties in the area of the watershed. The following are the key priority problems and their potential solutions as stated in the DRKN study:

- **Percent Stable Materials:** Solutions include reducing current and future increases in stream energy by enhancing riparian buffers and controlling stormwater runoff plus prevention and correction of erosion problems.
- **Bank vegetation and Embeddedness:** Solutions include riparian programs, the reduction of sediment from construction and erosion; and addressing the sediment coming from the Bradford Reservoir after rain events.
- **Habitat Cover:** The lack large woody debris and other habitat structure in the watershed reflects a stream energy problem
- **Velocity/Pool Variability; Bank Erosion:** Solutions include building of in-stream structures that provide habitat structures that will correct bank erosion problems.
- **Bank Materials Protection:** Solutions include programs that enhance riparian areas and reduce the amount of energy related stream stresses on streambanks. Examples include regrading the bank to lessen the slope and constructing rock vanes and similar techniques to divert stream away from eroding banks.
- **Riparian Width; Fish Barriers**; **and Leaning Trees:** Solutions include, riparian buffer planting programs, and eliminating landscaping practices that remove or cut vegetation in stream corridors; Remove barriers that block fish from moving up or downstream; the leaning trees will be solved by solving bank erosion and stream widening.

53 Delaware Riverkeeper Network: Little Neshaminy Watershed, Watershed Assessment & Restoration Feb.2003 pgs. 44 Priority Reaches

54 Delaware Riverkeeper Network: Little Neshaminy Watershed, Watershed Assessment & Restoration Feb.2003 pgs. 44 Priority Reaches

The study recommends implementation of a channel monitoring program to stay on top of the ever-evolving changes within the Little Neshaminy Creek Watershed. This could be done through baseline reference points placed throughout the watershed that would be used to analyze the area every five years. This program could help prevent future problems and help quicken the process of the waterways returning to a stable condition.

XIII. Public Survey

Public input is important in any planning effort. In addition to several public meetings, a short survey was distributed to give residents within the area of the Little Neshaminy Creek several opportunities to provide their ideas in the planning process. Although the survey may not be statistically significant due to the distribution method and number of responses, the survey was a useful tool to capture input from interested people within the watershed.

Surveys were made available to residents and others in the watershed in several ways. Each steering committee representative and municipality was provided with survey forms to distribute as they determined appropriate. Copies were also made available on municipal and Heritage Conservancy's websites. The surveys were distributed over about a one-year period starting in 2006. A copy of the survey is included in Appendix B.

Responses were received from 80 people. However, not everyone who responded answered all the questions. To start, here are a few statistics that profile those who did respond.

Demographic Profile of Respondents

People were asked where they lived within the watershed. Just over half of the 76 people who responded to this question lived in Warminster Township.

Table S-1 - Little Neshaminy Creek Survey – Location of Respondents

Municipality	Number	Percentage of Total
Warminster Township, Bucks County	39	51.3%
Warrington Township, Bucks County	10	13.2%
Warwick Township, Bucks County	10	13.2%
Horsham Township, Montgomery Township	9	11.8%
Northampton Township, Bucks County	3	3.9%
Upper Dublin Township, Montgomery County	2	2.6%
Lower Gwynedd Township, Montgomery Cty.	1	1.3%
Montgomery Township	1	1.3%
Ivyland Borough	1	1.3%

About half of the 76 people who responded to a question about the respondents' age where in the 45 to 65 age category and more than a quarter of the respondents were in the 25 to 44 age group.

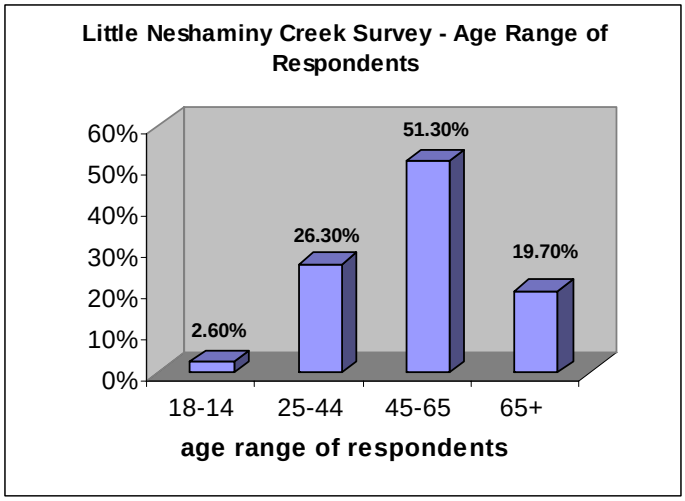


Table S-2 Little Neshaminy Creek Survey – Age Range of Respondents		
Age Range	Number	Percent of Total
18-24 years of age	2	2.6%
25-44 years of age	20	26.3%
45-65 years of age	39	51.3%
Over 65 years of age	15	19.7%

Most of the 78 people who responded to the survey lived in the municipalities for more than ten years.

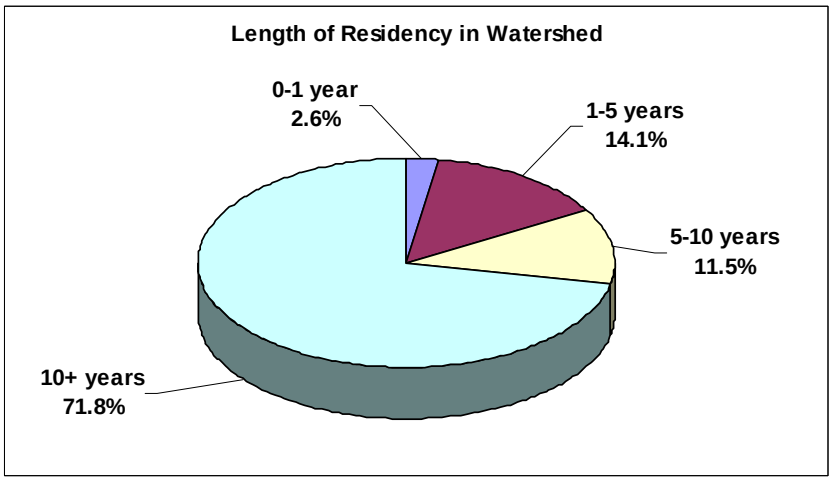


Table S-3 Little Neshaminy Creek Survey – Range of Years Lived in Municipality		
Range of Years	Number	Percent of Total
0-1 year	2	2.6%
1-5 years	11	14.1%
5-10 years	9	12.0%
Over 10 years	56	71.8%

Several questions were asked where residents lived in proximity to the Little Neshaminy Creek and the residents' experiences with flooding.

More than 70% of the 80 who responded live along or within a mile of the Neshaminy Creek and its tributaries.

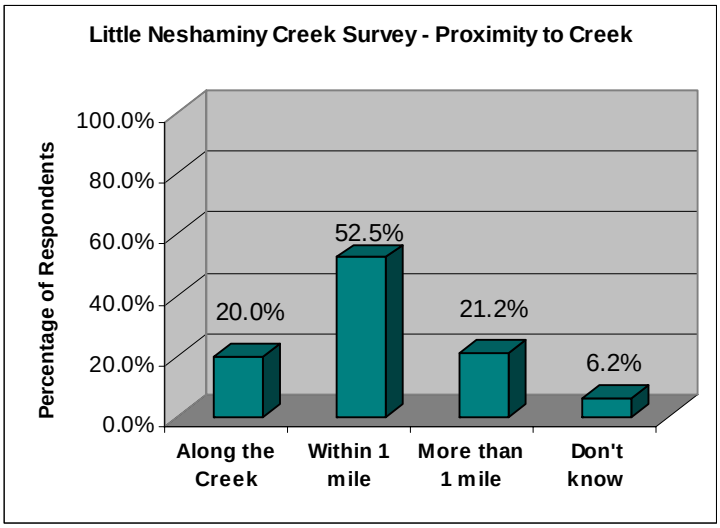


Table S-4 Little Neshaminy Creek Survey – Distance from the Creek		
Distance of Resident	Number	Percent of Total
Along the creek or its tributaries	16	20.0%
Within 1 mile of the creek or its tributaries	42	52.5%
More than 1 mile from the creek or its tributaries	17	21.2%
Don't know how far from the creek or its tributaries	5	6.2%

Flooding

Only 52 people answered the question regarding flooding. Of that number only about 13% indicated that their properties had been damaged by flooding. A number of these reported significant damage.

Table S-5 Little Neshaminy Creek Survey – Flooding Experience		
Flooding Experience	Number	Percent of Total
Yes, had experienced flooding	7	13%
No, had not experienced flooding	45	86.5%

For those who had responded that they did experience flooding, they described those events in several ways:

- During hurricane Floyd, had water in the basement.
- House is 1857 Schoolhouse, was built in the floodplain.
- Flash flooding of the first floor due to damming caused by a bridge and road bed being level with Old York Road near the Moland House. The township and Penn DOT have refused to do any mitigation work even though they were offered the opportunity to apply for FEMA funds over 3 years ago.
- Water damage to property during very large storms. Flooding. Land washed away.
- Flooded basement, lost car, furnace, dryer and garden.
- Flooded basement, lost vehicle.

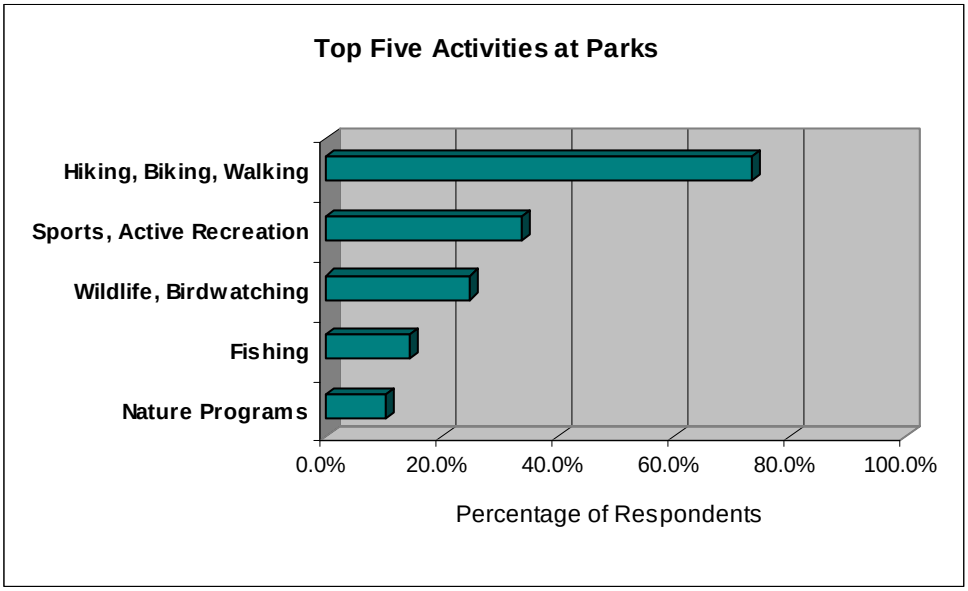
Use of Parks and Recreational Facilities

Several questions were asked about the use of public park and recreation facilities in the communities. A list and map of these facilities are included at the end of this chapter.

In response to the types of activities that people generally do at these parks, 74% of the 68 respondents noted they hike, bike or walk. This question did allow multiple answers. The top five activities are:

Table S-6 Little Neshaminy Creek Survey – Activities in Parks and Recreation Facilities

Activities	Number	Percent of Total
Hike, bike, walk	50	73.5%
Sports and active recreation	23	33.8%
Wildlife and bird watching	17	25.00%
Fishing	10	14.7%
Nature programs	7	10.3%



In 75 responses to a question of how often do people visit the creek or a park where the creek is located, 26.7% of the people said they visited the creek more than once a week and another 24% said they visited the creek occasionally.

Table S-7 Little Neshaminy Creek Survey – Frequency of Visits to Parks and Recreation Facilities

Frequency	Number	Percent of Total
Less than 1 time per week	9	12.5%
More than 1 time per week	20	26.7%
1 time per month	16	21.3%
1 time every 3 months	4	5.3%
Occasionally	18	24.0%
Never	8	10.7%

Threats to Watershed

People were asked to rank what they thought were the greatest threats to the Little Neshaminy Creek in Bucks and Montgomery Counties. Responses were received from 71 people.

People noted increased development and pollution from stormwater as their highest concerns.
The most noted mid-range threats were wastewater treatment plant discharges and damage from flooding.
Third level threats were runoff from agriculture and golf courses plus loss of wildlife habitat and streamside vegetation.
In addition, respondents also indicated that erosion and litter were posing threats to the creek.

Recreational Needs

People were also asked to rank what they thought were the three greatest recreational needs in Little Neshaminy Creek Watershed. Responses were received from 72 people.

Overwhelmingly, people ranked the need for more passive recreational opportunities, hiking trails, bird and wildlife watching opportunities as the greatest need.
Mid-range needs included better access to the creek for canoeing, kayaking and boating, plus improved fishing through stocking and habitat restoration.
Third level needs were more opportunities for organized activities, teams and recreation programs plus more active recreation facilities, ball fields, basketball courts, skate parks and tennis courts.

Important Resources

People were also asked to rank what they thought were the three most important resources in Little Neshaminy Creek Watershed. Responses were received from 71 people.

- Overwhelmingly, people ranked a category of natural features including open spaces, undeveloped woodlots, wetlands and wild areas as the most important resources.
- The second ranked resource in importance was the water resources including groundwater and water quality.
- Three categories were noted as third level resources. They included recreational opportunities, parks, playing fields and trails; historical resources, historically important buildings and districts; and agricultural resources, farms, nurseries and agricultural production, in that order of preferences.

In a follow-up question as to the opinion of what three resources need to be improved, the answer options were the same as asked in the previous question. A total of 71 responses were received and ranked in a similar manner as noted

above, except the order of preference was slightly different for the third level of concern.

- As above, overwhelmingly, people ranked a category of natural features including open spaces, undeveloped woodlots, wetlands and wild areas as the most important resources.
- The second ranked resource in importance was the water resources including groundwater and water quality.
- Three categories were noted as third level resources, but in different order. They included agricultural resources, farms, nurseries and agricultural production; historical resources, historically important buildings and districts; and recreational opportunities, parks, playing fields and trails, in this order of preferences.

Funding Options

Finally, people were asked to state how they thought the improvements they identified in the last questions should be funded. More than one answer could be submitted by respondents. A total of 71 people answered this question.

Table S-8 Little Neshaminy Creek Survey – Funding Options

Funding	Number	Percent of Total
Municipalities should pursue grant opportunities	55	77.5%
County government should fund	33	46.5%
Special referendum taxes (e.g. an open space referendum)	30	42.3%
Special interest organizations or non-profits should find funding	25	35.2%
Special fees for people or groups who use those resources	19	26.8%

The majority of respondents indicated that municipalities should pursue grant opportunities to fund improvements, followed by County government and special referendum.

Summary of the Survey's Findings

Based on the responses, more than half of the people who answered the survey were middle aged, lived in their homes for more than 10 years and were residents of Warminster Township. More than half lived within one mile of the Little Neshaminy Creek. Fortunately, very few respondents experienced flood damage to their properties, although those that did experienced a wide range of damage from flooded basements to loss of property.

In terms of recreational activities, respondents prefer to walk, hike and bike. About half state that they visit the creek or a park in which the creek is located more than one time per week or occasionally.

The top concerns about the creek are increased development and pollution from stormwater.

The top ranked recreational need is for passive activities, such as hiking trails and bird and wildlife watching.

The top ranked resources in the Little Neshaminy Creek Watershed are the natural resources including open space, undeveloped woodlots, wetlands and wild areas. People also thought these resources had the greatest need for improvement.

In order to pay for the needed improvements, respondents suggested that the top way to fund these enhancements would be for municipalities to pursue grant opportunities.

XIV. Management Options and Action Plan

The main purpose of the Little Neshaminy River Conservation Plan is to set forth a guidance document to direct implementation projects in a coordinated manner to preserve and enhance the resources of the watershed. Many projects may involve resources well beyond the capability of local watershed organizations or municipalities to undertake on their own, thus the plan will identify lead organizations as well as potential partners who may be able to provided needed financial and technical assistance to help accomplish the projects.

Partner Organizations

Many local, state and federal organizations can provide financial, regulatory and technical assistance to municipalities working on recommended river conservation projects. These organizations offer a variety of technical support services, review procedures, provide, or assist in developing educational materials, and provide sources of funding for specific activities. Some of the many partner organizations are listed on the following pages. Major partners also include the Little Neshaminy Creek Study Area municipal officials and their numerous boards and commissions as well as the volunteer watershed and environmental organizations in the region.

Bucks County Conservation District (BCD)

The Bucks Conservation District is a unit of state government and was authorized and formed by the Bucks County Board of Commissioners in 1961 under the provisions of the Conservation District Law, Act 217 of 1945, as amended. The mission of the Bucks Conservation District is to provide for the wise use, management and development of the county's soil, water and related natural resources. This is accomplished with the cooperation of both public agencies and private groups and individuals, especially landowners. The major priority at BCD is the control of soil erosion and the resulting sedimentation. The district oversees the implementation of erosion and sediment control plans on new development including reviews and compliance inspections.
http://www.bucksconservation.org/

Bucks County Department of Parks and Recreation (BCDPR)

The Bucks County Department of Parks and Recreation is the county agency, which provides for the development, management and operation of the recreational needs of county citizens. Programs of the BCDPR include: coordinating with municipalities and non-profit organizations in providing facilities for special needs; providing resource-based programs including nature centers, hiking, boating, fishing, camping and environmental education; providing for active recreation, including athletic events, concerts, festivals, and other leisure activities; and providing programs and activities

related to the environment and natural sciences.
http://www.buckscounty.org/departments/parks-recreation/

Bucks County Planning Commission (BCPC)

The planning commission provides functional and comprehensive planning to Bucks County and its 54 municipalities. Programs of the commission include sewage and storm water management, solid waste management, parks and open space, natural resources and housing planning, development of zoning, subdivision and land development ordinances and regulations. Commission staff provides consultation on planning and plan implementation. Under the Pennsylvania Municipalities Planning Code, the commission reviews and offers recommendations on all subdivisions, land developments, zoning change requests and other proposals submitted to the county's municipalities. The commission also manages an extensive resource library. http://www.buckscounty.org/departments/planning/index.html

Delaware River Basin Commission (DRBC)

The Delaware River Basin Commission was formed in 1961 by the signatory parties to the Delaware River Basin Compact (Delaware, New Jersey, New York, Pennsylvania and the United States) to share the responsibility of managing the water resources of the Basin. Since its formation, the Commission has provided leadership in restoring the Delaware River and protecting water quality, resolving interstate water disputes without costly litigation, allocating and conserving water, managing river flow and providing numerous other services to the signatory parties. Commission programs include water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood control and recreation. http://www.state.nj.us/drbc/

Delaware Riverkeeper Network (DRKN)

The Delaware Riverkeeper Network is a nonprofit, membership organization that has worked since 1988 to strengthen citizen protection of the Delaware River and its tributary watersheds. An affiliate of the American Littoral Society, a national conservation group, Riverkeeper works throughout the Delaware's entire 13,000 square mile watershed, which includes portions of NY, NJ, PA and DE. Programs include a watershed wide advocacy; taking a stance on regional and local issues that threaten water quality; a tributary task force initiative designed to organize and strengthen local communities working to protect local streams; restoration projects organizing volunteers to restore eroded stream banks using bio-engineering techniques; a volunteer monitoring program with sites along the entire length of the River; pollution hotlines; an enforcement program; and student intern opportunities.
http://www.delawareriverkeeper.org/

Delaware Valley Regional Planning Commission – (DVRPC)

DVRPC is a regional planning agency, which works to foster regional cooperation in the nine-county, two state area surrounding Philadelphia. DVRPC provides services to member governments and others through planning analysis, data collection and mapping services. Aerial photographs, maps and a variety of publications are available to the public and private sector. http://www.dvrpc.org/

Heritage Conservancy and other Land Trust Organizations

Heritage Conservancy along with the many other local-based and regional land trust organizations promote open space conservation, natural resource protection, historic preservation, wildlife habitat restoration and biodiversity through land use planning and design, adaptive reuse of historic structures, identification of key natural resources, and innovative land conservation and historic preservation strategies. Many land trust organizations provide technical assistance to municipalities and individual landowners through grants and fee-for-service. Land trusts located or working within Bucks and Montgomery Counties include: Brandywine Conservancy, Heritage Conservancy, Montgomery County Lands Trust, Natural Lands Trust and Perkiomen Watershed Conservancy, All are members of the Pennsylvania Land Trust Association, which provides conservation resources for land trusts and the public. http:// www.conserveland.org

Montgomery County Planning Commission (MCPC)

The Montgomery County Planning Commission (MCPC) offers professional planning services and innovative solutions to community challenges. MCPC's approach is to partner with municipalities, businesses, and organizations to maintain the high quality of life experienced in Montgomery County. These partnerships are fostered through increased communication, cooperation and coordination. Since its inception in 1950, the MCPC's major focus has been to promote orderly development while preserving valuable county amenities. The MCPC covers a wide range of planning areas, serving as an advisory body on land use, transportation, the environment, water and sewer service, parks and open space, farmland preservation, storm water management, site design, housing, zoning, development patterns, and demographic trends in the county. Professional planners develop county plans, model ordinances and other informational publications as well as provide technical assistance and services to the county's 62 municipalities. MCPC also serves as staff to the Montgomery County Commissioners on planning issues. http://planning.montcopa.org/planning/site/default.asp

Montgomery County Conservation District – (MCCD)

The mission of the Montgomery County Conservation District is to protect and improve the quality of life of the residents of Montgomery County and surrounding communities by providing, in cooperation with others, timely and efficient service, education, and technical guidance, for the wise use of

our soil, water, and related resources. The district coordinates a variety of different projects such as Tree Vitalize and rain barrel programs http://www.montgomeryconservation.org/

Montgomery County Department of Parks and Heritage Services (MCPHS)

Montgomery County established the parks department in 1939 and in 2005, the Department of Parks and the Department of Historic and Cultural Arts merged into a single department; the Department of Parks & Heritage Services (PHS). PHS, with assistance from a twelve member appointed advisory Board, is responsible for creating, enhancing and sustaining the open space system consisting of county parks, historic sites, natural areas, trails and greenways. The Mission of the Parks and Heritage Services Department is: To provide the premier system of natural, recreational, and historical sites in this region and state by giving an exceptional visitor experience that encourages respect and understanding for the County's natural and cultural resources.
http://parks.montcopa.org/parks/site/default.asp

Penn State Cooperative Extension Service (PSCES)

Cooperative Extension is an informal educational partnership with county, state and federal governments. Penn State University Extension extends its campus to communities through county offices staffed by university professionals. Through this system, the latest research and technical information of the university is accessible to county residents. Priority issues focus on the economic, social and environmental progress of families and communities. Cooperative Extension accomplishes education through short courses, seminars, meetings, newsletters, publications, personal consultation and mass media. http://www.extension.psu.edu/

Pennsylvania Department of Community and Economic Development – Governor's Center for Local Government Services (DCED)

The center oversees a number of financial aid programs including the Floodplain Land Use Assistance Program, the Land Use Planning and Technical Assistance Program, the Local Government Capital Project Loan Program, and the Shared Municipal Services Program.
http://www.inventpa.com

Pennsylvania Department of Conservation and Natural Resources (DCNR)

A priority goal of the DCNR is to develop and sustain partnerships with communities, non-profits and other organizations for recreation and conservation projects and purposes. The Department's Bureau of Recreation and Conservation is responsible for fostering, facilitating and nurturing the

great majority of these partnerships through technical assistance and grant funding from the Community Conservation Partnerships Program (C2P2).

The Community Conservation Partnerships Program provides state and federal grant dollars to help fund community recreation, land trusts, rails-to-trails, rivers conservation and Pennsylvania recreational trails projects. These components are combined into a yearly application cycle and a single application format and process reducing paperwork for the applicant.

The Community Conservation Partnerships Program Grant manual and many related materials are available on the web at www.dcnr.state.pa.us/grants

Pennsylvania Department of Environmental Protection (PA DEP)

The Pennsylvania Department of Environmental Protection (PA DEP) administers a wide array of grant and loan programs including the Growing Greener Grant Program, the Act 167 Storm Water Management Planning Program, the Act 537 Sewage Facilities Planning Grant Program and Environmental Education Grant Program. In addition, DEP provides grants for municipal recycling programs and brownfields redevelopment. PA DEP also provides technical support staff to assist in local projects. More information regarding DEP's grant programs may be found on the Department's website at www.dep.state.pa.us

Pennsylvania Environmental Council (PEC)

Since it's founding in 1970, PEC has played an active role in environmental policy discussions and decision-making in Harrisburg, in both the regulatory and legislative arenas. PEC is involved with a variety of land-use projects; including brownfields remediation, open space preservation, smart growth and transit-oriented development.
PEC has also been active in developing innovative projects that address land use, watershed protection and other issues. Some of these approaches involve new technology; others implement new ways to use familiar tools. PEC has several ongoing projects in the region including its stormwater basin retrofit program. For more information see: www.pecpa.org

Pennsylvania Fish and Boat Commission - (PA F&BC)

Founded in 1866, the Pennsylvania Fish & Boat Commission is one of the oldest and most effective conservation agencies in the nation. The Fish & Boat Commission is an independent state government agency with responsibilities for protecting and managing Pennsylvania's fishery resources and regulating recreational fishing and boating on Pennsylvania waters. The agency's mission is "To provide fishing and boating opportunities through the protection and management of aquatic resources." The Commission has a number of grant programs that provide funding in support of fishing, boating and aquatic resource conservation. Examples include: Coldwater

Heritage Partnership, Landowner Incentive Program, Sport fishing and Aquatic Resource Education grants, and the State Wildlife Grant program. For more information on these grant programs see the commission's website: http://sites.state.pa.us/PA_Exec/Fish_Boat/grants.htm

United States Department of Agriculture, Natural Resource Conservation Service (NRCS)

The Natural Resources Conservation Service is the federal public service agency that helps individuals, groups, organizations, and city, town, county, and state governments to protect and promote the wise use of land and water resources. Programs of the NRCS include soil and water conservation, natural resource and soil surveys, community resource protection and management, and agricultural conservation programs. NRCS can provide on-site consulting assistance to land users with soil and water problems. http://www.nrcs.usda.gov/

Regional Implementation and Listing on the PA Rivers Registry

Once the river conservation plan is approved, the municipalities and other partners will be responsible for prioritizing and implementing projects.

One of the final requirements of the planning process is to have municipalities endorse the plan and commit to implementing the recommendations. The last official responsibility of the steering committee is to see that the plan is presented to their municipal governing bodies and request endorsement of the plan and its recommendations.

Heritage Conservancy will prepare and forward the necessary documentation to PA DCNR and assure that requirements are met to have the plan placed on the PA State Rivers Conservation Registry. The GIS data developed for this plan will be provided to the Pennsylvania Spatial Data Access website.

In order to continue the work of the plan and improve inter-municipal communication, it is proposed that the local environmental leaders continue to meet on a formal basis to discuss implementation strategies, watershed issues and guide regional projects recommended in the plan. Strong cooperation and communication is needed among municipalities within the Little Neshaminy Creek watershed as well as within the adjacent Neshaminy Creek River conservation plan watersheds to raise awareness of projects affecting adjoining communities and to share information regarding upcoming funding opportunities. The Neshaminy Creek Watershed Alliance was formed for this specific reason and is one possible entity to coordinate watershed projects.

This regional information sharing will assist in implementation efforts related to this river conservation plan and also build local support for new partnerships to form in the community.

General RCP Goals

- Protect and improve the surface and ground water quality in the Little Neshaminy Creek Watershed to improve recreational opportunities, wildlife habitat and sources of drinking water.
- Improve the way stormwater is managed in the watershed to reduce flooding, protect stream baseflow and maintain the hydrologic balance.
- Mitigate impacts from floods.
- Protect Cultural Resources of the Watershed.
- Protect the Natural Resources of the Watershed
- Maintain and Enhance Recreational Opportunities and the Parks and Open Space Resources of the Watershed.
- Increase participation in Education and Conservation Activities.
- Encourage Sustainable Economic Development Practices.
- Improve Watershed-Wide Plan Coordination and Integration.
- Improve Neshaminy Creek River Conservation Plan Implementation Resources

Projects Listed by Municipality

As a supplement to the management options section, the Little Neshaminy Creek RCP Steering Committee suggested that recommended projects, consistent with the river conservation plan's goals, be listed by each participating municipality for ease of reference. The following projects within the watershed have been identified by the participating municipalities for future implementation. Where indicated, some of the projects have been drawn from the municipality's open space plan for areas specifically within the watershed boundaries.

Horsham Township

- Kohler Park: restoration of pond, trail, streambank restoration.
- Cedar Hill Road Park: retrofit detention basin, streambank restoration and recreational trail along Park Creek.
- Keith Valley Road Park: dam removal.
- In general, streambank restoration throughout watershed both on public and private properties.
- Address flooding on Keith Valley Road, Davis Grove Road, McKean Road and Limekiln Pike.
- Widen culvert on Limekiln Pike at McKean Road.
- Widen culvert on Horsham Road at Kohler Park.
- Creek identification signage.
- Develop, print and distribute more educational brochures for homeowners.

- Construct multiple pedestrian crossings over creek and tributaries along Township Power Line Trail from Limekiln Pike to Lower State Road.
- Acquire and/or permanently protect environmentally sensitive lands in the township.
- Funding to assist with storm drain stenciling.
- Assistance with goose control.
- Address stormwater issues especially when the Willow Grove Base closes...maybe a basin at Rt. 611 and Maple Avenue

Lower Gwynedd Township (from Open Space Plan)

- Acquire easements, encourage open space dedication at McKean Road Property to link two existing township trails and ultimately linking with Horsham Township.
- Adopt a natural resource protection ordinance, encourage open space dedication and acquire easements at Pharmaceutical Office Park Property.
- Adopt a natural resource protection ordinance, partner with non-profit land conservation organization and encourage open space dedication at Old York Road Gulf Club to establish trail network and protect natural features of site.

Montgomery Township

- Funding to acquire the township's most significant natural features property (the Zehr tract) along two tributaries to the Little Neshaminy.
- The County/Multi-municipal Powerline Trail from Horsham to Stump Road. This is in the Park Creek watershed. A township trail is planned to connect from the Powerline Trail near the Acura dealership on Route 309 across the watershed boundary and along a tributary to the Little Neshaminy to Windlestrae Park, the township's premier flagship park which has the Little Neshaminy running through it. All this is the #1 trail priority in the township.
- The #2 trail segment is to connect Windlestrae Park along a large tributary of the LN, past the Zehr tract, past the elementary school, connect to and cross the Parkway Trail, and continuing along the tributary to their Spring Valley Park, which already has a mile of in-park trails, is a linear park along the tributary, and constitutes a large preserved headwater area for the LN.
- The #3 trail is the connection of the #1 trail to the LN and the Parkway Trail and connecting upstream areas of the LN with trails.
- The #5 trail is 1 and 1/2 miles along the LN connecting the Parkway Trail to a historic landmark, the township building, a historic lodging complex and Windlestrae Park.
- Due to neighbor resistance, the trail segment downstream of Windlestrae was made priority #6. A recent development has

offered a segment of the LN to the township directly downstream from the sewage treatment plant, so the township is still working to acquire the land. They would also like to work with the sewage treatment plant to improve the creek there.

- Acquire a 20-acre area at County Line Road and Limekiln Pike and Lower State Road for either recreation purposes or for meadow or tree plantings (or both recreation and plantings.)
- Negotiate purchase of conservation easements for the 25-acres of privately-held woods within 5 properties along Kenas Road (in the LN watershed).
- Stump Road properties: the township may need to purchase portions of or easements on two properties for a part of the #2 trail segment. These constitute about 5 acres of woods along a major tributary to the LN.
- Negotiate easements or purchase of 20 acres of woods on the Connelly Tract on Upper State Road to preserve the woods and build a neighborhood park on adjacent open land. This would connect two large neighborhoods with a park, and since the woods back up to the Parkway, could provide a connection for these neighborhoods to that trail.
- Acquire the Glasgow Spring House Quarry once it is filled and a segment of the land around the quarry that includes a pond. Both of these areas are in the LN watershed at the headwaters of one of the tributaries.

Northampton Township

- Education of streamside property owners on proper riparian management and maintenance.

Upper Dublin Township

- Pursue ways to complete trails and links between existing parks and open space sites, the rest of the community and across municipal borders. Possible linkages within the Little Neshaminy Creek Watershed included connection with Horsham Township's trails (by proposed sidewalks and on-road bicycle trails) at Welsh Road and Limekiln Pike in Maple Glen.
- Protect/Preserve vulnerable parcels identified in Upper Dublin's Open Space and Environmental Resource Protection Plan.
- Promote and share Upper Dublin Township's informative stormwater web page with other municipalities located within the Little Neshaminy Creek watershed.
- Negotiate riparian buffer easements on lands that contain the headwaters of the Park Creek.
- Encourage cluster home sites in the so-called Acme property located at the intersections of Welsh Road, Limekiln Pike and Norristown Road. Permitting this type of housing will preserve the greatest

amount of open space. This 18-acre site is in the headwaters of the Park Creek and is already prone to flooding.
- Work with Horsham Township to manage stormwater from Upper Dublin Township that enters Park Creek.
- Pursue Growing Greener II grants for stream restoration.

Warminster Township

- Kemper Park Riparian Buffer Project - continue working with Delaware RiverKeeper Network on the Growing Greener grant riparian buffer project. Continue to monitor the 300 new trees, wildflower matting and evergreen revetment projects to reduce erosion. Grant project removed fish dam but repeated flooding continues to move rock creating additional dams. Positive results include improved water quality, increased buffer and a significant reduction of geese at this site because they no longer have direct access. Continued education regarding this project will include planting of more native species, educational signage about streamside parks and the watershed, and installation of a bio-swale to increase filtration off the parking lot.
- Kemper Park Improvements - extension of the nature trail to full length of Warminster's property, expansion of the parking lot with porous paving, movement of the ball field, and installation of additional trails. Creation of some type of cross-stream access to allow residents of the Hartsville section of the municipality to cross the Neshaminy from Log College Drive to get to Kemper Park.
- Barness Park -the Municipal Authority completed a massive sewer pipe replacement project in 2007; this will be followed by restoration of the park area. Parks & Recreation reminds residents not to dump in the park behind their homes (especially grass clipping, branches and leaves) that can be sent downstream during flooding
- Five Ponds Golf Course - - the same sewer project was completed through the golf course. During heavy storms, Five Ponds acts as the primary watershed "holding tank" for all stormwater runoff in this end of the Township which then is slowly release into the Neshaminy creek.
- Log College Park - installation of additional trees, nature trail from Log College Drive to Kemper Park.
- Munro Park - installation of trees, changes in swales to address low areas to feed into tributaries in Ivywoods Park.

Warrington Township

- Reconfiguration/Reconstruction of Parking Facilities and Construction of Miscellaneous Park Improvements at Barness Park.
- Completion of parking facilities and miscellaneous park improvements at King Park.

- Address drainage issues on 2nd field from Folly Road, add a war memorial and spectator seating, extend sanitary sewer to park at Upper Nike Park.
- Construct pedestrian bridge in Lower Nike Park in conjunction with interconnection of Lower Nike Park/Bradford Green walking trails.
- Construct limestone trail around pond, install a boardwalk bridge area around pond, clean up pond and eliminate geese population.
- Develop Braccia Tract into a passive/active recreation site.
- Construct new trailhead at Pennswood Park.
- Utilize stormwater best management practices on publicly-owned properties including stormwater basin retrofits to improve water quality benefits. Initial properties include drainage swale at township building and Titus Elementary School.
- Retrofit existing retention basin at Palomino Farms utilizing stormwater best management practices.
- Replace concrete medians with landscaping at various intersections along Route 611.

Warwick Township

- Place riparian buffers along the Moland Park property to aid in restoring and preserving the stream bank in this area.
- Consider possibility of placing various access points for canoeing and/or kayaking in Moland Park to enable our community to better enjoy the nature in our Township.
- Develop an educational area along the banks of the creek within the park to consist of informational placards and even possibly a natural setting classroom. This would help educate the community about the Little Neshaminy and environmental preservation.
- Acknowledge the Moland House within future plans.

Management Options Matrix

On the following pages, the list of goals and objectives has been expanded to identify general tasks, primary partners, supporting partners and projected implementation timing. The table identifies the roles each partner can play in planning and implementing conservation actions. Implementation timing has been generally determined based on the complexity and funding requirements of the recommended actions. As with any planning effort, the actual timing of a proposed action can be affected by other variables such as state or national economic policies, political will and unrelated projects requiring limited municipal resources.

Table 22 - Little Neshaminy RCP Management Options Matrix

Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
1. Water Quality *Goal: Protect and improve the surface and ground water quality in the Little Neshaminy Creek Watershed to improve recreational opportunities, wildlife habitat and sources of drinking water.*				
Improve In-Stream Habitat	• Increase streamside vegetation to increase canopy cover and moderate stream temperature • Promote sustainable land use practices to reduce impervious cover and increase infiltration of stormwater • Improve protection of headwaters • Reduce nutrient and sediment loadings to watershed • Develop and distribute educational materials to all landowners related to the proper care and management of streamside properties.	Municipalities, DEP, DCNR, BCCD, MCCD	PAF&BC	2-5 years
Protect Existing Riparian Areas and improve those lacking sufficient riparian corridors.	• Increase riparian buffer protection in areas lacking sufficient vegetative buffers (50% canopy cover and 50 foot width forest buffer) • Develop and adopt riparian corridor protection ordinances, in all watershed municipalities if one has not been adopted. • Improve land management practices for streamside properties • Purchase land or conservation easements in riparian zones to limit development and restrict uses.	Municipalities, DCNR, DEP, BCCD, MCCD,	HC, BCPC, MCPC	2-5 years
Improve Water Quality in Bradford Lake Reservoir	• Implement in-lake management practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment. • Implement Bradford Lake restoration activities to eliminate sources of taste and odor compounds impacting downstream drinking water treatment plants. • Design and construct forebay/constructed wetland structure to improve water quality of lake. • Implement watershed best management practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment. • Initiate projects to stabilize and protect streambanks and establish riparian buffers ✧Implement institutional practices recommended in Little Neshaminy and Bradford Lake Watershed Assessment. ✧Establish watershed organization for the lake.	BCDPR, BCCD, Warrington Township, water quality consultants	BCPC, DCNR, DEP	2-5 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	✧Develop and adopt a municipal lawn fertilizer ordinance for all municipalities within the watershed. Increase landowner education and continue annual water quality monitoring.			
Protect drinking water sources	• Institute wellhead protection programs • Reduce demand on drinking water sources through residential water conservation programs • Support efforts of local watershed groups to improve and protect water quality in the watershed	Water utilities, municipalities, DEP BCDPR; BCCD, MCPHS	BCPC, MCPC, DCNR, PAF&BC	2-5 years
Support water quality recommendations of the Little Neshaminy Watershed Assessment and Restoration	• Initiate cooperative projects to fulfill plan recommendations • Increase water quality monitoring through establishment of small network of channel reference sites • Explore alternative management of grass or turf areas of publicly owned lands • Explore stormwater retrofits within suburban campus and industrial lands • Initiate projects to restore Stage V streams and priority reaches. Priority reaches are: ✧Kemper Park, Warminster – Valley Road to Bristol Road ✧Downstream of Meetinghouse Road – Warwick – Bristol Road Bridge to below downstream bend. ✧Park Creek along Keith Valley Road – Horsham – Horsham Park to County Line Road.	BCDPR, DRK, HC, BCCD, MCCD, MCPHS, PCWA, water quality consultants	DEP, BCPC, MCPC, Municipalities	Ongoing
Prioritize water quality projects for implementation	• Support efforts of local watershed groups to improve and protect water quality in the watershed • Convene meeting of watershed municipalities, water utilities, wastewater utilities and DEP to explore cooperation meeting federal mandates.	Watershed groups, Neshaminy Alliance, municipalities, utilities	DEP, DCNR	2-4 years
Increase water quality monitoring in Park Creek and Little Neshaminy Creek.	• Train, recruit and educate volunteer water quality monitors. • Collect and analyze lake and stream samples for nitrogen, phosphorus, total suspended solids, and oil/grease.	DRK, Park Creek Watershed Association, Municipalities	BCCD, MCCD, Municipal EACs	1-2 years
Encourage programs to increase vegetative cover throughout watershed.	• Develop and implement residential, municipal and public education programs that address the benefits of naturalized land for water management and air quality	BCCD, MCCD, HC, PEC, Municipalities, PCWA	DCNR, DEP, SEFRA	1-2 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	• Initiate reforestation projects on certain public lands. • Educate and encourage homeowners, businesses, religious and non-profit organizations to plant as much soil-retaining, water holding vegetation on land presently in turf or lawn. • Increase the number of street trees in developed areas of the watershed • Increase forested riparian buffers adjacent to stream tributaries.			
2. Stormwater *Goal: Improve the way stormwater is managed in the watershed to reduce flooding, protect stream base flow, protect stream quality, and maintain the hydrologic balance.*				
Reduce stormwater runoff volumes	• Reduce residential stormwater run-off through the promotion and use of rain barrels, rain gardens and increased homeowner education on water conservation. • Encourage disconnection of roof-top runoff drains from storm sewer systems. • Provide incentives for developers to utilize pervious paving, bio-retention islands, green roofs and other low impact development technologies in new and redeveloped sites.	Municipalities, HC, BCPC, BCCD, MCPC, MCCD, PEC	DEP	1-2 years
Improve water quality of stormwater	• Perform stormwater basin assessments to determine candidate sites for retrofits or naturalization • Retrofit and/or naturalize BMPs where possible to promote infiltration and improvements in water quality • Utilize treatment wetlands and innovative BMPs as educational tools for the public, municipalities and agencies • Install innovative BMPs on public and school district lands to be used as demonstration sites • Provide incentives for developers to utilize pervious paving, bio-retention islands, green roofs and other low impact development technologies in new and redeveloped sites. • Encourage the use of stormwater BMPs in all types of development as recommended in the Pennsylvania Stormwater BMP Manual. • Adopt and enforce stormwater quality standards and criteria of	Municipalities, HC, BCPC, BCCD, MCPC, MCCD, PEC	DEP, Consultants, DVRPC, Universities	2-5 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	Neshaminy Creek Act 167 Stormwater Management Plan. • Prepare conservation and nutrient management plans for active farms.			
Update Land Use Practices and Ordinances to include water quality standards and criteria.	• Update natural resource protection ordinances to support better stormwater management • Review and update Subdivision and Land Development Ordinances to support low-impact development techniques to reduce impervious cover in new and infill developments. • Require installation of naturalized stormwater BMP's to improve water quality in all new developments. • Eventually adopt the stormwater management model ordinances of the updated Act 167 Stormwater Management Plan for the Little Neshaminy Creek in all watershed municipalities.	Municipalities, Heritage Conservancy, PEC, BCPC, MCPC		1-2 years
Improve stormwater management programming and financing.	• Support efforts to research requirements of establishing stormwater utility • Coordinate stormwater management, conservation and preservation efforts between organizations and municipalities throughout the Neshaminy Creek watershed • Implement and fund programs to identify and retrofit existing stormwater detention basins to improve water quality function.	Municipalities, BCPC, Local Municipal Authorities, MCPC, PEC, Neshaminy Alliance	State Legislators, DEP	
3. Flood Impact Reduction *Goal: Mitigate impacts from floods*				
Reduce impacts from flooding on economic, historic and natural resources.	• Sponsor study to remap 100 -year floodplain to account for upstream development as in Pennypack and Tacony creek watersheds • Strengthen existing ordinances to place more restrictive controls on the 100-year flood zone and flood fringe areas. • Reduce exceptions to existing ordinances allowing encroachment and building in floodplains and wetlands. • Regulate alluvial soils • Purchase flood prone properties for conversion to public open space. • Provide training to zoning hearing boards regarding the	Municipalities, BCPC, MCPC, ACE, DEP, FEMA, PEMA	Universities	1-5 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	cumulative effects of exceptions and increased impervious surface on the hydrologic cycle of watershed. • Improve existing stormwater infrastructure. • Encourage protection of existing wetlands and natural floodplain areas through conservation easements.			
Determine procedures for removal of debris and obstructions in the stream	• Establish dialog with Penn DOT, DEP, NRCS and ACE to determine and coordinate procedures for removal of obstructions and debris in streams, including obstructions upstream and downstream from exiting bridges.	ACE, DEP, Penn DOT, Municipalities, PAF&BC	State Legislators	1-2 years
Improve management of flood prone properties	• Purchase flood prone properties for conversion to public open space. • Ensure proper management of acquired land through property management plans • Support park department staff person to address property management.	BCDPR, BCCD, MCPHS, MCCD, HC	NRCS, FEMA, PEMA	Ongoing
Reduce zoning and building exemptions in sensitive areas.	• Provide training to zoning hearing boards regarding the cumulative effects of exceptions and increased impervious surface on the hydrologic cycle of the watershed. • Develop handbook for ZHBs educating them about cumulative impacts of impervious surfaces and offer recommendations of measures that can mitigate environmental damage.	HC, PEC, BCPC, MCPC	DCED	1-2 Years
4. Cultural Resource Identification and Protection *Goal: Protect Cultural Resources of the Watershed.*				
Identify and protect archaeological and historic resources of the watershed.	• Identify significant historic & archaeological properties to be protected • Protect and maintain historic & archaeological resources. • Conduct a comprehensive municipal survey of historic properties, if a survey has not been conducted. • Nominate historic resources that have been determined eligible for the National Register of Historic Places to the National Register. • Adopt or strengthen historic preservation ordinances. • Promote adaptive re-use of historic buildings.	Historical Societies, Municipalities, HC	BCPC, MCPHS, DCED, PHMC	1-2 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	• Strengthen financial and operational support of local historic preservation and Native American organizations.			
Preserve significant scenic views and view sheds	• Identify scenic views to be maintained. • Adopt or strengthen scenic preservation ordinances.	Municipalities	BCPC, MCPC	1-2 years
Link important cultural and natural resources	• Implement BCPC and MCPC proposed greenway networks. • Develop trails, bike paths and greenways linking important natural and historic resources.	Municipalities, BCPC, MCPC, Land Trusts, MCPHS	DCNR, DVRPC	2-5 years
5. Natural Resource Identification and Protection *Goal: Protect the Natural Resources of the Watershed*				
Identify and conserve sensitive natural resources of the watershed.	• Conduct or update municipal environmental resources inventories (ERI) to identify and prioritize natural areas. • Update municipal comprehensive plans to include protection of natural resource priority areas. • Review and strengthen natural resource protection ordinances for wetlands, floodplain, groundwater recharge areas, priority natural areas (NAI), woodlands, and forests, ponds, lakes, hydric and alluvial soils. • Protect most sensitive areas through acquisition or conservation easement. • Restore and protect riparian vegetation along streams in the watershed. • Restore and protect aquatic communities, habitats and stream channels. • Restore and protect natural floodplains. • Remove references to invasive species in zoning and subdivision ordinances. • Review examples of ordinances that include the removal of non-native species such as in Upper Makefield Township.	Municipalities, HC, BCPC, MCPC	DCNR	2-5 years
Protect groundwater resources and stream baseflow	• Identify important groundwater recharge areas and protect as open space.	Municipalities, BCPC, MCPC, HC		2-5 years
Reduce damage to natural areas	• Control invasive and exotic plants and animals. • Institute measures to reduce damage from Canada Geese and White Tailed deer.	BCDPR, BCCD, MCCD, MCPHS, Municipalities, HC,	NRCS, DCNR, SEFRA	1-2 years

Table 22 - Little Neshaminy RCP Management Options Matrix

Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	• Control illegal ATV use on open spaces.	Police Departments		
Implement riparian and streambank restoration where effective	• Restore streambanks and riparian buffers along priority reaches in the watershed as identified in Little Neshaminy Creek Watershed Assessment and Restoration Plan: ✧Kemper Park, Warminster – Valley Road to Bristol Road ✧Downstream of Meetinghouse Road, Warwick – Bristol Road Bridge to below downstream bend. ✧Park Creek along Keith Valley Road, Horsham – Horsham Park to County Line Road. • Continue to monitor and assess streambank conditions for additional riparian and restoration sites	BCCD,BCDPR,MCCD, MCPC, HC, PCWA, Municipalities	DRKN, DEP, DCNR	Ongoing
Support sustainable land management practices on community open spaces	• Promote invasive plant and animal control, reduced mowing schedules, and other environmentally sound management practices for community held open spaces and common areas. • Address illegal ATV in community open spaces. • Promote use of vegetated buffers around BMPs and ponds to discourage use by Canada Geese.	BCCD, BCDPR, MCCD, MCPHS, NRCS, PSCE, DCNR		Ongoing
Protect prioritized NAI and ERI sites and identified sensitive lands.	• Enact stricter resource protection regulations in designated NAI, ERI and conservation areas. • Protect NAI areas, ERI sites and sensitive lands through acquisition or conservation easements. • Sponsor training sessions on the use of conservation easements for open space protection.	Municipalities, Land Trusts	DEP, DCNR	Ongoing
Link important cultural and natural resources	• Implement BCPC and MCPC proposed greenway networks. • Develop trails, bike paths and greenways linking important cultural and natural resources.	Municipalities, BCPC, MCPC, Land Trusts, MCPHS	DCNR, DVRPC	2-5 years
6. Recreational, Park and Open Space Resources *Goal: Maintain and enhance recreational opportunities and the parks and open space resources of the watershed.*				
Improve connectiveness and management of open spaces throughout the watershed	• Link greenways throughout the watershed. • Support implementation of BCPC and MCPC proposed greenway networks • Develop trails, bike paths and greenways linking important	Municipalities, BCPC, MCPC, Land Trusts, MCPHS	DCNR, DVRPC	2-5 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	natural and historic resources. • Encourage multi-municipal trail linkages among existing park systems.			
Implement Parks, Recreation and Open Space Plans	• Prioritize large parcels for open space acquisition or conservation easements • Update existing municipal recreation, parks & open space plans. • Implement recommendations of existing municipal and county open space plans. • Specify and implement stewardship plans on existing community open space areas.	Municipalities, BCPC, MCPC, BCDPR, MCPHS	DCNR, HC	2-5 years
Increase and improve municipal passive and active recreation facilities	• Maintain and improve playground and recreational facilities. • Increase passive recreation opportunities for residents through acquisition and management of natural open spaces. • Improve bike path and bike trail network throughout the watershed and park systems.	BCDPR, BCPC, MCPC, MCPHS	DVRPC,DCNR	2-5 years
Improve access points to the creek for recreation.	• ID potential public access points • Identify and install canoe and kayak access points to the Little Neshaminy Creek. • Develop access points utilizing sound environmental design practices to serve as educational sites.	Municipalities, BCDPR, MCPHS	DCNR	1-2 years
Promote sustainable land management practices on community open spaces	• Specify and implement stewardship plans for public open spaces and all park land. • Encourage naturalization of open spaces. • Create fund for purchase of trees, shrubs and meadows grasses to be used by municipalities, schools and organizations for revegetating or naturalizing open spaces. • Promote invasive plant and animal control, reduced mowing schedules, and other environmentally sound management practices for community held open spaces and common areas. • Address illegal ATV in community open spaces. • Promote use of vegetated buffers around BMPs and ponds to discourage use by Canada Geese. • Encourage participation in the Audubon Cooperative Sanctuary	BCDPR, BCCD, MCCD, MCPHS, NRCS, PSCE, DCNR	HC, BCPC, MCPC DCNR	2-5 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	Program for existing golf courses and other types of property in watershed.			
7. Watershed Resources Education & Outreach *Goal: Increase Participation in Education and Conservation Activities*				
Promote and enhance the understanding of the cultural, spiritual, economic and natural resources of the watershed among residents, business owners, religious and non-profit organizations.	• Develop programs and materials to educate homeowners, business owners, religious and non-profit organizations on water quality practices at home and land management techniques for those with property along riparian areas. • Educate and encourage homeowners, businesses, religious and non-profit organizations to plant as much soil-retaining, water holding vegetation on land presently in turf or lawn. • Coordinate outreach and education with municipal NPDES II program requirements. • Promote hands-on environmental education to residents and businesses via programs such as tree planting, stream clean-ups, and stream visual assessments. • Educate farmers on preparing conservation and nutrient management plans for active farms. • Post educational signage at stream crossings, naturalized areas, public open spaces and historical sites.	Municipalities, DEP, DCNR, Watershed Associations, local institutions	BCCD, MCCD, BCPC, MCPC	1-2 years
Promote and enhance the understanding of the cultural, economic and natural resources of the watershed to municipal officials.	• Promote educational programs for municipal officials, staff, boards and commissions on the link between land use practices and natural resource protection. • Evaluate alternatives to low-density, sprawl forms of residential development. Research, distribute and implement model ordinances for consideration by the municipalities. • Create Environmental Advisory Councils in all watershed municipalities that do not currently have them. • Provide information, such as maps and fact sheets for the use of key decision-makers. • Create resource materials for use by municipalities regarding the benefits of using native vegetation in landscaping and residential	DEP, DCNR, Watershed Associations, HC, PEC.	BCPC, MCPC, BCCD, MCCD	1-2 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	gardens. • Encourage municipalities and school districts to adopt policy to use native vegetation in facility landscaping.			
Promote and enhance the understanding of the cultural, economic and natural resources of the watershed among elementary and secondary school students.	• Promote service learning programs at elementary and secondary schools to teach student about basic stream ecology. • Identify or provide access to the creek for school groups. • Work with school districts to coordinate, in partnership with non-profit organizations, curricula on the creek's resources. • Promote service learning programs and coordinate curricula on creek's resources for youth education at religious and non-profit organizations with property along riparian areas.	DCNR, DEP, BCDPR, MCPHS	Watershed Organizations, religious and non-profit organizations.	1-2 years
Promote and enhance the understanding of the cultural, economic and natural resources of the watershed to the development community.	• Educate development community on the economic and environmental benefits of conservation design and low-impact development techniques.	DEP, DCNR, Land Trust, BCCD, MCCD	Watershed Organizations	Ongoing
8. Sustainable Economic Development *Goal: Encourage sustainable economic development practices.*				
Promote conservation design principals and sustainable land use practices in new development within watershed communities.	• Update municipal comprehensive plans, zoning and subdivision ordinances to encourage the use of conservation design and low impact development techniques to reduce impervious surfaces. • Encourage the use of Stormwater Management Best Management Practices as recommended in the Pennsylvania's Stormwater Best Management Practices Manual.	Municipalities, BCCD, MCCD, BCPC, MCPC	DEP, DCED	Ongoing
Promote conservation design principals and sustainable land use practices in redevelopment and/or infill development activities within the watershed communities.	• Work cooperatively to identify economically viable adaptive reuse options for the NASJRB Willow Grove facility which incorporate conservation design principles. • Encourage reduction in impervious surfaces in redevelopment projects. • Promote adaptive re-use of existing underutilized or vacant facilities. • Promote the use of green roofs and rain gardens in highly	Municipalities, BCPC, MCPC	DEP, DCED	Ongoing and long term.

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
	developed areas. • Promote use of stormwater BMPs as recommended in Pennsylvania's Stormwater BMP Manual.			
9. Plan Integration and Coordination *Goal: Improve watershed-wide plan coordination and integration.*				
Integrate Little Neshaminy RCP recommendations with the management options and recommendations of the adjacent RCPs and other studies completed or underway for the entire Neshaminy Creek Basin.	• Establish plan clearinghouse to provide single repository and database for previous Neshaminy Creek plans, studies and assessments. • Review and integrate all RCP goals and actions. • Coordinate watershed-wide activities through Neshaminy Alliance to avoid duplicative efforts. • Review status of previous and ongoing studies within the watershed.	Neshaminy Alliance, PEC, HC	BCPC, MCPC, Municipalities, DEP, DCNR	Ongoing
Improve coordination among watershed organizations and stakeholders to prioritize and implement recommendations of RCPs and other watershed studies.	• Coordinate efforts between municipalities, water and wastewater utilities to cooperatively address SDWA, Act 167, NPDES Phase II and TMDL for Little Neshaminy Creek Watershed to capitalize on efforts. • Support efforts of local watershed groups to improve and protect water quality in watershed. • Implement water quality recommendations of Little Neshaminy Watershed Assessment & Restoration.	Neshaminy Alliance, Utilities, Municipalities	BCPC, MCPC, DEP, PEC, HC	2-5 years
Integrate goals of RCP with municipal plans and land use ordinances.	• Promote integration of RCP goals with comprehensive plans, open space and recreation plans, zoning and subdivision ordinances of municipalities within the watershed. • Encourage multi-municipal planning among the municipalities. Investigate funding and other incentives.	Municipalities, Neshaminy Alliance, BCPC, MCPC	DCED	1-2 years
10. Plan Implementation *Goal: Improve Implementation Resources*				
Establish a structure, mechanism or information system for continued funding for projects and programs to	• Organize working group to encourage plan project implementation • Identify leadership and establish a structure or information system to facilitate the implementation of the river conservation	Steering Committee Members, Neshaminy Alliance	HC, PEC Agencies	1-2 years

Table 22 - Little Neshaminy RCP Management Options Matrix				
Objectives	Conservation Actions	Primary Partners	Supporting Partners	Projected Implementation
maintain and enhance the resources of the watershed.	plan. • Provide copies of the river conservation management plan to each municipality and the legislators whose districts encompass the corridor along with a summary of funding needs. • Promote public support for conservation funding. • Sponsor public information sessions on municipal funding initiatives for open space and watershed initiatives. • Build the capacity (volunteers, staff, resources, etc.) to implement the river conservation plan. • One year after the adoption and approval of the river conservation plan, hold a meeting of the advisory committee and other interested parties to evaluate progress on the implementation projects. After five years, meet to evaluate progress on the priority projects and activities and conduct update if warranted.			

Abbreviations: ACE – Army Corps of Engineers, BC – Bucks County, BCAS – Bucks County Audubon Society, BCCD – Bucks County Conservation District, BCDPR – Bucks County Dept. of Parks and Recreation, BCPC – Bucks County Planning Commission, BCHD – Bucks County Health Department, BHWP – Bowman's Hill Wildflower Preserve, DCED – Pennsylvania Department of Community and Economic Development, DEP – Pennsylvania Department of Environmental Protection, DCNR- Pennsylvania Department of Conservation and Natural Resources, DRBC – Delaware River Basin Commission, DRK – Delaware River Keeper Network, DVRPC – Delaware Valley Regional Planning Commission, FEMA-Federal Emergency Management Agency, HC - Heritage Conservancy, MC – Montgomery County, MCCD – Montgomery County Conservation District, MCPC – Montgomery County Planning Commission, MCPHS – Montgomery County Department of Parks and Heritage Services, NPS – National Park Service, NRCS – Natural Resources Conservation Service, PAF&BC – Pennsylvania Fish and Boat Commission, PEC – Pennsylvania Environmental Council, PCWA - Park Creek Watershed Association, PEMA-Pennsylvania Emergency management Agency, PSCES – Penn State Cooperative Extension Services, PHMC – Pennsylvania Historical and Museum Commission, SEFRA _Southeast Forest Resources Association, USGS – US Geological Service, US EPA – US Environmental Protection Agency

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http://montgomerytwp.org/

http://www.northamptontownship.com/
http://www.upperdublin.org/

http://www.warringtontownship.org/main.shtml

http://www.warwick-bucks.org/

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http://www.buckscounty.org/government/departments/CommunityServices/PlanningCommission/index.aspx

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Appendix A. Ordinance Review Matrix

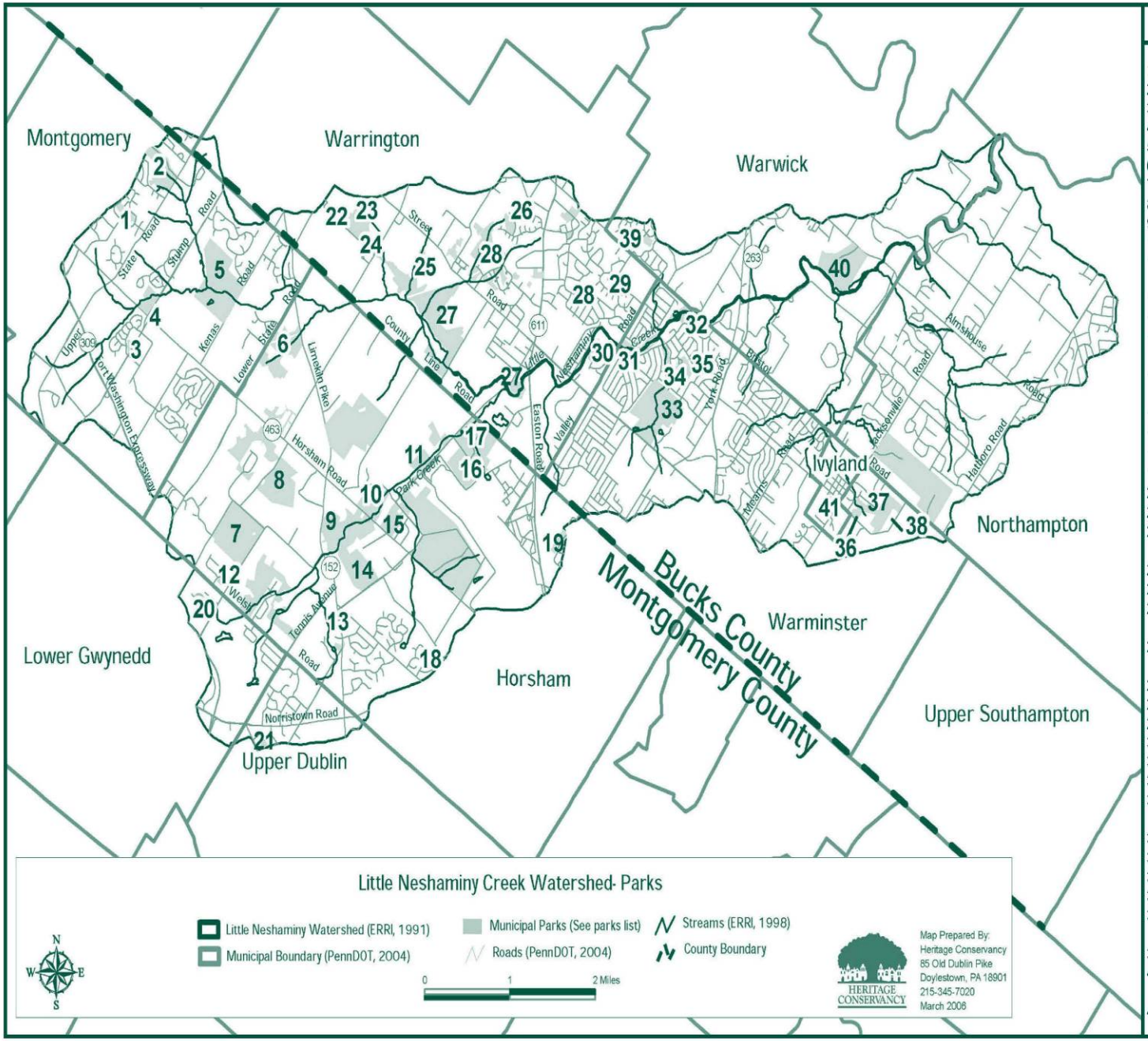
	Little Neshaminy Creek Watershed - Municipal Natural & Cultural Resource Ordinance Review								
Municipality	**Ordinance Reviewed and Date Enacted**	**Historic Resource Protection**	**Riparian Buffer Protection**	**Wetland Protection**	**Watercourse, Lake, Pond Protection**	**Floodplain Protection**	**% protected for development on 100-yr. floodplain**	**Restrict development on floodplain fringe**	**Stormwater Ordinance***
		Status of Ordinances	buffer width	% protected for open space	% protected for open space (ft)				Location and date of ordinance
Horsham	SALDO - 1999 Zoning -2004	Yes, Historic Preservation Overlay Ordinance in Zoning	Riparian Corridor Conservation District, 75 ft	100% and 50 ft. buffer	yes -100%	Floodplain Conservation District	100%	yes	SALDO
Lower Gwynedd	zoning, 1985, SLDO, 1976 with amendments	Currently drafting ordinance	yes, 25 ft zone with slope provisions	yes and 25 ft buffer zone	yes	Floodplain Conservation District	100%	yes	SLDO, CH. 1241
Montgomery	SALDO - 1964 w/amend to 2002 Zoning - 1981 w/amendments	Yes, Historic preservation cluster ordinance in Zoning.				Floodplain Conservation District	100%	yes, requires studies for alluvial soils	In SALDO - Adopted 2004
Upper Dublin	SALDO - 2004 Zoning -2004	Have drafted zoning ordinance amendment, but not adopted		yes	yes	Floodplain Conservation District	100%	yes	SALDO
Ivyland Borough	SALDO - 1995 zoning - 1996	None Found	Ordinance amend. 75 ft, 2 zone - 25 ft and 50ft	yes, 100%	100%	yes, Floodplain District	100%		In SALDO - Adopted 1995
Northampton	SALDO, 2001 zoning, 2002	None Found	80% within 100ft of lake, pond or watercourse.	yes, 100% and 80% margins in certain districts	100% +, 80% protection within 100 ft of lake, pond or watercourse margin	yes, floodplain and flood hazard districts	100%	yes, 50 ft. In CR, EP, R-1 and AR districts	Ch. 113, stormwater mgmt. & grading, 2005
Warminster	SALDO & Zoning 2002	None Found		yes, 100% and 80% for margins	ponds (bodies of water > 2acres) 80%, 150 ft	Floodplain Conservation District	100%	yes	ZO and SALDO
Warrington	SALDO - 1995 Stormwater - 1992	Zoning code authorizes 60 day demolition delay NR eligible or listed buildings		yes, 100%	100 Ft	Floodplain Overlay Restrictions	100%		Storm. Mgmt. Ord amended 1992
Warwick	SALDO - 1993 Zoning -1997 with amendments to 2004	Yes, has a hisotic district amendment in zoning covering three properties	Riparian Corridor Conservation District, 75 ft total 2 zones: 25 ft and 50 Ft.	yes, 100% in areas of cluster development	100%, 80ft stream buffer	Floodplain District	100%	yes	Storm. Mgmt. Ord SAlDO rev. 2004

Sources: Bucks County Planning Commission (2005) and Heritage Conservancy Analysis

*All municipalities adopted Model Stormwater Ordinance from Little Neshaminy Creek Act 167 Plan except Lower Gwynedd

Little Neshaminy Creek Watershed - Municipal Natural & Cultural Resource Ordinance Review							
Municipality	**Stormwater Quality**	**Erosion & Sedimentation Control**	**Control Development on Restricitive Soils**	**Steep Slope Protection**	**Woodland Protection**	**Tree Protection Zone**	**Active Environmental Advisory Commission or Board**
		Location of Criteria	% protected	Natural cover protection	% protected for open space		Status
Horsham	Requires groundwater recharge	yes, SALDO	100% on alluvial soils	yes > 15%	50%	yes	yes
Lower Gwynedd	infiltration requirement & post construction stormwater BMPs	yes, SLDO	Studies required for development on Alluvial Soils			yes	yes
Montgomery	post construction stormwater bmps	yes, SALDO Chapter 205	100% on alluvial soils		8-23 in. 66%, 23-48. 66%, Over 48in 100%	yes	yes
Upper Dublin	Requires groundwater recharge	yes, SALDO	100% on alluvial soils	yes > 10%			yes
Ivyland Borough		yes, SALDO		yes > 15%	75%	yes	no
Northampton		yes in SALDO	yes, 100% OS on floodplain soils	yes > 15%	80%	yes	yes
Warminster		zo and SALDO	100% on alluvial soils	yes > 8%	70%	yes	no
Warrington				yes > 8%	80%	yes	yes
Warwick		storm mgmt ord. SALDO, rev. 2004	100% on floodplain soils	yes > 15%	70%	yes	no

Appendix B. Residents Survey



PARKS

1. Hourglass Park
2. Spring Valley Park
3. Whispering Pines Park
4. Municipal Building Park
5. Windlestrae Park
6. Chestnut Creek Park
7. Squires Golf Course
8. Cedar Hill Road Park
9. Kohler Park
10. Deep Meadow Park
11. Keith Valley Road Park
12. Hideaway Hills Park
13. Lakeview Park
14. Horsham Valley Golf Course
15. Samuel Carpenter Park
16. Strawbridge Park
17. Graeme State Park
18. Jarrett Road Park
19. Maple Park
20. Wooded Pond Trail
21. Three Tuns Park
22. Igoe Porter Wellings (Upper Nike) Park
23. Twin Oaks Day Camp
24. Lower Nike Park
25. Special Equestrian Center
26. Mary Barness Tennis & Swim Club
27. Bradford Dam Park
28. Fairway Golf Course
29. Valley Glen Park
30. Alou Tot Lot
31. Kemper Park
32. Log College Park
33. Five Ponds Golf Course
34. Barness Park
35. WREC
36. Werner Park
37. Munro Park
38. Warminster Community Park
39. Hidden Pond Park
40. Neshaminy Valley Golf Course
41. Old Fire Dam Park

- Bark Park - Montgomery
- Lukens Park - orsham
- Limekiln Public Gof Course - Horsham
- Shank Tot Lot - Warrington
- Dapple Tot Lot - Warrington
- Palomino Park - Warrington
- Penns Wood Tot Lot - Warrington
- Warrington Village Tot Lot - Warrington
- Willow Knoll Park - Warrington
- The Playground - Ivyland
- Ivyland Common
- Village Green—Ivyland
- Eddowes Drive Prk Ivyland

Background Information:

Municipality in which you live:

_____

Age range: ❑ 18-24 ❑ 25-44 ❑ 45-65 ❑ 65+

Length of residency:

❑ 0-1 Yr. ❑ 1-5 yrs. ❑ 5-10 yrs ❑ over 10 yrs.

1. How close do you live to the Little Neshaminy Creek or one of its tributaries? Please check one.

- ❑ My residence is along the Little Neshaminy Creek or one of its tributaries.
- ❑ I live within one mile of the Little Neshaminy Creek or one of its tributaries.
- ❑ I live more than one mile from the Little Neshaminy Creek or one of its tributaries.
- ❑ I do not know how far I live from the Little Neshaminy Creek.

2. If you live along the Little Neshaminy Creek or a tributary, has your property ever been damaged by flooding?

❑ Yes ❑ No

If yes, please describe: _____

_____

_____

3. Which local parks do you visit most often?

(See enclosed Parks Map)

_____

_____

_____

_____

4. How often do you visit the creek or a park where the creek is located?

- ❑ Less than one time per week
- ❑ More than one time per week
- ❑ One time per month
- ❑ Every three months
- ❑ Occasionally
- ❑ Never

5. What activities do you participate in at these parks?

- ❑ Nature programs
- ❑ Fishing
- ❑ Hiking/biking/walking
- ❑ Wildlife/bird-watching
- ❑ Sports/active recreation
- ❑ Other _____

In questions 6 through 9, please rank your level of concern by using 1 as the highest and 3 as the lowest.

6. In your opinion what are the three greatest threats to the Little Neshaminy Creek Watershed in Bucks and Montgomery Counties?

- __ Pollution from stormwater runoff
- __ Wastewater treatment plant discharges
- __ Increased development
- __ Runoff from agriculture & golf courses
- __ Damage from flooding
- __ Loss of wildlife habitat/streamside vegetation
- __ Other _____

7. In your opinion what are the three greatest recreational needs in the Little Neshaminy Creek Watershed?

- __ More active recreation facilities, ball fields, basketball courts, skate parks
- __ More passive recreational opportunities, hiking trails, bird/wildlife watching opportunities
- __ Better access to the creek for canoeing, kayaking, boating
- __ Improve fishing through stocking/habitat restoration
- __ More opportunities for organized activities, teams, or recreation programs
- __ Other _____

8. In your opinion what are the three most important resources of the Little Neshaminy Creek Watershed?

- __ Historical resources (historically important buildings and districts)
- __ Natural open spaces (undeveloped woodlots, wetlands and wild areas)
- __ Water resources (water quality and groundwater)
- __ Recreational opportunities (parks, playing fields, and trails)
- __ Agricultural resources (farms, nurseries, and agricultural production)
- __ Other _____

9. In your opinion what three resources need to be improved?

- __ Historical resources (historically important buildings and districts)
- __ Natural open spaces (undeveloped woodlots, wetlands and wild areas)
- __ Water resources (water quality and groundwater)
- __ Recreational resources (parks, playing fields, and trails)
- __ Agricultural resources (farms, nurseries, and agricultural production)
- __ Other_____

10. How do you feel the improvements that you indicated in the previous questions should be funded? You may select more than one.

- ❑ Municipalities should pursue grant opportunities
- ❑ Special fees for people/groups who utilize those resources
- ❑ Special referendum taxes (an example is an open space referendum)
- ❑ County Government should fund
- ❑ Special interest organizations or non-profits should find funding

Opportunities for Involvement:

If you would like to participate in the River Conservation Plan process, or simply want to stay informed about the plan's progress, please provide the following information:

Name: _____

Address: _____

_____

City/State/Zip: _____

_____

Phone _____

Email: _____

Thank you for participating in this survey.

The Little Neshaminy Creek River Conservation Plan is a collaborative effort between Heritage Conservancy, Bucks County Conservation District, Bucks County Planning Commission, Montgomery County Conservation District, Montgomery County Planning Commission, PA Department of Environmental Protection, Horsham, Montgomery, Upper Dublin, Northampton, Warminster, Warrington and Warwick townships, and Ivyland Borough.

The Little Neshaminy Creek River Conservation Plan is funded by a grant from the PA Department of Conservation and Natural Resources, with matching funds and services provided by the project partners, PA Department of Environmental Protection Coastal Zone Management Program and National Oceanic and Atmospheric Administration.

HERITAGE CONSERVANCY

www.heritageconservancy.org

Preserving our Natural and Historic Heritage

To take this survey online visit us at: www.heritageconservancy.org/projects/l_neshaminy.php — Only one survey per person, please!

HERITAGE CONSERVANCY
85 Old Dublin Pike
Doylestown, PA 18901

Little Neshaminy Creek River Conservation Plan Public Survey

Municipalities within the Study Area

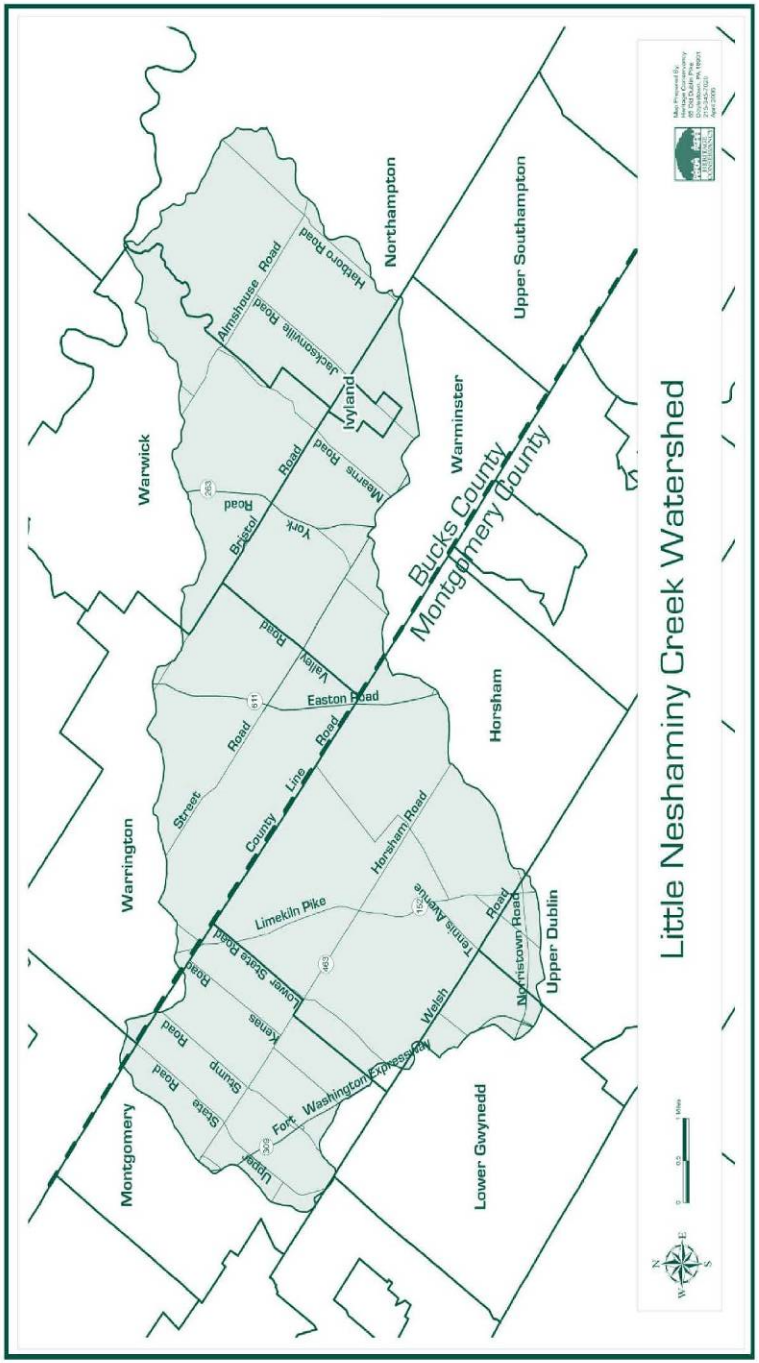
- Horsham Township
- Lower Gwynedd Township
- Montgomery Township
- Upper Dublin Township
- Ivyland Borough
- Northampton Township
- Warminster Township
- Warrington Township
- Warwick Township

Public input is critical to a successful plan. Your responses will help the project team better understand the environmental issues and concerns within the watershed communities.

If you live in or near the shaded area indicated on the map to the right, please take a few minutes to participate in our survey. You may complete and return this postage paid form or use the online form by visiting us at...

www.heritageconservancy.org/projects/l_neshaminy.php

Only one survey per person, please!



To take this survey online, visit us at: www.heritageconservancy.org/projects/l_neshaminy.php

Only one survey per person, please!

Appendix C. Comments on Draft Plan

Mr. Gerald Huestis
1570 York Rd.
Warminster, PA 18974

Memo written 2001

Submitted to THE WARWICK TWPS Supervisors in 2001
No Action

White Paper

Flood Mitigation Options for the Old York Road Bridge, over the Little Neshaminy Creek in Warwick Township.

Some History: The Old York Road was the original road between New York and Philadelphia. Although the history records are not exact, it probably was built in the late 1600's or early 1700's. Records show that it existed in the early 1700's and that George Washington used it in 1776 while headquartered at the Moland House. The Hart Mill (now a home at 1570 Old York Road) was built in the 1750s and was used by Washington to provision his troops and horses.

As a starting point for examining options, figure 1 is this writers sketch of the Little Neshaminy Creek and flood way as it must have existed before any bridge or road. The creek shows signs of meandering so the exact channel location may have been different than the current channel. It will be noted the there was no impediment to the flow of water at that time.
When the road was developed in the early 1700s, a covered bridge spanned the creek. The exact span of that bridge is unknown to the writer. Later in 1939 the bridge was replaced with a steel bridge and the bridge approaches were ramped up to the bridge level. In March 2001 the bridge was closed for repair and cosmetic changes. It remains closed as of this date. (about May 2001)

Figure 2 is a cross section sketch of the resultant .road bed and estimated levels above the flood plain.

It should be noted that the bridge and road now act as a dam in conditions where runoff waters can no longer pass through the channel and under the bridge. For a number of years this was no problem, and the installation of a dam by the Corp of Engineers upstream at Bradford Lane was a great factor in reducing downstream flow. For a number of years no flooding occurred. However recent development upstream in Warrington Townships and Montgomery County have increased the rate of flow to the point where even a modest storm causes the creek to overflow its' bank, and water backs up behind the bridge/road dam and floods houses on Old Your Road and Graeme Way. It is obvious that the 100 year flood plain metes and bounds are no longer valid.

Incident to the restoration of the Moland house a township plan was developed to repair the bridge and make cosmetic changes. After the hurricane Floyd flood this writer appealed to the Township Supervisors to widen span to increase the flow capacity. This request was denied on the basis of funding limitation and time to get permits, et al. The bridge was closed in March 2001 for repairs. The bridge was scheduled to reopen on June 19 but remains closed due to damage to the bridge caused by the June 17 flood. The bridge has to be repaired before reopening.

It should be noted that nothing was done in the repair to mitigate flooding. In fact the addition of rip rap at

the bridge abutments to reduce scouring and the increase in size of the structural beams has ,in fact ,reduced the flow-through capacity.

Flood mitigation options:

Option 1: Close the bridge and road permantly, remove bridge and road, bed.
This is probably the least expensive option and would probably receive no objection from the residents North and South of the bridge. Alternate access routes exist and no emergency services would be seriously affected. The route 263 bypass was specifically built to remove traffic from Old York Road and is now the main thoroughfare for North/South traffic.
In recent months the residents of new developments on Turkey Trot road have discovered that Old York Road is a convenient short cut to avoid the signal light on route 263 at Meyer Way and rush hour traffic at the signal light at the intersection of Bristol Road and route 263. This has increased the rush hour traffic on Old York Road and is a safety and noise pollution concern to the residents
In addition, closing would pave the way for extending the a walking trail from Kerringer Park to the planned Moland House trail. See attached Map.

Option 2: Increase the span of the bridge. This would require new abutments and dredging of the creek channel. This would entail an engineering study and this writer can only guess that funds required would

exceed the cost incurred in rebuilding the current bridge. However it is a valid option since the current bridge would again suffer damage in a subsequent flood.

Figure 3 is a sketch showing a new added span and new dredged channel.

Option 3: Install a number of culverts under Old York Road on each side of the bridge abutments. This would increase flow whenever the creek overflows its' banks . Figure 4 is a sketch showing the placement of these culverts.across the flood way .The number and diameter needed to accommodate the rate of flow is unknown but the information to calculate capacity can be obtained from the US Geological Survey. That agency had hydrological measurement crews at the site in both the 1999 and 2001 floods.

HERITAGE CONSERVANCY

Little Neshaminy Creek River Conservation Plan
Public Meeting to Review Draft
Warminster Township Municipal Building
May 29, 2007

COMMENT SHEET

Please provide your written comments on the draft plan by June 29, 2007 and return to: Heritage Conservancy, 85 Old Dublin Pike, Doylestown PA 18901, Attention: Susan Myerov. You may also send your comments via e-mail to Susan at smyerov@heritageconservancy.org

I HAVE WORKED ON A CMAQ/DCNR GRANT WHICH WAS RECEIVED BY WARRINGTON TOWNSHIP AS THE BIKE + HIKE TRAILS CHAIRMAN. THE GRANT WAS WRITTEN TO PLAN FOR INTERCONNECTING TRAILS TO MAKE THE TOWNSHIP MORE PEDESTRIAN FRIENDLY. (ABOUT 2002) WARRINGTONTOWNSHIP.ORG

THE NESHAMINY WATER GREENWAY + BRADFORD DAM + KEMPER PARK + PARK CREEK ARE MENTIONED AS VALUABLE INTEGRAL RESOURCES TO UTILIZE THE FLOOD PLAIN + GREENWAY TO TRANSVERSE/WALK/BIKE HIKE + POSSIBLY HORSEBACK RIDE UNDER RT 611 + RT 132 / STREET RD.
THERE CAN EASILY BE CONSTRUCTED PATHS THAT COULD INTERCONNECT FROM THE HEAD WATERS THROUGH TO TYLER PARK + BEYOND. IT MAY BE POSSIBLE TO EVENTUALLY CONNECT TO THE DELAWARE RIVER VIA THE MAIN NESHAMINY CREEK OR CONNECTIONS ON STREETS UNTIL RIGHTS OF WAY CAN BE OBTAINED. MANY OF THE NEIGHBORS SUPPORT THIS.

I ALSO BELONG TO THE CENTRAL BUCKS BICYCLE CLUB CBBC.ORG THEY SUPPORT TRAILS + PATHS THAT CATER TO PEDESTRIANS + BICYCLISTS TO PROMOTE BICYCLING + ALTERNATIVES TO AUTOMOBILES.

IT IS VERY IMPORTANT TO PROTECT THE FLOODPLAIN + ENCOURAGE EDUCATION OF THE WATER + ENVIRONMENT FOR THE PEOPLE. THIS ALSO EXTREMELY IMPORTANT TO ENCOURAGE EXERCISE OF WALKING DUE TO THE INCREASING EPIDEMIC OF HEALTH CONCERNS SUCH AS DIABETES + HEART DISEASE.
NOTHING IN MY BACKYARDERS SHOULD BE SEVERELY REPRIMANDED OR FINANCIALLY APPEASED.

I STRONGLY SUPPORT GOAL #6 AS TRAILS AS WELL AS ALL THE OTHERS

THANK YOU!

Michael Thom
EAGLEEYE442@GMAIL.COM
W. SOLARPANEL-RENTAL.COM

Stan

Municipal web site address - www.upperdublin.net

Executive summary
page 3 – last paragraph- Park Creek headwaters is located in both Lower Gwynedd and Upper Dublin Twps.. All maps should detail Park Creek tributarys beginning in Upper Dublin Twp. then flowing under both Tennis Ave and Welsh Rd.(Twp. boundary lines).
Relocate flood plain boundary lines
Little Neshaminy Creek River Conservation Plan

Municipal Open Space. Park and Recreation Areas Draft -
Page 65,67 - Three Tuns Park located in Upper Dublin Twp. contains 5.2 acres of land not 3 as indicated.
Project listed by Municipality page 135
Add-
Promote and share Upper Dublin Twp.'s informative Stormwater Web page with other Municipalities located within the Little Neshaminty Creek watershed.
Negotiate riparian buffer easements on lands that contain the headwaters of the Park Creek.
Encourage cluster home sites in the so called Acme property located at the intersections of Welsh Rd, Limeklin Pike and Norristown Rd. Permitting this type of housing will preserve the greatest amount of open space. This 18 acre site is the head waters of the Park Creek and is already prone to flooding.
Work with Horsham Twp. to manage stormwater from Upper Dublin Twp. that enters Park Creek.
Pursue Growing Greener II grants for stream restoration.

Can you e-mail Stan a sample resolution?