FINAL Report

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Poquessing Creek Watershed Rivers Conservation Plan

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Office of Watersheds
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Philadelphia, PA 19107

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Submitted by:
Borton-Lawson
Forbes Environmental

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Project Partners / Additional Project Support

Arch Bishop Ryan High School
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Bensalem Township
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Bucks County
Delaware Heritage Trail
Delaware River Greenway Partnership
Fairmount Park Commission
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Executive Summary

Imagine a Poquessing Creek with a variety of trails connecting the Creek and its tributaries to parks and schools, where fishing, hiking and birding along a clear, clean creek inhabited by a rich aquatic life surrounded by local wildflowers is a powerful possibility. This is the Poquessing Creek Watershed that we envision for the future. A Community Conservation Partnership Program grant from the Pennsylvania Department of Conservation and Natural Resources (DCNR) is getting watershed residents one step closer to this reality. This grant funded the development of a River Conservation Plan for the Poquessing Creek and its watershed. As a result, the major stakeholders and the team leaders of the River Conservation Plan identified the issues that threaten the watershed, the amenities that need to be protected in the area and the management options designed to improve the water quality, the natural environment and the quality of life of the people who live, work and play in the Poquessing Creek Watershed.

After two years of surveying the Poquessing Creek and its surrounding land, and acquiring feedback from the people that work and live in it, we have learned that the watershed possesses a number of environmental challenges, including a lack of access to its waters, stream encroachment and impaired aquatic life, invasive plant species, and erosion, among other issues. These are precisely the conditions that contribute to the perception of the urbanized Poquessing Creek being obscure and unnoticed by its watershed visitors, and even its residents.

Simultaneously, the Poquessing Watershed is blessed with a rich history, diverse culture and natural gems found within its urban setting. There exist significant American (and Native American) historic and cultural treasures. There are unique resources found in the communities of the Russian immigrants that are changing the social fabric of the area, in the slave cemetery at Burling and Old Townsend Road, the St. Katherine Drexel Mission Center and Shrine, and the Glen Foerd Mansion that sits at the mouth of the Poquessing Creek.

This watershed also offers ample outdoor recreational opportunities despite its limited number of parks and open spaces. Birders catch sightings of migrating species at the Benjamin Rush State Park, while other local residents fly model airplanes regularly there, and golfers enjoy the natural surroundings at the Bensalem Country Club and John F. Byrne courses. All of these sites are considered by their users to provide respite in the midst of a highly developed landscape.

In an effort to better understand the issues, resources and the people that live in the watershed, the River Conservation Plan team, guided by the Philadelphia Water Department and its consultants – Borton-Lawson Engineering and Forbes Environmental & Land Use Planning – pursued their reconnaissance work through a variety of means. They conducted an outreach campaign that solicited public input through brochures, surveys, key person interviews, community events, and meetings, among other projects. Furthermore, the team identified the previous and existing planning efforts already

completed or underway, ensuring that they are incorporated into this project. The team also prioritized residents' concerns and their recommendations through an extensive data collection effort via a Geographic Information System (GIS) application conducted to analyze the information about land and water resources, recreational, cultural and educational amenities.

The Poquessing Creek is almost entirely sewered for both stormwater and sanitary wastewater except for the golf courses and some of the larger parks. It is also classified as a Warm Water Fishery (WWF). Yet, in a creek where stressors, such as physical obstructions, sedimentation/siltation, erosion and hydrologic extremes are commonplace, there still exists a relatively diverse assemblage of aquatic life, threatened and endangered birds and various native plants in the creeks' corridor. These signs of survival give us hope and motivate us to work towards a more naturalized and beautiful habitat for these indicators (the organisms) of watershed health.

Despite the challenges and varied uses found in this small 21.5 square mile watershed, which crosses portions of Bensalem and Lower Southampton Townships in Bucks County, Lower Moreland Township in Montgomery County, and the City of Philadelphia, we discovered the most unique and valuable resource: the Poquessing Watershed Steering Committee. The steering committee is comprised of the major stakeholders in the watershed (those individuals with a vested interest in the watershed) – the Friends group, environmental advisory boards, major landholders (i.e., Northeast Philadelphia Airport), park managers, township officials, state representatives, educators and residents. The creek and its surrounding land are guarded by this exceptionally committed and diverse group of steering committee members. They meet quarterly to discuss the state of the watershed and to strategize the right approach for its proper management (see Appendix A.1 for a list of the steering committee members). This committee helped develop the River Conservation Plan recommendations to best reconnect residents and stakeholders with the Poquessing Creek, while also striving to further the goal to improve the health and beauty of the area. Each goal then categorizes the planning needs, data gaps, monitoring outcomes and educational outreach needs required to transform the goal into an exciting reality for the Poquessing Creek Watershed.

Poquessing Watershed River Conservation Plan Goals:

1.) Establish Comprehensive Watershed-Based Planning & Protective Regulations
2.) Improve Stream Habitat, Protect Aquatic Resources and Restore Aquatic Communities
3.) Improve In-Stream Flow Conditions
4.) Improve and Protect Water Quality of Ground and Surface Waters and Reduce Pollutant Loads
5.) Improve and Protect Stream Corridors
6.) Address Flooding
7.) Enhance and Improve Recreational Opportunities

8.) Improve Stewardship, Communication and Coordination Among Watershed Stakeholders
9.) Protect Significant Natural Features
10.) Protect Significant Historic & Cultural Features
11.) Initiate Sustainable Development on a Watershed Level
12.) Initiate Capital Improvements for Watershed Protection

The Poquessing Watershed River Conservation Plan provides the necessary framework to begin the transformation of the watershed. The projects resulting from the recommendations in this plan are tangible and they are lined up and ready for someone to adopt. The implementation of these projects will provide us with the watershed we envision for the future – a Poquessing Creek with a variety of trails connecting the Creek and its tributaries to parks and schools, where fishing, hiking and birding along a clear, clean creek inhabited by a rich aquatic life surrounded by local wildflowers is a powerful possibility. The River Conservation Plan generates the hope and excitement necessary to realize this future for the Poquessing Watershed. Be proactive - embrace a project and take pleasure in being a part of this watershed!

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Section 1: The Conservation Management Plan

1.1 Management Plan Introduction

Based on information collected for the Poquessing Creek Watershed Rivers Conservation Plan, the Poquessing River Conservation Plan Steering Committee has developed twelve (12) management goals. These goals are specific to the Poquessing Creek Watershed, however, consistent with the goals of conservation plans and watershed management plans developed for other watersheds in the City of Philadelphia, as well as with conservation management plans developed for Bucks and Montgomery Counties, their municipalities and for the public land holdings within this watershed.

Below is a list of Poquessing RCP Steering Committee Members:

Last Name	First Name	Affiliation
Barrett	Jim	Lower Southampton Environmental Advisory Committee (EAC)
Belfield	Tony	Bensalem Township Environmental Advisory Board/Bucks County Open Space Review Board
Bentley	Terri	Bucks County Planning Commission
Blaustein	Joan	Fairmount Park Commission
Brokaw	Bill	Borton-Lawson Engineering
Brummer	John	Delaware River Greenway Partnership
Butler	Lance	Philadelphia Water Department (PWD)
Bryson	Dean	Lower Southampton EAC
Colton	Bill	Friends of Fluehr Park
Cox	Ken	Crestmont Farms/Friends of Poquessing
Cuorato	James	Brandywine Realty Trust
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Ledesma-Groll	Tiffany	PWD (Winokur)
Leff	Michael	Pennsylvania Environmental Council
Mora	Denis	Resident of Poquessing/PWD
Olson	Jackie	Fairmount Park Commission Volunteer Coordinator

O'Neill	Councilman Brian J.	City Councilman O'Neill (R-10th dist.)
Pilling	Beth	MontCo. Planning Commission
Rapone	Bill	Councilman Brian O'Neill's Office
Remick	Donna	Friends of Poquessing
Rudolph	Alison	Lower Moreland Township
Tata	Angelo	Northeast Philadelphia Radio Control Club (Model Airplanes)
Taubenberger	Al	Greater Northeast Philadelphia Chamber of Commerce
Thompson	Michael	Philadelphia City Planning Commission
Tracy	Celeste	Delaware Heritage Trail/Delaware River Greenway Partnership
Waldowski	Jeanne	PWD
Zlotnick	Suzanne	Friends of Poquessing

In this section, the goals and recommendations are introduced along with the planning needs, data gaps, monitoring outcomes and educational outreach needs required to implement the goals. At the end of the section, a Management Options matrix identifies specific objectives and recommended activities that the steering committee developed to implement the major goals. The matrix will help watershed partners as it serves as a "to do" list based on completed research and input received from citizens and other stakeholders living and working within the Poquessing Creek Watershed.

1.2 Goals and Recommendations for the Poquessing Creek Watershed

Goal 1: Establish Comprehensive Watershed-Based Planning & Protective Regulations

The Poquessing Creek Watershed contains portions of three counties (Philadelphia, Montgomery and Bucks), the City of Philadelphia (Northeast Philadelphia) and parts of four municipalities (Bensalem, Philadelphia, Lower Southampton, and Lower Moreland). As noted in Section 2, the Pennsylvania General Assembly delegated planning and land use control (e.g., "police power") to the counties, cities and municipalities through the Pennsylvania Municipal Planning Code (MPC). In the City of Philadelphia, the Philadelphia Code and Charter is the primary regulatory land use development tool.

Although there are similarities among municipalities in the watershed in the way the Poquessing Creek Watershed is zoned and regulated, there are also differences. These differences arise due to the nature of streams and their watersheds typically extending into more than one municipality. The dilemma of consistently protecting water resources from the negative impacts associated with land development is not a new one. However, to the greatest extent possible, a major recommendation of this plan is to establish consistent watershed-based planning and land use regulations that are protective of the Poquessing Creek and the significant natural and man-made amenities within its watershed.

Planning and Data Gaps

A significant amount of research was completed to determine whether the municipalities and the communities within Northeast Philadelphia had completed Master Plans, Comprehensive Plans, Community Plans and functional Plans that were watershed-based or contained goals protective of the Poquessing Creek. The Parkwood Community Plan, in the Northeast Philadelphia portion of the watershed which is currently under development, is supportive of watershed-based protection. The remaining communities in this region (e.g., Torresdale, Somerton, and Greater Bustleton) do not have community plans. Plans for each of the communities that contain goals and recommendations for the protection of the Poquessing Creek and the amenities within its watershed are recommended.

Two of the three municipalities within the watershed have adopted comprehensive master plans. Their policies for land protection may differ slightly; however they have a consistent vision to protect the land and significant environmental features within the Poquessing Creek and adjoining watersheds. Policies from municipal comprehensive plans often form the basis for revised zoning (e.g., surface water protection overlay zones), land use ordinances (e.g., stream buffer protection), more intensive study in the form of functional plans (e.g., natural resources inventories), and/or special projects that benefit creek resources (e.g., streambank restoration, best management practices). Lower Moreland Township currently does not have a comprehensive plan; therefore, it is recommended that they complete a comprehensive plan that includes goals, policies and recommended activities that would benefit the Poquessing Creek.

Not all of the municipalities have functional plans addressing conservation of historic, recreational and natural resources (e.g., open space, recreational, natural resources protection, and historic preservation plans). Having updated functional plans is important, as the information and recommendations in them often leads to regulatory protection of these resources. Therefore, it is recommended that Lower Moreland Township complete a recreation plan, and that the three municipalities in the watershed complete natural resources and historic resources inventory and protection plans.

With regard to watershed planning, this Rivers Conservation Plan for the Poquessing Creek Watershed will provide useful goals, objectives and recommended activities. However the Poquessing Creek would also benefit immensely from the completion of an Act 167 Watershed Stormwater Management Plan. An Act 167 Watershed Stormwater Management Plan contains documentation of existing watershed characteristics (e.g., land use, soils, runoff conditions, peak flows, sub-area timing relationships, existing storm drainage problems, and flow obstructions), specific criteria and performance standards for managing stormwater runoff, a listing of best management practices specific to the watershed, a list of development priorities for implementing stormwater management practices within each municipality, and a model ordinance based on study findings. Therefore, it is recommended that an Act 167 Watershed Stormwater Management Plan be completed for the Poquessing Creek Watershed.

The Pennsylvania Department of Environmental Protection (PADEP) provides funding for Act 167 Stormwater Planning and both the PADEP and the local Planning Commissions provide sound technical support for the creation of Act 167 Plans. The PADEP is aware that the Poquessing Creek Watershed does not have a Watershed Stormwater Plan.

Although research was completed regarding existing zoning and land use regulations currently in place within the Poquessing Creek Watershed (e.g., zoning districts protecting the creek, environmental performance standards, stormwater management, erosion and sedimentation control), a comprehensive watershed-based review comparing and contrasting zoning and land development regulations was not. It is recommended that a zoning and regulatory study be completed to determine if protective land regulations have been adopted and are being implemented on a consistent basis.

Implementation

The creation and implementation of watershed-based comprehensive plans, functional plans, and supportive studies requires the local support, cooperation and coordination of a number of entities. Locally, watershed-based planning and the creation of protective regulations are the cooperative effort between elected officials, paid staff, municipal engineers and planners, and appointed committee and commission members (e.g., municipal supervisors, managers, planning and environmental commissions).

It is recommended that the effort to create these plans (e.g., funding acquisition, hiring consultants, completing research, and creating sound watershed-based plans), and protective regulations based on these planning efforts be completed in the municipalities and NE Philadelphia communities of the Poquessing Creek Watershed.

In addition, the Poquessing Creek Rivers Conservation Plan should be sent to a list of targeted committees and boards (e.g., zoning, planning commissions, etc.) who can further the development of overall watershed management regulations. The cover letter should state that the targeted board will receive an annual watershed-based planning report and update on watershed progress. Progress reports should be sent on an annual basis and provide information on whether the goals and objectives contained in the RCP management report have been attained.

Monitoring Outcomes

Monitoring watershed planning has been completed in the Poquessing Creek Watershed by the Delaware Valley Regional Planning Commission (DVRPC). The DVRPC has occasionally completed planning progress studies that include the adoption and regulation of natural resource protection standards and a gauge of open space acquisition by municipalities for the entire region. A number of agencies and professional planning groups (e.g., local chapters of the Pennsylvania Planning Association) are also cognizant

of those municipalities preparing and implementing watershed-based planning and land use protection efforts. The planners and engineers within local governments (e.g., Planning Commissions, Environmental Advisory Commissions, Zoning Hearing Board Officers) monitor watershed-based planning and regulatory efforts based upon the number of land developments that adhere to local policies and protective regulations. We recommend the continuation of these monitoring efforts and an increase in their frequency in order to gauge watershed-based planning progress.

Education

Educational programs that support watershed planning and land use protection are available through a number of public agencies and private organizations. These programs are evident in the Poquessing Creek Watershed. The Philadelphia Water Department is a positive example of an agency that has adopted watershed-based planning. Their staff actively educates local government, landowners, students and others about the importance of watershed-based planning and drinking water protection on a consistent basis through a variety of educational programs. The Friends of the Poquessing Creek is another example of a private, volunteer-based group actively implementing a watershed based curriculum in addition to educating community members about the positive impacts of watershed-based planning and land use regulation. A number of educators were involved in this project and provided curriculum examples that blend science, social science, and hands on community efforts that benefit their students and the Poquessing Creek (e.g., streambank restoration, grate mates program). There are a number of other examples of watershed-based outreach efforts that support watershed-based planning and regulatory protection. However, additional coordination is needed.

We recommend that the Poquessing Creek Steering Committee formed for this project continue to meet on a formal basis after plan completion and continue to coordinate and implement existing watershed-based educational efforts. The educational program should continue to include existing committee members from all sectors (see Appendix A.1 for members and their affiliations) and should continue to reach a "cross-sectional" audience including students, educators, parents, large and small landowners, elected officials and agency representatives. Educational materials should include a clearinghouse of existing information as well as the creation of watershed-based planning and regulatory materials geared toward identified planning and regulatory data gaps apparent in the Poquessing Creek Watershed.

Goal 2: Improve Stream Habitat, Protect Aquatic Resources and Restore Aquatic Communities

The Poquessing Creek Watershed contains many miles of surface water streams. A large percentage of those stream miles do not support the aquatic communities that should be present in the Poquessing Creek according to the state water plan and the Philadelphia Water Department's Baseline Assessment of the Poquessing Creek Watershed. Much of

this degradation is associated with negative impacts of stormwater flow and the sediment, nutrient and chemical inputs from stormwater runoff.

One of the ways in which stream habitat can begin to be improved and aquatic communities restored is through simple changes in the manner with which stormwater is managed within the watershed. Improving current stormwater management practices (Best Management Practices) reduces the percentage of runoff related issues within the stream itself such as pollution and erosion directly related to high flows. BMP's that improve stream health also directly enhance the health of the human community in the nearby region as well as the biological community that depends on the river for life and sustenance.

Planning & Data Gaps

In order to improve aquatic habitats, there is a need to identify sections of the stream channel that are geomorphically unstable. The causes for instability should be determined and addressed before habitat enhancement projects are planned and implemented. In stream reaches with stable suburban or urban hydrologic regimes, identification of projects that restore natural channel and floodplain geometry should be pursued. PWD has recently begun the Poquessing Fluvial Geomorphology (FGM) Program. This study will provide critical information needed to identify potential sites for stream channel and habitat restoration. PWD will apply information collected during the geomorphology study and this Conservation Plan as a basis for a subsequent Watershed Management Plan. The study is scheduled to begin in summer 2007.

Fairmount Park Commission's Environment, Stewardship and Education Division (ES & ED), developed a master plan for Poquessing Creek Park. As part of the plan, NLREEP performed habitat assessments for the Poquessing Creek within the park, and to a certain extent, on adjoining and privately owned land. From these assessments a prioritized list of habitat restoration projects was developed and included in the plan. Both plans should be used as models for assessing habitat quality in the Poquessing Creek Watershed for natural lands and other land outside of Poquessing Creek Park. The list of recommendations should be prioritized, and based upon the financial costs associated with each restoration project and the expected improvements to the stream. Part of this prioritization process would include the identification of landowners who possess large, contiguous riparian land holdings in order to encourage those landowners to implement or permit restoration activities. Stretches of the Poquessing Creek that possess good quality stream habitat should also be identified and measurements should be taken to prevent degradation.

Habitat restoration plans should include riparian buffer restoration projects. These restoration projects will ultimately help to reduce economic losses and property damage resulting from streambank and channel instability and will benefit the ecological integrity of the stream as well as the quality of life for those living, working or visiting the creek.

Implementation

There are many positive actions that should be implemented to improve in-stream habitats and to restore aquatic communities. The removal of dams on the stream and restoration of degraded stream channels back to their natural condition are important objectives to restore longitudinal connectivity within the stream corridor. Implementing stream channel design projects, especially in areas experiencing geomorphic instability, will improve water quality and create habitat for native aquatic biological communities.

Riparian buffer restoration projects and removal of non-native plant species from the riparian corridor also play a role in restoring stream habitats. Fish and aquatic macro invertebrates rely on riparian vegetation as sources for food and cover. Native forested riparian vegetation is important due to its contribution to the stream energy cycle and the food web.

Monitoring Outcomes

The Philadelphia Water Department's five year bio-monitoring program, the PADEP's water quality assessment and volunteer monitoring efforts provide mechanisms for monitoring in-stream habitat conditions in the Poquessing Creek. Habitat and riparian land restoration projects should be monitored in order to gauge success or provide improvements in the areas of water quality and enhanced biodiversity. Restoration projects should be monitored for desired outcomes and revisited to determine the long term sustainability of these efforts.

A volunteer monitoring network should be established to assist with the evaluation of habitat restoration projects. Volunteers should be trained to evaluate improvements in habitat and stream system stability to provide long term data associated with the benefits and sustainability of restoration projects. Well trained and equipped volunteer monitors should collect additional water quality, stream morphology and habitat data. Volunteer monitoring programs should be established to ensure data quality control and to build an historical information base. Existing groups, such as the Friends of the Poquessing Creek, Delaware Riverkeepers, and Trout Unlimited have trained volunteer stream monitors. These groups can work with the professionals at PWD and community members to build a volunteer monitoring network.

Education

Habitat protection and enhancement projects serve as opportunities to engage and educate the public about beneficial land use practices and actions that may be applied to improve the watershed environment. A targeted education and outreach effort for streamside property owners and large parcel owners should be developed to provide benefits to habitats within the Poquessing Creek Watershed.

Education for municipal officials and developers should accompany efforts to restore stream habitats. The economic benefits of preserving natural stream corridors should be one focus of the educational program.

Goal 3: Improve In-Stream Flow Conditions

The density of development and the extent of associated impervious surfaces in the watershed have resulted in low base flow and generally flashy conditions. The primary causes of reduced stream base flow are large areas of developed land with high amounts of impervious surfaces that prevent rainwater from infiltrating soils and recharging groundwater aquifers and the diversion of stream waters for industrial use. Within the Poquessing Creek Watershed, even small storm events cause the stream level in the main stem and tributaries to rise quickly, often causing significant flooding in certain areas of the watershed. Creek "flashiness" reduces the amount of water available during dry, low flow periods and increases stormwater run off during storm events in-stream levels and stream water energy. Large fluctuations in stream flow are not natural and impact aquatic life, streambank and channel stability, water quality, transportation safety, and property damage.

Dams, bridges and culverts (e.g., obstructions) also affect stream flows. Dams prevent the natural flow of the stream and create impoundments that result in upstream sedimentation and downstream erosion. Impoundments contribute to water quality degradation and hamper fish passage. Bridges and culverts, especially if not sized correctly or replaced due to increased development, also restrict streamflow and contribute to flooding.

Improving stream flow conditions requires addressing both base flow issues, to provide water for aquatic organisms during dry times, and obstruction issues on the stream channel that exacerbate flooding and stream velocity conditions during times of elevated stream flow.

Planning & Data Gaps

Present in-stream flow conditions of the Poquessing Creek are the result of complex interactions between groundwater withdrawals, large areas of impervious surfaces, wastewater discharges, land development patterns, historic methods chosen for addressing stormwater runoff and a number of other factors. Understanding these interactions is necessary to address the negative impacts that have impaired the Poquessing Creek.

As illustrated in this plan, there are many methods currently recommended to address historic and existing land use development and its impacts on in-stream flow conditions. Again, the Poquessing Creek Watershed is in need of a comprehensive stormwater management plan (Act 167 Plan) particularly to promote infiltration of surface water into the ground. Local land use, subdivision and land development controls need to be

consistently developed and implemented to ensure proper bridge and stream crossings, stormwater controls, habitat protection and a number of other required design criterion associated with elevated stormwater flows (see Goal 1). The detailed hydrologic studies associated with the completion of a stormwater management plan are critical to the identification of the main causes of flow fluctuations and constrictions. Identifying and prioritizing these causes allows these issues to be addressed in order of their severity.

Monitoring Outcomes

Long term flow monitoring data is an important tool for analyzing a wide variety of water quality and physical stream characteristics. Existing USGS flow monitoring stations should be maintained to provide these data. Data from these stations may be used to track changes in stream flow conditions as additional measures are implemented to reduce stormwater runoff, increase stream base flow, and reduce flooding.

The placement of additional flow monitoring stations should be investigated as additional stations will capture flow fluctuations associated with increased development and management practices aimed at improving flow conditions. Potential locations for stream gauging sites would be at the mouth of Byberry Creek before the confluence with the Poquessing Creek, the Poquessing Creek just upstream of the confluence with Byberry Creek, and the Poquessing Creek just upstream of Route 1.

Education

There is a need for in-stream flow information to be made available to a variety of audiences within the Poquessing Creek Watershed. Additionally, there should be educational programs that focus on the relationships between habitat preservation, land use development patterns, stormwater runoff, water conservation and the quality of the Poquessing Creek. Agency personnel, municipal officials, and appointed commission members would benefit from educational efforts geared toward the relationships between these criteria and how they relate to federal and state regulations. A better understanding of these issues for municipal supervisors and staff would also encourage innovative municipal tools to improve the watershed environment beyond meeting minimum regulatory requirements.

Goal 4: Improve and Protect Water Quality of Ground and Surface Waters and Reduce Pollutant Loads

Improving water quality in the Poquessing Creek Watershed is largely tied to improvements made through better management of stormwater and land use throughout the watershed. A large portion of the watershed had been developed before regulations requiring water quality improvements to stormwater were implemented (pre NPDES Phase II regulations) or local regulations requiring stream buffer, wetland, and open space protection. These areas generally have stormwater regulations that control peak rates at which stormwater can be discharged and do not consider pollutant loads, water

quality or total volume of stormwater discharged. The areas were also developed after building on or in proximity to the floodplain, stream buffer, on filled wetlands, and do not contain protective open space areas. As a result, unmanaged stormwater flow causes erosion, transports pollutants to the stream and impacts water quality.

Improving water quality and reducing pollutant loads means a reduction in the amount of erosion and sedimentation directly from stormwater runoff, as well as a reduction in the amount of nutrients in nonpoint source pollution, particularly phosphorous which is a major cause of eutrophication in streams. These reductions will most likely be the result of a combination of effective education, improvement of stormwater BMPS (in existing and new development) and the development and implementation of land use and subdivision ordinances that require habitat and open space protection (see also Goal 1).

Planning & Data Gaps

As indicated in the first goal, an Act 167 Plan for the Poquessing Creek Watershed would encourage open space protection, initiate additional water quality research efforts, instigate inter-municipal cooperation regarding stormwater management, require improved stormwater BMP function, and result in minimum standards for stormwater management in new developments throughout the watershed. An Act 167 Plan would also develop the required hydrologic and flow models that could be applied to other watershed planning and modeling efforts recommended.

Long-term monitoring and maintenance plans for the watershed's new and existing stormwater BMPs should be required. An inventory of existing BMPs, which note the condition of the BMP and the responsible party for operation and maintenance, is a positive first step toward addressing the quality and function of stormwater management structures. Each new BMP installed in the watershed should have a routine maintenance schedule and have an identified, fiscally responsible entity to ensure that long term operation and maintenance plans are carried out.

Implementation

Improving water quality in the Poquessing Creek Watershed will require a reduction in point and Nonpoint Source (NPS) Pollutant loads. Point source pollutant loads can be reduced by the continued efforts of agencies with wastewater jurisdiction, land use and subdivision and land development ordinances (see Goal 1), and wastewater utilities. Point source pollutant loads can be reduced by utilities and enforcement agencies that identify and repair leaking sewer infrastructure, track and eliminate illegal cross connections between storm and sanitary sewers, and by ongoing efforts by the City of Philadelphia to implement the cross connection program initiated in 1995.

Developing and implementing a Total Maximum Daily Load (TMDL) program to reduce sediment and nutrient loading to the Poquessing Creek from both point and nonpoint source pollution is another critical step toward effectively improving water quality.

Reducing Nonpoint Source Pollution inputs will require implementation of an Act 167 stormwater plan, ensuring that regulations are incorporated into all ordinances and land and subdivision development regulations, ensuring that all land development plans be developed to ensure continued compliance with NPDES regulations, and educating the community about their role in protecting water resources and implementing better land and stormwater management practices.

Monitoring Outcomes

Targeted water quality monitoring programs that accompany BMPs in existing and retrofitted scenarios are necessary to gauge the best possible tools to address and also monitor water quality in the Poquessing Creek Watershed. Monitoring programs should be established to document the effects of stormwater BMPs and all other water quality projects.

Additional water quality data for the watershed is also needed to better target the sources of pollution. The Philadelphia Water Department monitoring program has provided a valuable water quality snap-shot of the watershed. Analyzing the water quality data collected, and tracing the path upstream should be performed to better characterize the sources of pollutant loading on the watershed and provide a more complete picture of water quality fluctuations in the Poquessing Creek and its tributaries.

Education

Within the watershed there are many educators in public and private schools that are interested in providing hands-on experiences for their students to learn about their local environment and ways that they can improve its condition. This can make learning more interesting as well as meet curriculum requirements.

Improvements in water quality will be the result of the encouragement and education of private and public landowners, developers and municipal officials to adhere to existing regulations and to go beyond those regulations and practice watershed stewardship. There are many resources to assist municipalities and landowners and to provide watershed education. In addition, education is a requirement and a positive component of the NPDES Phase II stormwater regulations.

Education efforts should be implemented cooperatively between watershed municipalities, the City of Philadelphia, schools and the myriad of active organizations. Cooperation will result in reduced costs and reach the greatest number of landowners. Benefits of an effective education program will not only meet regulatory requirements but will ultimately reduce nonpoint source pollution and improve residential, municipal and construction land use practices that continue to contribute to water quality degradation.

Goal 5: Improve and Protect Stream Corridors

Natural stream corridors with dense, native vegetation buffers are important to the health of the Poquessing Creek and the ecological community of the watershed. Riparian and floodplain land use management directly impacts water quality, in-stream flows, safety and economic issues associated with flooding, recreation, habitat, aesthetics and other factors. Stream corridor and floodplain protection is a major goal of the Poquessing Creek Watershed Rivers Conservation Plan.

Planning & Data Gaps

Portions of the Poquessing Creek and its tributaries are protected by a green corridor of private and publicly protected land. In 2000, Heritage Conservancy identified and mapped forested riparian buffers using high-level area photographs and video of helicopter flyovers and analyzed the forested riparian buffers of southeastern Pennsylvania. High-altitude aerial photographs (1" = 400' black-and-white) and videotape from helicopter overflights were used to determine the presence or absence of a forested buffer for 1,200 miles of stream. The forest buffer conditions were classified and digitized into a GIS map. The final report on the project was presented to municipal officials, local conservation groups, and members of the general public at workshops. In addition, the goal of extending the existing green corridor and enhancing trail connections and recreational uses is evident in the City of Philadelphia, and in county and municipal planning documents. Planning and data gaps within these goals should be addressed through the cooperation amongst supporters and landowners in corridor areas.

Although some information exists through the Fairmount Park / Natural Lands Trust and Heritage Conservancy efforts, a more comprehensive database and mapping effort of the current land owners, zoning, land uses, existing easements and extent of stream buffers would provide an excellent planning tool for targeting efforts to extend the greenway and protect the stream corridors. A list of landowners along the main stem of the Poquessing Creek was developed for this project with assistance from the Friends of the Poquessing Creek and might serve as a positive first step toward this effort.

Protection of existing stream corridors on public and private lands is also a critical component for promoting this goal. Natural areas, parks, and golf courses in the watershed would benefit from the creation of land management plans, especially for the riparian corridor, invasive species control and deer management.

Implementation

All of the studies mentioned above should be revisited and an action plan to conserve/restore riparian areas developed. Implementation of watershed wide greenways and the preservation of green riparian corridors on public and private lands is dependant upon successful outreach efforts to riparian landowners. Landowners should be encouraged to establish riparian buffers to improve water quality and habitat values.

Outreach efforts should include information on the mechanisms and financial benefits associated with the donation of conservation easements. There are several land trusts, as well as the Friends of the Poquessing Creek that are actively seeking conservation easements in the Poquessing Creek Watershed. These groups can assist with clarifying the definition of "greenway" and illustrating the benefits related to greenways and voluntary conservation easement donations.

Implementation of greenway protection will also require funding and more community support than presently offered. Some funds are available through county and municipal bonds. Funding will need to be matched by other sources to acquire land or voluntary easements on private land in key corridor areas. Negotiations with large institutional land owners for voluntary greenway trail easements will be more successful if presented by a watershed coalition that has the support of adjoining landowners.

Monitoring Outcomes

Successful stream corridor and greenway preservation can be accomplished through monitoring annual statistics. To a certain extent, the DVRPC, Fairmount Park Commission and the municipalities have monitored parcels preserved on a periodic basis. However, information on the entire corridor (corridor parcels protected as well as corridor parcels developed) is not being monitored and a coordinated effort for the entire Poquessing Creek Corridor is needed. Stream corridor preservation efforts should be periodically evaluated to determine the most effective methods of preservation, the economic impacts of stream corridor preservation and the remaining unpreserved critical linkages for trails, greenways and wildlife corridors.

Education

Educating riparian land owners and the general public about the benefits of natural stream corridor protection, greenway development and voluntary easements is necessary. Riparian landowners should be offered educational programs and information regarding the benefits associated with stream corridor protection and donation of voluntary conservation easements along stream corridors.

Educational programs should also be directed toward watershed municipalities and developers. These educational efforts should focus on existing regulations protecting riparian corridors, the need for strengthening local zoning and ordinances, encouraging the preservation of riparian corridors when protective ordinances are not in place, and stressing the importance of regional greenway protection.

Goal 6: Address Flooding

Reducing the amount and degree of flooding is associated with other goals such as improving stream flow conditions and protecting stream corridors. Reducing losses associated with flooding is directly related to passing stricter land use regulations, implementing effective stormwater management measures and preventing encroachments upon the creek's floodplains and riparian corridors. A primary recommendation of this plan, offered to reduce damage from flooding in the watershed, is to prevent future development within the mapped floodplains through regulatory and non-regulatory means which include passing stricter regulations, ensuring regulations are followed, purchasing flood-prone land, enhancing the greenway and enhancing educational efforts.

Planning & Data Gaps

Municipal land use and land development controls are effective tools for eliminating development in the floodplain and stream corridors, and preventing floodplain and stream corridor encroachment. Currently the City of Philadelphia and the three municipalities in the watershed have ordinances controlling development in the Federal Emergency Management Agency (FEMA) delineated 100-year floodplain. However, they do not all have consistent zoning, stream corridor protection ordinances, stormwater ordinances or active greenway/open space enhancement programs. Although Lower Southampton has made positive efforts, a more watershed-wide study of all zoning, projected development, protective ordinances, open space protection efforts, and flood prone areas is needed to determine baseline information associated with flooding (see Goal 1).

With regard to floodplain development and existing FEMA regulations, a careful review of existing and projected development and its cumulative effect on downstream watershed needs should be considered when floodplain encroachments are proposed. The Temple University study of floodplains in the Pennypack Creek Watershed is an on-going effort which will result in a remapping of FEMA floodplains to reflect the impact of suburban development on the hydrology of the watershed. The study also includes the identification of structures within the new floodplain boundary. This study might prove useful and have similar applications to the Poquessing Creek Watershed. A coordinated Act 167 Watershed Stormwater Management Plan could establish stormwater management criteria, develop flows for better floodplain delineation, and evaluate the potential for regional flood control facilities.

Government and private landowners should work with FEMA and the PA Emergency Management Agency to develop flood emergency plans that improve flood response measures and reduce the potential loss of life and property. Areas within municipalities and the City of Philadelphia that experience flooding should have established mechanisms to engage state and federal emergency management agencies to assist flood victims. These plans should also include the evaluation of flood frequency and location information to aid in decisions made regarding buy-outs of flood prone properties and other flood mitigation measures.

Implementation

As noted earlier, flooding is caused by a number of factors already addressed by the previous goals. Therefore, effective enforcement of existing regulations, creation of stricter regulations, completion of the suggested studies, identification of flood prone properties, removal of structures from the floodplain, and elimination of further development of floodplain areas are critical to reducing economic losses and addressing existing flooding issues in the watershed.

The reduction of economic and environmental damage from flooding within this watershed will require the mitigation of structural constrictions in the creek, the removal of structures in the floodplain and the prevention of future floodplain encroachment throughout the watershed.

Identifying undersized bridges and culverts on the creek and its tributaries and redesigning / retrofitting the structures that accommodate flood flows is recommended. Mitigation efforts can be implemented when the structures are undergoing replacement or repair. Another step is to prevent future constrictions of the stream by ensuring that future bridge crossings and culverts are designed and constructed properly to allow for the passage of flood flows.

Some ponding is problematic and can exacerbate flooding. However, not all ponding is negative. One example is that ponding behind undersized bridges and culverts can reduce flooding in the lower reaches of the watershed. Therefore, it is recommended that a criteria be developed to identify areas where ponding or flooding has no adverse effect, so that "mitigation" is not sought in these beneficial situations.

Monitoring Outcomes

Floodplain encroachments should be tracked and documented to evaluate the progress associated with implementing floodplain management strategies and protecting the watershed's floodplain. These monitoring efforts will provide information on the number of new floodplain encroachments as well as how effective existing floodplain regulations are enforced. The information can then be analyzed to gauge existing flood management efforts and improve them as needed.

Education

The City of Philadelphia and municipal officials, staff, commission members and engineering staff would benefit from educational efforts regarding better flood management and protection. Educational materials should include updated floodplain protection ordinances, floodplain best management techniques, proper enforcement measures, study findings, and best management practices. These educational materials should stress the cumulative effects of continued floodplain encroachments and should be shared and distributed.

Goal 7: Enhance and Improve Recreational Opportunities

The open areas and parks within the Poquessing Creek Watershed offer a variety of active and passive recreational opportunities which include community gardening, sports fields, trails, bird watching, fishing and recreational programming. The quality and enjoyment of some of these parks is directly related to access to the Creek and the perceived or actual physical condition of the Poquessing Creek. The Poquessing is impacted by trash, erosion and sedimentation, droughts, floods, illegal use of ATVs, algal blooms, odors and a variety of other issues. Enhancing recreational opportunities depends upon the protection of the stream and the stream corridor, through improved access to the creek and formal maintenance and enforcement programs.

Planning & Data Gaps

The City of Philadelphia, the municipal and private parks and recreation, and open space planning efforts should consider the cultural, recreational and educational values offered by the Poquessing Creek. The Poquessing Creek corridor and potential greenway linkages should be incorporated into public and private park planning efforts. All new developments should further the goal of protecting stream quality and incorporating watershed wide greenway recreational efforts.

Stream access needs and stream corridor and greenway linkages have been studied by Fairmount Park Commission for the Poquessing Creek Park as well as by those interested in developing the Northeast Trail. Individual studies have been completed for municipal parks and Benjamin Rush State Park as well. However, a watershed-wide study has not been completed for the entire Poquessing Creek Corridor. Additionally, municipalities should complete municipal park and recreation plans where they are non-existent.

In addition, a comprehensive, watershed-wide park and greenway plan that builds on linking existing efforts is recommended. The plan would include existing open space, identified open space acquisition areas, existing recreational features, existing trails, planned trails, significant environmental features, and existing recreational and historic amenities. This plan would benefit the existing efforts aimed towards developing a protective recreational greenway for this watershed.

Implementation

Implementation of municipal park and recreation plans is recommended. Additionally, the implementation of a recreational greenway study that involves the acquisition of key open space parcels to provide linkages between the economic, cultural, environmental, and historical resources of the watershed should be a priority for the Poquessing Creek Watershed. The development of intended parks, the continued maintenance and law enforcement at existing parks should take place. The development of programming geared towards the community should continue and evolve as new areas are added.

Monitoring Outcomes

Fairmount Park Commission, municipal, county, state, regional agencies and recreation associations maintain standards for recreational lands and open space. As the watershed becomes more developed, open space will continue to become more difficult to obtain, preserve and maintain. Gains in open space and park acquisition and protection should be tracked and monitored. A common protected land database should be developed for the watershed to gauge open space and recreational planning efforts.

Education

The Poquessing Creek Watershed is home to many unique natural, historical and recreational areas. There are also many individual recreational education groups and programs that link recreational, historic and natural amenities. However, the watershed would benefit from efforts to educate the public about the importance of these features and how they relate to the recreational opportunities that are associated with the Poquessing Creek. This would raise awareness about existing recreational opportunities and create an environment conducive to obtaining additional recreational amenities. Comprehensive recreational outreach materials should include information on existing findings for all parkland and park resources as well as new ones from the recommended watershed wide study.

Goal 8: Improve Stewardship, Communication and Coordination Among Watershed Stakeholders

This goal is largely directed at encouraging the coordination and cooperation among watershed stakeholders, sharing information to promote successful efforts to improve the watershed and maintaining the structure and momentum of the Rivers Conservation Plan process. Implementing projects and ideas that impact the entire watershed requires sharing of ideas and resources, especially since the watershed encompasses all or parts of four municipalities in three counties. Inter-municipal and inter-agency cooperation is especially important to improving this complex watershed.

Planning and Data Gaps

The Poquessing Creek Watershed would benefit from the formalization of the Poquessing Creek Partnership or other organizations charged with promoting Poquessing Creek issues, acting as a clearinghouse of information regarding the challenges and opportunities in the watershed. This organization should serve as a steering committee to assist in the coordination of on-going efforts to improve the watershed. There are many successful models for the creation of such an organization. It is important for the existing organization to evolve into a formal partnership that can lead the implementation of the Rivers Conservation Plan objectives and promote on-going cooperation and dialogue among watershed stakeholders.

Poquessing Creek Watershed stakeholders need to be identified when forming a watershed management organization. Many of the stakeholders in the watershed should have been identified previously in the formation of the Poquessing Creek Steering Committee for this Rivers Conservation Plan. Minority community leaders also need to be identified to increase participation in watershed planning efforts from all communities.

Implementation

This goal can be obtained through a myriad of education and outreach efforts. The principal vehicle for fostering cooperation and coordination of watershed protection efforts should be a watershed partnership. This partnership can take many forms but should serve as a clearinghouse of watershed information and provide support for watershed improvement efforts. A watershed partnership should foster cooperation among the many organizations and institutions working in the watershed and ultimately increase awareness of the Poquessing Creek.

Monitoring

Implementation of this Rivers Conservation Plan's objectives should be reevaluated in five years to monitor progress towards plan goals and to make adjustments to implementation actions to reflect changing watershed conditions.

Education

Watershed awareness and education efforts are important to maintain momentum and promote watershed improvement projects. There is a vast amount of valuable, existing information regarding watershed issues. The stakeholders of the Poquessing Creek need an accessible clearinghouse to obtain and share this information.

Municipal leaders, developers, grass roots organizations and community groups are among many of the important target audiences for educational efforts to improve the watershed and address outstanding watershed issues. These efforts need to be coordinated to reduce duplication of effort and to standardize the message being given to these groups.

Goal 9: Protect Significant Natural Features

As described in Section 6, the Poquessing Creek Watershed still contains the physical and biological remnants of a Coastal Plain system despite its high density of development. The flora and fauna characteristic of this physiographic province are evident in open space areas as well as on and around the developed and undeveloped parcels proximate to the Poquessing Creek itself and its surrounding watershed. The preservation, enhancement and management of the significant natural features of the Poquessing Creek Watershed are important in ensuring natural features within the watershed for future generations. When information was obtained, "significant" was defined as "threatened,

endangered or locally significant" and then predominantly for individual species or geologic features rather than larger, ecologically significant systems. The exceptions were studies completed by the Fairmount Park Commission, their selected consultants and the Bucks County Natural Resources Inventory.

Planning and Data Gaps

One of the biggest challenges of this project was the identification of sources where biological resource information was housed. As stated earlier, biological information inventoried on a watershed-basis is rarely housed in one location or obtained by one specific entity. In fact, information about significant natural features specific to this watershed was obtained from at least 10 organizations and it was rarely presented on a watershed basis.

As noted previously, natural resources protection plans have not been completed by all of the local governments within the watershed. Therefore, an inventory of the significant natural features and ecological systems within the Poquessing Creek Watershed is recommended. The effort would include agencies with jurisdiction, the municipalities, the City of Philadelphia and landowners. The inventory would augment the local database and would be completed/ presented on a watershed-wide basis using accepted scientific standards and methods. The study should contain an associated management plan with specific preservation, protection, management and restoration recommendations for the habitats and their associated species that were identified. Recommendations for habitat protection should also be included so that the numerous threatened and endangered species present in this watershed will not only continue to survive, but prosper.

Implementation

It is recommended that natural resources protection plans be completed by all of the local governments in the watershed in addition to the completion of a Poquessing Creek Watershed Natural Resources Protection Plan. Implementation of this recommendation requires funding, the selection of a lead group to obtain funding and manage the project, as well as the cooperation of a variety of government and non-government organizations, landowners and scientists. It is recommended that the Poquessing Creek Steering Committee and the Friends of the Poquessing implement this watershed-wide study effort.

Monitoring Outcomes

The success of the study effort and the implementation of the study recommendations should be monitored by the managing group (e.g., Poquessing Creek Steering Committee, Friends of the Poquessing, etc). A successful outcome would be the completion of this study, distribution of findings and the associated management plan to jurisdictional organizations (e.g., PNDI, Fish and Wildlife, and local governments and community

groups). Incorporation of findings into local regulations should also be monitored. In addition, increased habitat acquisition, increased protection efforts, species survival and the removal of individual threatened and endangered species from state and federal lists would indicate successful implementation of this effort as well as protection of supportive habitats.

Education

Education is required to initiate the watershed-based natural resources inventory and protection project, to inform the public about the existing natural features and to ensure that information about project findings is distributed. First, local governments need to be aware of the importance of completing natural resources inventories and incorporating resulting information into local policies and land development regulations. Educational efforts focused on data gaps and the importance of completing a watershed-based inventory would also be helpful in order to obtain support for the project. Finally, educational materials focused on the project during the project duration and the specific findings (e.g., lack of habitat, existence of threatened and endangered species, recommendations for enhanced protection) should be distributed to ensure continued interest in protecting significant natural features and to obtain regulatory assurances that existing features are not negatively impacted by unsound land development practices.

Goal 10: Protect Significant Historic & Cultural Features

As illustrated in Section 7, despite the abundance of historic and cultural attributes in the Poquessing Creek Watershed, formal protection of historic districts and buildings is not taking place on a wide scale. Evidence of this can be seen in the fact that only four (4) sites within the watershed are nationally listed and only a handful are on the state list in the entire watershed.

The goal to preserve, enhance and manage the historic and cultural features is imperative to this watershed because it is comprised of features associated with historic Philadelphia and a Native American legacy.

Planning and Data Gaps

Similar to the planning and data gaps listed for significant natural resources and ecological systems, the identification of the number of historic features was difficult because historic and archeological data are generally not inventoried on a watershed basis, located in one place or obtained by one entity. The exception was the on-line information for historically-listed sites maintained by the Pennsylvania Historic Museum Commission's Cultural Resources Geographic Information System (CRGIS). Although watershed based information was presented for historic sites, it was not presented for archeologically significant sites. In addition, several watersheds were often grouped together, which made determining sites for only the Poquessing difficult.

As noted previously, historic preservation protection plans have not been completed by the local governments within the watershed. Therefore, an inventory of significant historic sites, historic districts, archeological sites and significant Native American sites for Poquessing Creek Watershed is recommended. The effort would include agencies with jurisdiction, the municipalities, the City of Philadelphia, landowners, Native American organizations and others. The historic inventory would be completed using accepted methodology to augment and improve existing information. The study should contain an associated management plan with specific historic and cultural preservation, protection, management and restoration recommendations for identified sites. Recommendations for historic protection should be included so that the numerous sites remaining unstudied could be inventoried and hopefully protected.

Implementation

It is recommended that historic and cultural inventory and protection plans be completed by all of the local governments in the watershed and that a Poquessing Creek Watershed Historic and Cultural Protection Plan be completed. Implementation of this recommendation requires funding, the selection of a lead group to obtain funding and manage the project as well as the cooperation of a variety of government and non-government organizations, historic and cultural preservationists, Native American Groups and local landowners. It is recommended that the Poquessing Creek Watershed Association coordinate with jurisdictional agencies and pursue implementing this watershed-wide study effort.

Monitoring Outcomes

The success of the study effort and the implementation of study recommendations should be monitored by the managing group (e.g., Poquessing Watershed Partnership (Steering Committee) jurisdictional agencies and organizations). A successful outcome would be the completion of this project effort and distribution of findings and the associated management plan to all pertinent organizations (e.g., NPS, PHMC, historic conservancy groups). Incorporation of findings into local regulations should be monitored. In addition, increased historic site acquisition, increased protection efforts, and the number of additional sites added to federal, state and local lists would indicate successful implementation of this effort.

Education

Educational efforts aimed at initiating interest in the completion of a watershed-based historic preservation plan are important. Educational efforts about the inventory and protection project and that are geared towards informing the public about existing historic and archeological sites is also important.

Again, there is a lack of study information at the local level. Therefore local governments need to be aware of the importance of completing historic inventories and incorporating their findings into local policies and land development regulations.

All developed educational materials should focus on the importance of studying sites and placing them on historic registries, as well as the importance of an archeological study before an area is developed.

Goal 11: Initiate Sustainable Development on a Watershed Level

Sustainable development implies a broad view of human welfare, a long-term perspective about the consequences of today's activities, and applies a more global cooperative view on attaining viable solutions. Put more simply the question of how the needs of today can be met without diminishing the capacity of future generations to meet the needs of tomorrow when considering development needs to be asked.

One answer is to encourage economic activities based on little or no impact to the unique natural, historic, cultural and recreational resources of the Poquessing Creek Watershed, and to ensure that economic activities remain compatible with and even enhance those valuable resources. One key to balancing the competing demands for the finite quantity of land available in the watershed is to minimize the loss of remaining open space land to development, maintain the vitality and viability of town centers (e.g., people living close to where they work), and redevelop vacant or under-utilized land. Therefore, an important and future-oriented goal suggested by project committee members is to foster the sustainable economic development within the Poquessing Creek Watershed.

Planning and Data Gaps

Making sustainable development decisions may only take place with adequate information or the data (also known as sustainable development indicators) commonly used to measure the short-term, long-term and cumulative impacts of our economic activities upon the environment or a geographic area. In this case, the geographic area requiring environmental or sustainable development indicators would be the 22 square mile Poquessing Creek Watershed. Sustainable development indicators measure sustainability or sustainable development performance in a given region. According to the United Nations (UN) Commission on Sustainable Development, the UN Department for Policy Coordination and Sustainable Development and more local organizations, indicators such as technical, social, financial, institutional, environmental and economic analyses attempt to measure:

- The pressure that land development trends place on the watershed environment (e.g., pollution and open space depletion),
- The resulting state of the watershed environment due to those incurred changes (e.g., lack of open space, flooding, inability to reach state water quality standards etc.) compared to a more desirable scenario, and

- The response to those impacts by existing jurisdictional governments, agencies and others (e.g., increased protective regulations, restoration efforts etc).

In June 2003, the EPA published its first ever national Draft Report on the Environment (ROE), using available indicators and data to answer questions pertaining to national environmental and human health conditions. It was developed as the first step in the Environmental Indicators Initiative. Two companion documents were published, the 2003 Draft Report on the Environment Public Report, and the 2003 Draft Report on the Environment Technical Document. These documents utilized indicators, which are numerical values derived from actual measurements of a pressure, state or ambient condition, exposure, or human health or ecological condition, over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment that are used to describe current conditions, trends, and data gaps.

Examples of EPA accepted environmental indicators were:

- Cleaner Air: Impacts of indoor air quality on human health and of outdoor air quality on health and ecosystems (e.g., particulates, sulfur dioxide, volatile organic compounds etc.).
- Purer Water: Drinking water, recreational water use, the condition of the water resources and the living resources sustained by them (condition of wetlands, urban land cover, stream flow changes, sedimentation, drinking water quality).
- Better Protected Land: Land use and activities that affect the condition of the watershed, including information on agricultural practices, Integrated Pesticide Management, waste management, emergency response and preparedness, and recycling (e.g., extent of development, presence of toxic waste, extent of woodlands, waste generation, population density).
- Human Health: Trends in diseases, human exposure to environmental pollutants and diseases thought to be related to environmental pollution (e.g., presence of certain types of waste, extent of pesticide residues, prevalence of disease, mortality rates, and birth defects).
- Ecological Condition: Trends and impacts to living and natural resources, current pressures or stressors on these resources and a look at their sustainability into the future (health and stability of natural systems, extent of urban and industrial land cover, health of freshwater systems).

For the most part, this type of formalized data is not available in one location nor is it presented on a watershed basis. For the most part, this information is not available for all locations to help individuals and key land use decision-makers within the watershed. Decision-makers must therefore continue to determine incompatible land uses, proper disposal of waste, expected health impacts and other potential impacts. They must continue to apply protective land management recommendations on a case-by-case basis, and do their best to encourage the use, development and redevelopment of land in a way that will support more sustainable growth. Therefore we recommend all previously

recommended goals be implemented throughout the watershed until a more comprehensive database is completed and made available to all decision-makers. In the future, a key recommendation is to develop EPA sustainable development indicators for the Poquessing Creek Watershed, so that land use decisions may prove more sustainable.

Implementation

Recommendations for developing and implementing more sustainable land development policies and protective regulations were previously provided (see all other goals). The development and implementation of a more comprehensive sustainable development database (e.g., developing baseline information and sustainable development indicators) will be even more challenging.

The lack of environmental indicators should be addressed because there is currently a lack of sufficient information to provide the basis for more sustainable development decisions. An important next step will be to require one entity (most likely EPA Region III) to work closely with other federal agencies, states (PADEP), local governments, non-governmental organizations, and the private sector organizations to create a long-term strategy for developing an integrated system of local, regional, and national indicators.

This work will involve a number of challenges, including the development of better data to create indicators that are more understandable and usable, as well as learning more about the linkage between the cause and effect relationship between environmental pollution and its stressors.

Monitoring Outcomes

As better data is developed by the environmental agencies in the region, the goals and implementation measures previously recommended will all apply to making better sustainable development decisions. In the interim, outcome monitoring recommendations previously suggested will assist with gauging implementation measures and their outcomes.

Education

In 1987, sustainable development was defined within the Bruntland Report. This report, also known as "Our Common Future" (Oxford University Press, 1987), alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment. Published by an international group of politicians that were comprised of civil servants and experts on the environment and development, the report provided a key statement on sustainable development, and defined it as: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The Brundtland Report addressed how to secure global equity, redistribute resources towards poorer nations, while encouraging their economic growth. The report suggested that equity, growth and environmental maintenance are simultaneously possible and that we are capable of enhancing our resource base and achieving our full economic potential. The report also noted that achieving this equity and sustainable growth would require technological and social change.

The report highlighted several fundamental components of sustainable development: environmental protection, economic growth and social equity. The philosophy was that the environment should be conserved and our resource base enhanced; however, society had to gradually change the ways in which we develop and use technologies.

In the last two decades this definition has been incorporated into public and private mission statements (business management as well as environmental management). Sustainable development concepts are now found in local municipal plans and school curriculums. It is therefore recommended that sustainable development concepts be applied to the Poquessing Creek and that the Poquessing Creek Steering Committee members work toward incorporating sustainability concepts into all subsequent educational efforts generated in the previous goals.

Goal 12: Initiate Capital Improvements for Watershed Protection

A comprehensive list of projects associated with the previous goals has been generated. However, every regulatory and non-regulatory recommendation has an associated financial cost whether it is direct cash funding or performed as an in-kind service from the organizations involved in the Poquessing Creek Watershed. Each recommendation was carefully formulated to address the identified preservation, management and restoration needs to improve the health of the Poquessing Creek and surrounding watershed. Therefore, the goal to initiate capital improvements is imperative.

Planning and Data Gaps & Implementation

The planning and data gaps and the recommended projects to address those gaps were identified in the previous goals. With regard to the required capital and in-kind funding needed to complete each goal, a variety of funding opportunities exist, some of which are provided in Appendix A.2. The Poquessing Creek Steering Committee members should strive toward implementing a combination of capital improvements methods. These methods would include federal and state grants, grant funding obtained by partnering organizations, foundation funding, private fund raising efforts, outright donations and the utilization of the professionals currently employed by the organizations active in implementing the Poquessing Creek Watershed Rivers Conservation Plan.

The Poquessing Creek Steering Committee and the members and partners that support the Committee should work together to create a work plan for funding to secure the capital required to implement the recommended plans, studies and projects. All

recommendations and issue areas should be included in the work plan as well as a hierarchy of the projects slotted for completion. Once listed on the Rivers Registry, the projects will be eligible for funding and should be pursued immediately after being placed on the Registry. The timeline information associated with each recommendation and included in the work plan/matrix is a great starting point for the Committee's work plan.

Monitoring Outcomes

Although fundraising efforts should be on-going, the Poquessing Creek Steering Committee and its member organizations should revisit the project list and gauge funding successes at least once a year. Adding funding opportunities is important because new programs and funding opportunities are made available every year and new grant cycles are often reinstated on a yearly basis. Successful implementation of this goal may be measured by the number of projects garnering successful funding and the number of projects completed throughout the watershed.

Education

A capital improvements program should involve an educational component. For instance the PADCNR will know, upon reviewing this plan, what is needed to improve the condition of the Poquessing Creek Watershed, but others will not be as knowledgeable. Therefore an overview of the project and a list of specific recommendations should be circulated to all potential funding organizations. This proactive educational effort will ensure that organizations with funding know that the Steering Committee and its organizational members are involved in an active fundraising effort.

The issues, actions, locations, partners, and timeline associated with each RCP goal are summarized in the following matrix.

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 1. Establish Comprehensive Watershed-based Planning and Protective Regulations				
Planning & Data Gaps	• Develop watershed-based Master Plans, Act 167 Plan, Comprehensive Plans, Community Plans, Zoning Ordinances, Recreation Plans, Natural Resources and Historic Resources Inventory and Protection Plans, and Functional Plans where non-existent	Act 167 Plan - watershed-wide; Parkwood Community Plan - NE Philadelphia; Comp. Plan and Rec. Plan - Lower Moreland; NRI and Historic Protection Plans - Lower Moreland, Lower Southampton, and Bensalem	PWD, Counties, Municipalities, Organizations	• 2007-2009
Implementation	• Promote the development of intermodal transportation, interregional transportation systems, park and ride facilities, and regional transit centers • Develop and enhance connections with existing and new developments • Promote inter-municipal reviews of development plans • Implement watershed-based Master Plans, Act 167 Plan, Comprehensive Plans, Community Plans, Zoning Ordinances, Recreation Plans, Natural Resources and Historic Resources Inventory and Protection Plans, and Functional Plans where non-existent • Assist municipalities in the preparation and adoption of land development regulations allowing more efficient use of transit services	Watershed-wide	PWD, Counties, Municipalities, Organizations, Elected Officials, Paid Staff, Municipal Engineers & Planners, Appointed Committee & Commission Members	• 2007-2009
Monitoring	• Continue to monitor the creation and implementation of plans	Watershed-wide	PWD, Counties, Municipalities, Organizations, DVRPC, Pennsylvania Planning Association, Local Govt. Planners & Engineers (e.g. Planning Commissions, Environmental Advisory Commissions, Zoning Hearing Board Officers)	• 2007-2009
Education	• Educate the public and private organizations and individuals on the benefits of watershed based planning • Create watershed based planning and regulatory materials geared to planning and regulatory gaps within the watershed • Create a clearinghouse of existing information	Watershed-wide	PWD, Counties, Municipalities, Organizations, Poquessing Creek Steering Committee, Friends of Poquessing Creek, Public and Private School Educators, Students, Parents, Large and Small Landowners, Elected Officials, Agency Representatives	• 2007-2009

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix				
Issues and Concerns	**Conservation Action**	**Specific Locations**	**Primary Partners**	**Project Implementation**
Goal 2. Improve Stream Habitat, Protect Aquatic Resources, and Restore Aquatic Communities				
Planning & Data Gaps	• Develop Comprehensive stream bank and Stream channel stability assessment • Develop riparian restoration project list • Incorporate findings from existing habitat assessments (e.g. Fairmount Park Master Plan, NLREEP Asessment • Adopt consistent natural resource protection ordinances for all watershed municipalities	To be identified in PWD FGM study	PWD, Bucks & Montco municipalities, FPC	• 2007-2008
Implementation	• Daylight buried and piped stream channels where feasible • Preserve streams that are currently in good health and restore/rehabilitate degraded streams by counteracting the effects of urbanization on aquatic systems • Remove dams • Restore degraded stream channels and implement stream channel design projects • Remove non-native plant species from riparian corridor and plan native riparian vegetation • Reduce and try to eliminate bank erosion problems • Restore geomorphic stability through active channel restoration	Area where the Bensalem Country Club abuts the Poquessing Creek	PWD, Bucks & Montco municipalities	• 2007-2008
Monitoring	• Establish volunteer monitoring network • Monitor & revisit all restoration projects on a consistent basis • Continue PWD's Bio-monitoring program • Monitor successes of habitat and species restoration efforts through agencies, volunteers and non-profit organizations	Watershed-wide	DRKN, FoP, FPC, PAFBC, PWD, TU	• On-going
Education	• Involve public & land owners in habitat protection & enhancement projects • Targeted outreach efforts to streamside landowners • Educate municipal officials on stream habitat restoration • Work with PA DOT and municipalities to ensure proper bridge and culvert design for new and redevelopment	Watershed-wide	DVRC, Municipalities, PA DOT, BTEAB, PWD, Landowners	• 2008-2009

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 3. Improve In-stream Flow Conditions				
Planning & Data Gaps	• Create enforcement of municipal stormwater groundwater surface water ordinances • Identify and prioritize areas where debris in stream impedes normal and storm flow • Complete Act 167 Stormwater Plan, which will include a detailed hydrologic study • Identify and prioritize stormwater BMPs for retrofits and new construction that promote infiltration and reduce stream flow variation during storm events	Watershed-wide	PWD, Counties, Municipalities	• 2007
Implementation	• Encourage all landowners to implement porous pavement, infiltration trench and other on-site infiltration projects • Retrofit stormwater BMPs for biological water treatment and longer detention times	Watershed-wide; Word of Life Church, E. Street Rd., Feasterville Brunswick Zone Stormwater Detention Basin, E. Street Rd., Feasterville	TU, PAFBC, Municipalities, LSTEAC, BTEAB, PWD	• 2007-2008
Monitoring	• Maintain existing USGS station • Establish additional flow monitoring stations on the creek	Watershed-wide	PWD, Counties, Municipalities	• On-going
Education	• Work with county conservation districts and municipal EACs to implement rain barrel, rain garden, green roof and other Stormwater Best Management Practices (BMP) workshops • Create educational programs that focus on relationships between habitat preservation, land use development patterns, stormwater runoff, water conservation & creek flow & quality • Create regulatory workshops for agency personnel and municipal officials and staff • Develop and present stormwater management workshops for homeowners, builders, municipal officials, etc. • Partner with landowners on innovative stormwater BMPs outreach program	Watershed-wide	CCD, Municipalities, PWD, Landowners	• On-going

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 4. Improve and Protect Quality of Ground and Surface Waters and Reduce Pollutant Loads				
Planning & Data Gaps	• Adopt and implement NPDES Phase II Regulations • Develop Act 167 stormwater management plan • Collect fecal coliform monitoring data to characterize sources of coliform, including wet weather sampling • Perform a full point and non-point source assessment of the streams • Develop BMP database, including location, ownership and maintenance needs • Develop headwater protection ordinance to assist municipalities with protection of headwater streams	Watershed-wide	PWD, Counties, Municipalities	• 2007
Implementation	• Institute stormwater BMP maintenance and monitoring program • Promote soil conservation practices to sustain productive capability and reduce erosion and sedimentation • Continue storm drain sewer program • Continue project that addresses manholes and develops manhole discharge practices • Coordinate with PennDOT and the PA Turnpike Commission and reduce roadway runoff and manage non-point source controls • Implement Act 167 Stormwater Plan • Continue compliance with NPDES regulation • Reduce point source and NPS pollutant loads • Eliminate illegal cross-connections • Repair leaking sewer infrastructure • Develop and implement TMDL program	Watershed-wide	CPC, Municipalities, PWD, wastewater utilities, PADEP, PennDOT	• On-going
Monitoring	• Implement aggressive monitoring program to track sewer infrastructure leaks and illegal cross connections • Encourage the identification and remediation of groundwater or surface water contamination areas • Promote the correction of malfunctioning community and on-lot wastewater treatment systems • Encourage the enactment and enforcement of comprehensive industrial wastewater pretreatment ordinances for all municipal sewer systems • Conduct additional water quality monitoring on the watershed to characterize pollutant loading sources • Develop long term monitoring and maintenance plans for new and existing stormwater BMPs in the watershed • Advocate the development of municipal management programs for on-lot disposal systems • Continue PWD monitoring program • Monitor water quality changes in BMP retrofits	Watershed-wide	CHD, DRKN, Municipalities, PWD, Utilities	• 2008-2010
Education	• Advocate and educate public on the environmentally sound handling and disposal of septage • Educate all landowners on NPDES Phase II stormwater regulations • Develop homeowner's manual for landowners in headwaters to improve water quality • Develop BMP demonstration Sites map and informational material for municipalities and developers	Watershed-wide	CPC, CCD, DRKN, Municipalities, PWD, Educators, Students, Parents, Landowners	• 2008

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 5. Improve and Protect Stream Corridors				
Planning & Data Gaps	• Develop watershed wide open space/ riparian corridor protection plan • Complete forested riparian buffer photographing for Poquessing Creek database • Create stream corridor management plans on large parcels (e.g. corridor, invasive species, deer management) • Create inventory database of riparian landowners to be used for outreach and education and research	Watershed-wide	FPC, CPC, CPD, NLT, PEC, Municipalities, Large Landowners, Heritage Conservancy	• On-going
Implementation	• Identify, encourage, and partner riparian landowners to apply for grants to promote better riparian management. • Actively remove non-native invasive plant species from riparian areas and restore riparian habitats by revegetating with native plant species	Area of the Poquessing behind the Woodhaven Mall Forested area of the Poquessing near Betz Laboratories	CCD, FPC, PAFBC, PWD, Landowners	
Monitoring	• Track progress for riparian restoration projects • Track annual statistics of open space acquired, easements donated and acres of land preserved in a common database	Forested area of the Poquessing below the railroad	GSA, CPC	• On-going
Education	• Conduct landowner outreach and education programs to promote better riparian land management • Educational programs directed towards developers and municipalities, focusing on regulations protecting riparian corridors, and the need for strengthening local zoning and ordinances • Hold workshop for golf courses, homeowners, corporations and apartment building managers and other large riparian landowners on stream and riparian management	Local golf courses, neighborhoods, and corporations.	CCD, CPC, Municipalities, PEMA, FoP	• Immediately

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 6. Address Flooding				
Planning & Data Gaps	• Update flood emergency management plans and maps • Promote compliance with Pennsylvania Floodplain Management Act, National Flood Insurance Program • Develop Act 167 Plan • Develop a watershed-wide study of all zoning, projected development, protective ordinances, open space protection efforts ,and flood prone areas • Work with PEMA and FEMA to develop mechanism for the removal or reconfiguration of log and woody debris jams to reduce erosion and flooding	Watershed-wide	PWD, Counties, FEMA, Municipalities, PEMA, Landowners	• Immediately
Implementation	• Buy out flood prone structures/properties to promote green river corridors • Limit flood plain development and enforce existing floodplain regulations • Promote the maximum use of stormwater runoff as a water resource, particularly as it relates to groundwater recharge • Enforce floodplain protection ordinances Design adequate bridge crossings and culverts • Mitigate structural constructions on creek (e.g. bridges, culverts) • Actively oppose variances that allow development in the floodplain	Watershed-wide	FEMA, Municipalities, PEMA, PA DOT	• On-going
Monitoring	• Track permitted floodplain encroachments and variances granted to allow development in the floodplain	Watershed-wide	CPC, Municipalities	• 2008
Education	• Hold BMP Workshop for owners of steep slopes • Develop materials stressing cumulative effects of floodplain development • Create clearinghouse of municipal information for repairing flood damage, protecting floodplains and floodplain BMPs	Watershed-wide	CPC, PEMA	• 2008

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 7. Enhance and Improve Recreational Opportunities				
Planning & Data Gaps	• Develop maintenance and management plans for existing recreational facilities and open spaces • Identify opportunities to improve stream access, especially in upper watershed where connection to stream is lost • Develop Park and Recreation plans for municipalities that currently do not have them • Promote recreational development that compliments the natural features without negatively impacting existing resources • Research the acquisition of natural features near existing public parks and recreation areas to enhance the existing park or area • Update recreation plans to include all identified greenway linkages (e.g. Fairmount Park Master Plan) • Develop comprehensive watershed-wide park and greenway plan • Completion of the development of Benjamin Rush State Park according to the plan proposed by the City of Philadelphia • Investigate opportunities for new active and passive recreational facilities in the watershed • Update recreation plans to reflect demographic change	Watershed-wide	CPC, CPRD, FPC, GSA, Municipalities, PDR, PWD, FPC NE Trail Group	• 2008-2011
Implementation	• Partner with property owners to discuss the implementation of trail connections. • Continue recreational upgrades and maintenance Implement watershed-wide greenway study • Conduct regular trail maintenance activities • Bicycle and inter-municipal connections/regional trails along stream corridors (esp. in park areas) • Use PECO ROW corridor to connect Pennypack trail to Poquessing - Rhawn St. through Pennypack park to Poquessing Creek; proposed development of a bike/ pedestrian trail along the CSX railroad right-of-way in the PECO corridor • Recreational goals should complement green preservation goals - target redevelopment for opportunities • Implement the trail network master plans, municipal park & recreation plans • Enforce laws against illegal ATV use • Advocate a watershed-wide and linked greenway park system and an interconnected system of open space and trails including continuous parkland along the Poquessing Creek connected through the various parks and open space areas within the watershed • Create a trail system using the Richelieu Road Bridge as a pedestrian walkway connecting the State Park to the proposed trail system • Develop an inter-county recreational/ trail plan to tie the different governmental factions in the stream corridor together	Watershed-wide	CPC, CPRD, FPC, GSA, Municipalities, SEPTA, PDR	• On-going
Monitoring	• Develop protected land database • Continue surveys to gauge public interest in proposed trail networks	Watershed-wide	GSA, CPC	• 2006
Education	• Market watershed's recreational amenities through development of brochures, maps and other educational materials • Work with and educate property owners when designing public trails to protect private property encroachments - no forcible easements • Educate public on the environment, history and use of the Poquessing Creek Park and the Fairmount Park System • Implement program similar to National Institute of Health, educating people about health benefits of walking, running and bike riding in a natural setting	Watershed-wide	CPC, CDC, CPRD, FPC, Municipalities, PDR	• On-going

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix				
Issues and Concerns	**Conservation Action**	**Specific Locations**	**Primary Partners**	**Project Implementation**
Goal 8. Improve Stewardship, Communication and Coordination Among Watershed Stakeholders and Residents				
Planning & Data Gaps	• Formalize Poquessing watershed committee • Incorporate and/or point to complementary goals already identified in municipal open space plans and Fairmount Park Master Plan • Create a watershed information clearinghouse or website that promotes and coordinates stewardship activities	Watershed-wide	CPC, FPC, BTEAB, PWD	• 2007-2008 & Ongoing
Implementation	• Conduct regular stream clean-ups • Conduct series of surveys and public outreach events to evaluate success of River Conservation Plan implementation projects • Partner with all of the municipalities in the watershed and make decisions jointly • Connect with the efforts of adjoining watersheds • Hold annual event to promote watershed issues	Watershed-wide	PWD, Partners	• On-going
Monitoring	• Review accomplishments of River Conservation Plan • Conduct series of surveys and public outreach events to evaluate success of River Conservation Plan implementation projects	Watershed-wide	CPC, CCD, GSA, PWD, BTEAB, PPSC	• On-going
Education	• Develop and distribute education materials • Hold workshops to reduce municipal miscommunication and promote regional planning • Develop a small scale map, brochure, or tour booklet to educate populace about watershed and reconnect headwater communities to the stream • Create and implement accredited stewardship program or watershed-based curriculum (i.e. Friends of Poquessing Curriculum) for schools and residents that meets state education standards - teach watershed resource identification and protection methods and encourage programs such as adopt a stream • Implement education program for residents about location, function and value of streams in their communities • Establish a Poquessing Environmental Center • Create recognition program such as municipal ecology awards to promote environmental stewardship and good ordinance development • Implement environmental education and program outreach to minority and religious groups • Create linkages through partnerships, etc. with private properties and local neighborhoods, etc. • Field trips to SW BMP sites and environmentally friendly golf courses, which would include educating the students on the environment and the golf course business • More TV shows, movie theater films, documentaries, and commercials that educate people on conservation/ environmental issues • Promote direct inter-municipal reviews of development plans affecting adjacent downstream communities	Watershed-wide, Bensalem Country Club	CPC, CCD, WD, BTEAB	• On-going

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix				
Issues and Concerns	**Conservation Action**	**Specific Locations**	**Primary Partners**	**Project Implementation**
Goal 9. Protect Significant Natural Features				
Planning & Data Gaps	• Develop and implement deer management plans for natural areas • Develop watershed wide natural resources inventory • Develop species (esp. invasive species) management plans for natural areas and parks • Address overpopulation of Canada Geese, especially near Race Track • Adopt woodland protection ordinances, in watershed municipalities, that limit removal of existing vegetation and update standards for tree replacement with species that were removed from the development site • Develop tree protection standards to be used by municipalities to protect existing trees and woodlands on present and future development sites	Watershed-wide	FPC, CPC, CPD, NLT, PEC, Municipalities	• On-going
Implementation	• Improve upstream/downstream connectivity by protecting existing green corridors and promote new green corridors through volunteer easements, land acquisition and donations • Work with landowners and developers to protect the open space along the Poquessing Creek • Restore the composition and structure of vegetation native to the parks and open space areas within the watershed in order to establish self-sustaining ecological communities • Name unnamed tributaries in the watershed • Designate, acquire and manage all significant natural features to maintain and enhance environmental, scenic, recreational and economic value • Maintain the integrity of rural areas by limiting development and the extension of public infrastructure and services • Improve upstream/downstream connectivity by protecting existing green corridors and promote new green corridors through volunteer easements, land acquisition and donations • Acquire additional community open space • Maximize the preservation and conservation of agricultural preservation areas, natural resources areas, park and recreational areas, and sites of outstanding historic or scenic interest • Review municipal ordinances and enforcement records with respect to landscape recommendations and the use of native species on development sites.	Watershed-wide	CCD, FPC, PAFBC, PWD, LSTEAC	• 2009-2011
Monitoring	• Plan for environmentally safe storage, transport, processing and disposal of "special" wastes (residual, sludge, hazardous, toxic, infectious and chemotherapeutic waste) • Monitor successes of habitat and species restoration efforts through agencies, volunteers and non-profit organizations	Watershed-wide	PWD, DEP	• 2007
Education	• Develop and distribute a model native plant and trees species list for municipal use • Educate municipal officials on the importance of completing a NRIS • Develop and implement a non-native plant management and education program to enhance existing natural resource value through effective park maintenance practices • Present open space preservation education programs	Watershed-wide	PWD, DEP	•

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 10. Protect Significant Historic and Cultural Features				
Planning & Data Gaps	• Promote land use methods that help to retain and enhance the character of historic buildings, historic districts and historic villages • Develop watershed-wide historical & cultural features inventory, plan & database	Watershed-wide	Agencies with jurisdiction, Municipalities, City of Philadelphia, landowners, Native American organizations, Poquessing Creek WSA	• On-going
Implementation	• Protect and identify historic and cultural resources - adaptive reuse of historic structures and preservation of important habitats associated with historic structures • When developing in the future, create gentle slopes instead of steep slopes for easier access to the creek • Promote land use methods that help to retain and enhance the character of historic buildings, historic districts and historic villages • Encourage the study and addition of more historic sites and regions to the applicable registries	Watershed-wide	Municipalities, City of Philadelphia, landowners, Native American organizations	• On-going
Monitoring	• Continue to assess features that warrant protection	Watershed-wide	Municipalities, City of Philadelphia, Native American organizations	• On-going
Education	• Distribute a Historic and Cultural Protection Plan	Watershed-wide	Municipalities, City of Philadelphia, Native American organizations	• On-going

Table 1 Poquessing Creek River Watershed Conservation Plan Management Option Matrix				
Issues and Concerns	**Conservation Action**	**Specific Locations**	**Primary Partners**	**Project Implementation**
Goal 11. Initiate Sustainable Economic Development on a Watershed Level				
Planning & Data Gaps	• Develop environmental/ sustainable development indicators for watershed	Watershed-wide	All partners	• 2007
Implementation	• Target municipalities, developers, etc. for education programs and encourage green building practices • Promote land development practices which minimize the amount of impervious surfaces • Advocate economic development on brownfields sites with environmentally friendly building practices • Create long-term strategy for developing and implementing environmental/ sustainable indicators project • Minimize stormwater runoff impacts created by new development by requiring the use of the most efficient, beneficial and environmentally sound (on-site) BMP's • Encourage measure to reduce demands for water supply • Discourage expansions of public sewer services beyond development areas where other infrastructure cannot or should not be extended • Advocate the use of innovative and alternative wastewater systems outside of development districts provided that the systems are part of an integrated management plan • Encourage water conservation devices in all new structures and incentives for implementing water conservation in existing structures • Encourage the provision of water service that is consistent with growth management • Promote the use of landfill and waste-to-energy facilities that have proven environmental and economic operational records • Enhance the integrity and quality of life of urban areas through infill development, redevelopment, downtown revitalization, neighborhood improvement and adaptive reuse • Prepare and follow environmental or sustainable development indicators • Encourage the use of land development, stormwater and wastewater techniques that maintain the natural functions of the hydrologic cycle • Integrate water resources planning with land use, sewage facilities, stormwater management, natural resources and park and recreation planning	Watershed-wide	All partners	• 2007-2010
Monitoring	• Monitor incorporation of environmental indicators into local regulations	Watershed-wide	All partners	• 2007-2010
Education	• Encourage and promote waste reduction, minimization, recycling and composting programs • Distribute overview of Bruntland Report to schools and educators • Encourage coordination and public education regarding solid waste management, natural resource management, and land use elements of comprehensive land use and environmental protection planning	Watershed-wide	All partners	• 2007-2010

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Goal 12. Initiate Capital Improvements for Watershed Protection				
Planning & Data Gaps	• Create a capital improvements plan to fund all projects noted in RCP	Watershed-wide	PWD, Poquessing WSA	• 2007
Implementation	• Reach out to small and large companies to sponsor community events • Create a work plan to raise funding for projects listed in RCP	Watershed-wide	PWD, Poquessing WSA	• 2008-2012
Monitoring	• Revise project list and gauge funding successes yearly • Add new funding programs as they become available	Watershed-wide	PWD	• 2012-on-going
Education	• Create & distribute an overview of funding and work plan			

Abbreviations: BRSP, Benjamin Rush State Park; BTEAB, Bensalem Township Environmental Advisory Board, CCD, County Conservation Districts; CDC, Community Development Corporations; CHD, County Health Departments; CPC, County Planning Commissions; CPRD, County Parks and Recreation Departments; DCED, Department of Community and Economic Development; DRGP, Delaware River Greenway Partnership; DRKN, Delaware River Keeper Network; Environmental Advisory Board; FEMA, Federal Emergency Management Agency; FPC, Fairmount Park Commission; FoP, Friends of the Poquessing; GSA, Green Space Alliance; LSTEAC, Lower Southampton Township Environmental Advisory Council; NLT, Natural Lands Trust; PA DOT, Pennsylvania Department of Transportation; PAFBC, Pennsylvania Fish and Boat Commission; PEC, Pennsylvania Environmental Council; PEMA, PA Emergency Management Agency; PRD, Philadelphia Department of Recreation; PWD, Philadelphia Water Department; TU, Trout Unlimited; SEPTA, Southeastern PA Transportation Authority

SECTION 2: Project Area Characteristics

2.1 Introduction

The project area characteristics provide the basis for describing both the physical features of the Poquessing Creek Watershed as well as other important socio-economic information.

In Pennsylvania, the power and responsibility for land use planning and land use regulation lies with local government. The Pennsylvania General Assembly delegated planning and land use control (e.g., "police power") to the counties, cities and municipalities through the Pennsylvania Municipal Planning Code (MPC). Therefore one of the major goals of the rivers conservation planning effort was to research, incorporate and apply a number of planning initiatives, both regulatory and community based, into this Rivers Conservation Plan.

A comprehensive watershed-wide planning and land use study was completed to ensure that all comprehensive planning, land use regulations, and socio-economic factors were considered, incorporated and applied to the conservation management plan. An overview of the Poquessing Creek Watershed planning study is included in the appendices (see Appendix A.3, Planning Study) and a general overview of findings is included in this section.

2.2 Location

The Poquessing Creek is a tributary to the Delaware River in southeastern Pennsylvania. The watershed boundary, as illustrated in Map I, extends into three counties: Bucks, Montgomery and Philadelphia. The main stem of the Poquessing Creek flows in a southerly direction from Lower Southampton Township in Bucks County, forming the boundary between Bensalem Township in Bucks County and the City of Philadelphia (Philadelphia County).

2.3 Watershed Area

The Poquessing Creek Watershed area is approximately 13,800 acres, or 21.5 square miles as delineated by the Pennsylvania Department of Environmental Protection (PADEP). GIS data was obtained from the PADEP (watershed boundary) and PennDOT (municipal boundaries). The watershed boundary was determined by examining topographic maps and outlining the area of land that has surface runoff in the direction of the Poquessing Creek.

Approximately 60% of the Poquessing Creek Watershed is within the City of Philadelphia (8,300 acres). About 36% of the watershed (4,960 acres) is in Bucks County (Bensalem Township, 3,015 acres and Lower Southampton Township, 1,943 acres). The remaining 4% of the watershed is located in Lower Moreland Township, Montgomery County (540 acres).

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- I: BASE MAP

Location Map

PERCENTAGE OF MUNICIPALITIES IN THE POQUESSING CREEK WATERSHED

Municipality	Acres	% of Watershed
Bensalem Township	3,014.62	21.85
Lower Moreland Township	542.69	3.93
Lower Southampton Township	1,943.41	14.09
Philadelphia City	8,295.31	60.13

UPPER SOUTHAMPTON
BUCKS COUNTY
LOWER SOUTHAMPTON
LOWER MORELAND
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
Poquessing Creek
Walton Run
Black Lake Run
Byberry Road
Woodhaven Road
Knights Road
Street Road
213
276
532
1
63
513
132
95
13
Delaware River
NEW
JERSEY
4,000 2,000 0 4,000
Feet

MAP-I
BASE MAP

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water Bodies
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary - PWD
Roads - PWD/PennDOT
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)

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Tel: 484-821-0470

PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

FILE: \\WBData\Projects\2005\1756\00\DATA\GIS\ArcMAP\wshed_poquessing.mxd

The main stem of the Poquessing Creek flows approximately 9.8 linear miles from the headwaters in Lower Southampton Township to the Delaware River. The Poquessing Creek Watershed, as shown in Figure 2-1, is bordered to the north and east by the Neshaminy Creek Watershed and to the west by the Pennypack Creek Watershed. All three of these watersheds are part of the much larger Delaware River Watershed which flows directly into the Delaware Bay before flowing into the Atlantic Ocean.

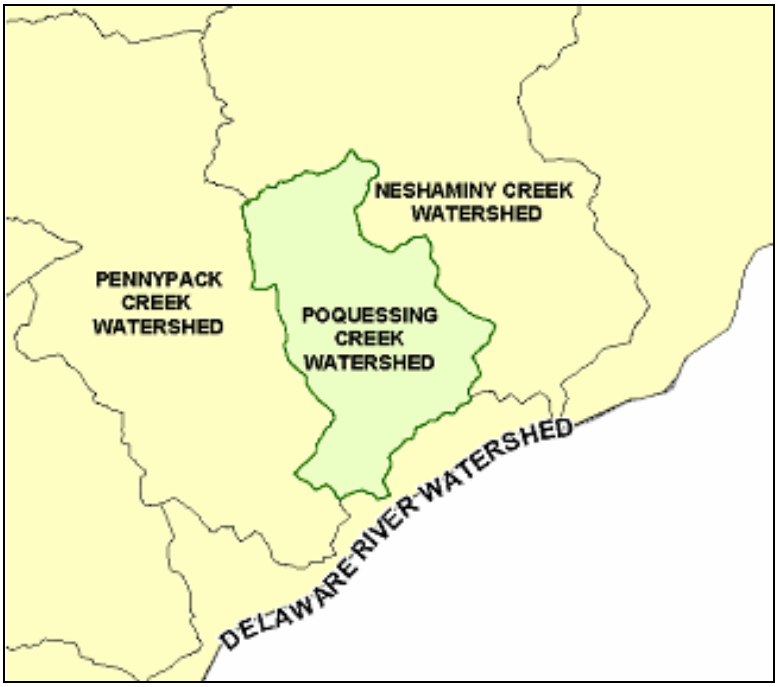


Figure 2-1. Regional Watershed Map

2.4 Major Tributaries

As illustrated in Map I, the Poquessing Creek is a tributary of the Delaware River. The creek itself has one major tributary, Byberry Creek, which flows along the western side of the watershed and enters the Poquessing Creek slightly north of Route 13. Byberry Creek originates southeast of Somerton in Philadelphia and flows approximately 6.6 miles southward under Route 1 towards Route 13, where it then flows east before entering the Poquessing Creek. A secondary, smaller tributary, Walton Run, feeds into Byberry Creek just to the west of Route 63.

There are numerous small tributaries within the watershed, most of which are unnamed. These small tributaries are typically the headwaters where surface water and shallow groundwater begin to flow in sufficient volume to form water channels. These small headwater streams are referred to as “first order” streams. Water channels in first order streams may be dry during significant parts of the year. Streams with defined water channels, but typically dry during parts of the year (typically summer months) are referred to as intermittent streams. Not all of the headwater streams in this watershed are

intermittent streams. Many of these intermittent or headwater streams are not mapped at the watershed wide scale because the majority of them are not named.

2.5 Topography

The lower part of the watershed, near the Delaware River, is in the Middle Coastal Plains ecoregion characterized primarily by flat plains and elevations ranging from 0 to 80 feet above mean sea level. The remainder of the watershed is in the Northern Appalachian Piedmont ecoregion characterized by hilly to rolling terrain with a few high ridges reaching up to 300 feet above mean sea level. The Piedmont area between the coastal plain and the Appalachian Mountains is described as "…the roots of an ancient coastal mountain chain that is now worn down to low relief" ("Ecological Subregions of the United States" US Forest Service WO-WSA-5, McNab and Avers). The highest elevation in the watershed is a point in Lower Moreland Township located 311 ft above mean sea level whereas the lowest elevation is located at sea level at the confluence with the Delaware River.

The slopes in the Poquessing Creek Watershed were determined using USGS digital elevation models (DEM). A DEM is a map consisting of a series of grids that measure 10 meters by 10 meters (32.81 by 32.81 feet). Each grid is assigned an elevation value based on the original topographic contours as mapped by the USGS. Slope is determined by the change in elevation over the change in distance. For example, when one grid has an elevation value of 10 feet above mean sea level and a grid 100 feet away has an elevation of 20 feet above mean sea level, the slope between these two areas is 10% (10 feet of elevation rise divided by 100 feet of distance). Map II depicts the slopes and topographic relief of the Poquessing Creek Watershed.

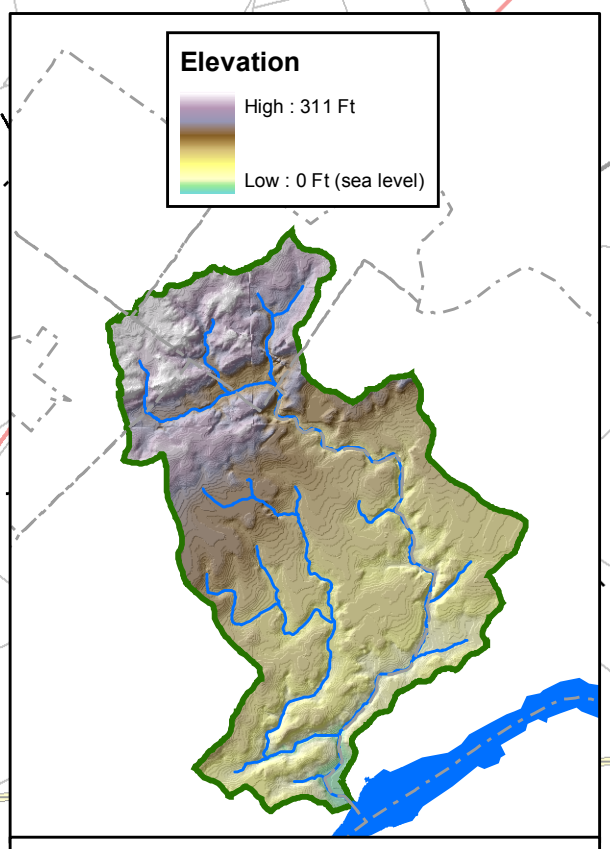
Approximately 95% of the Poquessing Creek Watershed was calculated to have slopes of less than 10% (based on the USGS DEM data) and is considered mostly level. Roughly 39% of the watershed is almost entirely flat with slopes calculated to be 0%. There are few isolated areas where slope values exceed 10%. Some of these slope areas are found immediately along the Poquessing Creek and its tributaries where the creek has carved a channel through the landscape. Other areas with slopes exceeding 10% are found in the upper reaches of the watershed where the elevation is slightly higher and there are gently rolling hills. Contiguous steep slope areas are generally small and localized.

2.6 Land Use and Land Use Planning in the Poquessing Creek Watershed and Corridor

As noted in the introduction to this section, in Pennsylvania, the power and responsibility for land use and its regulation lies with local government. The Pennsylvania General Assembly delegated planning and land use control (e.g., "police power") to the counties, cities and municipalities through the Pennsylvania Municipal Planning code (MPC). Bucks, Montgomery and Philadelphia Counties and the municipalities in the Poquessing Creek Watershed area, have a strong history of regional and local planning efforts, which form the basis for land use regulation in the Poquessing Creek Watershed.

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- II: TOPOGRAPHY AND SLOPES

Location Map



Topographic Relief

SLOPES

- SLOPE 0-10%
- SLOPE 11-15%
- SLOPE 16-20%
- SLOPE > 20%

4,000 2,000 0 4,000
Feet

MAP-II
TOPOGRAPHY AND SLOPES

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
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DATA SOURCES:
Watershed Boundary: PWD
Roads: PWD/PennDOT
Counties: PennDOT
Municipalities: PWD
Streams: PWD
Water Bodies: U.S. Fish and Wildlife Service (Derived from NWI Wetlands)
Slopes: Derived from USGS Digital Elevation Models (DEM)

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DATE: 06/01/2007 PROJECT #: 2005-1756-00

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The ultimate goal of the Poquessing Creek Watershed Rivers Conservation Plan is the improvement of water quality and the natural environment. As land use and the manner in which land is developed greatly impact water quality and the natural environment, existing land use planning and regulatory efforts are an important feature of this Rivers Conservation Plan.

The Philadelphia Water Department adopted new stormwater management regulations to manage stormwater runoff for quality and quantity from new and redevelopment. The new guidelines include new approaches to stormwater management that include controls to improve the quality of stormwater prior to discharge, controls to reduce the erosive effects of stormwater, and measures to increase groundwater recharge. The regulations were modeled after the Darby-Cobbs Creek Act 167 stormwater Plan and model ordinance which went through a rigorous State, county and municipal review process. The new stormwater regulations in Philadelphia will ensure that Philadelphia has an up-to-date and effective stormwater program that meets the state and federal requirements and can be coordinated with the changing regulations occurring in upstream municipalities.

In addition, the Philadelphia Stormwater Management Guidance Manual has been created to assist developers in meeting the requirements of the Philadelphia Stormwater Regulations. The manual is intended to lead developers through the requirements and expectations of PWD in terms of stormwater management. The manual provides guidance for the entire site design process, beginning with initial site design considerations, through the post-construction stormwater management plan submittal elements, and ultimately the acquisition of stormwater plan approval. Tools are provided to assist in completion and submittal of a stormwater management plan. They include flowcharts to guide the developer through the process, worksheets to assist with calculations, and checklists to ensure the plan is complete. These tools work together to address stormwater management on the development site from concept to completion.

The following table (Table 2-1) provides a very general overview of pertinent planning efforts (e.g., comprehensive plans, master plans, functional plans, resource inventories, and site-specific projects), and land use regulations (e.g., zoning, subdivision and land development ordinances) currently in place within the project area. A more comprehensive overview of existing land use, land use planning efforts and land development regulations is provided in the appendices (see Appendix A.3).

Table 2-1. Poquessing Creek Watershed, Land Use Planning & Land Development Ordinances

	Comprehensive Plans	Functional Plans	Zoning Ordinance	Subdivision & Land Use Ordinance
Philadelphia County		* Parkwood Community Plan * Fairmount Park Strategic Plan * Fairmount Park Natural Lands Restoration Master Plan * Fairmount Park Master Restoration Plan: Poquessing Creek Park * Fairmount Park Adjoining Lands Study	The Philadelphia Code and Charter (Title 14)	The Philadelphia Code and Charter (Title 14) Stormwater Regulations (Section 600)
Bucks County	Bucks County Comprehensive Plan	* Bucks County Land Use Plan * Bucks County Open Space Plan * Bucks County Natural Resources Inventory	**N/A**	**N/A**
Montgomery County	Montgomery County Comprehensive Plan	* Montgomery County Land Use Plan * Montgomery County Open Space Plan	**N/A**	**N/A**
Bensalem Township	Bensalem Township Comprehensive Plan	* Bensalem Township Open Space Plan	The Bensalem Township Zoning Code (Chapter 232)	Bensalem Township Subdivision and Land Development Ordinance (Chapter 201)
Lower Southampton Township	Lower Southampton Township Master Plan	* Lower Southampton Township Recreation, Park and Open Space Plan	Lower Southampton Township Zoning Code (Chapter 27)	Lower Southampton Township Subdivision and Land Development Ordinance (Chapter 22)
Lower Moreland Township		* Lower Moreland Township Open Space Plan.	Lower Moreland Township Zoning Code (Chapter 208)	Lower Moreland Township Subdivision and Land Development Ordinance (Chapter 180)

2.7 Land Cover/Land Use

The terms "land cover" and "land use" are often used interchangeably, but they should not be. Typically, land use refers to the use of a parcel of land as recorded by the tax assessor. There are various types of use such as single family residential, commercial, school, etc. In some cases, the land use categories can be very detailed and specific, even including the number of stories that structures have on the property or the presence of outbuildings. An entire parcel of land may be assigned a single land use even if it varies because land use is assigned on a parcel basis. Because the land use is assigned on a parcel basis, an entire parcel may be assigned a single land use, even if it varies. For example, a five-acre heavily wooded parcel with a small commercial building may be classified as commercial even though only a small percentage of the area is used for this purpose.

Land cover more frequently refers to the appearance of the land surface as viewed in aerial photographs or satellite imagery. Land cover classifications are often less detailed than tax assessors land use data, but are usually more spatially accurate. Land cover categories such as hardwood forest, agricultural, wetlands, etc. are based on actual observations and interpretation of the aerial photos or satellite images rather than land use which relies on property lines based solely on ownership.

The land cover data used for this plan were derived from the interpretation of aerial photos from 2000 by the Delaware Valley Regional Planning Commission (DVRPC). The aerial photos were examined and contiguous areas of land cover were delineated. The degree of delineation depends on the feature being mapped. For example, in some cases such as parking lots, small areas (less than 0.1 acres) were delineated. In other cases, such as a commercial building in the middle of a five acre heavily wooded lot would typically not be delineated and would instead be incorporated into the surrounding land cover. The overall process of land cover interpretations is subjective and therefore prone to some degree of judgment based on the experience and expertise of the interpreter. The interpretations are also subject to becoming obsolete because land cover may change soon after the aerial photo was taken.

As illustrated in Map III, the Poquessing Creek Watershed is a complex mosaic of differing land cover classifications. It is almost entirely urbanized with some forested areas that are mostly parklands, in the Fairmount Parks System. Table 2-2, shown below, illustrates the different land cover classifications used by the DVRPC and the approximate percentages of these land cover areas in the watershed.

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- III: DVRPC LAND COVER

Location Map

LAND USE (DVRPC: 2000)

- Agriculture
- Commercial
- Community Services
- Manufacturing: Light Industrial
- Military
- Recreation
- Residential: Mobile Home
- Residential: Multi-Family
- Residential: Row Home
- Residential: Single-Family Detached
- Paved
- Transportation
- Utility
- Vacant
- Water
- Wooded

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Delaware River
Poquessing Creek
Byberry Road
Street Road
Woodhaven Road
Walton Creek
Knights Road
213
276
532
1
513
132
63
95
13

4,000 2,000 0 4,000
Feet

MAP-III
DVRPC LAND COVER

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary: PWD
Roads: PWD/PennDOT
Counties: PennDOT
Municipalities: PWD
Streams: PWD
Water Bodies: U.S. Fish and Wildlife Service (Derived from NWI Wetlands)
Land Use - Delaware Valley Regional Planning Commission (2000)

Forbes Environmental and Landuse Planning
12 Brookdale Drive
New Britain, PA 18901
Tel: 215-230-9549

Borton-Lawson
Lehigh Valley
3893 Adler Place
Bethlehem, PA 18017
Tel: 484-821-0470

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Table 2-2. Land Cover Percentage

23.98%	SINGLE FAMILY DETACHED
16.52%	COMMUNITY SERVICES
11.60%	WOODED
6.64%	PARKING
6.54%	ROW HOME
6.41%	LIGHT INDUSTRIAL
6.21%	MULTI-FAMILY
6.15%	RECREATION
5.77%	COMMERCIAL
4.25%	TRANSPORTATION
4.06%	VACANT
1.06%	AGRICULTURE
0.40%	WATER
0.37%	UTILITY
0.03%	MILITARY
0.01%	MOBILE HOME

Even with the grouping of multiple land use categories together, it is evident that the watershed is fairly fragmented. There is evidence of a semi-contiguous greenway area in the form of a riparian buffer immediately adjacent to the main stem of the Poquessing Creek that leads from the mouth of the creek northward towards the upper reaches of the watershed. This greenway, as illustrated in Map III, is very narrow in some places and non-existent in a few locations due to commercial land, but it does appear that a riparian buffer is present along the majority of the main stem of the creek.

2.8 Population Information

It has been commonplace to hear the view that the "population explosion" has had a significant and what some consider a "negative" impact on our natural environment. These impacts have resulted in an increasing scarcity of open space and wildlife, have impaired the natural beauty of vast regions, and changed the quality of life. Population data is therefore important information to include in any environmental planning effort.

The following population information was obtained from the Delaware Valley Regional Planning Commissions "*Delaware Valley Data,*" which is an on-line series of data bulletins, analytical data reports and data reference guides for the region. According to the DVRPC website, the commission *is an inter-state, inter-county and inter-city agency that provides comprehensive and coordinated planning for the orderly growth of the Greater Philadelphia region*. The DVRPC provides technical assistance and services to its member state, county, and local governments, the private sector, and the public.

The data bulletin entitled *Population Change in the Delaware Valley*, 1930-2000 addresses regional population growth between 1930 and 2000 (see Table 2-3). The Poquessing Creek Watershed Population Trends, 1930-2000, illustrates population trends

in the three municipalities and the City of Philadelphia. During this time period, the Delaware Valley region gained almost 2.1 million new residents. Significant population increases took place between 1930 and 1970, with the region's population increasing by over 50%. During this time period, the City of Philadelphia's population peaked in 1950 and then experienced significant declines until 1970. The largest population increases occurred in Bucks County.

In comparison, the database illustrates that in later decades (e.g., 1970-2000) the region experienced a population shift, rather than additional population growth. For instance, between 1970 and 2000, the region's overall population grew by only 5%, as the City of Philadelphia continued to experience population declines, and outlying counties experienced moderate population increases. During those 30 years, every suburban county realized growth, with the greatest absolute increases seen in Montgomery and Bucks counties. With regard to municipal growth in the Poquessing Watershed, between 1930 and 2000, Bensalem Township was one of the fastest growing municipalities in the region and experienced a 2,764% population increase. Lower Moreland Township and the City of Philadelphia experienced population declines.

Population projections are also a useful guide to gauge projected population growth in an area. If projections indicate that there will be a significant increase in population in an area, additional environmental impacts may be expected. If there is a population decline, there is often an associated economic decline and concurrent decline in housing stock and neighborhood health.

The DVRPC database in the Regional Data Bulletin entitled, "Population and Employment Forecasts, 2000-2030, Revised #73," was used to determine statistical projections for the municipalities and Northeast Philadelphia through 2030.

Table 2-4 illustrates population projections, and indicates “less robust population growth” in the three Poquessing Creek Watershed municipalities, and “relatively static” population growth throughout Philadelphia County.

Table 2-3. Poquessing Creek Watershed Population Trends, 1930-2000

Region of Watershed	1930	1940	1950	1960	1970	Absolute Population Change 1930-1970	Percent Population Change 1930-1970	1980	1990	2000	Absolute Population Change 1970-2000	Percent Population Change 1970-2000
Bensalem Township	5,645	7,276	11,365	23,478	33,042	***27,397***	***485.3%***	52,368	56,788	58,434	***25,392***	***76.8%***
Lower Southampton Township	1,077	1,843	3,562	12,619	17,578	***16,501***	***1,532.1%***	18,305	19,860	19,276	***1,698***	***9.7%***
Lower Moreland Township	1,300	1,451	2,245	5,731	11,665	***102,365***	***797.3%***	12,472	11,768	11,281	***-384***	***-3.3%***
Philadelphia City	1,950,961	1,931,334	2,071,605	2,002,512	1,949,996	***-965***	***0.0%***	1,688,210	1,598,577	1,517,550	***-432,446***	***-22.2%***

Source: DVRPC, Regional Data Bulletin, #82, April 2000.

Table 2-4. Poquessing Creek Watershed Population Projections, 2000-2030

Region of Watershed	2000	2005	2010	2015	2020	2025	2030	Absolute Change 2000-2030	Percent Change 2000-2030
Bensalem Township	58,434	59,530	60,490	61,120	62,010	62,510	62,620	***4,186***	***7.2%***
Lower Southampton Township	19,276	19,560	19,790	19,910	20,110	20,200	20,145	***869***	***4.5%***
Lower Moreland Township	11,281	11,650	11,360	11,440	11,550	11,710	12,000	***719***	***6.4%***
Near Northeast Philadelphia City	241,865	238,370	235,870	244,340	246,110	246,500	243,500	***1,635***	***0.7%***
Far Northeast Philadelphia City	158,123	158,190	159,030	165,000	166,400	166,500	167,000	***8,877***	***5.6%***

Source: DVRPC, Regional Data Bulletin, 73, March 2005.

2.9 Transportation Facilities

Access to the Poquessing Creek Watershed is possible through a variety of routes (see Map I, Base Map) including the interstate highway system and a variety of state and locally-owned primary, secondary and tertiary roadways.

The American Association of State Highway Officials (AASHO), working in conjunction with the Department of Agriculture's Bureau of Public Roads, laid out the US highway system based on primary intercity roads in the early 1920s. A list of proposed route numbers was considered and a final list of US highways was agreed upon in 1926. Prior to the 1930s, roadways were unimproved "auto trails." The condition of these "auto trails" was improved during the Great Depression through the effort of federal and state governments working together to put men to work. The nation's roads and highways were extended and improved by grading, surfacing, and the adding of drainage structures. In the 1950s, roads were widened, straightened and divided because they were inadequate for the faster and wider cars of this period. President Eisenhower signed a bill in 1956 modeled after Germany's Autobahns that created the National System of Interstate and Defense Highways.

The Pennsylvania Interstate system recently celebrated its 50th anniversary. Interstate 276, which is a portion of the Pennsylvania Turnpike, runs Northwest to Southeast through the northern portion (Lower Southampton and Bensalem Townships) of the watershed. The section of I-276 that traverses through the watershed was constructed in 1951 as part of a 33-mile section linking the Valley Forge exit to Bristol. In 1956, the toll bridge crossing the Delaware River was constructed making access to the New Jersey Turnpike possible soon thereafter to be able to travel from Maine to the Ohio Indiana border without a traffic light or cross road.

The major North-South highway along the East Coast, Interstate 95, was originally planned by the City of Philadelphia as a link between the Port of Philadelphia, downtown and locations to the Northeast. Constructed in 1962, I-95 runs Northeast to Southwest through the southern portion (Bensalem Township and Northeast Philadelphia) of the watershed.

United States Highways Routes 532/Bustleton Avenue, 132/Street Road and state routes 63/Woodhaven Road, 13/Bristol Pike, 1/Roosevelt Boulevard all criss-cross the Poquessing Creek Watershed. These interstate and state highway systems link with local primary, secondary, and tertiary roadways.

Through comprehensive plan research and public outreach efforts associated with the Poquessing Creek Watershed Rivers Conservation Plan, watershed-wide transportation concerns were evident. All three comprehensive plans note issues associated with increased congestion of roadways due to increased development and population.

In the one-on-one interviews, citizen surveys, and neighborhood meetings (see Section 3 of this Plan) the Woodhaven Road (Primary State Highway 63) or the proposed "spur to the northeast" was the transportation project most frequently noted with concern.

According to the Delaware Valley Regional Planning Commission (DVRPC), the Woodhaven Road Expressway carries approximately 60,000 vehicles per day (Average Annual Daily Traffic). It is a well-traveled transportation corridor within the watershed. Construction of Woodhaven Road began in 1962 and was completed in 1966. The six-lane expressway is considered a "spur" because it connects I-95 in Bensalem, Bucks County with Lower Moreland Township, Montgomery County. The Woodhaven Road Expressway serves the far northeast section of Philadelphia, and connects Roosevelt Boulevard/US 1 with I-95. The expressway provides six lanes of traffic from I-95 northwest to the Franklin Mills Boulevard and Millbrook Road interchange. There are four lanes traveling northwest from the Millbrook Road interchange to the Roosevelt Boulevard cloverleaf interchange.

In 1996, reconstruction took place at the PA 63 / Woodhaven Road exit. The project provided access to a new park-and-ride lot serving the Cornwells Heights railroad station (SEPTA, R7-Northeast Corridor line). In 2002, the Pennsylvania Department of Transportation (PennDOT) initiated a project to rebuild Woodhaven Road from US 13 in Bensalem Township northwest to the Evans Street terminus in Northeast Philadelphia. Roadway shoulders, medians and pavement were reconstructed and concrete paving replaced. The $10 million dollar project also included streetlight upgrading, resurfacing of five bridges and the construction of new sound barriers. This project was completed over two years ago.

An extension of Woodhaven Road is currently under consideration to address additional traffic from Woodhaven Road to Evans Street and Byberry Roads. The DVRPC estimates this portion of Woodhaven Road is accommodating 40,000 vehicles per day (AADT) due to rapid development in that region and the addition of the Franklin Mills Outlet Mall.

Woodhaven Road Extension Plans were developed by the Philadelphia Department of Streets and the DVRPC. The plans call for a 2.3 mile Woodhaven Road extension continuing northwest to the intersection of Byberry Road and Philmont Avenue in Lower Moreland Township, Montgomery County. A full-diamond interchange is proposed at Bustleton Avenue (PA 532).

There has been opposition to the project even though draft environmental impact statements (1977, 1979) indicated the extension would not have adverse effects on the environment and the FHWA permitted construction. The project was put on hold in the late 1970s due to fiscal constraints, and reconsidered in the 1980s when additional funding became available. At that time, environmental regulations had been amended and the FHWA required PennDOT to complete another environmental impact assessment. According to our public outreach efforts, opposition has grown due to the expectation of additional traffic on local roadways around the western terminus of the

proposed extension (Byberry Road and Philmont Avenue). Some of this opposition is from the Westwood subdivision near Bustleton Avenue as well as from Lower Moreland Township. Project supporters contend that, in the absence of the extension, Byberry Road would need to be expanded and the Byberry Road Bridge (crossing the CSX-Conrail tracks) is worsening.

In 1996, PennDOT removed the extension from their long-range plans. Four years ago, public hearings were held and the DVRPC recommended construction of the extension in their regional-wide transportation improvement plan. PennDOT is currently presenting five alternatives (four "build" and one "no build") to the Woodhaven Road Extension. The four "build" alternatives recommend widening local roads (Byberry Road, County Line Road and Huntingdon Pike/PA 232) and improving existing intersections.

2.10 Employment Sources

Employment source information for the Poquessing Creek Watershed was obtained from DVRPC's on-line database. The report entitled *Three Decades of Job Growth and Decline in the Delaware Valley* (Employment Base Analysis and Economic Census Update, #12, May 2006) provided analysis of the Region's Economic Base by employment sector using 2002 Census data and the North American Industry Classification System employment codes). This particular data source notes that most local employment sectors in the region (e.g., as retail and wholesale trade, transportation, real estate, and administrative services) are at a healthy average, although manufacturing and accommodation/food services are below average employment sectors. These employment sectors have been exported to other areas, however the service sector is the region's "primary economic engine" and other sectors are excelling (e.g., financial and insurance, professional technical and scientific services, and education).

With regard to absolute levels of employment, health care and social assistance have the highest ranking at 378,334 jobs, followed by retail with 313,850 jobs, and manufacturing with 262,470 jobs. White-collar service sectors are the largest employers including jobs in finance, professional, scientific and technical services (430,000 jobs). The report notes that these jobs are considered "basic" jobs that export their services and lead to growth in the region. They are important, because they have a multiplier effect. For example, every one white collar job results in supporting additional jobs.

The data source further notes that traditional industries account for over 460,000 jobs in the area (e.g., 200,000 jobs in the hospitality services, 260,000+ in manufacturing). Although the report indicates that regional manufacturing has continued to decline, many specific manufacturing sectors (e.g., chemical manufacturing) are export leaders bringing wealth into the region. Many smaller, simpler manufacturing industries are also strong employment sectors in the region (e.g., beverages, apparel, wood, paper and plastics, printing products and services). Complex manufacturing products, such as transportation equipment and fabricated metals also bring diversity to this economic sector.

The social service sector of education and health care providers are considered strong employment and economic sectors in the region. The report notes that they "may be emerging wealth engines for our region." Another important employment sector is dubbed "the Knowledge Economy" as these jobs comprise the highest percentage of total employment in the region, and consist of the greatest number of our well-paid, highly skilled export-oriented jobs. Again, this employment sector includes financial and insurance services, securities, funds and trusts, and telecommunications.

Some additional employment source losses are discussed in the report, including a loss in strength in the environmental consulting and engineering employment sector. Although a strong sector in a promising new industry, the report notes that the sector may be stagnating relative to nationwide growth. For example, in 1997, engineering jobs represented nearly 29,000 jobs. By 2002, the number of engineers had actually dropped to 20,000 with a percent decline of -31%. The report notes that this may be due to the severe economic downturn in manufacturing, and services related to manufacturing and engineering.

The report summarizes its employment and economic findings by noting the importance of varied and strong pools of professional, scientific, and technical labor. It questions the viability of a knowledge driven economy that does not excel in basic physical R&D and engineering, and expresses concern regarding the region's ability to capture new growth industries (e.g., green industries). Some of the reports' employment and economic recommendations are noted below:

- Expand existing pools of skilled knowledge labor in the regional economy.
- Create new pools of skilled knowledge labor in the regional economy.
- Connect these pools to each other to grow the specialized industries that will turn the region into an export leader.
- Strengthen research and development and engineering sectors.
- Foster green industries (e.g., green building industries).

2.11 Outstanding & Unique Features

The Poquessing Creek Watershed possesses a wealth of outstanding natural and man-made features. To begin with, the watershed is located in the coastal plain region, and exhibits a variety of natural attributes and unique features associated with coastal plain geology and geography such as permeable soils and flat topography.

The region was, for thousands of years, populated by Native Americans of Lenape descent and was one of the first areas in the United States to be colonized by William Penn and dubbed the "City of Brotherly Love." Through the years, Philadelphia became one of the major port cities of the world, the birthplace of American democracy, and played an important role in the American Industrial Revolution.

As a result of the region's natural and cultural importance, there are a variety of features in the Poquessing Creek Watershed that are of federal, state and local importance. The land resources component of this Rivers Conservation Plan (Section 4) provides an overview of outstanding and unique land resources such as geological characteristics and open space areas. It also provides an overview of the various land preservation programs and successful land acquisition programs to date.

The Water Resources Section (Section 5) provides an overview of ground and surface water resources, floodplain areas, wetlands, lakes and ponds. Ground and surface water quality is also addressed as well as the regulatory framework for protecting and enhancing water resources.

Despite the level of development of the region, there are a variety of intact and significant biological resources located in the Poquessing Creek Watershed. The unique flora and fauna are explored in Section 6 of this plan as well as information on their management and protection.

Finally, Section 7 of the plan provides an overview of historic, cultural and recreational resources including historic districts, historic structures, cultural and scenic amenities, parks, trails and plans underway to develop a linked trail system.

SECTION 3: Issues, Concerns, Constraints, and Opportunities

3.1 Introduction

According to the Pennsylvania Department of Conservation and Natural Resources (PADCNR) and other conservation and environmental professionals, one of the most critical elements of any planning project is to efficiently and effectively determine the recreational needs and interests of the public. It is also important to ascertain the public's feelings about the environment that surrounds them. For instance, it would be illogical to plan a recreational trail or an environmental interpretive area within a given community that has not expressed the need or desire for this type of amenity. Therefore, a public participation process should be designed in such a way as to provide the project team with the means to determine the elements, mind-set, values and behaviors of the individuals living and working within the Poquessing Creek Watershed.

The first step in the beginning of this project was to involve the residents and community leaders. This step caused an increase in the knowledge of the project team, encouraged volunteer participation and educated the public about planning efforts. The substantial public involvement in the initial planning stages increased the likelihood that the Poquessing Creek Watershed Rivers Conservation Plan would contain the correct and relevant information needed to move it towards the implementation of the conservation management plan.

The public participation process for the Poquessing Creek Watershed Rivers Conservation Plan was extensive, and a number of common concerns and assets were expressed. They are illustrated below and include the following categories of watershed concerns and assets:

Watershed Concerns

Planning, Land Use, Land Ownership & Zoning: The public was aware that much of the land adjoining the creek is under private ownership, which makes it difficult to protect or regulate. Concerns about the loss of open space, the impact of rampant development on existing resources, and the lack of consistent land use regulations or consistent implementation of those regulations were commonly expressed. Public comment also included the need for additional or consistent land use planning and land use protection tools such as: Act 167 Stormwater Plan (Act 167), consistent comprehensive and master plans and functional plans, zoning and site development policies and regulations.

Significant Resources: The public commented frequently that existing regulations were not adequately protecting significant resources such as water quality, open space, and other resources.

Environmental Issues: The most common environmental impacts expressed during the public participation process included: increased stormwater runoff, erosion and

sedimentation, filling in of wetlands, tree removal, degraded drinking and surface water quality, leaking underground storage tanks, high bacteria levels, the spreading of non-native and invasive vegetation, and illegal littering and dumping. Although supportive of land redevelopment efforts, the public expressed concern with the dumping of asbestos and other materials from brownfields redevelopment efforts.

Safety Issues- The public is often concerned with personal safety and concerns for safety in this watershed included: increased flooding, illegal ATV use, illegal trespass, and illegal activities (e.g., aggressive paint ball games, aggressive ATV use, drinking, drug use, vandalism, and littering). Many citizens knew about Fairmount Park Commission's plans for additional trail development, and the most common concerns were related to safety, increased littering, and potential lawsuits.

Education- The project team commonly heard about the need for additional watershed education and in the following subject areas: local involvement in land use and zoning efforts, the importance and location of wetlands, and the association between land use development and stormwater. Many expressed interest in involving themselves and their children in hands-on projects and a formal curriculum intended to improve the watershed.

Volunteerism/Participation- Some groups and individual citizens have participated in a number of watershed projects, but expressed the need for more volunteers and a program designed to increase participation and spread a consistent cohesive watershed protection message. Several individuals noted the need for an "umbrella" watershed group.

Watershed Assets

Planning, Land Use, Land Ownership & Zoning - The project team also experienced private landowners coming forward to express interest in supporting greenway and creek restoration efforts. Other community members noted the effectiveness of existing land use planning and regulatory efforts in their municipalities and communities.

Significant Resources - The community shared a list of existing resources they felt improved the quality of the environment and their lives. These resources included: The Glen Foerd Mansion and surrounding area, historic bridges and roadways, osprey nests at the confluence of the Poquessing and the Lower Delaware River, Benjamin Rush State Park, and the Benjamin State Park "Significant Birding Area" designation.

Environmental Efforts - Several times, the public shared they felt that fish and wildlife diversity and water quality had improved in recent years. The public also commended and supported improvements in open space protection and stream restoration efforts.

Education - The public shared many effective and existing educational efforts that were on-going in the schools and through individual organizations. In addition, the public participation process benefited greatly from *active* participation from members of the Friends of the Poquessing Creek. As the President participated in creating project outreach materials and attended the majority of community meetings, they were able to

spread the word about their existing curriculum and outreach programs. The PWD, Friends of the Poquessing and a number of local educators noted their existing educational efforts, had several meetings during the course of this project, and will continue coordinating educational outreach efforts.

Volunteerism/Participation - Individuals and groups in the watershed have illustrated that there are a number of active volunteer efforts to improve watershed quality. Groups like the Friends of the Glen Foerd Mansion, Friends of the Poquessing Creek, and a myriad of community associations meet consistently to discuss land use and watershed protection efforts. Several local citizens running for public office on environmental platforms attended RCP meetings. Also, active neighborhood groups/community associations and landowners living on the creeks and tributaries expressed interest in streambank stabilization projects.

In the following subsections, we will discuss the public participation process, the selected approaches to educational outreach and the information gathered due to those efforts.

3.2 Project Team

The project leaders were comprised of professionals from the Philadelphia Water Department Office of Watersheds and the two consulting firms (Borton-Lawson & Forbes Environmental & Land Use Planning). The project team includes representatives from Philadelphia Water Department, Fairmount Park Commission, Benjamin Rush State Park, Bucks County Conservation District, Montgomery County Conservation District, Friends of Poquessing, Delaware River Greenway Partnership, Lower Southampton Township Environmental Advisory Council, and Bensalem Township Environmental Advisory Board. The project team was responsible for submitting the application to the Department of Conservation & Natural Resources (DCNR) for the Community Partnership grant award which funded this project. The project team leaders agreed that public participation was very important for the following reasons:

- Effective public participation provides the community residents and community leaders an opportunity to voice their opinions;

- Information gathered from an effective public outreach approach informs elected officials and others about the needs and feelings of the community;

- Public outreach provides the general public and community leaders with an opportunity to support and be involved with the creation and implementation of the plan and;

- Effective public participation and outreach provides project leaders with the public support required to implement the recommendations included in the Rivers Conservation Plan.

3.3 Public Participation

The project team began the public education and outreach program by involving residents and leaders in the rivers conservation planning process. The selected methods of public outreach included: creating a committee, hosting quarterly steering committee meetings and public outreach meetings, attending neighborhood meetings, completing key person interviews, and hosting a variety of events.

3.3.1 The Poquessing Creek RCP Steering Committee

The Philadelphia Water Department (PWD) began the public outreach process by inviting a number of community leaders from a variety of agencies, non-profits, businesses, etc. to serve on the Poquessing Creek Watershed Rivers Conservation Plan Steering Committee. PWD recruited a number of the committee members and, for some, secured their interest at the time they submitted the grant application to the Pennsylvania Department of Conservation & Natural Resources (PADCNR). The list of steering committee members for the Committee is listed below.

The voluntary Steering Committee was important to the planning process because meetings were an effective forum in which to obtain opinions and feedback from the committee members. Each quarterly meeting began with an informal "meet and greet" followed by special presentations on a variety of environmental topics and project updates. Adequate time for discussion and feedback was provided at each meeting. Many committee members did much more than simply attend quarterly meetings; they helped promote events, reviewed materials, and provided contact information. The project team was pleased with the level of participation throughout the planning process. Steering committee meeting agendas, sign-in sheets, and minutes are found in Appendix A.1.

Figure 3-1. Steering Committee Meeting, Members

Below is a list of Poquessing RCP Steering Committee Members:

Last Name	First Name	Affiliation
Barrett	Jim	Lower Southampton Environmental Advisory Committee (EAC)
Belfield	Tony	Bensalem Township Environmental Advisory Board/Bucks County Open Space Review Board
Bentley	Terri	Bucks County Planning Commission
Blaustein	Joan	Fairmount Park Commission
Brokaw	Bill	Borton-Lawson Engineering
Brummer	John	Delaware River Greenway Partnership
Butler	Lance	Philadelphia Water Department (PWD)
Bryson	Dean	Lower Southampton EAC
Colton	Bill	Friends of Fluehr Park
Cox	Ken	Crestmont Farms/Friends of Poquessing
Cuorato	James	Brandywine Realty Trust
Dahme	Joanne	PWD
Davinger	Calvin	Philadelphia International Airport, Division of Aviation, Terminal E, Philadelphia, PA 19153
DeBarry	Paul	Borton-Lawson Engineering
Donahue	Gerry	Arch Bishop Ryan High School
Bruce	Josh	Benjamin Rush State Park
Forbes	Suzanne	Forbes Environmental
Graham	Glenn	Philadelphia NorthEast Trail
Kates	Jim	Lower Southampton EAC
Kenney, Jr.	George T.	State Rep. George Kenney (R-170th dist)
Ledesma-Groll	Tiffany	PWD (Winokur)
Leff	Michael	Pennsylvania Environmental Council
Mora	Denis	Resident of Poquessing/PWD
Olson	Jackie	Fairmount Park Commission Volunteer Coordinator
O'Neill	Councilman Brian J.	City Councilman O'Neill (R-10th dist.)
Pilling	Beth	MontCo. Planning Commission
Rapone	Bill	Councilman Brian O'Neill's Office
Remick	Donna	Friends of Poquessing
Rudolph	Alison	Lower Moreland Township
Tata	Angelo	Northeast Philadelphia Radio Control Club (Model Airplanes)
Taubenberger	Al	Greater Northeast Philadelphia Chamber of Commerce
Thompson	Michael	Philadelphia City Planning Commission
Tracy	Celeste	Delaware Heritage Trail/Delaware River Greenway Partnership
Waldowski	Jeanne	PWD
Zlotnick	Suzanne	Friends of Poquessing

The partners that were unavailable to attend meetings were kept informed via e-mail.

3.3.2 Outreach Materials

Several outreach materials were created and intended for use throughout the planning process including: an active website, project overview handouts, a tabletop display, a map entitled "show us where you live," and an e-mail and phone contact list.

The website of the Philadelphia Water Department (http://www.phila.gov/water/) was used to create a watershed partnership webpage specific to the Poquessing Creek Watershed Rivers Conservation Plan project (www.phillywater.org/poquessing/). Throughout the project, information was posted on this web page that kept the public and our partners informed about the progress of the plan, meeting dates, photographs, and special events.

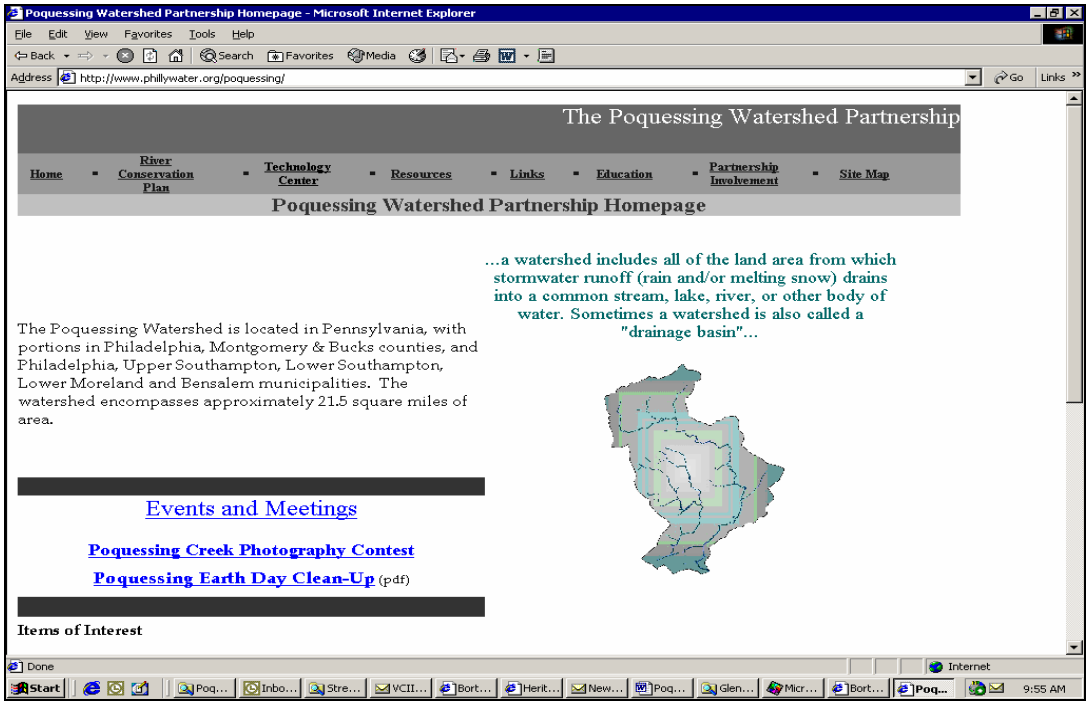

Figure 3-2. Watershed Partnership Webpage

The project team also created a project overview hand out and a tabletop display for use throughout the planning process. The handout was provided to all participants at all events and the tabletop display traveled from meeting-to-meeting as well.

Another item created was a large watershed map illustrating the project area (e.g., watershed boundaries, major roadways, preserved land, large land holding, water features, and tax parcels). The public was invited to place a push pin in the map showing where they live within the Poquessing Creek Watershed and in adjoining

watersheds. By the end of the project many people had participated in that public outreach exercise. (see Appendix A.4 for meeting handouts).

3.3.3 Key Person Interviews

Early in the planning process, the project team and Steering Committee members noted the importance of one-on-one interviews in order to obtain contacts, management plan recommendations, obtaining data, and map information. The project team consulted with PADCNR regarding the best approach to conducting key person interviews (KPI). The PADCNR public participation guide for planning projects noted the following regarding KPI completion:

A critical element of any planning project is to determine the public's recreational needs and interests. Through a well-designed public participation process; the attributes, attitudes, beliefs and behaviors of community residents are identified. Also, involving residents in the beginning of a project assists with decreasing opposition and increasing volunteer participation. After years of funding planning projects, The Bureau has found that substantial public involvement at the planning stage increases the likelihood that recreation projects will go beyond the planning stage to implementation. These experiences have prompted the Bureau to require significant public participation throughout the planning process. Through previously funded projects, we have found that public participation is important because it:

- *Provides the community residents and community leaders an opportunity to voice their opinions;*
- *Informs the elected officials of citizen attitudes and needs;*
- *Helps to express broad-based public support for the planning process and the plan proposals; and,*
- *Provides the general public and community leaders with an opportunity to support and be involved with the execution of the plan.*

The guidelines also provided the following advice for key person interviews (KPI's):

The purpose of key person interviews is to give community leaders (beyond the elected officials) an opportunity to voice their concerns and respond to a standard set of questions. This engages these individuals, with substantial influence in the community, in the planning process. Depending on the project the Bureau project manager will recommend a minimum number of interviews to be conducted. Key individuals that should be interviewed include: elected officials, school district administrators, police chiefs, service club leaders, religious leaders, chamber of commerce/business leaders, non-profit administrator, key recreation personnel, for profit recreation facility owners, major employers, bank presidents, and real estate developers.

The guidelines also included commonly asked questions for the KPIs. The project team combined DCNR recommended questions and Committee interview questions for the KPI process. These interviews were an important and effective way of receiving community feedback.

The KPI portion of the planning research and public outreach facets of the project were initiated in June 2005. The Philadelphia Water Department, Steering Committee, and their consultants agreed on a list of interviewees, interview questions and an interview approach. Forbes Environmental & Land Use Planning obtained interview appointments via phone, e-mail, fax and postal service. Once contacted, the interviewee was provided with a verbal and written overview of the project and the list of questions. The interviews were completed between July 2005 and May 2006.

During that ten month time period twenty one people were interviewed. The vast majority of interviewees knew the definition of "watershed" and the location of the Poquessing Creek. Although less than 50% of the interviewees knew the location of the watershed boundary, most understood the importance of watershed protection efforts as they were important to them personally or to their employers. Most provided land preservation as they understood the relationships between preservation of land resources and the positive impacts upon the biota and quality of life. Although most of the interviewees felt that the Poquessing Creek and surrounding watershed was degraded, many could suggest positive features within the watershed (e.g., ecological, historical, recreational, cultural), and could recommend a number of suggestions to improve the Poquessing Creek and the surrounding watershed.

In conclusion, the interviews led to strengthened partnerships and an increase in the level of interest in the project. Additionally, the feedback from interviewees is incorporated throughout this plan. For a more comprehensive overview of interview findings, please refer to the overview of interview findings memo included in Appendix A.5.

3.3.4 The Citizen Survey

Following the initiation of the KPI process, members of the watershed committee were introduced to the concept of "the citizen survey," and shown a variety of questionnaires that were completed for other PWD planning projects in adjoining watersheds. Again, the PADCNR public participation guide for planning projects was consulted. The guide noted the following regarding citizen surveys:

A random sample survey of a community's citizens is an effective way to gather valid input and opinions from all segments of the community if conducted in a statistically valid manner. Conducting a survey is recommended for the following reasons:

- *This is the only means of collecting data and opinions representing all residents.*

- *Even with a low response rate, you hear from more residents than any other method; particularly public meetings where typically less than 50 people attend.*
- *Results can be more accurate and powerful than other methods.*

Early in the planning process, the project team and the Poquessing Creek Steering Committee noted the importance of the neighborhood survey and began designing a method for random community sampling. A questionnaire was designed to educate the community and to generate a high response rate. The three-page questionnaire contained directions, an introductory overview of the Poquessing Creek Watershed Rivers Conservation Plan, a definition of what defines a watershed, a map of the watershed, a list of major tributaries to the Poquessing Creek, over twenty (20) questions/fill-in-the-blanks (e.g., categories: general respondent information, general watershed awareness, overall perception, suggested recommendations, opportunities for involvement), and an overview of the Poquessing Creek Watershed Partnership.

The residents closest to the main stem and the major tributaries of the Poquessing Creek were targeted for the neighborhood survey. Two-thousand (2000) landowner addresses were identified and stored in a database for use in this portion of the project.

Due to the Poquessing Creek Watershed's dense population (see population and statistical information in the Poquessing Creek Watershed Rivers Conservation Plan), the 2000 addresses acquired adequately fulfilled the PADCNR's suggested sample size for surveys in heavily populated areas. Pre-addressed and prepaid community surveys were mailed in early January 2005, with a three month time period provided for questionnaire responses. Of the 2000 surveys that were mailed out, 126 were returned.

Similar to the key person interview responses, the community survey responses were also shared with the committee and incorporated into this plan. Some of the responses were intriguing, for instance the youngest respondent was 25 and the oldest respondent was 89 and those living in the watershed for the longest period of time (e.g., over 20 years) were more apt to answer the questionnaire. Other findings were quite positive. For example, the majority of respondents knew the definition of watershed, felt that protecting the watershed was important, and felt the most valued features associated with the Poquessing Creek were the scenery and beauty.

Although the majority of respondents rarely spend time on the creek, many noted that the water quality had remained the same for many years and took the time to recommend ways to improve the Poquessing Creek. In addition, of the 126 individuals responding to the survey, over eighty people provided contact information to receive additional information about watershed events and project meetings. A number of individuals submitted written comments about their opinions as well as photographs of their land. Several community members shared very specific problems within their responses that needed to be addressed. For example, one property owner complained about his battles with trash, open fires and other problems

on his stretch of the Poquessing Creek. Within two weeks, the Philadelphia Water Department contacted the landowner and arranged a clean-up on the landowner's section of the river.

In conclusion, the responses from the community survey really helped to shape the committee's development of the goals, objectives and recommended activities within the conservation management plan. A copy of the questionnaire, memo noting findings and a table of the received responses / written comments are included in the appendices (see Appendix A.6).

Figure 3-3. Landowner's Backyard Before Clean-up

Figure 3-4. Trash Removed from Landowner's Backyard

3.3.5 Neighborhood / Community Meetings

Neighborhood meetings were another selected means to educate the public and solicit feedback and input for the Poquessing Creek Watershed Rivers Conservation Plan. The purpose of these meetings was to gather information from residents about their attitudes and interests, as well as their reactions to the project's findings and recommendations.

PWD, the project team and the Steering Committee agreed that hosting neighborhood meetings would be more convenient for some residents because many were unable to attend quarterly steering committee meetings and public meetings.

Many neighborhood organizations were identified early in the planning process, and for over a year, the following groups were very helpful and provided worthwhile information and recommendations: Bustleton Civic Association, East Torresdale/Andalusia Community Group, The Friends of Glen Foerd Mansion, The Friends of the Poquessing Creek, Parkwood Civic Association, Nazareth Academy, Mechanicsville Civic Association, Lin Park Civic Association, Liberty Square Development Homeowners Association.

Quite a bit of effort went into trying to meet with and present information to additional community groups (e.g., West Torressdale Civic Association, municipal Environmental Advisory Committees, Walton Park Community Group, and the Somerton Civic League), however the timing of this particular project phase did not always coincide with the needs of the community groups and their individual members (e.g., election time, start and end of school year etc.). Despite that fact, these meetings provided worthwhile information, helped educate citizens, and generated additional recommendations for the conservation management plan.

Generally, 30-45 minutes were provided to the project team, and a number of important items were addressed at every presentation (e.g., definition of watershed and project area, an overview of the facets of the Poquessing Creek Rivers Conservation Plan, information and information sources for inclusion in the plan, the public outreach and education program, the definition of watershed amenities and issue areas, community input on amenities and issue areas, and an open comment period). This approach also allowed individuals from the selected neighborhoods an opportunity to voice special issues that directly affect their neighborhood as well as addressing municipal-wide concerns. An overview memo providing information obtained from each meeting is included in Appendix A.7 of this plan.

3.3.6 Special Events

The Philadelphia Water Department Office of Watersheds has hosted a number of special events that provide environmental education and family fun. One example is the Philly Fun Fishing Fest hosted in September which celebrates the revitalization of

sport fishing in the Schuylkill River. This particular event is a fishing tournament open to all skill levels and ages.

The Stormwater Best Management Practices (BMP) Recognition Program is another special event sponsored by PWD. This event provides an opportunity for education and acknowledgement. The goals of the Stormwater BMP Recognition program are:

- To recognize innovative stormwater management BMPs in the region.
- To increase awareness and understanding of innovative stormwater management.
- To create incentives to continue the development of stormwater BMPs.

The BMP program highlights stormwater management projects based on natural designs (e.g., rain gardens, green roofs, infiltration swales, treatment wetlands). Participants are provided with a venue to highlight their projects and are acknowledged at an awards ceremony. Other events sponsored by PWD have included informational venues such as the 2005 and 2006 Urban Watersheds Revitalization Conference.

Several special events and workshops were organized, hosted and implemented by PWD and the project team for the Poquessing Creek RCP project. They are described in the following subsections.

Earth Day Clean Up

During the spring of 2006 (April 22, 2006) an Earth Day Cleanup in the Poquessing was coordinated by PWD, PA CleanWays, Fairmount Park Commission, the Poquessing Watershed Partnership and the Pennsylvania Department of Environmental Protection.

PA CleanWays is a non-profit organization that helps residents take action against illegal dumping and littering in their communities. Their mission is to eliminate illegal dumping and littering in Pennsylvania, and their core programs revolve around cleanups, adoptions and education. Their mission is carried out in local communities through PA CleanWays chapters and affiliates, special projects, and programs that encourage everyone to join the fight against illegal dumping and littering.

The partnering groups worked together to select two sites (Frankford & Hegermen Road and Townsend Road), supply all necessary materials, and advertise the cleanup event (see flyer in Appendix A.8 of this plan).

The Earth Day Clean Up at Frankford & Hergerman Roads was quite successful. The total weight of trash removed was 3,280 pounds. Two (2) cars were also removed from that site (5,000 pounds). Therefore the total weight of trash removed from that site was 8,280 pounds.

A subsequent cleanup at Townsend Road included the removal of eleven (11) cars and 105 tires. Therefore the total weight of trash removed from that site was 40,585 pounds.

Figure 3-5. Earth Day Cleanup 2006

Information about the Poquessing RCP was provided to all participants in the cleanup. A tabletop display about the project was set up on site and a number of brochures were distributed about upcoming events. Several volunteers were added to our e-mail list and continued to participate in the planning process and related events.

Photography Contest *and 2008 Poquessing Watershed Rivers Conservation Plan Calendar*

In June 2006, a photography contest geared towards amateur photographers was also implemented – ***Distinctive & Picturesque Poquessing: A Photography Contest***. The contest was part of an educational outreach effort sponsored by the Philadelphia Water Department (PWD) and associated with the completion of the Poquessing Creek Watershed Rivers Conservation Plan. The intent was to reach out to another sector of the community, provide them with information about the Rivers Conservation Plan, and provide another way to get involved.

The contest was free of charge and participants were asked to focus on the Poquessing Creek and its many distinctive and picturesque features. Examples of distinctive and picturesque features included natural features (nature and landscapes), cultural & historic features (architecture, cultural events), and recreational features (outdoor activities).

Hard copies of the flyers and contest rules (see Appendix A.9) were distributed to over 40 camera shops, schools, photography clubs and film developers throughout the watershed (e.g., drug stores, camera sales and repairs shops, high schools). Those distributing information were contacted afterward via phone and supplied with additional flyers if needed. The event was also advertised on the PWD website, as well as at meetings and events throughout project duration. Eight submittals were received and judging was completed by members of the Poquessing Creek Watershed Rivers Conservation Steering Committee.

There were three winning photographs and an honorable mention, all from a Philadelphia area High School. All winners received prizes. The winning photographs are included in Appendix A.9.

The photographs from the contest were placed in a 2008 calendar, titled "Poquessing Creek Watershed, 2008 Calendar" (see Appendix A.15). This project was partially funded by a Coastal Nonpoint Pollution Program (CNPP) grant from the Department of Environmental Protection (DEP). The calendar includes the River Conservation Plan Executive Summary, in addition to the twelve RCP goals, which represent each month of the calendar. The photographs in the calendar include the winning photographs from the photography contest, in addition to photographs provided by partners of the Poquessing Watershed Partnership. The calendars have been distributed at events throughout the watershed and to steering committee members, whom will also act as distribution vehicles.

Grate Mates™ Storm Sewer Education

A third event involved local schools in a hands-on project we hoped would teach participants at Arch Bishop Ryan High School about stormwater runoff and stormwater BMP's for the Poquessing Creek Watershed.

Planet CPR is a non-profit organization that develops new ways to help more people conserve, protect and restore the environment. The organization is currently working on a major initiative called "The Grate Mates™ Fundraising Program". The Grate Mates fundraising program is a partnership between youth groups and businesses to reduce water pollution and protect aquatic habitat by installing special cloth filters in parking lot storm drains. The grate mates are filters designed to catch oil and sediment from stormwater runoff before the pollution drains to nearby water bodies (see Appendix A.10 for additional information). The installation is completed by trained youth volunteers.

The Poquessing Creek Steering Committee began working with Archbishop Ryan High School when one of their educators interviewed for this project expressed an interest in participating on the Committee (see Section 3.3.3, Key Person Interviews). The educator began attending quarterly meetings and requested that his students begin working on projects to address stormwater problems in the Poquessing Creek.

During the 2005-2006 school years, PWD and project consultants provided written material, measured two storm drains in the parking lot of Archbishop Ryan High School, ordered the grate mates materials intended for installation, and provided hands on educational materials for pre and post installation stormwater pollution measurement. Although the restoration was not completed (a decision was made to install the grate mates in another area of the watershed due to logistical reasons) a positive partnership was made with the high school and educational outreach did take place.

3.3.7 Public Meetings

Public meetings were another way that the Poquessing Creek Steering Committee and the project team educated the public about the status and findings of the RCP. More importantly, the public meetings provided an additional venue to obtain feedback on key phases of the project, especially the goals, objectives and recommended activities included in the conservation management plan. Four public meetings will be held by the time the RCP is completed. Please refer to Appendix A.11 for public notices.

Table 3-1. Public Meeting Schedule

Public Meeting #	Title	Date	Time	Location	Hosted By
1	Poquessing RCP Public Meeting	April 25, 2006	6:30 p.m.	Glen Foerd Mansion	Poquessing Watershed Partnership
2	Poquessing Historical Presentation & Poquessing RCP Public Meeting	April 5, 2007	7:30 p.m.	Community College of Philadelphia	Friends of Poquessing
3	Land Management Workshop & Poquessing RCP Public Meeting	April 25, 2007	3:30 p.m.	Community College of Philadelphia	Partnership for Delaware Estuary
4	Native Plants Workshop, Rain Barrel Giveaway & Poquessing RCP Public Meeting	May 5, 2007	10:00 a.m.	Academy Ave. & Torrey Rd. (park)	Fairmount Park Commission/ Friends of Poquessing

SECTION 4: Land Resources

4.1 Introduction

The Poquessing Creek Watershed is a fairly small suburban watershed transected by several heavily traveled arteries including the major interstate highway, I-95. It is dominated by residential and commercial development, but it has a reasonably high percentage of recreational area, considering its urban setting. It is located between the Atlantic Coastal plain and the Appalachian Mountain lowlands. Prior to urbanization it was an agricultural region due to the presence of good soil, fairly level terrain and its proximity to major transportation routes, including the Delaware River. The watershed is in close proximity to two major population centers, Philadelphia and New York City. The Poquessing Creek Watershed is around 50 miles from New York City and approximately 60% of the watershed is within the boundary of the City of Philadelphia.

4.2 Land Ownership

Approximately 16% of the Poquessing Creek Watershed is publicly owned, while the majority of the land is privately owned (Map IV). Detailed land ownership for the watershed was not available in digital GIS format, therefore, the locations of parks, schools and other known public sites (such as the airport) were overlain over the parcel outlines that were made available by Bucks, Montgomery and Philadelphia Counties, as illustrated in Map IV. The parcels that corresponded to the publicly owned areas were selected and their total areas were tabulated (see Table 4-1). This is not an exact calculation, but the numbers generated do indicate that there is a reasonable amount of public land within the boundaries of the watershed.

Table 4-1. Publicly Owned Land

Category	**Acres**
PARKS/ RECREATION	972
AIRPORT	422
SCHOOLS	406
FORMER STATE HOSPITAL	361
HOSPITALS	27
MUNICIPAL COMPLEXES	5
LIBRARIES	1
FIRE STATIONS	1
TOTAL	**2,195**
Percent of Watershed	16

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- IV: PUBLICLY OWNED LAND

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
Benjamin Rush State Park
Poquessing Creek Park
Philadelphia NorthEast Airport
Bensalem Country Club
John F. Byrne Golf Course
Fluehr Park
Glen Foerd Estate
Delaware River
NEW JERSEY
Poquessing Creek
Walton Creek
Byberry Creek
Byberry Road
Woodhaven Road
Knights Road
Street Road
213
276
532
1
63
132
513
95
13

PUBLICLY OWNED LAND

- AIRPORT
- FIRE STATION
- HOSPITAL
- LIBRARY
- MUNICIPAL COMPLEX
- PARK/ RECREATION FACILITY
- SCHOOL
- PUBLIC - OTHER

4,000 2,000 0 4,000
Feet

MAP-IV
PUBLICLY OWNED LAND

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water Bodies
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary - PWD
Roads - PWD/PennDOT
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Publicly Owned Lands - Derived from Philadelphia, Montgomery and Bucks County parcel data and other data layers.

Forbes Environmental and Landuse Planning
12 Brookdale Drive
New Britain, PA 18901
Tel: 215-230-9549

Borton-Lawson
Lehigh Valley
3893 Adler Place
Bethlehem, PA 18017
Tel: 484-821-0470

PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

FILE: \\WBData\Projects\2005\1756\00\DATA\GIS\ArcMAP\wshed_poquessing.mxd

The larger public sites within the watershed include Benjamin Rush State Park, the Fairmount Park System, the Bensalem Country Club, the former Philadelphia State Hospital and the Philadelphia Northeast Airport. The largest tract of publicly owned land is the approximately 422 acres (Philadelphia Northeast Airport). The Benjamin Rush State Park and the Fairmount Park system account for approximately 473 acres together (Benjamin Rush State Park, ~ 275 acres; Fairmount Park system, ~198 acres). The Bensalem Country Club is located on approximately 150 acres and the former State Hospital lands occupy 361 acres. The former State Hospital lands are currently under public ownership, but they are planned for commercial and residential development in the near future.

4.3 Geologic Characteristics

The southern two-thirds of the watershed is underlain by the Wissahickon and the Pennsauken and Bridgeton Geologic formations. The area is predominately the Wissahickon formation which is characterized by schist and gneiss but contains inclusions of sands and some gravel (Pennsauken and Bridgeton). The geology of the northern portion of the watershed is a combination of the Chickies, Felsic Gneiss, Mafic Gneiss and Ledger formations with a band of diabase in the northwestern corner.

Gneiss rocks are the metamorphic form of sedimentary or igneous rocks, typically granite, meaning that they have metamorphosed into Gneiss through the interaction of heat and pressure at depth within the Earth's crust. Gneissic rocks are banded, coarsely foliated (meaning the individual mineral grains split off easily into flakes or slabs) and largely recrystalize, but do not carry large quantities of micas, chlorite or other platey minerals. Whereas the schists are a group of medium-grade metamorphic rocks typically formed from phyllite that are strongly foliated and noted for being composed mainly of minerals, such as micas, chlorite, talc, horneblende and graphite. The different types of gneiss and schists are a function of the major minerals that make up that particular rock.

The diabase in the northwestern corner of the watershed is an igneous rock formed when lava seeps toward the Earth's surface as a dike or sill and cools before ever reaching the surface. It is a hard, fine-grained very dense rock that does not readily erode when exposed at the Earth's surface due to its hardness and lack of foliation. Diabase can be found at the crest of local ridges and hills within the watershed because it has persisted in the environment due to its low erodibility where other less dense, more erodable rocks have eroded away long ago and left the level terrain seen at present.

A narrow band of dolomite, which is composed of calcuim-magnesium carbonate is also present near the border of Philadelphia and Montgomery County, parallel to one of the upper reaches of the Poquessing Creek. This band of dolomite is known as the Ledger formation. Dolomite is a form of limestone and as such is highly erodable and typically has voids within it where the rock was dissolved by water. These voids can often be large enough to store large volumes of groundwater which then feeds nearby streams and

rivers. This action helps maintain a baseflow in the stream during dry periods. The geologic map of the watershed can be found in Map V.

Below are descriptions of the geologic formations found in the watershed:

SOUTH PORTION OF WATERSHED
MAP SYMBOL: Cch NAME: Chickies Formation GEOLOGIC DESCRIPTION: Light-gray, hard, massive, *Skolithos*-bearing quartzite and quartz schist; thin, interbedded dark slate at top; conglomerate (Hellam Member) at base.
MAP SYMBOL: gqm NAME: Graphitic felsic gneiss GEOLOGIC DESCRIPTION: Medium grained, medium to dark gray; locally gneissic, predominantly feldspar and quartz, plus dark accessories and various alteration minerals.
MAP SYMBOL: Cl NAME: Ledger Formation GEOLOGIC DESCRIPTION: Light-gray, locally mottled, massive, pure, coarsely crystalline dolomite; siliceous in middle part.
MAP SYMBOL: Xmgh NAME: Mafic gneiss GEOLOGIC DESCRIPTION: Dark, medium grained; includes rocks of probable sedimentary origin; may be equivalent to "mgh" in places.
NORTH PORTION OF WATERSHED
MAP SYMBOL: md NAME: Metadiabase GEOLOGIC DESCRIPTION: Dark-gray, fine-grained intrusives; locally, mineralogy is altered and unit has greenish color.
MAP SYMBOL: Tpb NAME: Pensauken and Bridgeton Formations, undifferentiated GEOLOGIC DESCRIPTION: Dark-reddish-brown, cross-stratified, feldspathic quartz sand and some thin beds of fine gravel and rare layers of clay or silt.
MAP SYMBOL: Qt NAME: Trenton Gravel GEOLOGIC DESCRIPTION: Gray or pale-reddish-brown, very gravelly sand interstratified with crossbedded sand and clay-silt beds; includes areas of Holocene alluvium and swamp deposits.
MAP SYMBOL: Xw NAME: Wissahickon Formation GEOLOGIC DESCRIPTION: Includes oligoclase-mica schist, some hornblende gneiss, some augen gneiss, and some quartz-rich and feldspar-rich members due to various degrees of granitization.

These descriptions are taken directly from the pdf document "explanation.pdf" as obtain from the Pennsylvania Department of Conservation and Natural Resources. The explanation.pdf file is a reproduction of the document "**EXPLANATION OF GEOLOGIC UNITS:** The descriptions are modified from Berg, T. M., Geyer, A. R., Edmunds, W. E., and others, compilers, 1980, *Geologic map of Pennsylvania*, Pennsylvania Geological Survey, 4th ser., Map 1."

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- V: GEOLOGY

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
BUCKS COUNTY
LOWER MORELAND
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Byberry Road
Poquessing Creek
Street Road
Walton Creek
Woodhaven Road
Knights Road
Delaware River
213
276
532
1
513
132
63
95
13

Geology

- Chickies Formation
- Felsic Gneiss, Pyroxene bearing
- Ledger Formation
- Mafic Gneiss, Hornblende bearing
- Metadiabase
- Pensauken and Bridgeton Formations, Undifferentiated
- Trenton Gravel
- Wissahickon Formation (Oligoclase Mica Schist)
- Limestone

4,000 2,000 0 4,000
Feet

FILE: \\WBData\Projects\2005\1756\00\DATA\GIS\ArcMAP\wshed_poquessing.mxd

MAP-V
GEOLOGY

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water Bodies
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
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DATA SOURCES:
Watershed Boundary: PWD
Roads - PWD/PennDOT
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service (Derived from NWI Wetlands)
Geology - PA DCNR/PA Geologic Survey

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DATE: 06/01/2007 PROJECT #: 2005-1756-00

4.4 Soil Characteristics

There were two different sets of soil data obtained for the Poquessing Creek Watershed from the USDA Natural Resources Conservation Service (NRCS): the General Soils data and the individual County Soil Surveys data. Both of these surveys are the most up-to-date certified soil data that is currently available.

General Soils

The General Soils data is a statewide soils map generated to illustrate overall soil characteristics (see Map VI). A generalized soils group can consist of up to 21 different soil components; however, the naming convention is typically based on the three largest components within the group. Only two generalized soil groups were identified in the Poquessing Creek Watershed: the Chester-Glenelg-Manor group and the Urban-Westbrook-Pits group.

The Chester-Glenelg-Manor group extends from the northern part of the watershed down through the center reaching Interstate 95. It encompasses almost all of the area north of Route 1, except for the area around the interchange with Route 63 (Woodhaven Road), north of the airport. This group represents more naturally occurring soils, less disturbed soils than the Urban-Westbrook-Pits group.

The Urban-Westbrook-Pits group represents more disturbed areas where a natural soil profile may not exist. This soil group is found on both the eastern and western sides of the watershed. It corresponds to areas on the western portion of the watershed around the airport and the corridor along Route 132 (Street Road) leading into Route 513. Some of this area is included in the group due to its developed nature while other areas are included because they are existing or historic tidal marshes that are associated with the Delaware River.

Below is a listing of the general soils groups within the watershed and a description of the three largest components.

CHESTER-GLENELG-MANOR (PA061)
CHESTER The Chester series consists of very deep, well drained, moderately permeable soils on uplands. They formed in materials weathered from micaceous schist. Slopes range from 0 to 65 percent.
GLENELG The Glenelg series consists of very deep, well drained, moderately permeable soils on uplands. It is formed in residuum weathered from micaceous schist. Slopes range from 0 to 55 percent.
MANOR The Manor series consists of very deep, well drained to somewhat excessively drained, moderately permeable soils on uplands. They formed in materials weathered from

micaceous schist. Slopes range from 0 to 65 percent.

URBAN-WESTBROOK-PITS (PA072)
URBAN LAND Urban land is nearly level to a moderately steep mixture of soil, rock, and miscellaneous manmade material. It is found in industrial, commercial, and some residential areas where urban structures and works are so obscure on the land surface that identification of the soils is not practical. Most areas are on uplands or terraces, but some are on flood plains. In many places the original soil profile has been completely destroyed, but in some scattered areas the soils remain intact. Urban land is used as sites for shopping centers, schools, factories, railroads, homes, and other urban and industrial facilities.
WESTBROOK
The Westbrook series consists of very deep, very poorly drained soils formed in organic deposits over loamy mineral material. They are in tidal marshes subject to inundation by salt water twice daily. Saturated hydraulic conductivity is moderately high to very high in the organic layers and low to high in the underlying mineral sediments.
PITS The Pits series consists of very deep, poorly drained soils that formed in fine-textured alluvium, weathered from extrusive and basic igneous rocks. Pits soils are on flood plains and in basins. Slopes range from 0 to 5 percent

County Soil Surveys

For county soil surveys, individual mapping units were delineated by soil scientists and detailed information compiled about the various types of soils observed. The soil mapping areas were drawn on aerial photos and the information about the soils from field analysis was written up and published in the county soil survey booklet. These original county surveys were done independently for each county, resulting in soils along county borders not matching well and having different descriptions even though they are the same soil.

The USDA is currently in the process of matching the soil mapping units that are located along the county boundaries and converting these maps into a digital format and creating a digital database of the soils. The digital database that they are creating with the soils information is referred to as the National Soil Information System (NASIS). The digital soil maps and the NASIS database were obtained pertaining to Montgomery, Bucks and Philadelphia counties. The digital soils map data were processed to produce a single GIS layer for the watershed and the databases queried to obtain pertinent information about the soils.

POQUESSING CREEK WATERHSED RIVER CONSERVATION PLAN
MAP-VI: GENERALIZED SOILS

Location Map

GENERALIZED SOIL GROUPS

- PA061: CHESTER-GLENELG-MANOR
- PA072: URBAN-WESTBROOK-PITS

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
PA061
PA072
Byberry Road
Poquessing Creek
Street Road
Walton Creek
Woodhaven Road
Knights Road
Delaware River
NEW JERSEY
213
276
532
1
63
132
513
95
13

4,000 2,000 0 4,000
Feet

MAP-VI
GENERALIZED SOILS

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Railroads

Roads

- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads

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DATA SOURCES:
Watershed Boundary - PWD
Roads - PWD
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service (Derived from NWI Wetlands)
Generalized Soils - USDA/ NRCS: State Soil Geographic (STATSGO) Database

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Approximately 72% of the watershed is dominated by soils classified as Urban Land. This is not a soil description but rather a land use designation because this soil has been highly modified through development and large portions of it covered by impervious surfaces such as buildings, roads, etc. Where there is soil present at the surface, it is most likely fill from another area within or outside the watershed. The soil may also have been extensively reworked through grading and other activities, therefore the soil characteristics cannot be described on a regional basis because the soils are not native to the location that they are in.

There are generally five basic categories of soil as illustrated in Map VIIA. These categories are sandy, loam, silt loam, schist and gneiss, and gravel.

There are only a few small areas within the watershed that contain sandy and gravelly soils. A small portion of sandy soil is found near the mouth of the Poquessing Creek. Gravelly soils can be found along Interstate I-95, where it transects the watershed, near the intersection of Route 63 and Route 13 and near the intersection of Route 63 and Byberry Road.

About 2% of the soil in the watershed is classified as a loam soil and about 22% is considered to be a silty loam (indicating a higher percentage of silt). The largest areas of loamy/silty soils are found in the middle of the watershed in the general vicinity of Benjamin Rush State Park and at the north western portion of the watershed in Lower Moreland and extending into Lower Southampton Townships. Loamy soils contain a balance of sand, silt and clay (approximately 40% sand, 40% silt, 20% clay) that makes it a good soil for many uses such as gardening, agriculture and forests.

Schistic and gneissic soils make up approximately 3% of the watershed and are not concentrated in any particular area. These soils are less weathered than the loam and silty loam and more closely resemble the parent materials, the bedrock geology. These soils are described as being “micaceous” indicating that they contain observable flakes of mica and are somewhat granular. They are found in the area underlain by Wissahickon, Mafic Gneiss, Felsic Gneiss and Chickies formations.

Among the soil characteristics recorded by the USDA-NRCS is the soil’s runoff potential (see Map VIIB). Almost all of the soil within the watershed has a high runoff potential with a few isolated areas having medium or low runoff potential because the majority of the soil in the Philadelphia area is designated as urban because the area is densely developed. Areas that are not paved or otherwise covered with structures or other impervious surface may have a lower runoff potential if the areas are large and relatively undisturbed. Individual lawns, small parks and other heavily used areas are likely to be heavily used and thus the soil is more compacted leading to high runoff potential.

Soils with high runoff potentials have the ability to significantly impact streams. Soils with high runoff potential are unable to absorb large quantities of rain and therefore flooding is more intense in urban areas with high runoff potential because a larger

volume of water reaches the stream than in rural areas with low runoff potentials. Erosion rates are often much higher in areas with high runoff potentials because of the soil's inability to absorb water; therefore, more water is available to erode.

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- VIIA: GENERAL SOIL CHARACTERISTICS

Location Map

UPPER SOUTHAMPTON
BUCKS COUNTY
LOWER SOUTHAMPTON
LOWER MORELAND
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Poquessing Creek
Byberry Road
Street Road
Woodhaven Road
Knights Road
Walton Creek
Delaware River
213
276
532
1
63
513
132
95
13

Soils

GENERAL DESCRIPTION

- Sandy
- Loam
- Silt Loam
- Schist and Gneiss
- Gravel
- Quarries
- Urban Land

4,000 2,000 0 4,000
Feet

MAP-VIIA GENERAL SOIL CHARACTERISTICS

Philadelphia Water Department

Prepared for: PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

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Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Soils - USDA/NRCS National Soil Information System

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POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- VIIB: RUNOFF POTENTIAL

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BENSALEM
PHILADELPHIA
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
NEW JERSEY
Delaware River
Poquessing Creek
Byberry Road
Street Road
Woodhaven Road
Knights Road
Walton Creek
213
276
532
1
63
132
513
95
13

Soils

- Urban Areas
- Very high
- High
- Medium
- Low
- Very low
- Negligible

4,000 2,000 0 4,000
Feet

MAP-VIIB
RUNOFF POTENTIAL

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
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Roads - PWD
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Soils - USDA/NRCS National Soil Information System

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Another significant effect of soils with high runoff potential is the inability of rains to percolate through the soil to replenish the groundwater table. Shallow groundwater is the predominate source of base flow in small low-order streams. When rain water percolates through the soil, it accumulates on less permeable layers and forms a saturated zone or a water table. Water tables can sometimes be perched above depressions in bedrock which impedes water infiltration. When enough water accumulates, a wetland is formed. When water tables develop on any sort of slope, the water moves by gravity downslope, the rate of which depends on the type of soil. Loose sandy soils are unable to hold large amounts of water, but they transmit the water quickly, whereas silty/clayey soils hold large amounts of water but do not readily move the water. Eventually, the water table may reach the surface and seep out of the soil and contribute to a stream or river. During dry periods, the groundwater may be the only source of water that keeps a stream flowing to maintain the aquatic habitat. During dry periods, groundwater may be the only source of water that keeps the stream flowing and maintains the aquatic habitat.

4.5 Land Preservation Programs and Preserved Land

Although there has been development in the majority of the Poquessing Creek Watershed for many years and headwater areas in the outlying municipalities have been subjected to suburban sprawl, there are still several key areas in the watershed that remain relatively undeveloped. Many other areas within the Watershed are protected by a number of government and non-government preservation programs. These areas are explored more closely in the Historic, Cultural, Scenic and Recreational Resources Section (Section 7) and are illustrated on Map IV (Publicly-Owned Land) and Map VIII (Open Space and Recreation).

Some of the active land preservation programs and open space advocacy programs in the Poquessing Creek Watershed include the following:

- County (Bucks, Montgomery and Philadelphia) open space and farmland preservation programs
- Delaware Valley Regional Planning Commission
- Friends of the Poquessing Creek Watershed
- Fairmount Park Commission
- Heritage Conservancy
- Montgomery County Lands Trust
- Municipal open space programs
- Natural Lands Trust
- Pennsylvania Department of Agriculture, Bureau of Farmland Preservation
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Environmental Commission
- Penn Environment Research & Policy Center
- Philadelphia Green Plan (completion due December 2007)
- Preservation Alliance for Greater Philadelphia

- Ten-thousand Friends of Pennsylvania (The Southeastern PA Metropolitan Development Network)
- Temple University
- University of Pennsylvania

According to the Delaware Valley Regional Planning Commission (DVRPC), the suburban counties have been initiating efforts since the 1980s to buy up remaining open space as a means of protecting natural resources and providing for recreation (DVRPC, Locally Funded Open Space Programs, June 2006). They further note that seven of the eight suburban counties and about 30% of the municipalities in the region have dedicated funds for open space preservation through bond referendums and special taxes.

The DVRPC also maintains an inventory of protected public and private open space in the Delaware Valley. The last inventory was completed in December 2004; however, it is updated periodically. The inventory tracks federal, state, county and municipally owned lands, preserved farmland and privately owned protected open spaces. State, county and municipal programs preserve farms by purchasing development rights with public funds. Land trusts and conservancies protect privately owned open space lands from development by purchasing easements or by acquiring land outright with a combination of public and private monies. Table 4-2 notes the regionally protected open space in the Delaware Valley region. Again, open space areas more specific to the Poquessing Creek Watershed are explored further in Section 6 of this plan.

Table 4-2. Regionally Protected Open Space

Publicly Owned Lands							*Privately Owned Lands*				
County	*Federal*	*State*	*County*	*Municipal*	*Total Protected Public Open Space*	*Protected Public Open Space as Percent of Total Area*[10]	*Public Protected Acreage per 1000 People*[11]	*Preserved Farmland*	*Land Trust or Privately Protected*	*Total Protected Private Open Space*	*Protected Private Open Space as Percent of Total Area*[10]
Bucks[1]	0	12,880	8,322	10,363	31,565	8.12%	52.8	8,014	7,617	15,631	4.02%
Chester[2]	1,290	7,105	5,792	7,714	21,901	4.53%	47.9	20,688	30,660	51,348	10.61%
Delaware[3]	726	2,683	844	5,197	9,450	8.02%	17.2	208	2,289	2,497	2.12%
Montgomery[4]	1,964	4,475	5,770	11,031	23,240	7.52%	31.2	6,183	3,606	9,789	3.17%
Philadelphia[5]	365	282	8,126	1,360	10,133	11.72%	6.7	0	531	531	0.61%
PA TOTAL	**4,345**	**27,425**	**28,854**	**35,665**	**96,289**	**6.95%**	**24.8**	**35,093**	**44,703**	**79,796**	**5.76%**

Source: DVRPC, Protected Open Space Inventory, December 2004

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- VIII: OPEN SPACE AND RECREATION

Location Map

LAND OWNERSHIP	ACREAGE	PERCENT
CEMETERIES	578.7	4.2
FAIRMOUNT PARK COMMISSION	373.8	2.7
PRIVATE RECREATION	262.6	1.9
BUREAU OF STATE PARKS	251.8	1.8
COUNTY & LOCAL PARKS	400.5	1.8
LOWER MORELAND PROTECTED LANDS	20.1	.1
HOMEOWNER'S ASSOCIATION OPEN SPACE	12.5	.0
LOWER SOUTHAMPTON TOWNSHIP OWNED	3.1	.0

LOWER SOUTHAMPTON
LOWER MORELAND
BENSALEM
PHILADELPHIA
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
BUCKS COUNTY
NEW JERSEY
Russell Elliott Memorial Park
Bensalem Twp. Trails
Pennypack Trail
Tacony Park Trails
Eagle Pointe (Formerly Phila. State Hospital)
Philadelphia Park Race Track
Benjamin Rush
Bensalem Country Club
Torresdale - Frankford Country Club
Byrne Golf Course
Fluehr Park
Glen Foerd
Northeast Philadelphia Trail
Poquessing Creek
Walton Creek
Byberry Road
Woodhaven Road
Knights Road
Street Road
Delaware River
213
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Feet

MAP- VIII
OPEN SPACE AND RECREATION

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Streams
- Existing and Proposed Park Trails
- Proposed Trail Connectors
- Proposed Northeast Philadelphia Trail
- Interstate
- US Federal Highway
- PA State Road
- Local Roads
- Railroads

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Roads - PWD
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Recreational Facilities -
Parks - PWD
Park Trails - City of Philadelphia

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4.6 Potential Hazard Areas

The United States Environmental Protection Agency (USEPA) and the Pennsylvania Department of Environmental Protection (PADEP) monitor existing and potential hazardous waste areas. Areas of environmental concern include EPA Superfund Sites, CERCLA landfills and other permitted and non-permitted hazardous waste land uses. In order to research those areas considered "potentially hazardous," both the USEPA and PADEP were contacted to locate sites in the Poquessing Creek Watershed.

Federal Hazards Information

On its website, the EPA notes that it is "committed to public access to environmental information." Toward that end, the Agency has created several databases that are placed on the internet for public access of its data systems. The databases provide information contained in core EPA data systems. The Enforcement and Compliance History on Line (ECHO) database system focuses on facility compliance and EPA/State enforcement of environmental regulations. In previous years, the data included within ECHO were in the public domain through Freedom of Information Act requests and the mainframe computer subscription; however, it was not available in a searchable Web format. The ECHO database is intended to make it much easier for the public to obtain compliance records from the internet. ECHO is a Web interface that draws data from the Integrated Data for Enforcement Analysis system (IDEA). IDEA, operated by EPA's Office of Enforcement and Compliance Assurance, integrates facility data from disparate EPA databases, and allows users to find inspection, violation, enforcement action, informal enforcement action, and penalty information about facilities for the past three years. Facilities regulated under the following environmental statutes are included in the database: Clean Air Act (CAA) Stationary Source Program, Clean Water Act (CWA), National Pollutant Elimination Discharge System (NPDES), and Resource Conservation and Recovery Act (RCRA).

A database search through CAA, CWA, NPDES and RCRA permits are not available on a watershed-wide basis through the ECHO data base; however EPA staff recommended a zip code search for the most comprehensive data available. By default, ECHO database searches focus on larger, more regulated facilities which are based on the regulatory program. However, information on smaller facilities is provided in the table below.

According to the EPA, *Violation, noncompliance, significant noncompliance, and high priority violation are all terms used by the ECHO site to describe the facility status in regard to compliance with the law. In many cases, these terms reflect determinations made by EPA or States when conducting inspections or reviewing facility self-reports. These determinations assist the government in tracking resolution of violations through the enforcement process and do not necessarily represent a final adjudication by a judicial or administrative body. In such cases, these characterizations should be considered alleged violations.* Permit violations are noted in the table below for major facilities only.

Table 4-3. Federal Hazardous Waste Facilities, Poquessing Watershed

Search Area	Major Facilities (#)	Minor Facilities (#)	Alleged Current, Significant Violations (Major Facilities)	Informal/Formal Enforcement Actions (Major Facilities)
NE Philadelphia 19114	9	68	None	None
NE Philadelphia 19116	5	60	None	None
NE Philadelphia 19154	4	57	None	1 (Delaware Valley Hospital
Bensalem Township 19020	17	199	None	2/1 (Bake Rite Rolls) 1/0 (Metal Improvement) 0/1 (Holy Ghost School) 0/1 (School Lane Charter School)
Lower Southampton Township 19053	5	92	None	2/1 (Boekel Industries) 2/0 (Tolas Health Care Packaging)
Lower Moreland Township 19006	4	76	None	1/0 (Bostik PLT) 1/1 (Fredericks) 0/1 (Valley Christian Schools)

Source: USEPA Enforcement and Compliance History on Line (ECHO).

State Hazards Information

Several departments within the PADEP handle watershed planning, water quality and water quantity issues, and waste management concerns. In order to obtain information on existing landfills, transfer stations, and industrial uses of concern, the Department of Waste Management's Environmental Facility Application Compliance Tracking System (E-Facts) database was consulted. This database was recently expanded from what was formerly called the DEP Compliance Reporting System.

The E-Facts is an on-line database that has been available to the public for several years and contains compliance information on regulated facilities as well as information on permitting, licensing and pending applications. According to PADEP, the Council of State Governments named the DEP Compliance Reporting System as one of 1999's eight most innovative programs in the United States and Canada. When the Compliance Reporting System was introduced by the PADEP in 2004, seven public Compliance Roundtables were held at different locations throughout the state that involved over 500 citizens, local officials, representatives of business and industry and environmentalists. The improved database now includes:

- A significantly enhanced list of regulated sites and their owners;

- Information about issued permits when that information is available electronically;
- Information about the status of pending permit applications, including Money-Back Guarantee processing times; and
- Links between violations and their regulatory citations in addition to the on-line version of the Pennsylvania Bulletin.

This database now allows the public to search for individual permit authorizations, names and locations of waste-generating facilities, as well as find information on PADEP inspections, pollution prevention visits, inspection results, and enforcement data when violations are noted. Facility compliance status may also be cross referenced with federal data through the EPA's ECHO and Envirofacts databases that were noted previously. A slight drawback with the database, however, is that information is displayed on a municipal-by-municipal basis rather than by watershed. Therefore, the information in Table 4-4 is presented in a municipally-based manner.

Table 4-4. State Compliance Tracking Information

Watershed Municipality	Number of Regulated Sites
City of Philadelphia	3722
Bensalem Township	394
Lower Southampton Township	166
Lower Moreland Township	142

Source: PADEP Environmental Facility Application Compliance Tracking System Database, October 2006

The PADEP programs covered under the E-Facts Program and noted within the watershed municipalities, include permits obtained from the following programs: Air Quality, Land Recycling and Waste Management, Safe Drinking Water, Radiation Protection, Water Pollution Control, and Water Resources Management.

The types of permits obtained and monitored for the watershed municipalities include: Air Emissions, Hazardous Waste Generation, National Pollution Discharge Elimination System (NPDES), Radiation, Incineration, Industrial Waste Water Discharges (Minor and Major), Municipal Waste Transfer Stations, Storage Tanks (Above and Underground), Pipelines and Conduits, and Water Obstructions and Encroachments, and Water Crossings. Within the Watershed, there are a significant number of facilities that currently hold permits like those listed above and are under constant monitoring. A significant amount of additional work would need to be completed to determine the number of facilities within the watershed boundaries.

SECTION 5: Water Resources

The Delaware River is wide and tidal at the mouth of the Poquessing Creek. The water is fresh, not brackish or salty and is used as a water supply for the region. The Baxter Water Treatment Plant is located along the Delaware River just south of the confluence of the Poquessing Creek with the Delaware River. The water from the Poquessing Creek is therefore part of the water supply for the region.

5.1 The Poquessing Creek and its Tributaries

The Poquessing Creek possesses three named tributaries: Byberry Creek (6.09 miles), Black Lake Run (0.74 miles) and Walton Run (2.17 miles). The rest of the streams in the watershed are unnamed tributaries to the Poquessing Creek. The watersheds of Byberry Creek, Black Lake Run, and Walton Run are shown in Map IX.

The largest tributary to the Poquessing Creek is the Byberry Creek, which flows in a southerly direction through the City of Philadelphia. The Byberry Creek Watershed encompasses approximately 2,930 acres (4.58 square miles), or 21.24%, of the overall Poquessing Creek Watershed. The confluence of Byberry Creek and the Poquessing Creek is located slightly north of Route 13 at the border of Bucks and Philadelphia counties. Nearly 83% of the Byberry Creek Watershed is designated either low density urban or high density urban. Land cover designated as agriculture in the northern portion of the Byberry Creek watershed accounts for only 7.8% of the subwatershed and forest covers 7.6%.

The second largest tributary to the Poquessing Creek is Walton Run which is a tributary of Byberry Creek and drains approximately 1,843 acres of which are contained entirely within the City of Philadelphia. Walton Run is the most developed subwatershed within the Poquessing Creek Watershed with over 92% of the area fully developed.

Also located entirely within the city of Philadelphia, Black Lake Run encompasses 550 acres (3.98%) of the Poquessing Creek Watershed. Approximately 71% of the watershed is designated as high density urban or low density urban. Agricultural use occupies 18% of the watershed and forest comprises only 8%.

Table 5-1. Tributaries and Subwatersheds of the Poquessing Creek

Name	Location	Length (miles)	Watershed Size	Percentage of Watershed
Byberry Creek	Philadelphia	6.09	2,930 acres (4.58 square miles)	21.24
Walton Run	Philadelphia	2.17	1,843 acres (2.88 square miles)	13.36
Black Lake Run	Philadelphia	0.74	550 acres (.86 square miles)	3.98

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- IX: SUBWATERSHEDS

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BENSALEM
PHILADELPHIA
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
NEW JERSEY
Delaware River
Poquessing Creek
Byberry Road
Street Road
Woodhaven Road
Knights Road
Walton Creek
Black Lake Run
Byberry
213
276
532
1
63
513
132
95
13

Subwatersheds

- Black Lake Run
- Byberry Creek
- Poquessing Creek
- Walton Run

4,000 2,000 0 4,000
Feet

MAP-IX SUBWATERSHEDS

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Water Bodies
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary - PWD
Roads - PWD
Counties - PennDOT
Municipalities - PWD
Streams - PWD
Water Bodies - U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Sub Watersheds - PWD

Forbes Environmental and Landuse Planning
12 Brookdale Drive
New Britain, PA 18901
Tel: 215-230-9549

Borton-Lawson
Lehigh Valley
3893 Adler Place
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PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

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The remainder of the Poquessing Creek Watershed consists of unnamed tributaries and surrounding land areas that drain directly into the main stem of the Poquessing Creek. This 13.2 square mile area comprises the largest portion (61.42%) of the total watershed area. Most of this portion of the Poquessing Creek Watershed is high or low density urban (almost 82%). Agricultural land makes up 5.57% of this area, while 10.79% is covered by forest.

Most of the streams in the watershed are first order streams. First order streams do not have any tributaries leading into them, in other words they are the headwater streams. These are the natural headwaters of the watershed where water begins to accumulate and form a water channel. Often these headwaters are overlooked especially during dry periods when they do not contain flowing water. Black Lake Run is the only named first order tributary. The other first order streams are simply referred to as unnamed tributaries of the stream into which they flow. Some of the upper reaches of Poquessing Creek and Byberry Creek in addition to Walton Run are considered to be second order streams. These streams receive flow from first order streams as well as surface runoff and groundwater flow if it is present. The lower reaches of Poquessing and Byberry Creeks are considered third order steams and receive water from both first and second order streams as well as surface water and groundwater flow. Below its confluence with Byberry Creek, the Poquessing Creek is considered to be a fourth order stream due to it receiving water from Byberry Creek which is a third order stream. From I-95 South to its confluence with the Delaware River, the Poquessing Creek is considered a tidal stream because of its daily fluctuations in level due to the tidal changes in Delaware Bay.

5.2 Water Quality

The Philadelphia Water Department has studied the water quality in the Poquessing Creek Watershed as part of both its Stormwater Management Program (2005) and its Comprehensive Watershed Monitoring Program (2005). It also conducted a preliminary biological assessment of the watershed in 2001. The Stormwater Management Program and the Comprehensive Watershed Monitoring Program are closely related and implemented as part of the National Pollution Discharge Elimination System (NPDES) Program. As part of its NPDES Stormwater Management Permit, the City of Philadelphia has the authority to operate and maintain the Stormwater Management Program which includes various ordinances, regulations and policies enforced by City departments. The Philadelphia Water Department's Office of Watersheds developed a comprehensive assessment strategy to provide information regarding water quality of surface waters in watersheds that intersect the City's boundaries.

5.2.1 Surface Water Quality Protection

Pennsylvania's surface water quality standards are established in Chapter 93 of the Pennsylvania Code. Chapter 93 establishes the water quality goals and policies underlying the management of the state's surface water quality. These standards require that all surface water bodies be classified based upon use and water quality.

Once classified, existing stream water uses and the level of water quality necessary to protect the existing uses of a stream shall be maintained and protected in accordance with the anti-degradation requirements of Chapter 93. These criteria are used to establish waste discharge permit limits. The basis for these anti-degradation standards is established in the Federal Clean Water Act at 40 CFR 131.12. Anti-degradation standards apply to all surface waters and stipulate that existing uses must be either maintained or protected and that no irreversible changes to water quality are allowed that would impair or preclude the attainment of designated uses. This regulation also requires states to adopt anti-degradation policies based on at least three levels of protection.

The Poquessing Creek and all of its tributaries are classified as a Warm Water Fishery (WWF). The WWF classification refers to the water quality in terms of the aquatic life that can survive in the warm water and its associated parameters within the stream. WWF is the lowest classification for aquatic life that streams can be designated as and it is applied to all Pennsylvania surface waters except when otherwise specified by law or regulation (PA Ch. 25 Section 93.4).

The federal Clean Water Act prohibits the discharge of pollutants from a point source into waters of the United States without a permit. This law was amended in 1987 to require large and medium sized municipalities to obtain a NPDES permit for their stormwater discharges through their municipal separate storm sewer systems.

In accordance with the requirements of the stormwater discharge permit and the provisions of PA Code, Chapter 93, the City has promulgated ordinances to protect surface waters. The most specific language is found in Chapter 13, Sections 603 (the chapter covering stormwater sewers) wherein it is stated:

"(3) *Prohibitions*.

"(a) No person shall discharge pollutants to the storm sewer system, either by placing pollutants directly into the storm sewer system, by placing pollutants in areas which drain into the storm sewer system, or by allowing stormwater from premises owned by such person to transport pollutants to the storm sewer system, unless specifically authorized by this section or any regulation promulgated pursuant to this section."

The Poquessing Creek Watershed is almost entirely sewered for both stormwater and sanitary waste water except for golf courses and some of the larger parks (separate collection pipes exist for sanitary waste and stormwater). Therefore, this provision of the Clean Water Act covers the entire watershed area within Philadelphia. The sewered regions of Montgomery and Bucks County that fall within the Poquessing Creek Watershed are also covered by the Federal Clean Water Act and Pa Chapter 93.

5.2.2 Surface Water Quality

Figure 5-1. Algae Sampling

The water quality in the Poquessing Creek Watershed was studied as part of the overall source water assessment for the Baxter Water Treatment Plant, located on the Delaware River approximately 6,700 feet downstream of the mouth of the Poquessing Creek as shown in Figure 5-2. The water quality of the Poquessing Creek Watershed was also studied as part of Philadelphia's Comprehensive Watershed Monitoring Program and its Stormwater Management Program due to the impact the creek has on the Delaware River.

The PADEP has a long term plan to assess the water quality of the region as part of its State Water Plan. The State Water Plan is currently being developed and a finalized report has not been published. As part of this plan the PADEP is dividing the state into six major basins and identifying critical water planning areas. Water budgets are being developed in conjunction with population projections to determine if the available supply of water will be able to meet demand. The plan will guide long term policy decisions and the laws and regulations relative to water supply and quality.

Figure 5-2. Baxter Plant Aerial Map

The Poquessing Creek Watershed is not highly industrialized and has no major dischargers of industrial wastewater, or wastewater treatment plant effluent, in the watershed. Even though the flow from the Poquessing Creek is minor in comparison to the flow in the Delaware, its proximity to the intake of the Baxter Water Treatment Plant could make it a significant potential source of contamination.

According to the Baxter Water Treatment Plant Source Water Assessment Report (2002), the watershed falls within the areas designated as "Zone A," relative to the Baxter Treatment Plant. Zone A is described below.

Zone A - This is the critical area of highest potential impact on the water supply, as proximity to the water supply's intake results in reduced response times and potentially lower dilution and attenuation of a contaminant. Any potentially significant source within a five-hour time of travel of the water supply including one-quarter mile downstream and within a one-quarter mile-wide area on either side of the river/stream from the water supply should be included in the contaminant inventory. These may include large and small discharges, catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

The sampling and focus of most studies conducted for the Baxter plant concentrate on the Delaware River itself and major tributaries. A limited amount of data presented in the 2005 annual report is specific to the Poquessing Creek. Sampling results indicate concentrations of three semi-volatile organic compounds (SOCs) during the fall 2000 monitoring study.

The SOVs detected were dieldrin (pesticide), diethylphthalate (plasticizer) and phenanthrene (petroleum hydrocarbon). These contaminants are most likely associated with stormwater runoff rather than point source discharges.

The PADEP conducted a rapid bioassessment of the watershed in 1998 and the PWD conducted its own bioassessment in 2001. The PADEP sampled at 7 locations and the PWD sampled at 13 locations as shown in Figure 5-5, Comprehensive Watershed Assessment Program (2005). Both assessments determined that the streams in the watershed are biologically impaired with the exception of the tidal portion.

The 2001 PWD assessment included biological assessments (Rapid Bioassessment Protocols III and V), benthic macroinvertebrate, fish, water and habitat sampling to investigate various point and nonpoint source stressors. Benthic sampling collects a representative sample of material from the stream bottom, identifies and quantifies the species of invertebrates collected, and uses those results to interpret the overall condition of the area. The invertebrates encountered are typically found in poor water quality. These include net-spinning caddisfly larvae and midge larvae. The biological and physical assessments were compared to a control section located in the French Creek watershed, Chester County, Pennsylvania. Chemical sampling was obtained to determine and compare differences in water quality throughout the watershed. The data suggests impairment of the stream at all sampling locations.

As shown in Table 5-2, multiple species of fish are observed in the Poquessing Creek. Moderately pollution tolerant shiners, minnows, suckers, and dace are present in the creek. Shiners are recorded at all sampling locations. American eel and white suckers are also observed during sampling. As depicted in Figure 5-3, almost 99% of the species that were collected are considered to be tolerant or moderately tolerant of pollution. One pollution intolerant species, eastern silvery minnow (*Hybognathus regius)* was found at only three of the thirteen sampling stations. The three stations were located near the mouth of the Poquessing Creek and just upstream of where the stream passes under Interstate I - 95, at the lowest reaches of the watershed.

The fish sampling data are used to establish the “Index of Biotic Integrity” (IBI) score. The range of IBI values are from 12 to 60 with 60 indicating high quality fish habitat. The mean IBI score of the Poquessing Creek Watershed is 36, placing it in the “fair” category. Overall, the highest IBI score was at the most downstream site while the lowest IBI score was at the most upstream site. (*Biological Assessment of the Poquessing-Byberry Watershed (Fall 2001),* pg. 46, Philadelphia Water Department report).

Included in the assessment are water samples from seven locations analyzed for microbial, physical and chemical parameters. The parameters are bacteria (*e. coli and fecal coliform*), dissolved oxygen, alkalinity, nitrogen compounds, phosphorus, solids, turbidity, conductivity, phenols, residual chlorine and select metals. Eight

chemical monitoring stations are proposed in the watershed as shown in Figure 5-4, Comprehensive Watershed Assessment Program (2005).

Overall, water samples collected meet Pennsylvania's minimum water quality standards with some exceptions. There is no excessive concentration of bacteria or nutrient pollution (nitrogen compounds and phosphorus), and dissolved oxygen and alkalinity are present at acceptable levels.

The Philadelphia Water Department (PWD) implemented the Comprehensive Watershed Monitoring Program which targets the streams and tributaries of the watersheds that intersect the City of Philadelphia. The Poquessing Creek was assessed in 2001 and is scheduled to be assessed again for chemical and biological parameters during a period running from 2008 to 2010. Table 5-3 shows the chemical parameters proposed for monitoring (Source: Comprehensive Watershed Monitoring Program: Proposed Strategy 2005-2010 Philadelphia Water Department, Office of Watersheds).

PWD concludes that while most sites meet minimum standards for warm water fisheries, there is evidence of human impact and room for improvement. Discrete water samples provide information about water quality at the date of sample collection. Water quality can vary considerably depending on the time of year, air temperature, precipitation and the potential of intermittent or accidental discharges.

Table 5-2. Fish Species Collected in the Poquessing – Byberry Watershed

Common Name	Species	Number (n)	Biomass (b)	Percent (n)	Percent (b)
Brown Bullhead Catfish	*Ameiuris nebulosus*	1	142.50	0.009	0.258
American Eel	*Anguilla rostrata*	552	17678.49	4.739	31.957
White Sucker	*Catostomus commersoni*	1732	13103.62	14.868	23.687
Spotfin Shiner	*Cyprinella spiloptera*	36	55.34	0.309	0.100
Satinfin Shiner	*Cyprinella analostana*	1966	1722.76	16.877	3.114
Tessellated Darter	*Etheostoma olmstedi*	891	1173.90	7.649	2.122
Banded Killifish	*Fundulus diaphanus*	1392	2062.52	11.950	3.728
Mummichog	*Fundulus heteroclitus*	113	467.95	0.970	0.846
Eastern Silvery Minnow	*Hybognathus regius*	151	782.78	1.296	1.415
Redbreast Sunfish	*Lepomis auritus*	271	5115.02	2.326	9.246
Green Sunfish	*Lepomis cyanellus*	67	2150.69	0.575	3.888
Pumpkinseed Sunfish	*Lepomis gibbosus*	120	2675.98	1.030	4.837
Sunfish Hybrid	*Lepomis hybrid*	1	65.14	0.009	0.118
Bluegill Sunfish	*Lepomis macrochirus*	9	58.66	0.077	0.106
Common Shiner	*Luxilus cornutus*	125	728.36	1.073	1.317
Smallmouth Bass	*Micropterus dolomieu*	1	23.75	0.009	0.043
Largemouth Bass	*Micropterus salmoides*	3	171.08	0.026	0.309
Golden Shiner	*Notemigonus crysoleucas*	68	97.42	0.584	0.176
Comely Shiner	*Notropis amoenus*	8	0.00	0.069	0.000
Spottail Shiner	*Notropis hudsonius*	215	1082.91	1.846	1.958
Swallowtail Shiner	*Notropis procne*	1710	1735.94	14.679	3.138
Fathead Minnow	*Pimephales promelas*	4	5.42	0.034	0.010
Blacknose Dace	*Rhinichthys atratulus*	1700	2410.00	14.594	4.356
Longnose Dace	*Rhinichthys cataractae*	241	576.87	2.069	1.043
Creek Chub	*Semotilus atromaculatus*	272	1232.57	2.335	2.228

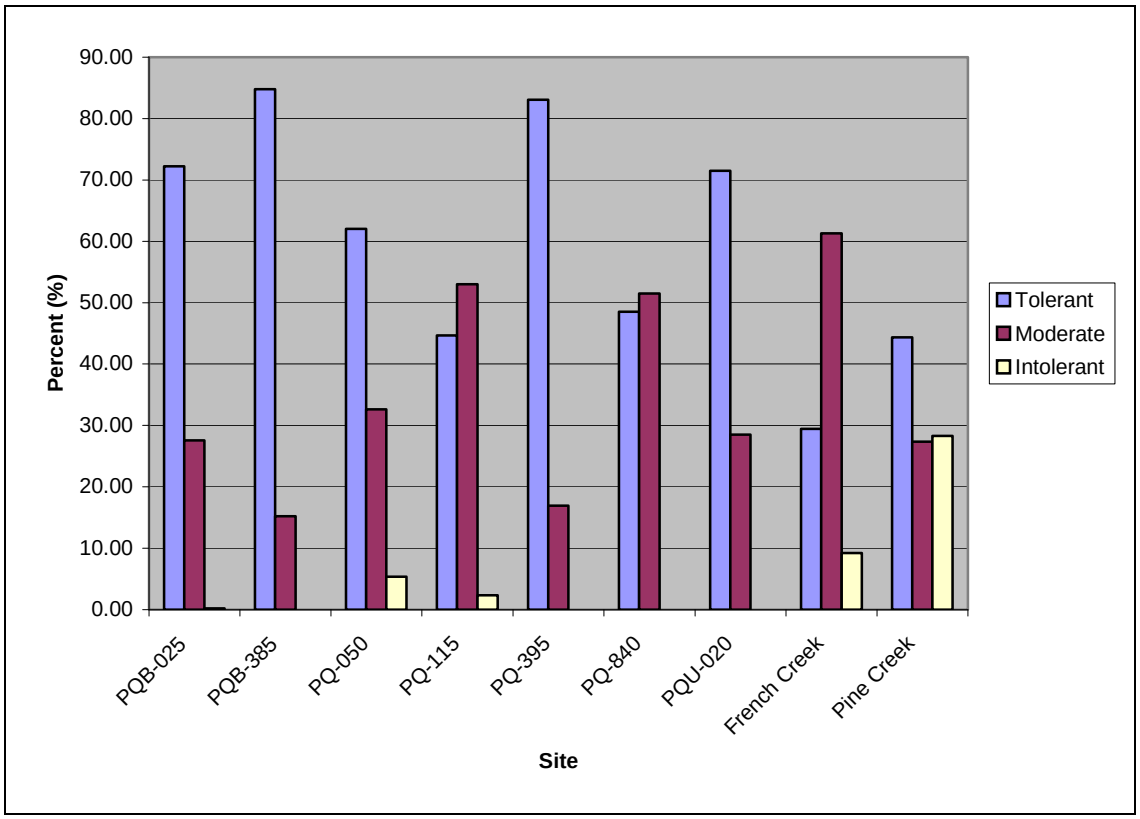

Figure 5-3. Pollution Tolerance Values of Fish Collected at Sampling Locations

Table 5-3. Chemical Analysis Collected During Chemical Monitoring Programs

Parameter	Units
Temperature	deg C
pH	pHU
Specific Conductance	uMHO/cm @ 25C
Alkalinity	mg/L
Turbidity	NTU
TSS	mg/L
TDS	mg/L
DO	mg/L
BOD_5	mg/L
BOD_{30}	mg/L
$CBOD_5$	mg/L
Ammonia	mg/L as N
TKN	mg/L
Nitrite	mg/L
Nitrate	mg/L
Total Phosphorus	mg/L
Phosphate	mg/L
Aluminum	mg/L
Calcium	mg/L
Cadmium	mg/L
Chromium	mg/L
Copper	mg/L
Fluoride	mg/L
Iron	mg/L
Dissolved Iron	mg/L
Magnesium	mg/L
Manganese	mg/L
Lead	mg/L
Zinc	mg/L
Total Chlorophyll	Ug/L
Chlorophyll A	ug/L
Fecal Coliform	#/100 mls
E. coli	#/100 mls
Phenolics	mg/L

Eight chemical monitoring stations are proposed in the watershed as shown in Figure 5-4.

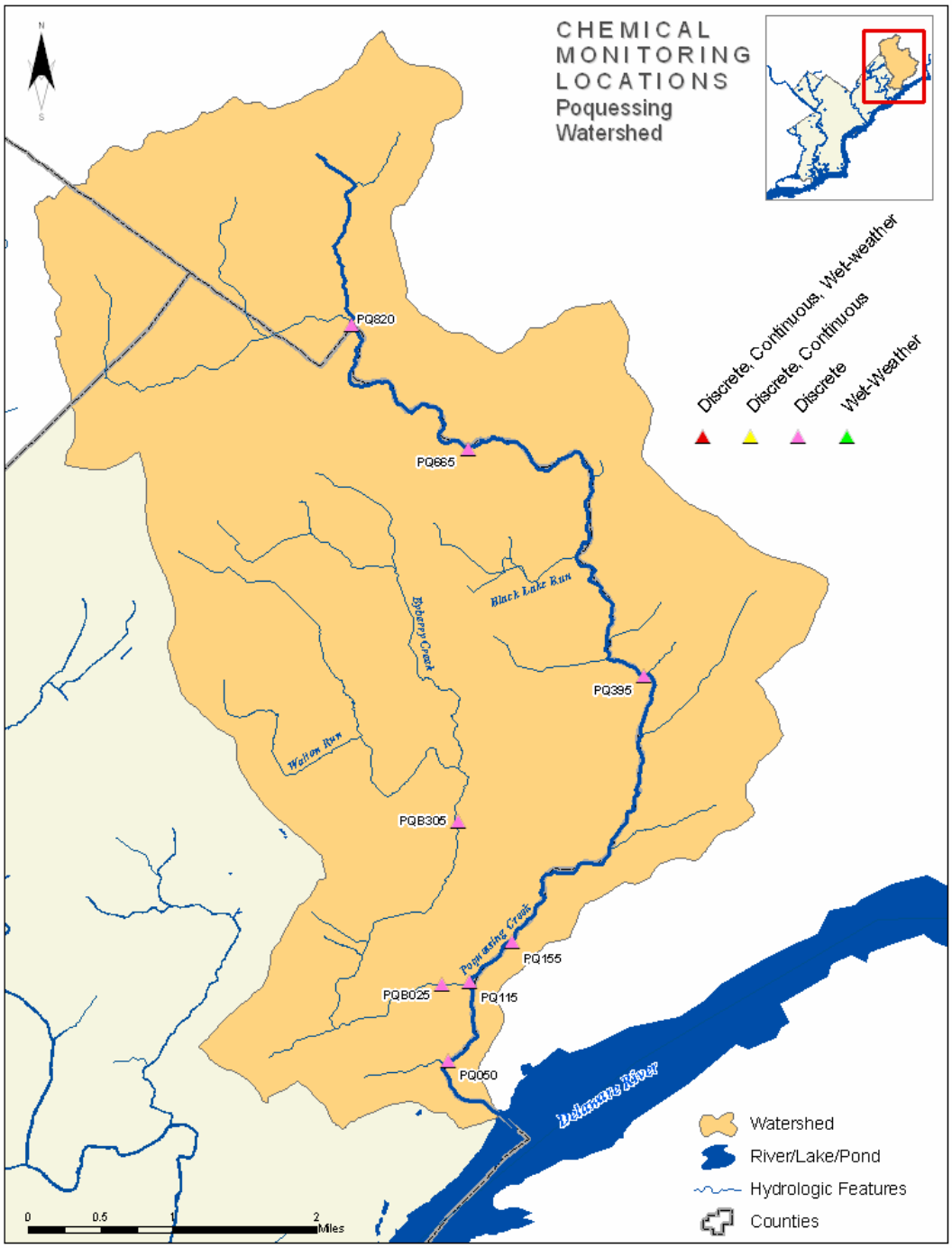

Figure 5-4. Chemical Sampling Location Map

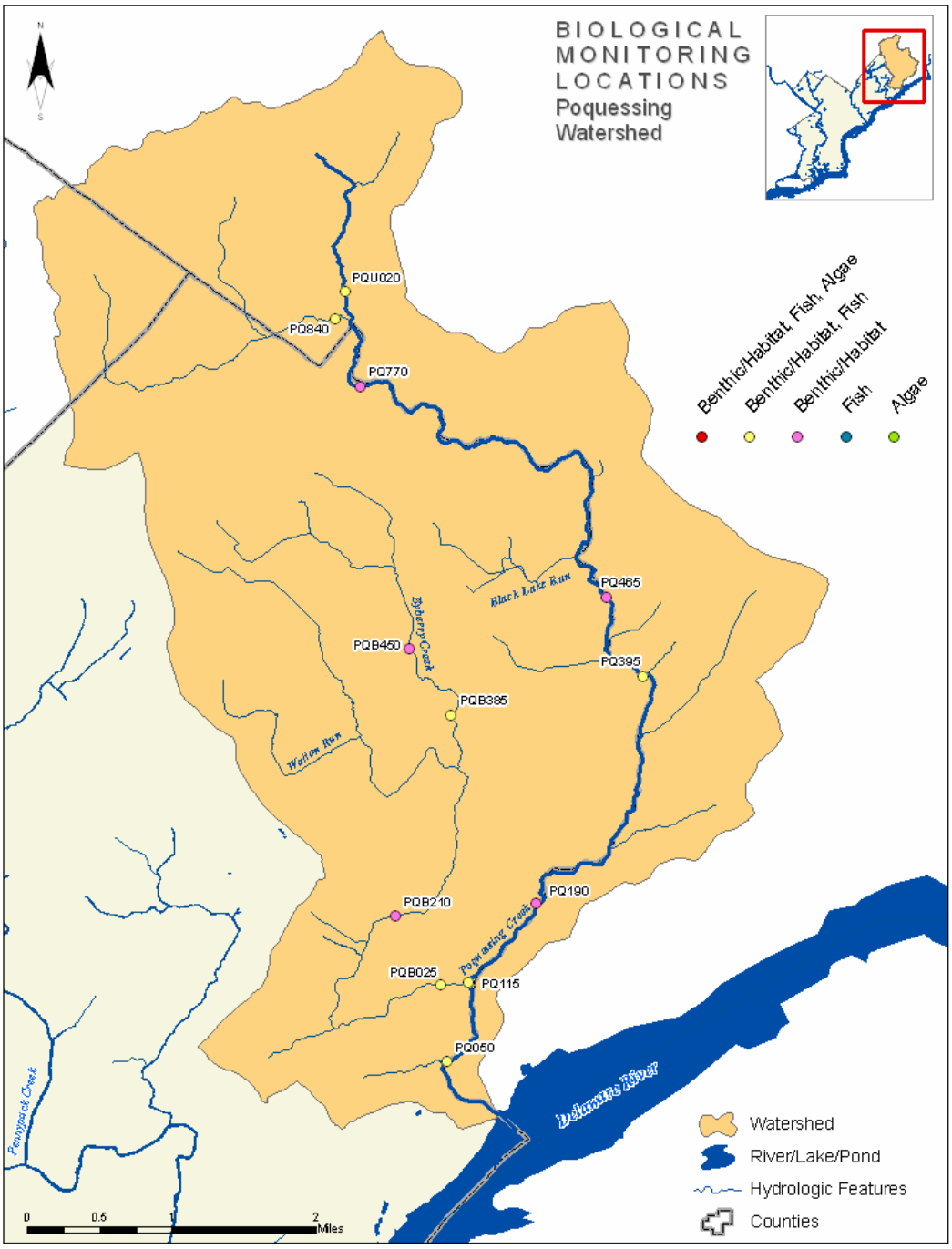

Figure 5-5. Philadelphia Water Department Biological Sampling Location Map

Figure 5-6. PWD Biologist Discusses Invertebrate Sampling at RCP Public Meeting

5.2.3 Surface Water Flow

A USGS stream gauge is located on the Poquessing Creek just before it passes under Interstate 95, as shown in Figures 5-7 and 5-8. The stream gauge measures the flow of water from the Poquessing and all its tributaries.

Mean daily flows vary between approximately 20 and 40 cubic feet per second (cfs) at the stream gauge station (150 to 300 gallons per second, gps). This is a modest flow for over 20 square miles of drainage area. Mean daily flow is highest in March and lowest in October. This is due to typically higher flows in the spring months due to direct snowmelt runoff and groundwater recharge and subsequent discharge to the streams. The lowest flows in late September and October are typically due to previous dryer summer months and the maximum period of evapotranspiration.

Flow measurements at the stream gauge show that peak flows can be over 100 times the normal daily flow in the Poquessing. This can be attributed to the developed nature of the watershed and the high percentage of impervious surfaces (roads, parking lots and buildings) that do not allow infiltration of rain and cause greater runoff within the watershed. In the approximately past 20 years of measurements, yearly peak flows have ranged from a low of 1,310 cfs (9,800 gps) for 1995 (January 20, 1995) to a high of 5,540 cfs (41,400 gps) in 1984 (July 7, 1984). Hurricane Ivan resulted in a peak flow of 5,430 cfs (40,600 gps) on September 28, 2004. The annual peak flow graph in Figure 5-9 illustrates the fluctuation in peak stream flow from 1996 to 2005.

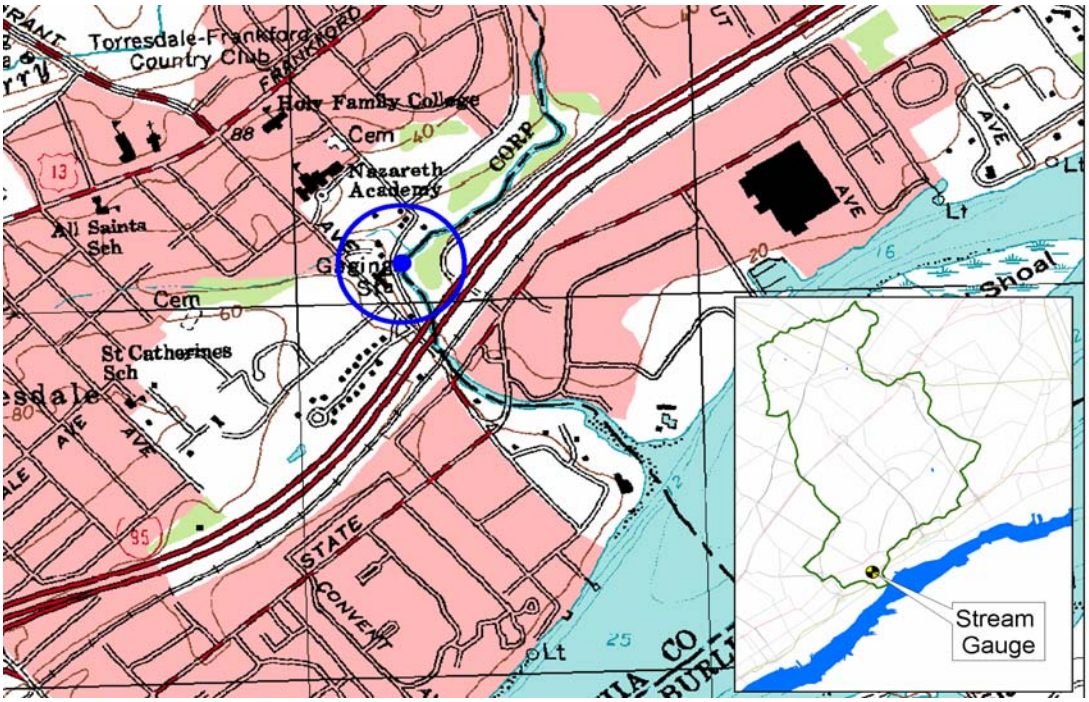

Figure 5-7. Stream Gauge Location Map

Figure 5-8. Stream Gauge Photo

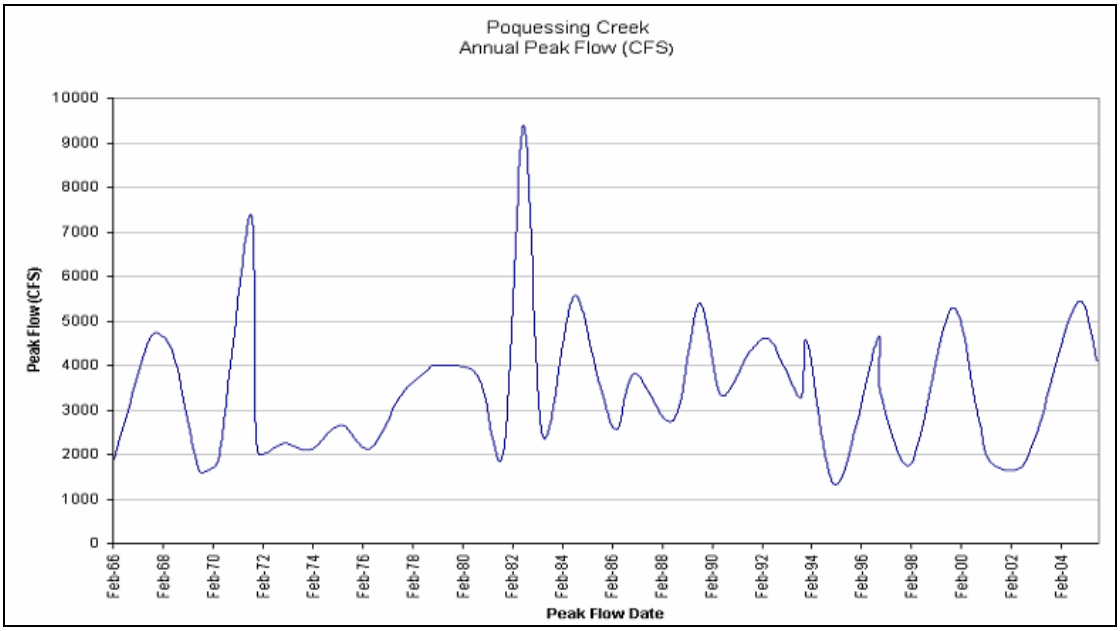

Figure 5-9. Annual Peak Flow Graph

The stream can also exhibit a dramatic fluctuation in flow over a single day. On June 6, 2006, a rainfall event resulted in a six foot rise in the stream elevation over a three hour period. The elevation rose from three feet at base level to slightly over nine feet at the peak in the time period of 3:00 to 6:00 AM. This equates to a normal flow of approximately 20 cubic feet per second (150 gallons per second) to a storm flow of approximately 2,500 cubic feet per second (18,700 gallons per second) within that 3-hour period as shown in Figure 5-10.

By 5:00 PM the water level had returned to about three feet. This event illustrates the rapid rise and fall of water in the creek. This storm event was significant, but not extreme. The resulting stream flow illustrates the rapid rate of runoff in the watershed. Rainwater falling on roofs, sidewalks and paved surfaces quickly runs off into the watershed streams through storm sewers and overland flow. The streams fill to capacity and in some areas localized flooding is common.

This rapid runoff causes a chain reaction that reduces the quality of the environment in the watershed and results in accelerated erosion of exposed soil along the streambanks and tributaries. Severe erosion of the streambanks and exposed roots can be seen near the stream gauge station. The trees in this area are large, mature trees and are leaning towards the water. Streambank erosion can oftentimes cause the trees to fall into the stream exacerbating the erosion problem.

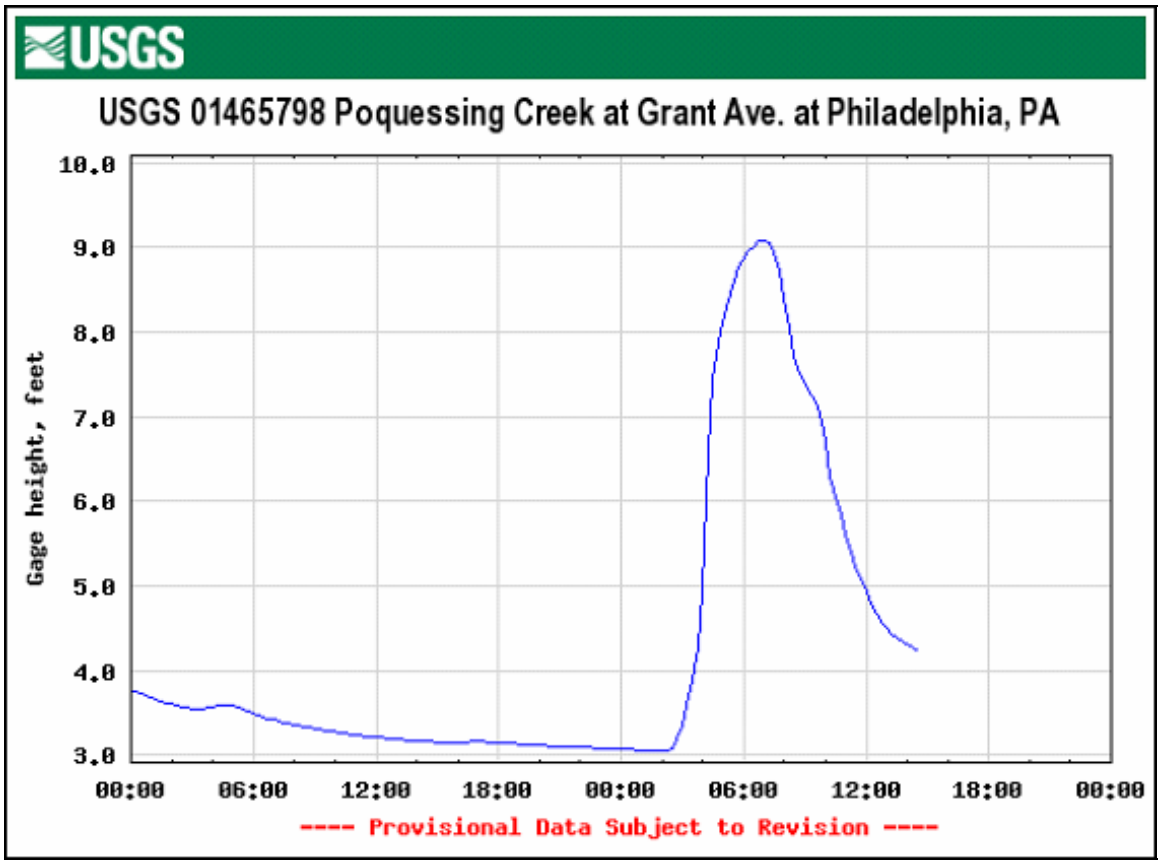

Figure 5-10. Stream Gauge Height

The increased erosion increases sedimentation and subsequently degrades the water quality. The reduced water quality and increased sedimentation lowers the quality of the aquatic habitat and coats the bottom of the stream with silt and sediment. With rapid runoff, the chance of rain water infiltrating into the ground is reduced, thus preventing it from reaching and replenishing the groundwater system which provides baseflow to streams.

Below the stream gauge the water in the stream is influenced by the Delaware River. The Delaware is tidal in this region. The rising and falling of the tides in the river cause water to be pushed upstream into the Poquessing. This mild flushing action helps improve the water quality and has resulted in a slightly better habitat in this area, as evidenced by the 2001 biological assessment of the creek. The most downstream monitoring station PQ-050 (located near the stream gauge, approximately 0.5 miles from the confluence with the Delaware) had the highest biotic integrity index in the watershed, which placed that site in the "good" category. Water quality in the upper reaches does not benefit from the tidal action replenishing stream water supplies. The rapid runoff of surface water and lack of adequate groundwater recharge in the upper reaches causes some reaches to dry up entirely within a relatively short period of time.

5.2.4 Ground Water Quality and Quantity

Groundwater is not a source of municipal potable water in the Poquessing Creek Watershed. While there are numerous private wells located in the watershed, there are no municipal public water supply wells and only a few domestic wells (see Map X). Groundwater is used for irrigation on some golf courses and for industrial uses. There are two groundwater monitoring network wells in the watershed, one at the Forest Hills Cemetery in Montgomery County and another located just south of Poquessing Valley Park, near Mechanicsville.

These wells are monitored by the PADEP to assess groundwater quality. A recent round of samples indicated that the groundwater in the area of the wells does not meet EPA drinking water standards, particularly for inorganic compounds such as thallium (a compound used for rat poison). The thallium concentration was 45 parts per billion, well exceeding the EPA standard of 2 parts per billion. This well was also assessed for its vulnerability to contamination (based on factors such as geology and soils) and found to have a high vulnerability. This indicates that if contaminants were spilled on the ground or leaked from underground sources (such as an underground storage tank or pipeline) the contamination would be able to migrate to the groundwater.

The inclusions of Pennsauken and Bridgeton geologic formations in the lower part of the watershed are characterized as being composed of sand and quartz. These types of aquifers typically have the capacity to hold large volumes of water due to the amount of interstitial spaces between grains. Wells drilled in these aquifers often have high volume yields and can be good water sources. Sandy aquifers tend to be more susceptible to contamination due to the ease through which water and associated contaminants can pass through the material.

The Wissahickon formation is also a potentially good source of water. Irrigation located in the Wissahickon formation at the Torresdale - Frankford Country Club have recorded yields from 80 to 116 gallons per minute (gpm). Most other wells in the watershed are 35 gpm or less.

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- X: WELLS

Location Map

Geology

- Chickies Formation
- Felsic Gneiss, Pyroxene bearing
- Ledger Formation
- Mafic Gneiss, Hornblende bearing
- Metadiabase
- Pensauken and Bridgeton Formations, Undifferentiated
- Trenton Gravel
- Wissahickon Formation (Oligoclase Mica Schist)

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
BUCKS COUNTY
LOWER MORELAND
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Byberry Road
Poquessing Creek
Street Road
Walton Creek
Woodhaven Road
Knights Road
Byberry Creek
Delaware River
213
276
532
1
63
513
132
95
13

WATER WELL INVENTORY
USE OF WATER

- DOMESTIC
- INDUSTRIAL
- IRRIGATION
- PUBLIC SUPPLY (NOT MUNICIPAL)

4,000 2,000 0 4,000
Feet

FILE: \\WB\Data\Projects\2005\1756\00\DATA\GIS\ArcMAP\wshed_poquessing.mxd

MAP-X: WELLS

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
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(Derived from NWI Wetlands)
Geology - PA DCNR/PA Geologic Survey
Wells - PADEP Groundwater Information System Data

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PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

As discussed in earlier sections, groundwater often serves as the base flow for streams. The quality of the groundwater, especially the shallow groundwater (also referred to as the water table) can have an impact on surface water quality. In cases where groundwater is used for irrigation, the water that does not evaporate or transpire through vegetation either enters the water table or runs off directly into streams. In these cases the deeper groundwater from the aquifer can be transferred directly to the streams. Therefore, even in areas where groundwater is not used for human consumption, enforcement of groundwater protection regulations and good management practices can have a positive effect on surface water quality. Groundwater in urban areas is frequently unsuitable as a water supply due to poor quality. This is often due to spills and releases of chemical and petroleum products over a long period of time. Leaking underground storage tanks (notably gasoline stations) are an especially significant cause of groundwater contamination.

5.3 Floodplains in the Poquessing Creek Watershed

Floodplains are valuable low lying areas bordering streams, ponds or lakes which are subject to flooding. Natural floodplains serve many beneficial functions including groundwater recharge, flood storage, prevention of soil erosion, maintenance of water quality, and wildlife habitat. Undisturbed floodplains protect the structural integrity of streambanks thereby reducing soil erosion and maintaining water quality. Naturally occurring vegetation in floodplain areas provide wildlife habitat and travel corridors for a variety of birds and mammals.

Floodplains also ameliorate and mitigate flood sources and the dangers of storm related flooding. Undisturbed floodplain areas store water by accommodating fluctuating stream volumes during heavy rains, which moderates storm surges and decreases the magnitude of flooding. When floodplains are maintained in an undisturbed state, expensive flood control structures are unnecessary. In response to disastrous flood events in the past, the Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program (NFIP) have implemented measures to regulate development on floodplains. Maps produced by FEMA define and delineate floodways and flood fringe areas. The NFIP states that there shall be no new construction or substantial improvements in floodways and that all new construction must be above the base flood elevation.

According to 1996 FEMA National Flood Insurance Program Q3 data, the Poquessing Creek has almost 683 acres of 100-year floodplain and approximately 227 acres of 500-year floodplain. Most floodplain areas occur directly adjacent to the Poquessing Creek and are fairly narrow. Approximately 75% of the area in the floodplains is developed with housing, commercial areas and pavement. Wooded areas, recreational areas and vacant lands make up the remaining 25%. Map XI depicts the 100-year floodplains within the Poquessing Creek Watershed (Note: floodplain data is outdated due to post-1996 development).

5.4 Wetlands in the Poquessing Creek Watershed

In the Commonwealth of Pennsylvania, freshwater wetlands are currently regulated at the State and federal levels of government. At the federal level, the U.S. Army Corps of Engineers (COE), in accordance with Section 404 of the Clean Water Act, regulates the dredging and filling of "Waters of the United States"; this includes streams, lakes, impoundments, intermittent drainage ways, and associated wetlands. At the State level, wetlands, bodies of water (a natural or artificial lake, pond, reservoir, swamp, marsh or wetland) and watercourses (a channel or conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow) are regulated in accordance with Chapter 105 of the Dam Safety and Waterway Management Act. Both regulatory agencies define wetlands as:

> *"Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."*

In other words, lands must possess the soils (hydric), hydrology and vegetation typical of wetlands to be considered as wetlands

The majority of wetlands in the Poquessing Creek Watershed occur along the Poquessing Creek and its tributaries. Map XII illustrates the wetlands mapped by the US Fish and Wildlife Service and indicates that there are approximately 355 acres of wetlands within the Poquessing Creek Watershed. These area wetlands are mapped as part of the National Wetland Inventory and are commonly referred to as NWI wetlands. NWI data are digitized from wetland maps developed by the U.S. Fish and Wildlife Service. In NWI maps, wetlands are classified according to the Cowardin Classification System, which is a federal standard for wetland mapping. NWI maps are compiled from photointerpreted aerial photography from the National Aerial Photography Program (NAPP) 1:40,000 scale, and the National High Altitude Photography Program (NHAP) 1:58,000 or 1:80,000 scale. Source dates range from the 1970s to the present. The minimum mapping unit for treeless areas is 1/4 acres, 1 to 3 acres in general. It should be noted that wetlands may exist in the watershed that have not been mapped and are not part of the NWI. There also may be wetlands shown on the NWI maps that no longer exist either due to filling and development or natural succession. Wetlands may convert to uplands if they accumulate silt or lose their source of water due to a drop in the water table or diversion of surface water.

Almost 91% of the NWI wetlands in the watershed are broad-leaved deciduous, forested, palustrine wetlands, some of which are temporary or seasonal flooded. Broad-leaved deciduous wetlands are described as woody tree or shrubs that have wide, flat leaves that shed in the cold or dry season. Forested wetlands are characterized by woody vegetation

that is more than 6 meters high. Approximately 10 acres are classified as open water wetlands.

As part of the Southeast Regional Wetland Inventory and Water Quality Improvement Initiative, the Philadelphia Water Department performed a wetland assessment for the Poquessing Creek Watershed. As part of the assessment, their consultants assessed current wetlands, additionally selected stormwater outlets, and potential wetland creation sites for the purpose of potential long term water quality improvement. Although wetland boundaries were not surveyed, wetlands were identified in September and October, 2004 using the United States Army Corps of Engineers (USAC) guidelines. The Oregon Freshwater Wetland Assessment Methodology was used to determine wetland functional assessment and the Human Disturbance Gradient (HDG) method was performed to determine human impact. The report (PWD, 2006) identifies enhancement of existing wetlands, as well as locations for potential wetland creation and treatment opportunities associated with waterways and/or stormwater outfalls.

Areas with soil classified as hydric soil are also shown in Map XII. Hydric soils are soils which show evidence that they have been saturated long enough during the growing season to develop anaerobic conditions and support wetland vegetation. For an area to be classified as a wetland, it needs to contain hydrology, aquatic plant life and hydric soil. However, not all areas with hydric soil can be classified as wetlands.

POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- XI: FLOODPLAINS

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Byberry Road
Roosevelt Boulevard
Woodhaven Road
Knights Road
Street Road
Poquessing Creek
Walton Creek
213
276
532
1
63
132
513
95
13

4,000 2,000 0 4,000
Feet

MAP-XI FLOODPLAINS

Philadelphia Water Department

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water Bodies
- Floodplains (100 yr)
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary: PWD
Roads: PWD
Counties: PennDOT
Municipalities: PWD
Streams: PWD
Water Bodies: U.S. Fish and Wildlife Service
(Derived from NWI Wetlands)
Floodplains - Federal Emergency Management Agency

Forbes Environmental and Landuse Planning
12 Brookdale Drive
New Britain, PA 18901
Tel: 215-230-9549

Borton-Lawson
Lehigh Valley
3893 Adler Place
Bethlehem, PA 18017
Tel: 484-821-0470

PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

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POQUESSING CREEK WATERSHED RIVER CONSERVATION PLAN
MAP- XII: WETLANDS AND HYDRIC SOILS

Location Map

UPPER SOUTHAMPTON
LOWER SOUTHAMPTON
LOWER MORELAND
BUCKS COUNTY
MONTGOMERY COUNTY
PHILADELPHIA COUNTY
PHILADELPHIA
BENSALEM
NEW JERSEY
Byberry Road
Roosevelt Boulevard
Woodhaven Road
Knights Road
Street Road
Poquessing Creek
Walton Creek
Byberry
213
276
532
1
63
513
132
95
13

NWI data are digitized from wetland maps developed by the U.S. Fish and Wildlife Service. In NWI maps, wetlands are classified according to the Cowardin Classification system, which is a federal standard for wetland mapping. NWI maps are compiled from photointerpreted aerial photography from the National Aerial Photography Program (NAPP) 1:40,000 Scale, and the National High Altitude Photography Program (NHAP) 1:58,000 or 1:80,000 Scale. Sources dates range from the 1970's to the present. The minimum mapping unit for treeless areas is 1/4 acres, 1 to 3 acres in general.

4,000 2,000 0 4,000
Feet

MAP-XII
WETLANDS AND HYDRIC SOILS

Prepared for:
PHILADELPHIA WATER DEPARTMENT

Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water Bodies
- NWI Wetlands
- Hydric Soils
- Interstate
- US Federal Highway
- PA State Road
- Other State Road
- Local Roads
- Railroads

NOTES:
Portions of this map were generated from the existing data sources as listed below. These existing data were utilized for base mapping purposes and are shown for spatial reference only. This map should only be used in conjunction with the complete Poquessing Creek River Conservation Plan.

DATA SOURCES:
Watershed Boundary: PWD
Roads: PWD
Counties: PennDOT
Municipalities: PWD
Streams: PWD
Water Bodies: U.S. Fish and Wildlife Service (Derived from NWI Wetlands)
Wetlands - USFWS National Wetlands Inventory
Hydric Soils - USDA/NRCS - SSURGO and NASIS data

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PREPARED BY: WSB CHECKED BY:
DATE: 06/01/2007 PROJECT #: 2005-1756-00

FILE: \WBData\Projects\2005\1756\00\DATA\GIS\ArcMAP\wshed_poquessing.mxd

5.5 Lakes and Ponds in the Poquessing Creek Watershed

As with most urbanized watersheds, lakes and ponds are not a common feature of the landscape. In the Poquessing Creek Watershed most of the water bodies are relatively small and few and far between. Most are small ponds, some associated with golf courses.

Lakes and ponds increase the biodiversity of a watershed by providing habitat for a variety of aquatic organisms including amphibians, fish, aquatic mammals, and birds such as waterfowl and wading birds. Lakes and ponds may store water during rainfall events potentially reducing or moderating peak flow. Lakes and ponds may also be a source of stream flow in between rainfall events and may contribute to groundwater.

SECTION 6: Biological resources

6.1 The Landscape of the Poquessing Creek Watershed

The landscape of the Poquessing Creek Watershed is a complex mosaic of predominantly urban and suburban land intermixed with agricultural and woodland areas that have withstood major land use developments (see Section 2.6). The current landscape composition and patterns of development within the watershed reflect a long history of development that began in the 17th century when William Penn received the deed to the area and brought his European perceptions of land use and development to North America.

Existing land use practices, socio-economic factors and environmental features within the region (e.g., Atlantic Coastal Plain Physiographic Province, underlying geology, soils, slopes, etc.) interact in a myriad of ways. Therefore, the development of evolving environmental planning initiatives requires an understanding of the biological resources that remain.

The following subsections explore recent planning and research efforts that describe and inventory the biological resources remaining in the Poquessing Creek Watershed. The City of Philadelphia and other municipal resource inventories are explored as well as their recommendations for preservation, restoration and continued management.

Figure 6.1 – Algal growth in a tributary to the Poquessing Creek

6.2 Poquessing Creek Biological Resources

Biological resource information for the Poquessing Creek Watershed is not housed in one location. In fact, it is normally located in a number of places including federal, statewide, and regional agencies as well as studies completed by government and non-government entities. The following sources were utilized for this section of the Rivers Conservation Plan (See bibliography for full citations):

- **Philadelphia Water Department -** A biological study (Biological Assessment of the Poquessing-Byberry Watershed, Fall 2001) was completed and information incorporated in this portion of the Rivers Conservation Plan. (Fall 2001)
- **United States Fish & Wildlife Service** - A formal request was submitted to the USFWS and a federally-listed species report was provided.
- **Pennsylvania Department of Conservation and Natural Resources (PADCNR), Pennsylvania Natural Diversity Inventory Review (PNDI)** - A PNDI request was submitted to PADCNR and a report was provided listing plants, natural communities, terrestrial invertebrates and geologic features.
- **Pennsylvania Fish and Boat Commission** - A formal request was submitted and a list of fish, amphibians, reptiles and aquatic organisms provided.
- **Pennsylvania Game Commission -** A formal request for birds and mammals was requested and received.
- **Regional, City of Philadelphia & Municipally-Based Plans and Studies** - A number of documents (e.g., county-wide resource inventories, municipal planning efforts) was obtained for important flora, fauna and significant areas of importance.
- **Non-Government Study Efforts** - A number of studies were completed by private entities (e.g., Heritage Conservancy riparian corridor mapping project) and obtained for the Poquessing Creek Watershed Rivers Conservation Plan.
- **Fairmount Park Commission** – A Poquessing Creek Park Master Plan was prepared by the Academy of Natural Sciences for the FPC.

Some key information from each source is highlighted in the following subsections.

Philadelphia Water Department

The Philadelphia Water Department (PWD) has completed a number of biological assessments throughout seven watersheds in Philadelphia and surrounding municipalities. Each study has determined the level of impairment and provided restoration and management recommendations to improve watershed quality. This forward-thinking program is part of the PWD's "Five-Year Biomonitoring Cycling Program".

During fall 2001, the PWD's Bureau of Laboratory Services and Office of Watersheds conducted biological assessments and habitat assessments at thirteen locations along the Poquessing and Byberry Creeks. As noted in the water quality section of this Rivers

Conservation Plan (See Section 5) all stream miles within the watershed, with the exception of the tidal reach, have been categorized as "unattained" (i.e., biologically impaired) due primarily to urban runoff and storm sewers discharges. An overview of those study findings are noted in Section 5 of this Rivers Conservation Plan.

With regard to bioassessment findings, the study noted the following:

- There were identified biological impairments in the macroinvertebrate community at all assessment locations in the Poquessing-Byberry Watershed.

- The pollution tolerance values and trophic designations of macroinvertebrates indicated a presence of moderately tolerant generalists (e.g., hydropsychid caddisflies and chironomid midges).

- Ichthyofaunal (e.g., fish) assessments revealed a relatively diverse population, although the conditions are not optimal for fish reproduction and re-colonization.

- A total of 24 species of seven fish families including American eel (*A. rostrata*), sunfish (*L. auritus*), bass (*M. dolomieui and M. salmodies,* eastern silvery minnow (*H. regius*), longnose dace (*R. cataractae*), mummichog (*F. heteroclitus*), spottail shiner (*N. hudsonius*), satinfin shiner (*C. analostana*), swallowtail shiner (*N. procne*), common shiner (*L. cornutus*), comely shiner (*N. amoenus*), golden shiner (*N. crysoleucas*), blacknose dace (*R. atratulus*).

- Anthropogenic influences (e.g., fish population stressors), such as channelization, impoundments (e.g., dams), stream encroachment and surrounding land development have altered the physical structure of the stream and the flow characteristics of the water.

- Fish population stressors such as increased sedimentation, siltation and streambank erosion have resulted in negative impacts to the fish populations and have impacted the reproductive ability of certain species.

- Physical habitat assessments suggest that physical parameters are likely the chief source of impairment within benthic macroinvertebrate and ichthyofaunal communities in the Poquessing-Byberry Watershed. These factors include hydrologic extremes (i.e., low base flow and accentuated flow during storm events); physical obstructions and sedimentation/siltation appear to be the major environmental stressors on the aquatic ecosystem.

The study also contains a comprehensive list of recommendations to improve the ecological condition of the Poquessing and Byberry Creek Watershed including:

- Aggregation of all available biological, chemical and physical data into a meaningful data base for purposes of spatial and temporal comparison.
- Site-specific bioassessments upstream and downstream from suspected sources of pollution.
- Development of a fish reintroduction program targeting extirpated species and predatory species.
- Implementation of fluvial geomorphological studies to better understand the rate and severity of streambank erosion and sedimentation and its effects on the aquatic biota.
- Incorporation of algae and nutrient analyses into comprehensive bioassessment programs to better understand the relationship between trophic levels and food-web interactions.
- The development of a comprehensive watershed education program targeted to students and residents to inform them of the importance of individual actions on the aquatic biota of the watershed.

Fish & Wildlife Service Report

The United States Department of the Interior (Fish and Wildlife Service) provided a report on the federally listed and proposed endangered and threatened species within the area of the Poquessing Creek Watershed. The USFWS provided comments in response to our formal request and pursuant to the Federal Endangered Species Act of 1973. The written report was based upon a search of endangered and threatened under their jurisdiction. A field inspection was not completed by their State College Pennsylvania Field office.

The report noted the presence of the Bog Turtle (*Clemmys muhlenbergii*) as well as a list of other federally listed, proposed and candidate species in Pennsylvania. Those species noted for Philadelphia, Bucks and Montgomery Counties are also included in Table 6-1, and a copy of the full report is included in the appendices (see Appendix A.12). The following report was provided for the Bog Turtle:

The project is within the known range of the Bog Turtle (Clemmys muhlenbergii), a species that is federally listed as threatened. Bog turtles inhabit shallow, spring-fed fens, sphagnum bogs, swamps, marshy meadows, and pastures characterized by soft, muddy bottoms; clear, cool, slow-flowing water, often forming a network of rivulets; high humidity; and open canopy. Bog turtles usually occur in small, discrete populations occupying suitable wetlands habitat dispersed along a watershed. The occupied "intermediate successional stage" wetland habitat is usually a mosaic of micro-habitats ranging from dry pockets, to areas that are saturated with water, to areas that are periodically flooded. Some wetlands occupied by bog turtles are located in agricultural areas and are subject to grazing by livestock. Since the Poquessing Creek Watershed Rivers Conservation Plan does not require any construction or other land alterations activities at this time, this project will not affect the bog turtle. However, if future plans

require surface disturbance within this watershed, further consultation with our agency will be necessary.

PADCNR, Pennsylvania Natural Diversity Inventory Report (PNDI)

The PADCNR provided a report via the Pennsylvania Natural Diversity Inventory (PNDI) within the area of the Poquessing Creek Watershed. The PNDI program is a partnership between the Pennsylvania Department of Conservation and Natural Resources, the Nature Conservancy and the Western Pennsylvania Conservancy in cooperation with the Pennsylvania Game Commission, the US Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission. It is a tool to determine "potential impact" or to provide a species of special concern impact review. The watershed area was screened for potential impacts to species and resources of special concern under the Department of Conservation and Natural Resources' responsibility. This includes plants, natural communities, terrestrial invertebrates and geologic features. According to the report:

This response represents the most up-to-date summary of the PNDI data files. An absence of recorded information does not necessarily imply actual conditions on site. A field survey of the site may reveal previously unreported populations.

The report noted the presence of 15 plant species of concern within the watershed boundaries. They are located primarily in proximity to the Delaware River with the exception of Walters Barnyard Grass (*Eehinochloa walteri*), which is in the southwestern portion of the watershed. The list is included in Table 6-1 along with the current Pennsylvania status (Title 17, Chapter 45, Conservation of Native Wild Plants) for each species. A copy of the full report (including global and state ranking) and corresponding map is included in the appendices (see Appendix A.13).

Pennsylvania Game Commission

The Pennsylvania Game Commission provided a report on special concern species of birds and mammals and State Game Lands. The report contained the following information:

Our office has determined that the project should not cause any adverse impacts to any special concern species of birds or mammals. Ospreys (Pandion haliaetus) have been confirmed on a channel marker in the Delaware River adjacent to the southeast corner of the project. No State Game Lands are located close enough that any impacts to them are anticipated.

Pennsylvania Fish & Boat Commission

The Pennsylvania Fish & Boat Commission provided a report on rare or protected species. According to the report, the Red-Bellied Turtle (*Pseudemys rubriventris*) a

threatened species in Pennsylvania is present within the vicinity of the Poquessing Creek Watershed. The Commission recommends wetland and waterbody protection and the employment of best management procedures. The report also noted:

The red-bellied turtle (Pseudemys rubriventris) is one of Pennsylvania's largest native aquatic turtles. This turtle species is known to inhabit relatively large, deep streams, rivers, ponds, lakes and marshes with permanent water and ample basking sites. Red-bellied turtles are restricted to south central and southeastern regions of the Commonwealth. The existence of this turtle species is threatened by habitat destruction, poor water quality and competition with aggressive non-native turtle species that share its range and habitat (e.g., red-eared slider, Trachemys scripta elegans).

Regional, City of Philadelphia & County-Wide Plans and Studies

The DVRPC has several studies that were helpful for determining data sources containing biological information in the Poquessing Creek Watershed. The DVRPC notes the importance of municipal land use planning and municipal land use regulations for preserving open space and natural resources.

In 2002, the Commission completed a comprehensive survey of local resource protection tools being used within the Watershed such as environmental resource inventories, open space plans, and many of the ordinances noted in Section 3 of this study. The culmination of that survey was a series of maps that indicated whether municipalities did or did not have natural resources inventories or other plans in place that identified biological resources. Their intent was to highlight the use of municipal natural resource and open space preservation tools in an effort to achieve the vision recommended in their regional 2030 plan for open space, natural areas and greenways. Table 6-1 indicates that the municipalities do not have natural resources inventories. However, Bucks and Montgomery Counties and the Fairmont Park Commission of the City of Philadelphia have completed Natural Resources Inventories. Information was therefore obtained from these inventories and other municipal sources, which are described in subsequent sections.

The City of Philadelphia Planning Commission (and the Philadelphia Water Department) have a series of planning tools, mapping efforts and programs that identify significant natural features, land uses and factors that directly impact species diversity (e.g., maps identifying percent tree and grass cover, community greening sites, community planning efforts and water quality programs). Many of these tools and programs are discussed in other sections of this plan as they directly relate to land use, water quality, and natural resources management recommendations.

As noted in previous sections, much of the undeveloped land area within the Philadelphia portion of the Poquessing Creek Watershed is managed by the Fairmount Park Commission. Specific biological resources and significant features within the Fairmount Park Commission are somewhat inventoried in their studies such as, the *Fairmount Park*

Adjoining Lands Study (Natural Lands Trust, 1999) and the *Trail Master Plan for the Poquessing Creek Park* (Andropogon Associates et al, 2001). However, these studies focus on land acquisition for linear parks rather than biological significance. Acquisition of fragmented land is an important process because it helps to preserve the natural habitat corridors that currently exist between already fragmented habitats which helps to preserve ecological diversity. The land adjacent to the creek contains floodplains, habitats, and a diversity of ecologically significant flora and fauna. Those noted include: significant soils, steeply sloping land, and floodplains.

The *Montgomery County Natural Areas Inventory* (Montgomery County Planning Commission, 1997) was completed in an effort to list and protect rare plants, animals and natural communities. The focus of this inventory was to protect bio-diversity, including genetic diversity, species diversity and ecosystem diversity. The inventory contains maps that identify known high-quality natural communities and the location of flora and fauna of special concern. This plan indicated that there are no areas of special concern within the small portion of the Poquessing Creek within Lower Moreland Township.

The *Natural Areas Inventory of Bucks County, Pennsylvania* (Rhoads & Block, 1999) contains an inventory and prioritized listing of plants, animals, natural communities and geological and hydrological features throughout Bucks County. The sites are prioritized at four levels of importance (e.g., Priority 1-4) for the 54 municipalities in Bucks County.

- **Priority 1 Sites** - Areas with state-wide or county-wide significance due to the uniqueness or exceptionally high quality of their natural resources.
- **Priority 2 Sites** - Areas with county-wide and in some cases state-wide significance due to their overall quality and diversity, and importance of the resources they contain.
- **Priority 3 Sites** - Areas that have county-wide or local importance.
- **Priority 4 Sites** - Sites with biological or ecological resources that are important primarily at the local level.

The Atlantic Coastal Plain, the physiographic province for the entire watershed, stretches from the Delaware River in Morrisville to the Pennsylvania border with the state of Delaware, south of Philadelphia. The inventory and many of those interviewed in our public outreach efforts, note the importance of this province because the Atlantic Coastal Plain supports species *that are found nowhere else in Pennsylvania and a substantial number have been lost due to habitat destruction. Because so little remains, the few remaining examples of natural Coastal Plain vegetation are extremely important to protect.* The inventory also notes that the freshwater tidal marshes along the Delaware Estuary and the remnant stands of coastal plain forest habitats are, although fragmented, "vitally important to protect."

Within the Poquessing Creek Watershed, there are no priority sites noted for Lower Southampton Township and four priority sites noted for Bensalem Township.

- **Priority 2: Mature Forest, Poquessing Creek** - According to the inventory, this site is located in Bensalem Township just below the railroad in the Linconia section of Bensalem Township. The forest in this area is one of the least disturbed and most mature along the entire Poquessing Creek Valley with canopy trees 80-100 feet tall and diameter at breast height (dbh) ranging from 15-36 inches. Tree species at the site include Red and White oaks (*Quercus rubra and alba*), Beech (*Fagus grandifolia*), Black gum (*Nyssa sylvatica*), Red maple (*Acer rubrum*), Shagbark hickory (*Carya ovata*) and Iron wood (*Carpinus caroliniana*). Wood species include Witch hazel (*Hamamelis virginiana*) and Spicebush (*Lindera benzoin*). The herbaceous species diversity is considered relatively high.

- **Priority 3: Mature Native Woodland Forest, Woodhaven Mall Site** - This scenic woodland track rises abruptly above the creek on a 30 foot Wissahickon schist cliff. It contains upland forests containing Red oaks (*Quercus rubra*), at more than 40 inches at diameter breast height (dbh). Dominant species include Pin oak (*Quercus palustris*) and a variety of non-native invasive species.

- **Priority 3: Forest, Betz Lab Site** - This successional floodplain forest is about 60 acres in size and lies between the railroad bridge and Brownsville Road. It is dominated by Tuliptree (*Liriodendron tulipifera*), Red oak (Quercus rubra), Black walnut (*Juglans nigra*), Shagbark hickory (*Carya ovata*), Ironwood (*Carpinus caroliniana*), White ash (Fraxinus americana), Black willow (Salix nigra), Red and Silver maple (*Acer rubrum* and *saccharinum*) plus several nonnative invasive species. The site also contains mature stands of American beech (*Fagus granifolia*), and Black-gum (Nyssa sylvatica).

- **Priority 4: Bensalem Country Club Site** - This mature riparian forest and pond is located along the east bank of the Poquessing Creek between Knights Road and Yezzi Park. Wissahickon Schist is visible in portions of this site. The banks of Poquessing Creek are forested and the lower portion contains several seeps and wetland areas on the floodplain. Skunk cabbage (*Symplocarpus foetidus*) is prominent.

Municipally-Based Planning Efforts

As noted previously, the three municipalities of Bensalem Township, Lower Southampton Township and Lower Moreland Township in the Poquessing Creek Watershed have not completed biological inventories. However, biological inventory information is often contained in other planning efforts and as the basis for formulating biological protection recommendations.

Bensalem Township

The Bensalem Township Open Space Plan (Evans & Associates, Bensalem Township EAB, 1998) notes that the Township has approximately 2,900 acres of open space concentrated primarily along stream valleys that contain numerous wetlands. The primary goal of this plan is to protect critical habitats along creeks. The plan specifically notes the importance of biological and natural features associated with the Poquessing Creek and its surrounding watershed. These features include: floodplains, floodplain woodlands, freshwater wetlands, brackish tidal marshes, freshwater stream valleys, coastal plain soils, Wissahickon Schist, and flora and fauna of significance. Flora and fauna noted in the plan were similar to those reported by the state agencies. Additional species contained in the Open Space Plan (PNDI and Morris Arboretum) are noted in Table 6-1.

The Township of Bensalem Comprehensive Plan (Schoor DePalma Inc., 2002) does not contain a biological/natural features protection plan. Although, the Open Space component of the plan does include the goal to protect critical habitats along the Poquessing Creek.

Lower Southampton Township

The Lower Southampton Township Recreation, Park and Open Space Plan (Toole Recreation Planning and Heritage Conservancy, 1999) notes the main land use issues are limited open space areas and traffic congestion. The goals in the plan speak to the need for *a high level of protection and stewardship of the township's natural resources*. Critical natural features noted in the plan and associated with the Poquessing Creek Watershed include: floodplains, floodplain soils, hydric soils, riparian buffers, wetlands, wetland margins, ponds, pond shore areas, steep slopes, woodlands, Wissahickon Schist, and the Poquessing Creek. A PNDI search was completed for this study with two identified species of concern. They are noted in Table 6-1.

The Lower Southampton Township Plan (Schoor DePalma Inc., 2002) does not contain a biological / natural features protection plan or goals specific to protecting critical habitats along the Poquessing Creek.

Lower Moreland Township

The Lower Moreland Township Open Space Plan Update (Walter C. Evans & Associates, Inc., 2005) notes the need to preserve open space in the Township. The goals in the plan note the importance of conserving environmentally sensitive natural features such as steep slopes, floodplains, wetlands, woodlands, water supplies, unique or fragile natural areas, riparian buffers, stream corridors, headwater areas, springs, and wildlife habitat. A PNDI search may have been completed for this study; however information was not contained in the plan. Lower Moreland Township does not have a municipal comprehensive plan.

Table 6-1. Poquessing Creek Watershed Biological Resources

Information Source	Biological Resource	Comments
United States Fish & Wildlife Service	**Bog Turtle** *(Clemmys muhlenbergii*) **Bald Eagle** *(Haliaeetus leucocephalus)* **Shortnose Sturgeon** *(Acipenser brevirostrum)* **Small-whorled pogonia** *(Isotria medeoloides)*	**Federal Listing-** Threatened **Federal Listing-** Threatened (Distribution in Bucks and Montgomery Counties) **Federal Listing-**Endangered (Distribution Delaware River, Jurisdiction National Marine Fisheries Service) **Federal Listing-** Threatened (Distribution Montgomery and Philadelphia Counties)
PADCNR PNDI Report	**Waterhemp Ragweed** *(Amaranthus cannabinus)* **Elliot's Beardgrass** *(Andropogon gyrans)* **Swamp Beggar-ticks** *(Bidens bidentoides)* **Beggar-ticks** *(Bidens laevis)* **Walter's Barnyard Grass** *(Echinochloa walteri)* **A Eupatorium** *(Eupatorium rotundifolium)* **Grass-leaved Goldenrod** *(Euthamia tenuifolia)* **Multiflowered Mud-plantain** *(Heterantera multiflora)* **Swamp dog-hobble** *(Leucothoe racemosa)* **Bugleweed** *(Lycopus rubellus)* **Nuttail's Milwort** *(Polygala nuttallii)* **Southern Red Oak** *(Quercus falcata)* **Subulate Arrowhead** *(Sagittaria sublata)* **Netted Chainfern** *(Woodwardia areolata)* **Indian Wild Rice** *(Zizania aquatica)*	**PA Status**- Pennsylvania Rare (PR) **PA Status**- No Current Legal Status (N), Under Review for Future Listing **PA Status**- Pennsylvania Threatened (PT) **PA Status**- No Current Legal Status (N), Under Review for Future Listing **PA Status**- Pennsylvania Endangered (PE) **PA Status**- Tentatively Undetermined (TU) Insufficient Data **PA Status**- Pennsylvania Threatened (PT) **PA Status**- Pennsylvania Endangered (PE) **PA Status**- Tentatively Undetermined (TU) Insufficient Data **PA Status**- Pennsylvania Endangered (PE) **PA Status**- No Current Legal Status (N), Under Review for Future Listing **PA Status**- Pennsylvania Endangered (PE) **PA Status**- Pennsylvania Rare (PR) **PA Status**- No Current Legal Status (N), Under Review for Future Listing **PA Status**- Pennsylvania Rare (PR)
Pennsylvania Game Commission	**Osprey** *(Pandion haliaetus)*	**PA Status**- Species of Special Concern
Pennsylvania Fish & Boat Commission	**Red Bellied Turtle** (*Pseudemys rubriventris)*	**PA Status**- Threatened
Fairmount Park Studies	**Floodplain Areas**	**Areas of Concern-** Variety of features related to floodplain ecosystem
Bucks County Natural Resources Inventory	**Coastal Plain Physiographic Province** **Mature Native Woodland Forest, Poquessing Creek** **Mature Native Woodland Forest, Woodhaven Mall**	**Areas of Concern-** Natural Coastal Plain Vegetation, Freshwater Tidal Marshes Priority 2 Status Priority 3 Status

	Forest, Betz Lab Site **Bensalem Country Club Site**	Priority 3 Status Priority 4
Bensalem Township Open Space and Comprehensive Plan	**Long-Lobed Arrowhead** *(Sagitaria montevidensis)* **Willow Oak** *(Quercus phellos L.)* **River Bulrush** *(Schoenoplectus fluviatilis)* **Purple Sandgrass** *(Triplasis purpurea)* **Wright's Spikerush** *(Eleocharis dulcus)* **Coastal Plain Leopard Frog** *(Rana utriculata)* *Note: See PNDI report for additional species.*	Noted as PA Endangered/Threatened Plant and Animal Species.
Lower Southampton Township Recreation, Park & Open Space Plan and Master Plan	**Bushy Aster** (Aster dumosus) **Arogos skipper** (Astrytone arogos arogos) *Note: See PNDI report for additional species.*	Noted as PA Species of Concern.

SECTION 7: Historic, Cultural, Scenic, and Recreational Resources

7.1 Historic and Recreational Resources: A Brief History of the Poquessing Creek Region

The majority of the Poquessing Creek Watershed is located in the Philadelphia region which happens to be one of the first areas settled by Europeans when they first arrived in North America. The region had previously been inhabited for thousands of years prior to European settlement in the area, by the Native American tribe known as the Lenape. According to the Fairmount Park Commission's Trail Master Plan for the Poquessing Creek Park (FPC, 2001), the word "Poquessing" ("Poetquessnick" in the Algonquin language which the Lenape spoke) has been translated to mean "place of many mice." The following is an excerpt from a book dedicated to all Lenape and entitled The Lenape-Delaware Indian Heritage: 10, 000 B.C. – A.D. 2000 (Herbert C. Kraft, 2001):

In 1524, the Florentine navigator Giovanni da Verrazano and the crew of the French caravel Dauphine were the first know Europeans to sight Lenapehoking ("land of the Lenape"). This region encompassed what is now New Jersey, southeastern New York State, eastern Pennsylvania, almost all of Delaware, and a small part of southwestern Connecticut!

Attracted to the ports and the fertile soils in the region, the Swedish were among the first to settle in the Poquessing Creek area. English settlers began to inhabit the area after Thomas Holme surveyed the area on behalf of William Penn. He selected the lower portion of the creek for Penn's City, which for many years was known as "Old Philadelphia."

In 1682, Charles II granted Pennsylvania to the religious dissenter, William Penn. William Penn believed that this land grant did not override native (Lenape) rights to the land, therefore, he sent William Markham to negotiate the purchase of southeast Pennsylvania from the Lenape prior to his arrival and the beginning of his "Holy Experiment" (beginning a colony with religious tolerance).

In November of 1682, William Penn arrived to Pennsylvania and signed a treaty at Shackamaxon (Philadelphia) with Chief Tammanend, who was a popular chief that was chosen to be the representative by several local Lenape clans. This agreement has been described by Voltaire, and local Lenape decedents to this day, as "the one treaty with the Indians that the whites never broke."

Penn's three sons by his second marriage inherited his estate at his death in 1718. However, William Penn's sons did not inherit his honesty or his esteem for the Lenape. Penn's sons are known for the infamous Walking Purchase "agreement," a treaty signed in 1686 in which the Lenape ceded the land between the junction of Delaware and Lehigh Rivers "as far west as a man could walk in a day and a half."

Lenape decedents refer to this particular land deal as the Walking "hoax" rather than the Walking "purchase" because three of the fastest men in the colony were hired by William Penn's son Thomas to "walk" the area with the promise of a prize to whomever could cover the greatest distance. Rather than follow the agreement to "walk," these men ran prepared paths that allowed them to cover twice the distance the Lenape had anticipated. This "Walking Purchase" cost the Lenape most of the Lehigh Valley.

Smaller than adjoining creek valleys, the Poquessing Creek Valley was not as popular to Europeans for the establishment of milling sites. However, farming did take hold in the region, and Mechanicsville is one example of a small milling community that took hold in 1843 and is still evident today (FPC, 2001). The port City of Philadelphia was connected to the cradle of American industrialism (e.g., Easton in the Lehigh Valley) through the system of turnpikes and canals that transported coal and other goods along the Delaware River and north through the Poquessing Creek Watershed. Therefore it is no surprise that farming in the Poquessing was soon followed by early industrialism.

The Native American presence followed by European occupancy has resulted in a rich and varied historical record within the Poquessing Creek Watershed. The following subsections provide an inventory of some of the vast cultural, historical and recreational amenities still present in the Poquessing Creek Watershed. Statewide historic register lists, municipal and non-government sources were researched to obtain the historic and cultural resource inventory for this Rivers Conservation Plan.

- **National & State Registers** – The Pennsylvania Historical & Museum Commission, the Cultural Resources Geographic Information System (CRGIS, a Joint Venture of the Pennsylvania Historic & Museum Commission and the Pennsylvania Department of Transportation), and Pennsylvania Historic Architecture and Archeology (ARCH database).

- **Regional & Local Sources** – Delaware Valley Regional Planning Commission, Fairmount Park Commission, Bucks and Montgomery County Planning Commissions, Bensalem, Lower Moreland and Lower Southampton Township Comprehensive Plans (Historical Features Components), the Friends of the Poquessing Creek Watershed, and key person interviews with local historians.

National & State Register Historic Information

According to the Pennsylvania Historical and Museum Commission (PHMC), the PHMC Cultural Resources Geographic Information System (CRGIS) is a map-based inventory containing historic and archaeological sites and surveys stored in the files of the State Bureau for Historic Preservation (BHP). CRGIS is a partnership between PHMC and the Pennsylvania Department of Transportation (PennDOT), with financial support from the Federal Highway Administration (FHA), the Baltimore District of the Army Corp of Engineers (ACOE) and the Pennsylvania Department of Environmental Protection (PADEP).

The Pennsylvania Historical and Museum Commission has been collecting information concerning archaeological sites and historic resources for the greater part of a century. Currently there are over twenty-thousand archaeological sites and over one-hundred and twenty-five thousand historic properties in these files. Paper records are free of charge and open to the public by appointment. However, CRGIS is a means of accessing some of the information via computer (specific information about archeological sites is restricted and understandably granted only to qualified individuals on a need to know basis). There are several archeological sites associated with the Poquessing Creek Watershed (e.g., SEPTA Line, I-95 Interchange geographic regions), however this information is regional in nature and released only to professional archeologists.

The national, statewide and local historically and culturally significant sites in the Poquessing Creek Watershed (see Table 7-1) were obtained from the CRGIS database. Although all sites were double-checked with statewide and local resources, the CRGIS database lumps sites in the Poquessing Creek Watershed with sites in the Pennypack Creek Watershed, therefore the list may not be comprehensive and may contain information on adjoining watersheds.

Through the U. S. Department of the Interior, the National Park Service (NPS) maintains the National Register of Historic Places, which is the Nation's official list of cultural resources that are worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Included among the over 80,000 listings that make up the National Register are: all historic areas in the National Park System, National Historic Landmarks that were designated by the Secretary of the Interior, and properties nominated by governments, organizations, and individuals. These properties include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. There are four (4) nationally listed properties in the Poquessing Creek Watershed; the Comly-Watson School, the Glen Foerd Mansion, the Frankford Avenue Bridge, and the Mechanicsville School.

- **Comly-Watson School** – The Comly Watson School, also known as Somerton Masonic Hall is located at 13250 Trevose Road in Philadelphia. The school and social meeting hall were designed and built by Joseph Anschutz and L. Dieterich. It was added to the National Historic Register in 1988 due to its Colonial Revival Style (1875-1899 Period).

- **Frankford Avenue Bridge** – The Frankford Avenue Bridge located on Frankford Avenue was designed by John McManamy and its period of significance is 1900-1924.

- **Glen Foerd Mansion** – Glen Foerd Mansion, also known as the Lutheran Center for Education and the Arts at Glen Foerd, was added to the National

Historic Register in 1979. The Glen Foerd Mansion is considered significant for its architecture, literature, industry and landscape architecture. The periods of significance associated with this historical listing are: 1850-1874, 1875-1899, 1900-1924. It is currently an educational and cultural center.

- **Mechanicsville School** – The Mechanicsville School, located on Mechanicsville Road in Philadelphia, was added to the National Historic Register in 1986. It was designed/ built by Seth K. Samm and its period of significance is 1850-1874. It originally functioned as a school but is currently a private home.

Figure 7.1 – Glen Foerd Mansion

The remaining sites listed in Table 7-1 are sites eligible for the National Register, sites as yet undetermined for the National Register, sites listed on the Pennsylvania Statewide list of historic places, and areas of local significance (e.g., Fairmount Park Land, Municipal Interest).

On April 5, 2007, Adam Levine, a PWD historical consultant specializing in watershed history, presented his findings on the Poquessing Watershed to the Poquessing Watershed partners at the Community College of Philadelphia. The presentation is titled, "A Brief History of the Poquessing Creek Watershed" and it can be viewed in Appendix A.16.

Table 7-1. Poquessing Creek Watershed Historic and Cultural Resources

Information Source	Historical and Cultural Resources	Comments
National Register of Historic Sites (ARCH Database)	Mechanicsville School	**Mechanicsville Road, Philadelphia-** National Listing, Architecturally significant (1850-1874)
	Frankford Avenue Bridge	**Frankford Avenue-** National Listing, Engineering Significance (1900-1924)
	Comly-Watson School	**Trevose Road (13250 Trevose Road, Philadelphia)-** National Listing, Architecturally significant (1875-1899)
	Glen Foerd Mansion	**(Grant Avenue, Philadelphia)-** National Listing, Architecturally significant (1850-1874, 1875-1899, 1900-1924).
	Premier Products	**(2500 Byberry Road, Philadelphia)-** Undetermined
	Somerton Animal Hospital	**(13400 Philmont Avenue, Philadelphia)-**Undetermined
	Newport David House	**(526 Philmont Avenue, Lower Southampton)-** Undetermined (Mid 19th Century).
	Holy Ghost Prep School	**(2201 Bristol Pike, Bensalem)-**Eligible (1909)
	St. Elizabeth Convent	**(3800 Bristol Pike, Bensalem)-** Eligible (1862)
	PA Railroad (Amtrack)	**(Station Road, Philadelphia)-** Eligible (1930)
	Robert Jonathon House	**(87 Street Road Bensalem)-** Undetermined (1880)
Fairmount Park Commission	Benjamin Rush State Park	**Burling Avenue & Vicinity-** Established as Park 1975, Commemorating Dr. Benjamin Rush.
	Benjamin Rush Birthplace	**Intersection of Red Lion and Keswick Roads-** Demolished in 1969.
	Century Lane Stone Bridge	**Century Lane (State Road) -** Constructed in 1850. Crossing the Poquessing, Philadelphia and Bucks County Line.
	Historic Red Lion Road County Bridge	**Red Lion Road-** Constructed 1850, Three Arch Bridge, Largest on Poquessing Creek, Dividing Line of Philadelphia and Bucks Counties.
	Red Lion Inn	**Kings Highway (Bristol Pike)-** Established 1726, First Public House in Area, John Adams Dining Spot.
	Townsend Road Stone Bridge	**Benjamin Rush State Park-** 19th Century Construction, Crossing Into Bucks County.
	Chimney Remains	**Stevenson Street-** Remains of Old Estate Mansion.
	Risdon Tavern & Ferry	**Glen Foerd Mansion Vicinity-** Now Demolished Tavern & Ferry Established 1700's and Serving Delaware River Travelers.
	Glen Foerd Mansion	**Grant Avenue (Confluence of Poquessing Creek & Delaware River)-** Built in 1850, Delaware River Estate House, Now Owned by Fairmount Park Commission.
	Poquessing Ferry Wharf	**Confluence of Poquessing Creek & Delaware River-** First Proposed As William

	Eden Hall Pennsylvania Railroad	Penn's Philadelphia Site, Once Accessible Wharf. **Grant Avenue (Fleuhr Park) - Stone** Pillar Gate Marking Location of Eden Hall Estate and Now 61 Acre Recreational park. **Grant Avenue-** Established 1876, Rail Line Crossing Poquessing Just Beyond Present Location of Torresdale/SEPTA R7 Line.
Bensalem Township (Comprehensive Plan, Open Space Plan, Heritage Conservancy)*	Albert Rochen House Belmont House Trevose Manor (Browden-Galloway Mansion) Sisters of the Blessed Sacrament/ St. Elizabeth's Convent Giles Knight House Bensalem United Methodist Church Andalusia Manor Bensalem African Methodist Episcopal Church Growden Mansion Pen Ryn Mansion Church of the Redeemer & Kings Library	**Ridge Avenue (4809) -** Heritage Conservancy Historic Registry Database. **Bristol Road (3779) -** Heritage Conservancy Historic Registry Database. **Old Trevose Road (Neshaminy Blvd.) -** Heritage Conservancy Historic Registry Database. **Bristol Pike (1663)-** Location where Saint Sister Katherine of Drexel took vows. **Colmar Avenue (2682) -** Heritage Conservancy Historic Registry Database. **Hulmeville Road (4300) -** Heritage Conservancy Historic Registry Database. **State Road/Delaware River-** Mansion (1794), engine house and property National Historic Landmark). **Bridgewater Road (1200)-** Little Jerusalem Church (1856) **Neshaminy Valley Drive (5408)-** Stone Mansion (1740) small stone vault (1860) **Lerch Road-** Site of historic interest (1730). **Bristol Pike-** Sites of historic interest in Andalusia (1860 & 1882).
Lower Southampton Township (Open Space Plan, Heritage Conservancy*)	The Willett's Farm Buck Cemetery Harding Cemetery Willett-Knight House David Newport House	**Bustleton Pike (1547)-** Local Register of Historic Places. **Street & Fairview Roads-** Local Register of Historic Places. **Street Road-** Local Register of Historic Places. **Bustleton Pike (1409) -** Local Register of Historic Places. **Philmont Avenue (526) -** Local Register of Historic Places.
Lower Moreland Township (Open Space Plan)	None Listed For Watershed Area	Very Small Portion of Township
Friends of the Poquessing Creek (Poquessing Pathfinder Newsletter, Fall/Winter 2002 Issue)	Red Lion Road Bridge Hart Burial Ground Red Lion Inn Century Lane Bridge Townsend Road/Richlieu Road Bridge Byberry Bensalem Turnpike/Lincoln Highway Bridge Benjamin Rush Home/Birthplace	**Red Lion Road-** See Fairmount Park Listing. **Vicinity Red Lion Road-**Established 1683, Early Settler Burial Ground (Dr. Benjamin Rush) **Kings Highway (Bristol Pike) -** See Fairmount Park Listing. **Century Lane (State Road) -** See Fairmount Park Listing. **Benjamin Rush State Park-** Established 1849 **Benjamin Rush State Park-** See Fairmount Park Listing. **Intersection of Red Lion and Keswick Roads-** See Fairmount Park Listing.

*Sources: Refer to previous list and bibliography. * Municipal Wide Information. Not available on watershed basis.*

7.2 Recreational Resources: An Introduction to Benefits & Regional Planning Efforts

The importance of recreation areas, especially in urban areas cannot be underestimated. Large, linked and uninterrupted expanses of open space, or greenways, that provide for human recreation and ecological preservation can be even more valuable. The importance of preserving land for recreation and ecological preservation was frequently noted by the project committee and the people interviewed as part of this project, which was supported by the research materials obtained for this section from various agency and municipal sources.

Although portions of the Poquessing Creek Watershed and Creek areas have been greatly impacted by development, other areas have been preserved. Protection of the remaining undeveloped regions of the watershed and its associated riparian ecosystem provides for wildlife migration, species interchange, nature study and certain degrees of recreation. Therefore, enhanced and protected open areas also provide a means to protect, maintain and enhance native vegetative associations, wildlife, the existing level of biodiversity, and water resources.

A variety of studies and publications address the relationship between providing recreational areas and open space with human health and ecological preservation. In 2004, the Pennsylvania Department of Conservation and Natural Resources (PADCNR) completed a state-wide Recreation Plan (*Pennsylvania's Recreation Plan, 2004-2008*, April 2004). Along with recommendations to increase funding and build more effective partnerships, a major goal of the plan is to create healthy and livable communities. Evidence of this plan can be seen through the successful efforts in the Poquessing Creek Watershed on behalf of the state and Fairmount Park Commission (e.g., Benjamin Rush State Park, Poquessing Creek Park). According to the Pennsylvania Recreation Plan:

The physical, mental and social benefits of recreation are well known and documented. Recreation enriches people's lives and provides outlets for socializing and family activities. Studies have shown that spending more time in nature lowers rates of asthma and diabetes and quantifiably reduces stress levels. Children who have access to parks are less likely to engage in juvenile crime. And greater access to outdoor recreation facilities, particularly close-to-home walking and biking opportunities can combat obesity, America's number one health threat. Recreation also contributes strongly to the vitality of the state's economy. Outdoor recreation generated expenditures in 1997 of $4.03 billion, or 33 percent of Pennsylvania's leisure travel spending.

Local agencies such as the Delaware Valley Regional Planning Commission (DVRPC) and the Philadelphia City Planning Commission (PCPC) agree with the Pennsylvania Recreation Plan as indicated through several of their studies, plans and projects. In 2002, the DVRPC completed the Recreational Open Space Needs Analysis for the Delaware Valley (DVRPC, May 2002) where a population-based recreational needs assessment and other analyses (e.g., New Jersey's balanced land use guidelines, adjusted land use

guidelines considering Delaware Valley growth) were completed. This effort included an evaluation of the Delaware Valley's current inventory of recreational open space. The inventory considered the publicly owned regions and accessible lands, including municipal, county, state and federal parks, state forests, state gamelands, wildlife preserves, lands in the national park system, and various other publicly owned and accessible lands. The need to protect open space and recreation for human and ecological benefits were also noted in that plan. Additionally, using adjusted land use guidelines, the Plan noted a need for an additional 19,000 acres of county, state and federal parklands by 2025. The Plan notes the following:

Open space for both active and passive recreation is a critical need for the Delaware Valley. The Delaware Valley can create an extensive, diverse, and well distributed open space system that not only serves the recreational needs of a large metropolitan population, but also maintains the health and integrity of the region's natural resources, increases its attractiveness to current and future residents, and preserves the regions cultural identity and heritage.

The Philadelphia City Planning Commission has published a number of comprehensive recreational plans and policies as well. The plans and policies cover the need to protect open space, create passive and active recreational areas, and provide specific guidelines for developing suitable recreational areas in the Poquessing Creek Watershed and along creeks and the Delaware River. A publication frequently noted during the one-on-one interviews for this Rivers Conservation Plan included Philadelphia: The New River City (PCPC, 2005). According to the plan:

To position itself for growth in the 21st Century, the City of Philadelphia plans to coordinate and take advantage of the resources of its riverfronts as new places for living, recreation, working, and environmental enhancement. By identifying itself as a New River City, Philadelphia will redefine and improve the City's relationship to its rivers, waterfronts, and communities. The New River City concept will be a planning and management tool for appropriate contemporary development.

The goals in that plan involve bringing the City back to its rivers, reclaiming/redeveloping/linking vacant industrial land along major and tributary rivers for mixed uses, marketing the area throughout the region and the country, and ensuring public physical and visual access. The plan notes the importance of creating a riverfront network of recreational trails, open space, and active recreational uses that serves a local and regional audience

As noted previously in the report, the Fairmount Park Commission (FPC) has a park master plan (FPC, 1983) and has diligently worked toward implementing a series of comprehensive open space and recreational goals and objectives. The FPC's Natural Lands Restoration and Environmental Education Program (NLREEP), Natural Lands Restoration Master Plan (FPC and Academy of Natural Sciences, 1999), and Trail Master Plan for Poquessing Creek Park (FPC & Andropogon Associates, 2001) are some

examples of their commitment to creating linked passive and active recreational areas in the Poquessing Creek Watershed and throughout their region of jurisdiction. Although the creation of a trail system is still under discussion within the watershed, the Trail Master Plan notes the following:

The trail system is at the heart of every park. It determines the nature of our experience and how we see the landscapes and features of each place. A trail system that works enables the user to access the landscape with as few negative impacts as possible. Good trails both protect and reveal the landscape. They introduce the user to the history of a place as well as link the community and the natural landscape.

7.3 Recreation: Local Recreational Planning Efforts

A number of recreational planning and implementation efforts are taking place at the municipal level through recreational planning projects in Bensalem, Lower Southampton, and Lower Moreland Townships and the local level through the interest of local recreational groups and individuals.

The three municipalities in the watershed have embraced recreational and open space planning as evidenced by the goals and objectives in their respective municipal comprehensive plans and open space and recreational plans. Many of their adopted policies address open space acquisition to preserve ecological integrity and to provide places for recreational pleasure.

The Bensalem Township Comprehensive and Open Space Plans note the importance of preserving recreational land to address quality-of-life issues, and they both state the need to create linear parks, greenways, small parks close to the highest density population areas and preserve habitat in critical lands. The plan contains six target areas for open space acquisition, the second of which is relevant to the Poquessing Creek Watershed and the 8.25 mile length of the Poquessing Creek within the Township. A greenway centered on the Poquessing Creek is the subject of this target area and a Greenway Trails Master Feasibility Study is currently being completed (Simon, Jaffee and Collins, Brian Stietz).

Both the Lower Southampton Township Master Plan and Recreation, and the Park and Open Space Plan (Toole & Heritage Conservancy, 2000) advocate park preservation for quality of life issues and ecological preservation. Providing parkland for growing populations and preserving environmentally sensitive areas are highlighted in their municipal policies and implementation projects.

The Lower Moreland Township Open Space Plan has a consistent philosophy toward providing recreational areas and protecting significant natural features. Although the Lower Moreland Township area is a very small part of the Poquessing Creek Watershed, it is important to the overall watershed because it is a headwater area. Their goal of providing a superior environment complete with sufficient open space and recreational

facilities is consistent with policies noted for adjoining municipalities as well as local and regional agencies in the watershed.

7.4 Recreational Inventory & Overview of Largest Recreational Parcels

The recreational inventory prepared for the Poquessing Creek Watershed Rivers Conservation Plan was completed using regional and local information sources (e.g., agency and municipal planning documents) and geographical information systems (GIS) information supplied by the Delaware Valley Regional Planning Commission (DVRPC) and local municipal sources. The information sources are listed below as well as on Map VIII, Open Space and Recreation. Information sources are as follows:

- **State Information Sources** - The Pennsylvania Department of Conservation and Natural Resources (DCNR).

- **Regional & Local Sources** - The Delaware Valley Regional Planning Commission, Fairmount Park Commission, Bensalem, Lower Moreland and Lower Southampton Township Comprehensive Plans (Recreation Features Components) and functional plans (open space and parks and recreation), and key person interviews with local recreation advocates.

As map VIII indicates, over 373 acres or 2.7% of the watershed contains parkland under the jurisdiction of the Bureau of State Parks, Fairmount Park Commission, County and local parks, and private landowners. The map legend indicates the location and illustrates the acreage breakdown.

Fairmount Park Recreational Lands

The largest acreage within the Watershed (approximately 374 acres) is under the ownership of the Fairmount Park Commission and subject to the Trail Master Plan for the Poquessing Creek Park (Fairmount Park System and Andropogon Associates, Ltd., 2001). The recommended trail plans are discussed later in this plan (see subsection 6.5), however the plan does contain key findings regarding current land holdings in the Poquessing Creek Watershed. The majority of these findings were consistent with the feedback received from our community survey, key person interviews, community meeting feedback, and committee member comments. Fairmount Park (Poquessing Creek Park) inventory findings were as follows:

- **Use Patterns** - There has been a dramatic increase in the popularity and use of mountain bikes and ATVs. Unpaved trails on landholdings have been negatively impacted.
- **Rogue Trails** - Users are creating rogue trails (over 2.9 miles) that are damaging to parkland.

- **Stormwater** - Damage from stormwater is evident due to existing rogue trail placement, existing trail use (e.g., compaction) and general increased stormwater production.
- **All Terrain Vehicles** - Illegal operation of ATVs on Fairmount parkland poses serious impacts to the natural areas and existing trail infrastructure.
- **Security Issues/Park Information** - Trail users reported feeling some insecurity when using Fairmount Park for recreational purposes and requested the presence of more park ranger as well as more trail signage and mapping information.
- **Traffic/Diminished Hiking Experience** - Traffic is a problem and hikers expressed dissatisfaction with the lack of courtesy and observation of park rules by vehicles. Additionally, the trails network is dense which makes restoration and management of natural areas difficult.

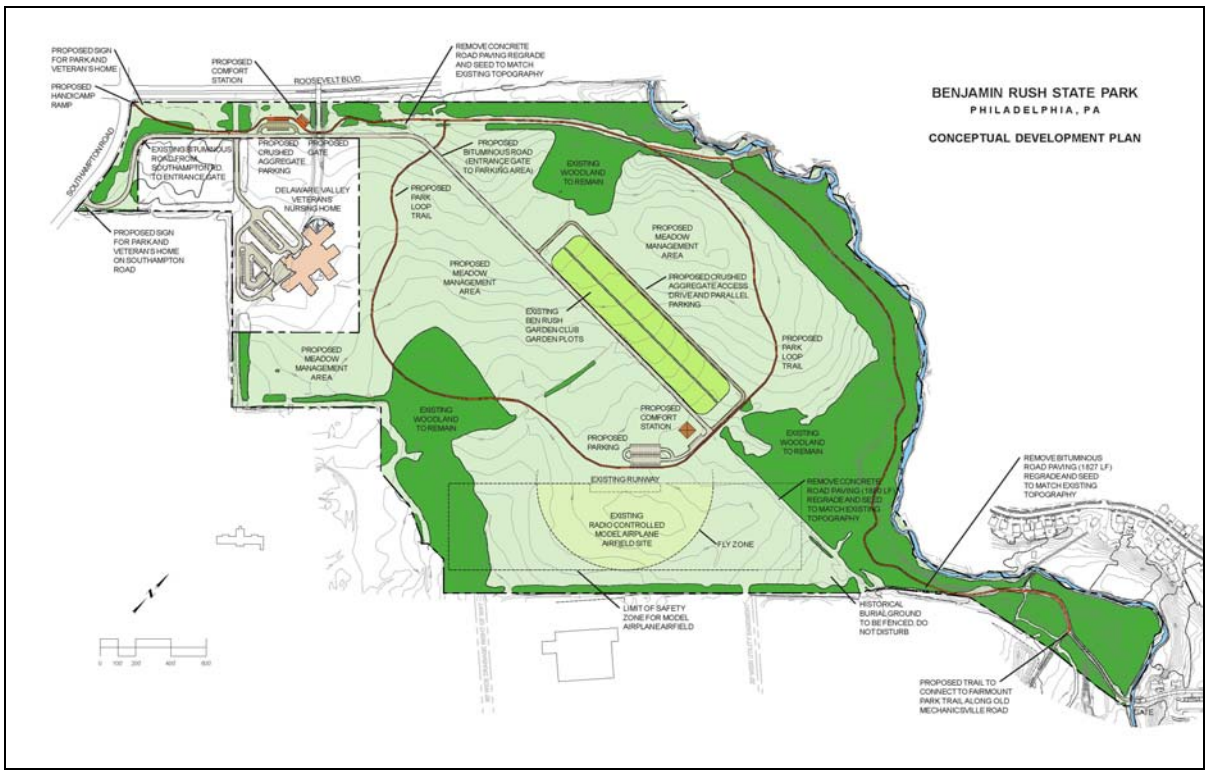
Benjamin Rush State Park

Benjamin Rush State Park is the only state park in Philadelphia County. It is located on Roosevelt Boulevard (see Map VIII) in the eastern central region of the watershed. The land for Benjamin Rush State Park was once part of the Byberry State Hospital property which was transferred to the Bureau of State Parks in 1975. Additional acreage that included a mix of open fields and woodlands, a large community garden, and a field for flying model airplanes was added to the park in 2003. As noted in the historical section of this plan, the park was named after the Philadelphia-born physician, Benjamin Rush, who was also a medical teacher and one of the signers of the Declaration of Independence.

This currently undeveloped state park is approximately 300 acres in size and is a mixture of open fields and woodlands. According to PADCNR, Benjamin Rush has the world's largest community garden, and a popular radio-controlled model airplane airfield site.

The PADCNR is planning to preserve open space and natural features within the park and provide parking and comfort stations to better serve the current community garden and flying field. As the draft conceptual development plan illustrates (see Figure 7.2 below), the PADCNR is planning interpretive kiosks about Benjamin Rush, Native American medicine, native plants and their ties to Lewis and Clark, a network of bicycle and pedestrian trails, as well as water, sewer and storm water controls. The Friends of the Poquessing Creek has regular bird watching trips to the park and several community clean ups take place each year.

Figure 7-2. Benjamin Rush State Park, Conceptual Development Plan



Source: PADNCR, Manager & Committee Member Joshua Bruce

Private Recreational Areas

Private recreational areas (e.g., country clubs, golf courses, etc.) along with county and local parks comprise the remaining acreage of recreational areas within the Poquessing Creek Watershed.

Torresdale-Frankford Country Club is located on Frankford and Grant Avenues. According to the owners, Torresdale Golf Club was established in 1896, and began with a nine-hole course laid out by Scottish golfing professional Willie Campbell. The last three holes were considered "back-breakingly long for the time (e.g., 550 yards, 500 yards, and 600 yards). The Frankford Country Club was founded in 1901. Torresdale and Frankford were separate clubs until 1922, when they merged to form Torresdale-Frankford Country Club. Donald Ross was hired to design the current eighteen-hole course, which features narrow fairways and sloping greens.

The Bensalem Country Club is another popular recreational area in the Poquessing Creek Watershed. According to manager and PGA-certified golf pro Jim Bogan, the public club has one of the finest 18 hole par 70 layouts in the Delaware Valley, including the golf course, full driving range, modern clubhouse with full service bar and restaurant, shower and locker rooms for both men and women, fully stocked pro-shop and a PGA-

certified golf pro on staff. Mr. Bogan was interviewed as part of this project (see Appendix A.5) and is involved in a number of educational outreach efforts, including the implementation of ecologically-driven turf/coarse management approaches and a junior golf league. The most ecologically sensitive areas of the course are off-limits to the general public.

A portion of Philadelphia Park is within the Poquessing Creek Watershed. Located on Street Road (Route 132) in Bensalem, the Philadelphia Park was opened in 1974. The park has changed hands and names several times and is now owned by Greenwood Racing, Inc. It was recently refurbished and expanded. Philadelphia Horse Park is the home of 2004 Kentucky Derby and Preakness Stakes winner Smarty Jones. His victories have generated renewed interest for this track. Facility Director, Stan James, was interviewed for this project (see Appendix A.5) and noted a number of best management practices being implemented so the park maintains the recreational atmosphere while addressing stormwater runoff and local water quality issues.

Remaining park areas are noted on Map VIII.

7.5 Recreational Trail Efforts in the Poquessing Creek Watershed

Throughout the planning process, an interest in greenway and trail development was evident as well as private landowner concerns related to trail development. As noted previously, the planning and implementation documents developed by regional agencies and local municipalities all contain goals, objectives and recommendations supporting the development of open space and parks. They all support the development of greenways and trails as well.

For example, The Bensalem Township Open Space Plan supports the efforts of Fairmount Park for the Poquessing Creek corridor noting that, “Both Philadelphia and Bensalem have existing rudimentary trail systems along the creek that when connected, could create a continuous trail along the creek to the Delaware River.” Abandoned historical bridges along the creek could be utilized as stream crossings, linking sections of this main trail and creating loop trails. In addition, the Lower Southampton Recreation, Park and Open Space Plan notes that the township does not currently have trails or greenways within the existing park system, and further states, “Greenways are important because of the ecological benefit gained from connecting green areas.”

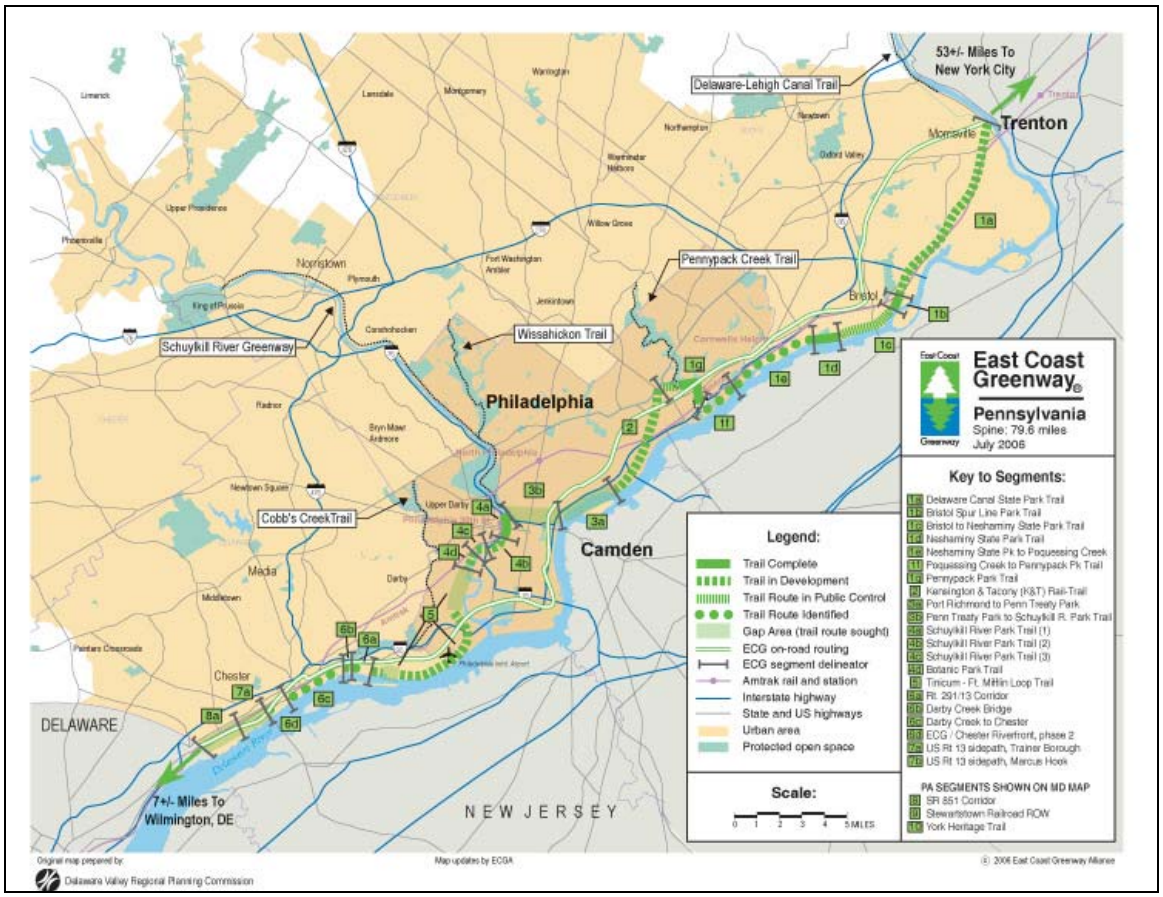
Research contained in locally completed plans also noted the fact that much of the land in the Poquessing Creek Watershed, and particularly along major creek corridors, is privately owned. It is important to note that part of the concern associated with trail development is how the agencies and municipalities define “trail.” Landowners are also interested in knowing about the intended pattern of trails, whether planned trail systems will link public and private land, whether private land will be taken by eminent domain, how intended designs will impact landowner privacy and security.

However landowners were also interested in how to deal with on-going issues associated with "rouge" trails. Those issues are fully listed in Appendix A.6 and include illegal use of ATVs, illegal dumping of trash, trespassing, and illegal activities within open space areas. Despite the number of public meetings associated with open space, park and trail plans developed through the years, private landowners remained concerned with impacts.

Several trail development efforts are underway in the Poquessing Watershed as well as in adjoining watersheds; they are illustrated on Map VIII. These trail planning efforts include the following:

- East Coast Greenway- The East Coast Greenway is an on-going effort to connect all of the major cities of the East Coast along a continuous, off-road path. The East Coast Greenway vision is a trail that spans 2,950 miles from Calais, Maine to Key West, Florida. It is frequently likened to an urban Appalachian Trail, and is now 21 percent open for public use. The figure below illustrates that the Greenway would follow the Delaware River. The Poquessing Creek Trail linkage would be at Glen Foerd Mansion.

Figure 7-3. East Coast Greenway



Source: Delaware Valley Regional Planning commission, 2004

- **The Northeast Philadelphia Trail** - The northeast Philadelphia Trail would follow the Norfolk-Southern Freight Line north and parallel to Roosevelt Boulevard. It begins at Rhawn and Dugan Streets and is located primarily on PECO property
- **Fairmount Park Poquessing Creek** – Information from The Trail Master Plan for Poquessing Park (Fairmount Park and Andropogon Associates, Ltd, 2001) is included on Map VIII. The trail is a system of streetscapes, paved multiple use trails, unpaved low-impact trails and linkages to existing trails through public and private lands. A good part of it is proposed to run along the Creek corridor from the Delaware River confluence to a meadow north west of the former Byberry State Hospital.
- **Benjamin Rush State Park** - As noted previously, the Poquessing Creek Trail would run along the creek and through Benjamin Rush State Park. The proposed park loop trail would be connected.
- **Bensalem Township** - As mentioned earlier in this plan, Bensalem Township is currently working on a Greenway Trails Master Feasibility Study. The intent is

to link proposed and existing Bensalem Township Trails with the Northeast Philadelphia trail and to the Poquessing Creek Trail.

- **Linkages to Existing and Proposed Trails in Adjoining Watersheds** - Three adjoining watersheds have existing and proposed trails of their own (e.g., Tacony Park Trail, Pennypack Trail System, and the Kensington-Tacony Trail system. Each trail would form a link with the Northeast Philadelphia Trail and the East Coast Greenway Trail.

Section 8: Watershed Assessment and Creek Corridor Inventory

8.1 Introduction

Streambank assessments provide the public with an opportunity to participate and learn about the problems in the stream first-hand and about those sections of the stream that are in good shape and those that need further protection. Also, these assessments assist with prioritizing the locations of restoration projects once the plan is completed. Lastly, they will provide a baseline (a snapshot of existing conditions) that can be used to measure where efforts have improved conditions or whether there is a need to adopt different strategies for improvement.

Members of the community and local organizations conducted the visual assessments of the main stem beginning at the headwaters in the Lower Southampton and Lower Moreland Townships and ending at the Delaware River. In the summer of 2006, volunteers were trained in conducting stream assessments, divided into smaller groups, and assigned a stream segment. The assessment form was used to record and document the conditions observed at the time of the assessments. Photographs were taken to document the conditions and then linked to the general location on a map of the area. The level of description for each segment will vary due to the differences in individual interpretation and background and skill of the volunteers.

The assessments are broken down into nine segments. Section one covers the Lower Southampton and Lower Moreland segment and the other eight sections cover the City of Philadelphia's segment of the stream.

8.2 Volunteer-based Watershed and Corridor Visual Assessment

Section 1: Lower Southampton region of the Poquessing stream

This area of the Poquessing stream was residential and had limited access, so the assessments were conducted from six different roadways. All assessments were done on a clear day.

Woodbine and Lake Roads

This section was a spring into the Poquessing stream. The water was clear with no odor present. The composition of the streambed was sand, gravel, and boulders. There were dark green and brown algae attached to rocks. Fish were moderately abundant with only one species noted.

This unchannelized segment was 1 to 2 feet wide with a streambank height of 1 to 2 feet. The bank was stabilized with a boulder. The depth was 6 inches and approximately 70 percent pool.

The stream was partially exposed with only 25 to 50 percent shaded. There was 30 to 70 percent coverage of plants, rocks, and logs with most of the surrounding area composed of lawns.

Trash was moderately abundant and consisted of plastic bags and a car battery.

Hickory Road

The stream was 4 to 6 feet wide with a 4 foot streambank and fully shaded. Some bank erosion was noted and some bank stabilization of large rocks was on the upstream side of the road crossing. The surrounding area was 30 to 70 percent covered with vegetation with residential lawns as the main coverage. Some Maple and Oak trees were noted as well as the invasive plant, Multiflora rose.

The water was clear and odorless. The stream bottom composition was sand, gravel, and boulders with no algae present. Fish were moderately abundant with one species seen.

There was a catch basin going directly to the stream with no discharge at the time of the assessment. Trash was moderately abundant and consisted of bottles, cans, plastic bags, and paper.

Steele Road

The stream was 5 to 6 feet wide upstream and became wider downstream. The streambank was 4 to 5 feet high with concrete stabilization project done by two property owners (down stream). The stream was partially shaded by Maple and Beech trees. Residential lawns were the dominant vegetation from the streambank creating a buffer of approximately 50 feet.

The water was clear and odorless with sand, gravel, and boulders making up the stream bottom. A brown algae was attached to rocks. No fish were observed on this day. There were two catch basins on the street with no discharge noted. Trash was absent.

Street Road

The water was clear and odorless with one species of fish moderately abundant. No algae were present and sand and gravel made up the composition of the stream bottom.

This fully shaded area of stream was channelized upstream and not channelized downstream. The stream was 12 to 15 feet wide, with a one foot depth, and had a 4 foot high streambank. There was a 7 foot build-up of the bank near a store in the strip mall. There is also some bank reinforcement done with rip rap along the strip mall parking lot. From the streambank to 50 feet back there was 30 to 70 percent coverage of plants, rocks, and logs. Some Black Walnut trees were noted along with the invasive species, Multiflora rose.

This segment of stream was commercial and residential. One stormwater outfall with no discharge was noted downstream. Trash was moderately abundant and consisted of bottles, cans, plastic bags, and paper. There were signs of residential dumping on the bank (grass clippings).

Sterner Mill Road

This partially shaded area of stream was 10 to 12 feet wide with a one foot stream depth. The water was clear and odorless. The composition of the stream bottom was sand, gravel, and boulders. A brown algae was attached to rocks. Two to three species of fish were abundant and no other wildlife was seen.

This unchannelized segment had good coverage of plants, rocks, and logs going from the streambank and back 100 feet. The stream runs through some of the homeowner's lots, so the 100 foot buffer may include some impervious areas as well as lawns, gardens, and sheds. Oak and Maple trees were noted as well as the invasive, Multiflora rose. The height of the streambank was 4 feet and had some signs of erosion.

This residential area was free of trash.

Philmont Avenue

The water was clear and odorless. The stream bottom consisted of gravel and boulders and a light green algae was present in spots and attached to rocks. One species of fish was moderately abundant.

This segment was residential with a car repair shop and landscape supply store closely located to the stream. The stream was unchannelized with a pipe noted crossing the stream in the streambed, looking downstream on the right bank. There were some bridge barriers along this segment.

Trash was moderately abundant and consisted of bottles, cans, plastic bags, and paper.

Black Walnut was the dominant tree species and the invasive, Multiflora rose, was spotted in some areas. The stream was partially shaded with a width of 10 to 12 feet and a depth of one foot. The streambank was 4 feet high and had approximately 70 percent coverage of plants, rocks, and logs from the stream with a 50 foot buffer.

Recommendations:

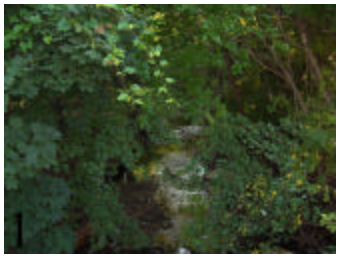
- Remove invasive plant species
- Restore streambank where erosion is present
- Educate homeowners about the benefits of having a natural riparian buffer
- Investigate concrete stabilization project at Steele Road
- Conduct stream clean-ups where needed

Poquessing Creek Visual Assessment: Section 1

Woodbine Rd. looking downstream

Hickory Rd. looking downstream

Steele Rd looking downstream



Street Rd. looking downstream

Sterner Mill Rd. looking downstream

Philmont Ave. looking upstream

Section 2: Trevose Avenue to Linconia Avenue

This segment was broken down into two sections. The first section was from Trevose Avenue to the CSX rail line (assessed by students of Communications Technology High School) and the second was from the CSX rail line to Linconia Avenue.

Trevose Avenue to CSX rail line

The water was clear, but became brown and muddy towards the CSX rail line, with no odor present. The stream bottom was made up of sand, gravel, and silt. There were no algae present. There were no fish observed but some ducks and other bird species were seen. The stream was fully shaded up to the CSX rail line, where it became partially exposed. There was good vegetative coverage from the streambank to 100 feet back. The dominant tree species were Maple, Sycamore, Elm, and Pine. The invasive species Multiflora rose, Celandine, Violets, Nettles, and Milkweed were present.

The width of the stream ranged from 20 to 40 feet with a stream depth of 2 inches (Trevose Avenue) to 3 feet (CSX rail line). The streambank height varied from 2 feet to 8 feet throughout this section and bank erosion was noted for the entire section. The stream became channelized approximately mid-way of section.

The common land use was residential, industrial, and parkland. There were some woody debris barriers and a pipe emptying a discharge into the stream approximately 100 yards upstream from the CSX line. Trash was moderately abundant and consisted of plastic bags, cinder blocks, paper, diapers, a manhole cover, furniture, bottles, cans, and car bumpers.

CSX rail line to Linconia Avenue

*This section was assessed on two different occasions.

The water was muddy and brown (possibly due to rain) for the first half of this section and clear for the second half. No odor was detected throughout the whole section. The stream bottom consisted of gravel, boulders, sand, silt, and bedrock. Light green, dark green and brown algae were present in spots. Fish were mostly absent except for some guppies near Carter Road. Wildlife consisted of frogs, woodpeckers, a gold finch, a cardinal, gnats, and a Monarch butterfly.

This section went from fully exposed to the sun at CSX to fully shaded at Linconia Avenue. There was good vegetative coverage for the majority of this section. The dominant tree species were Maple and Sycamore. The invasive species noted were Celandine, Queen Anne's lace, Nettles, Skunk cabbage, and Violets.

The stream width was 30 to 40 feet with a depth of 3 feet (CSX rail line) to approximately 1 foot (Linconia Avenue). The streambank averaged 4 to 6 feet with erosion evident on both banks. Barriers in the stream were waterfalls, small dams,

woody debris, and a shale barrier. One pipe was noted with an odorless discharged near Poquessing Creek Lane.

Common land uses were residential, parkland, and industrial. The local uses were fishing and recreation. Illegal ATV activity was taking place near the Linconia Playground. Trash was moderately abundant and consisted of bottles, cans, plastic bags, tires, shopping carts, cinder blocks, and furniture. The area from Carter Road to Linconia Avenue looked like a possible dump site.

Recommendations:

- Restore streambanks where erosion is evident
- Investigate pipes near CSX rail line and Poquessing Creek Lane
- Conduct clean-up of entire segment
- Remove woody debris barriers
- Remove invasive species
- Investigate possibility of Carter Road dump site
- Investigate illegal ATV use
- Create natural barriers to end illegal ATV use

Poquessing Creek Visual Assessment: Section 2

Eroding Streambank

Woody Debris

CSX Rail Line

Eroding Streambank

Students from Communications Technology High School

Trash

Section 3: Linconia Ave. (Lin Park) to Old Lincoln Highway

Assessment started at Linconia Avenue (Lin Park) and continued downstream to Old Lincoln Highway for a total length of ¾ of a mile.

The assessment day started out sunny but became cloudy approximately a quarter of the way downstream. The water was clear and the streambed consisted of sand and gravel. Some dark green and brown algae were attached to rocks in the upper section of the stream. No smell was detected. The depth of the stream ranged from 3 inches to 3 feet. Fish were moderately abundant with two to three minnow species observed as well as mallards, ducklings, and raccoon tracks.

The creek was well shaded and had good riparian buffer consisting of typical eastern deciduous forest species; however, erosion was widespread and appears to be the biggest problem facing this section. The non-native invasive species consisted mostly of Multiflora rose and Garlic mustard, with fewer amounts of Lesser celandine, Mile-a-minute and Japanese knotweed.

This unchannelized section had a width ranging from 20 to 45 feet. The height of the left and right banks averaged 7 feet with the right bank ascending to 20 feet towards the end of the section.

Wetlands were observed in two areas and some woody debris barriers were noted. A deep pool suggests the possibility of a stream blockage towards the middle of this section but there was no access in order to verify this possibility.

Several storm sewer outfalls were located, originating from the industrial park near the stream on the Bensalem side of the stream, including one with cloudy coloration in the plunge pool. No odor or visible sewage or solids were present at this location and it was not currently discharging.

The common land uses for the upper section were parkland, commercial, and residential; the middle section was all parkland; and the lower section was parkland and commercial. The stream is not being used much, except by the illegal use of ATVs. Trash was minimal throughout this section with car tires seeming to be the biggest problem. A large amount of landscaping debris near Old Lincoln Highway, on the Bensalem side, suggests the possibility of illegal dumping.

Recommendations:

- Restore streambanks where erosion is present
- Investigate possible illegal dumping site
- Remove invasive plant species
- Create natural barriers to end illegal ATV use
- Investigate stormwater outfall on Bensalem side to ensure it's functioning properly

Poquessing Creek Visual Assessment: Section 3

Woody Debris

Cloudy Outfall

Eroding Streambank

Landscape Debris

Outfall

Wood Blockage

Section 4: Old Lincoln Highway to Dunks Ferry Road

This segment began at Old Lincoln Highway and extended a mile and a quarter to Dunks Ferry Road.

The adjacent land uses along the upper portion of this segment were listed as parkland (Phila.), industrial and residential (Bensalem), and residential and parkland towards the end of this segment. The water was clear with no odor present and the composition of the stream bottom was gravel, boulders, silt, and bedrock. There was light and dark green algae attached to rocks and matted on the streambed throughout this segment. Seventy percent of this unchannelized stream is run. Several outfall pipes were observed but only one had discharge with no odor present.

The stream was partially shaded and there was 70 percent natural coverage from the streambank to 100 feet back. The stream was 20 feet wide, with a water depth ranging from 6 inches to 4 feet, with a bank ranging from one to 6 feet. Barriers in the stream consisted of bridges and woody debris. There were two areas with heavy blockage found, one mid-way and the other towards the end of the segment. There is heavy bank erosion in many areas with streambanks mowed to the edge in the residential areas. There was blacktop almost to the edge at Hunter's Glen apartment building.

Trash was moderately abundant consisting of bottles, cans, and plastic bags. There was a large quantity of dirt and some concrete pieces dumped on the Bensalem side near Century Lane.

The fish species observed were sucker 7 – 8 inches; minnows; Johnny Darters; and sunfish. Other wildlife was a green frog; a bullfrog; mallards; pearl crescent butterflies; robins; red bellied woodpeckers; a Baltimore oriole; a warbling vireo; a blue-gray gnatcatcher; and deer and great blue heron tracks.

The dominant natural coverage was day lilies, may apples, and trees such as Locust, Black Walnut, Cherry, Box Elder, Ash, Elm, Beech, and Catalpa. There was 50 percent area coverage of the invasive Japanese knotweed, and much smaller amounts of other invasive species such as Garlic mustard (10 percent), Wild rose (10 percent), Lesser celandine (10 percent), and English ivy (5 percent).

There were many ATV trails throughout the whole segment with some going directly into the stream.

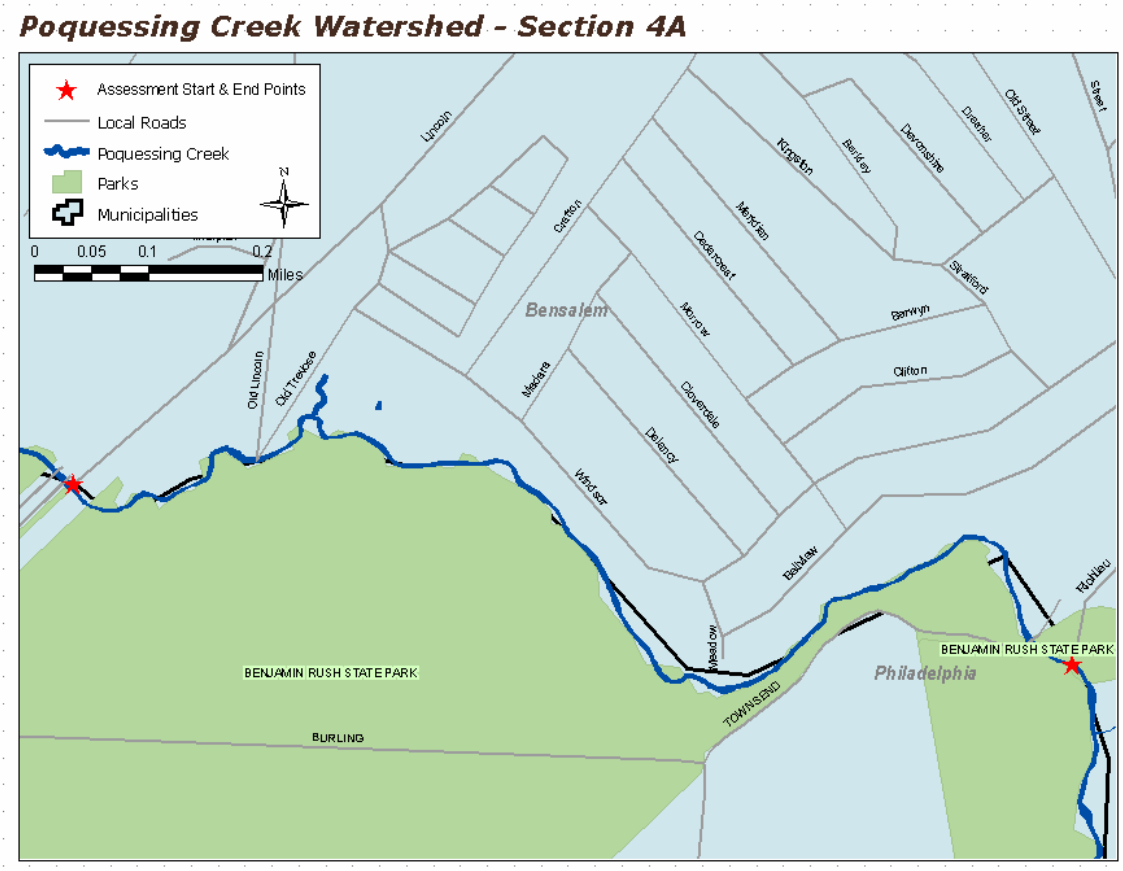
Recommendations:

- Have blocked areas dislodged
- Educate homeowners and businesses about the benefits of having a natural riparian buffer
- Investigate the possibility of landscaping/construction dumping
- Investigate illegal ATV use
- Create natural barriers to end the illegal ATV usage

Poquessing Creek Visual Assessment: Section 4A

Woody Debris blockage

Concrete Debris and fallen trees



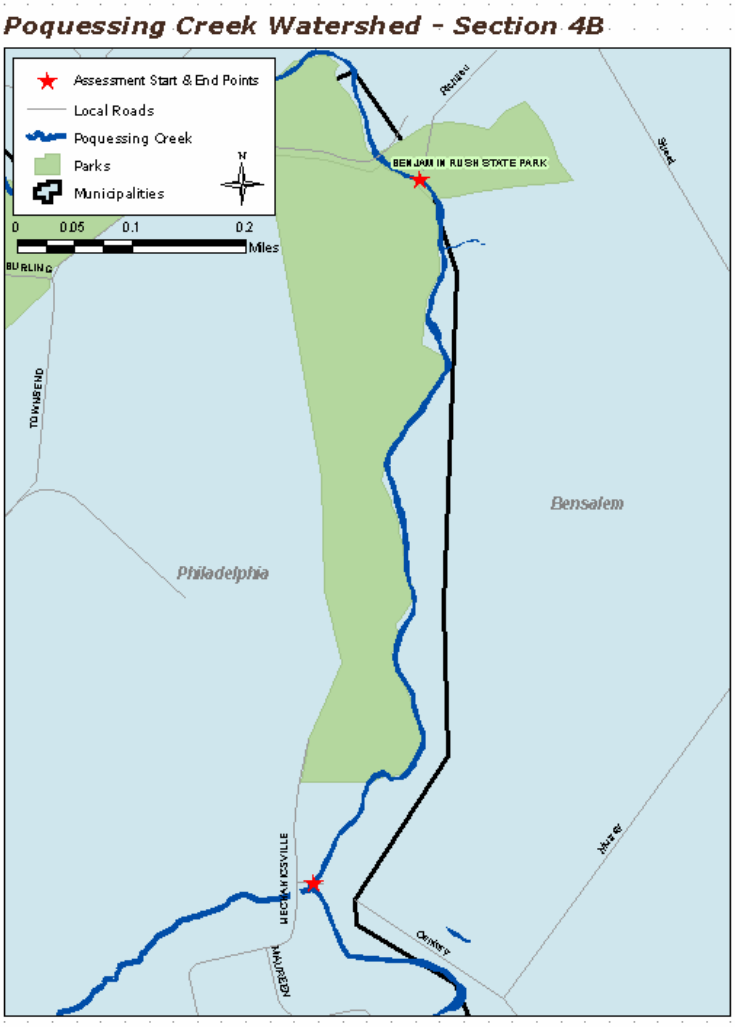
Eroding Streambank

Eroding Streambank - Downstream

Poquessing Creek Visual Assessment: Section 4B

Mowed Streambank

Outfall



Tire Swing

Woody Debris Blockage

Section 5: Dunks Ferry Road to Knight's Road

This segment began at Dunks Ferry Road and extended approximately three quarters of a mile to Knight's Road.

The water was clear with no odor present with a depth of 1 to 3 feet. The stream bottom was made up of sand, gravel, and silt. Some light and dark green algae were present in spots. The average width of the stream was 25 feet with a streambank height of 2 to 5 feet. Fish populations were also noted.

There was a 7 foot concrete retaining wall located on the west bank that was contributing to erosion of the east bank. This segment is channelized due to human build-up of this wall.

Streamside vegetation was consistent on both sides with invasive species dominating the vegetative cover. Mexican bamboo, Garlic mustard, and Multiflora rose dominated the understory, while various species of Maple and Sycamore as well as the invasive Tree-of-heaven were dominant in the overstory. There was good streambank coverage throughout this segment.

The most common land use is residential and is used by the public for recreational activities such as fishing and swimming (illegal).

Along all sections of the stream, abundant trash and debris were deposited with impacts more notable in areas of residential development and wooded areas along the floodplains on both sides of the stream. Most debris consisted of shopping carts, bicycles, tires, bottles, trash, and general litter.

Recommendations:

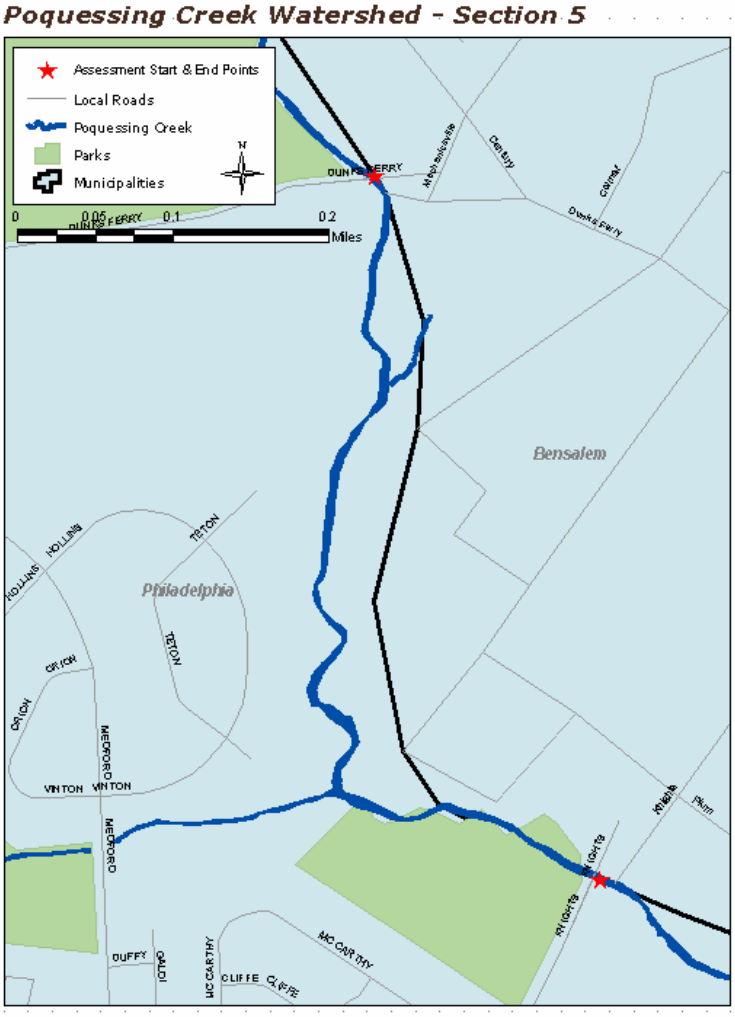
- Remove invasive species
- Investigate possibility of illegal dumping
- Conduct major clean-up of whole segment
- Post "No Swimming" signage
- Post "No Dumping" signage

Poquessing Creek Visual Assessment: Section 5

Trash and Dead Wood

Construction and Woody Debris

Graffiti on Outfall and Bikes



Hot Water Heater

Invasive Species

Shopping Carts in Stream

Section 6: Knights Road to Byberry Road

This segment began at Knights Road and extended approximately one mile to Byberry Road. The majority of this stream segment is in close proximity of the Franklin Mills Mall. This assessment was completed by students and teachers of Arch Bishop Ryan High School.

This area is parkland and residential with some homes very close to the stream. The local uses were recreation and drinking water supply. The water was clear and no odor was detected. The stream bottom consisted of sand, gravel, and bedrock. Dark green and brown algae were present in spots and attached to rocks. There were not many fish present but the wildlife observed included a turkey vulture, a duck, cardinals, red-tailed hawk, red-bellied woodpecker, sparrows, a frog, and a garter snake.

This partially shaded, channelized stream was approximately 20 feet wide, 6 inches to 2 feet deep with a streambank ranging from 6 inches to 7 feet high. The left bank was lower than the right bank. Exposed tree roots were signs of erosion and the right bank had significantly more erosion. There was good coverage of plants, rocks, and logs from the streambank to 100 feet back.

Some of the dominant tree species were Sycamore, Oak, and Box Elder. The invasive species Lesser celandine, Bamboo, Japanese knotweed, Garlic mustard, Multiflora rose, and Honeysuckle were present throughout the segment.

Some woody debris barriers and a silt island were noted. Trash was moderately abundant and consisted of bottles, cans, shopping carts, appliances, a metal shed, toys, a doll house, police tape, and a trash can.

Recommendations:

- Remove invasive species and replace with native plants
- Remove all debris
- Restore streambanks where there is erosion present

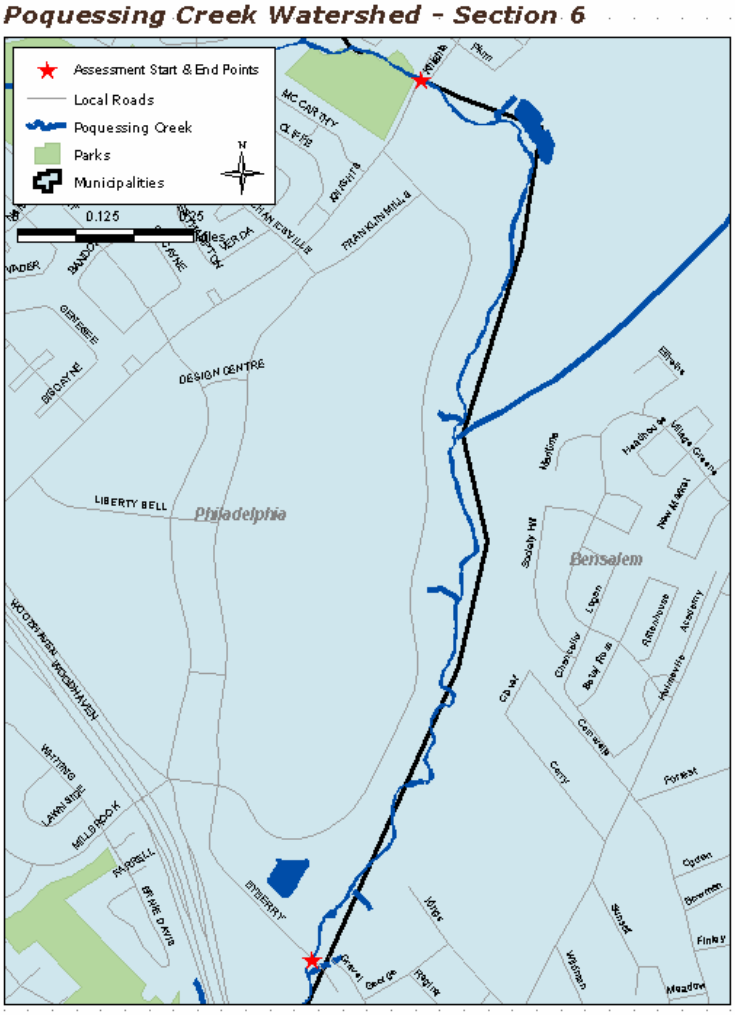
Poquessing Creek Visual Assessment:
Section 6

Trash in Stream

Woody Debris

Concrete Debris

Eroding Streambank



More Eroding Streambank

Shopping Cart in Stream

Silt Island

Trash and Woody Debris

Section 7: Byberry Road to Cedar Avenue

This segment of stream had very limited access. The two points of access were Evan Street to Byberry Road (70 feet) and Telfair Road to Greenmount Road (1,000 feet). Greenmount Road to Cedar Avenue was inaccessible.

Evan Street and Byberry Road

The water had a green hue and there was no odor present. The stream bottom was composed of sand and boulders. A light green algae was present everywhere and was seen floating on the water's surface. Fish were absent and only two brown birds were noted.

The stream was fully exposed to the sun and there was very little vegetative coverage from the streambank back 25 feet. The stream's width was 15 feet and the water depth was approximately 3 feet. The streambank was 10 feet high and was channelized with boulders and a wire mesh retaining wall throughout the entire section. There was some exposed bank on the other side of the bridge that had signs of major erosion. One hundred percent of this segment was pool.

The surrounding area was industrial/commercial and appeared to have no local use. There was one outfall pipe with no discharge but the water was green at the pipe's location.

Telfair Road and Greenmount Road

The water had a brown hue and no odor was present. The stream bottom was made up of sand, gravel, and silt. A dark green algae was attached to rocks in the beginning of this segment. Only one fish and a cardinal were seen.

The stream was partially shaded and had very good coverage of plants, rocks, and logs from the streambank back 100 feet. The width of the stream was 40 feet and the water depth was approximately 4 inches. The streambank was 22 feet high on the Bensalem side and was severely eroded and 3 feet high on the Philadelphia side. This segment was unchannelized.

The area near Telfair Road had a large pool of water and resembled a marshland. Trash was abundant and consisted of bottles, cans, shopping carts, paper, a refrigerator, a mattress, and children's toys. It appears to be an illegal dump site. The invasives Japanese knotweed and Japanese honeysuckle were present. There were also two manholes with missing covers.

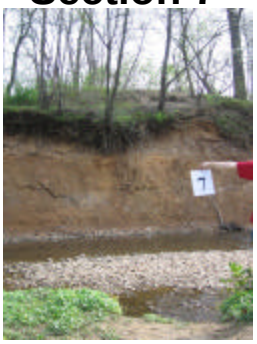
The surrounding area was residential. People were fishing and exploring the area towards the end of this segment (near Greenmount Road) and trash was absent from this area.

Recommendations:

- Restore streambanks where erosion is present
- Investigate possible illegal dumping
- Investigate marshland for potential wetland features and potential wetland mitigation site
- Conduct clean-up of sites
- Replace missing manhole covers
- Investigate cause of green water
- Plant trees to shade stream and reinforce streambank

Poquessing Creek Visual Assessment: Section 7

Wire Mesh Retaining Wall



Eroding Streambank

Marshland Near Telfair Road

Missing Manhole Cover

Shopping Cart in Stream

Trash in Marshland

Section 8: Cedar Avenue to Frankford Avenue

This segment went from Cedar Avenue to Frankford Ave. for approximately ½ a mile.

The water was clear with no odor present. The stream bottom was sand and gravel with a dark green and brown algae attached to rocks and matted on the streambed. Fish were absent on this day but one of the volunteers, who lives nearby, said the fish community comes and goes with the rainfall. He stated that the stream carries so much stormwater flow that a heavy rainfall actually flushes the fish from the stream and they gradually return from the Delaware River over the next two to four weeks. No other wildlife was noted.

This channelized segment of stream was 30 feet wide, with a water depth of 1.5 feet and a 5 foot streambank height. There is erosion throughout the segment. The stream was partially shaded with a 30 to 70 percent vegetative coverage from the streambank back 25 feet and 70 to 100 percent coverage from 25 feet and back 100 feet. The dominant tree species were Box Elder; Ash; Red Maple; and Oak. The invasives, Japanese knotweed, Multi-flora rose, and Lesser celandine covered 10 to 25 percent of the area.

The predominant land use was single-family residential on both sides of the stream. A condominium complex and commercial area was noted near the Frankford Avenue area. The common local use was wading (illegal). There was stormwater run-off into the stream from Colonial Road. A large tree obstruction was noted near Colonial Road and illegal ATV use between Colonial Road and Old Red Lion Road. Some asphalt paving seems to be deteriorating along the right bank near Colonial Road. Looking downstream, just above Old Red Lion Road, was rip rap stone on the bank causing the channel to narrow. The trash noted for this segment was bottles, cans, plastic bags, shopping carts, and paper.

Note: Looking downstream from Old Red Lion Road Bridge is the sampling location for the Friends of the Poquessing.

Recommendations:

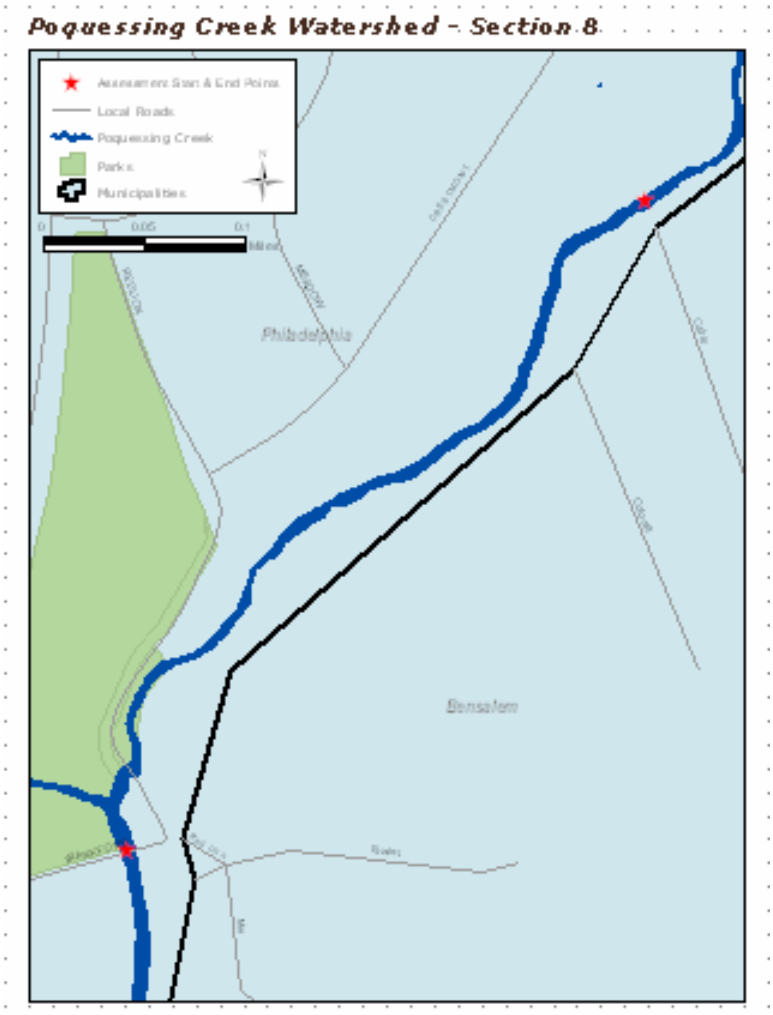
- Lessen or eliminate stormwater run-off into the stream
- Remove invasive species
- Repair asphalt
- Remove tree obstruction from the stream
- Conduct trash clean-up
- Investigate illegal ATV use
- Create natural barriers to deter ATV usage

Poquessing Creek Visual Assessment: Section 8

Tree Obstruction

Deteriorating Asphalt Paving

Illegal ATV Use



Rip-rap on Streambank

Sampling Location

Silting

Section 9: Mill Road to Delaware River

Frankford Avenue to Mill Road was not accessible.

Assessment started at Mill Road and continued approximately 200 feet to the Delaware River.

The water had a brown/green color with no odor present. The stream bottom was composed of sand and gravel and had dark green and brown algae present in spots. Fish were moderately abundant with two to three species noted. One frog was seen and an osprey nest at the Delaware River.

This segment is partially exposed to sunlight and from the streambank and back 100 feet the area was 30 to 70 percent covered with vegetation. The width of the stream was 15 to 20 feet with a water depth of 12 to 18 inches. The streambank was 10 to 12 feet high and showed little sign of erosion. The dominant tree species were Oak, Maple, and Sycamore. The prominent invasives were Japanese knotweed and Japanese honeysuckle.

This unchannelized area consisted of single family dwellings, apartments, and light industrial structures. A community pool is located near Mill Road and I-95. A submerged pipe was located near the Salem Harbor Apartment complex. There were two bridges, one at State Street and the other at Bristol Road. Trash was moderately abundant and consisted of bottles, cans, plastic bags, and paper.

Note: The Glen Foerd Mansion is located on banks of the Delaware River.

Recommendations:

- Remove invasives
- Plant trees to shade the stream
- Make sure the community pool managers are educated on the environmental impact of releasing chlorine into the stream
- Investigate if submerged pipe is connected to the outdoor pool located at the Salem Harbor Apartment complex

Poquessing Creek Visual Assessment: Section 9

Salem Lot Apts. - Pool

Abandoned Car – Mill Road

Eroded Streambank

Exposed Tree Roots

Invasive – Japanese Honeysuckle

Invasive – Japanese Knotweed

Osprey Nest in Delaware River

Pipe in Stream