MUNICIPAL STORMWATER MANAGEMENT PLAN
MASTER PLAN ELEMENT

TOWNSHIP OF PENNSAUKEN
CAMDEN COUNTY, NEW JERSEY

Township Resolution #P2005-26
Township Approved June 9, 2005
Township Resolution memorialized July 26, 2005

PREPARED FOR:

PENNSAUKEN TOWNSHIP PLANNING BOARD

PREPARED BY:

T&M ASSOCIATES

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IN CONSULTATION WITH:

DENNIS O'ROURKE, P.E.
PENNSAUKEN TOWNSHIP ENGINEER

March 2005
Revised June 9, 2006

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ADOPTING RESOLUTION

Resolution # P2005-24

Date application approved or denied: 6/09/05

Date Resolution memorialized 7/26/05

RESOLUTION OF THE PLANNING BOARD OF THE TOWNSHIP OF PENNSAUKEN ADOPTING A STORM WATER MANAGEMENT PLAN ELEMENT AS PART OF THE MASTER PLAN

WHEREAS, the Planning Board of the Township of Pennsauken seeks to adopt a storm water management plan for the Township of Pennsauken;

WHEREAS, the Master Plan of the Township of Pennsauken does not have a Storm Water Management Plan as part of its Master Plan;

WHEREAS, the storm water management plan will help regulate and revise the impact of storm water runoff within the township and also to its surrounding communities and will have an impact on the waterways both within and outside of the boundaries of Pennsauken Township;

WHEREAS, a Municipal Stormwater Management Plan was prepared by T&M Associates in consultation with Dennis O'Rourke, P.E., under date of March 2005;

WHEREAS, the meeting(s) were compliant with the New Jersey Open Public Meetings Act and **N.J.S.A. 40:55D-1** et seq. , the Municipal Land Use Law; and notice of the hearing was published in a newspaper of general circulation to the Township of Pennsauken and Pennsauken's surrounding municipalities at least ten days prior to the hearing date of June 9, 2005; and notice was provided to the clerks of the municipalities surrounding Pennsauken and to the County;

WHEREAS, the public at the public portion of the meeting were heard; and

WHEREAS, the report, its contents and recommendations were considered by the Planning Board at meeting held on June 9, 2005 at 6:30 PM at the Municipal Building located at 5605 North Crescent Boulevard, Pennsauken, New Jersey; and

WHEREAS, the Planning Board of Pennsauken had a quorum; and

BE IT RESOLVED that the after review the Planning Board of the Township of Pennsauken adopts the report and the recommendations contained within the Municipal Stormwater Management Plan under date of March, 2005 and adopts it as part of its Master Plan.

The undersigned, Secretary of the Planning Board of Pennsauken, hereby certifies that the above is a true copy of the resolution adopted by said Board on the 9th day of June, 2005

Date: 7/26/05

Mary L Leonard

Mary L. Leonard. Secretary

1.0 INTRODUCTION

As required by the Municipal Stormwater Regulations (N.J.A.C. 7:14A-25), the Township of Pennsauken has developed this Municipal Stormwater Management Plan (Plan) to address the impacts resulting from stormwater related issues associated with future development and land use changes. The Plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts through the incorporation of stormwater design and performance standards for new development and redevelopment projects that disturb one or more acres of land. The stormwater regulations are intended to minimize negative or adverse impacts of development such as degraded water quality, increased runoff, and reduced of groundwater recharge. In addition to standards intended to minimize these impacts, the Plan provides long-term operation and maintenance measures for existing and proposed stormwater management facilities.

The Municipal Stormwater Management Plan presents strategies for managing stormwater and conserving the natural resources of Pennsauken. This Stormwater Management Plan Element shall be incorporated into *Master Plan Reexamination for Pennsauken Township.*

New ordinances and amendments to existing ordinances are recommended to expedite the implementation of stormwater management strategies. The Stormwater Management Plan also includes a mitigation plan to enable the Township to grant variances or exemptions from proposed design and performance standards set forth in this document. Since the Township has less than one square mile of developable or vacant land, a build-out analysis is not required.

1.1 GOALS & OBJECTIVES

The goals of this Plan are to:

Goal A: ***Reduce flood damage, including damage to life and property.***

Goal B: ***Minimize, to the extent practicable, any increase in stormwater runoff from a new development.***

Goal C: ***Reduce soil erosion from development, redevelopment, or construction projects.***

Goal D: ***Ensure the adequacy of existing and proposed culverts, bridges, and other in-stream structures.***

Goal E: ***Maintain groundwater recharge and base flow of streams during periods of drought.***

Goal F: ***Prevent, to the greatest extent feasible, an increase in non-point source pollution.***

Goal G: ***Maintain the integrity of stream channels for their biological function, as well as for drainage.***

Goal H: ***Minimize pollutants and the amount of total suspended solids in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, commercial, industrial, and other uses of water.***

Goal I: ***Protect public safety through the proper design and operation of stormwater basins and Best Management Practices.***

In addition to the State mandated requirements described above, the Township has the following additional goals:

Goal J: ***Limit disturbance of environmentally sensitive lands such as steep slopes,***

floodplains and wetlands.

Goal K: ***Protect groundwater and surface water quality to safeguard its use for drinking water, recreation, and natural habitat for animals.***

Goal L: ***Protect important wildlife habitat, streams, waterways, wetlands and other unique or irreplaceable land types.***

Goal M: ***Preserve important visual amenities, placing special emphasis on preservation of river views, wetland marshes, woodland, vistas, and other scenic resources.***

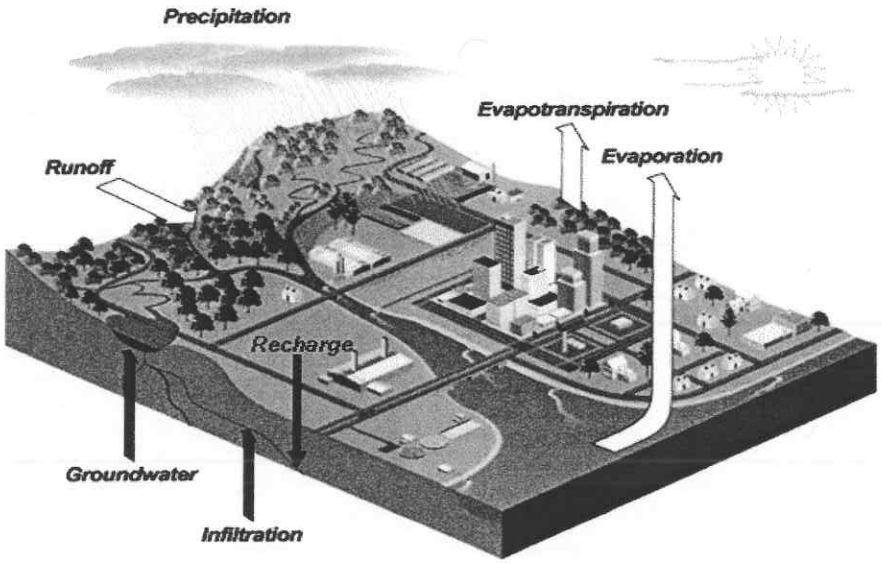
Goal N: ***Review site plans to minimize environmental disruption and to encourage development of landscapes and streetscapes consistent with these goals.***

2.0 STORMWATER DISCUSSION

2.1 HYDROLOGIC CYCLE

The hydrologic cycle or water cycle (below) is the continuous circulation of water between the ocean, atmosphere, and the land. The driving force of this natural cycle is the sun. Water, stored in oceans, depressions, streams, rivers, water bodies, vegetation and even land surface, constantly evaporates due to solar energy. This water vapor then condenses in the atmosphere to form clouds and fog. After water condenses, it precipitates, usually in the form of rain or snow, onto land surfaces and water bodies.

The Hydrologic Cycle



Definitions:
Runoff – water that travels over the ground surface to a channel
Groundwater flow – movement of water through the subsurface
Infiltration – penetration of water through the ground surface
Recharge – water that reaches saturated zone

Source: Kern River Connections
http://www.creativille.org/kernriver/watershed.htm

Precipitation falling on land surfaces is often intercepted by vegetation. Plants and trees transpire water vapor back into the atmosphere, as well as aid in the infiltration of water into the soil. The vaporization of water through transpiration and evaporation is called evapo-transpiration. Water percolates through the soil as groundwater, while water that flows overland is called surface water. Water flows across or below the surface to reach major water bodies and aquifers and eventually flows to the Earth's seas and oceans. This constant process of evapo-transpiration, condensation, precipitation, and infiltration comprises the hydrologic cycle.

2.2 Impacts of Development and Stormwater

As towns and cities develop, the landscape is altered. Both residential and non-residential developments have a great impact on the hydrologic cycle at a specific site. Localized impacts to the hydrologic cycle will ultimately impact the hydrologic cycle of the entire watershed encompassing the developed site.

Prior to land development, natural vegetation often intercepts precipitation directly or absorbs infiltrated runoff into their roots. Development often replaces natural vegetation with grass lawns or impervious cover, such as pavement or structures, thereby reducing the amount of evapo-transpiration and infiltration. Regrading and clearing of lots disturbs the natural topography of rises and depressions that can naturally capture rainwater and allow for infiltration and evaporation. Construction activities often compact soil, thereby decreasing its permeability or ability to infiltrate stormwater. Development activities also generally increase the volume of stormwater runoff from a given site.

Connected impervious surfaces and storm sewers (such as roof gutters emptying into a paved parking lot that drains into a storm sewer) allow the runoff to be transported downstream more rapidly than natural areas. This shortens travel time and increases the rainfall-runoff response of the drainage area, causing downstream waterways to peak higher and quicker than natural areas, a situation that can cause or exacerbate downstream flooding, and sedimentation in stream channels. Furthermore, connected impervious surfaces do not allow pollutants to be filtered, or for infiltration and ground water recharge to occur prior to reaching the receiving

waters. Increased volume combined with reduced base flows results in a greater fluctuation between normal and storm flow rate causing greater channel erosion. Additionally, reduced base flows, flow rate fluctuation, and soil erosion can significantly affect the downstream hydrology and ecological integrity of the watershed.

Connected Impervious Surfaces

Rainwater is intercepted by roofing and collected into gutters. The water then discharges the downspout onto a paved driveway and flows to the gutter and storm drain inlets. Alternatively, the collected water is piped underground directly to the storm sewer.
Photograph source: Titan Gutters

Water quantity impacts, combined with land development, often adversely impact stormwater quality. Impervious surfaces collect pollutants from the atmosphere, animal wastes, fertilizers and pesticides, as well as pollutants from motor vehicles. Pollutants such as hydrocarbons, metals, suspended solids, pathogens, and organic and nitrogen-containing compounds, collect and concentrate on impervious surfaces. During a storm event, these pollutants are washed directly into the storm sewers. In addition to chemical and biological pollution, thermal pollution can occur from water collected or stored on impervious surfaces or in stormwater impoundments, which has been heated by the sun. Large impervious areas can result in "heat islands" where the surface temperatures are up to 10 degrees warmer than the

surrounding areas. Thermal pollution can affect aquatic habitats, adversely impacting cold-water fish. Removal of shade trees and stabilizing vegetation from stream banks also contributes to thermal pollution.

Proper stormwater management will help to mitigate the negative impact of land development and its effect on stormwater. This Plan outlines the Township's plan to improve stormwater quality, decrease stormwater quantity, and increase groundwater recharge. By managing stormwater, the Township will improve the quality of aquatic ecosystems and help restore the natural balance to the environment.

3.0 BACKGROUND

Incorporated in 1892, Pennsauken Township covers approximately 12 square miles and is located in Camden County, New Jersey. As a riverfront community fronting the eastern bank of the Delaware River, Pennsauken is characterized by a mix of residential, commercial and industrial development. Due to its age, location and accessibility, Pennsauken has nearly reached full build-out. Vacant lands that remain are predominantly smaller in-fill sites. (*Master Plan Reexamination for Pennsauken Township 1998)*

In 1998, the Pennsauken Township Planning Board updated their master plan. A detailed study of existing conditions and trends within Pennsauken was performed as part of this comprehensive update and includes numerous goals, objectives, and recommendations for the future development of the Township.

3.1 DEMOGRAPHICS

This Municipal Stormwater Management Plan has been prepared for incorporation into the Township's Master Plan. It is intended to expand the research, background information, policies, objectives, goals, and recommendations included in the 1998 *Master Plan Reexamination for Pennsauken Township.*

Table 1 presents population changes of Pennsauken from 1960 to 2000, with comparisons to the population changes of Camden County and New Jersey. Based on the 2000 census data, the population of Pennsauken is estimated at 35,737, Camden County at 508,932, and the New Jersey at 8,414,350.

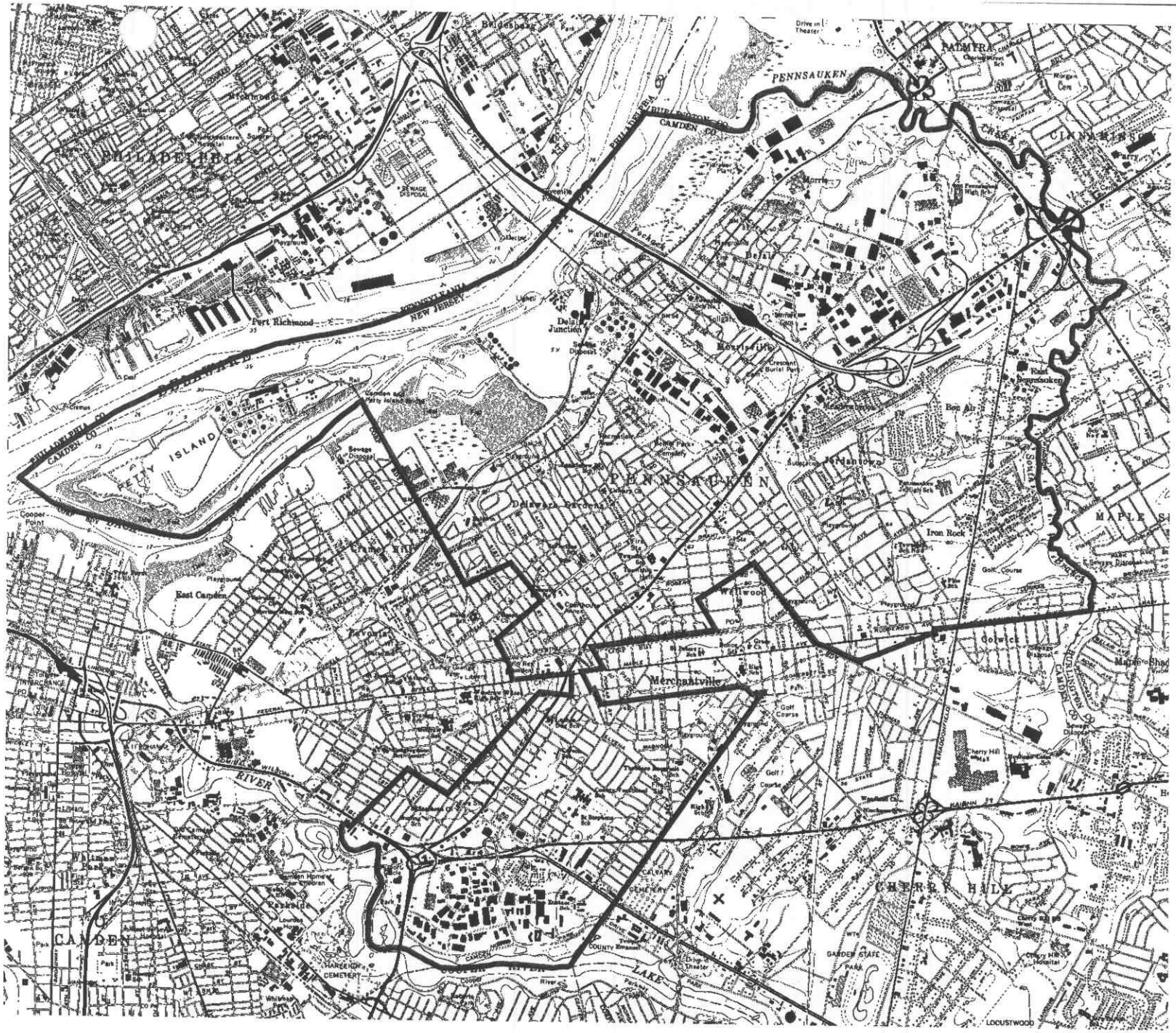
From 1960 to 2000, the population of Pennsauken increased only 5.8 percent (%), while Camden County increased 29.8%, and New Jersey increased 38.7%. These figures are attributed to the Township's early development and nearly built-out condition.

Table 1: Historical Population Growth 1960 – 2000

Year	*Pennsauken Township*		*Camden County*		*New Jersey*	
	Total Population	*Average Annual Growth Rate Over the Prior Period*	*Total Population*	*Average Annual Growth Rate Over the Prior Period*	*Total Population*	*Average Annual Growth Rate Over the Prior Period*
1960	33,771	N/A	392,035	N/A	6,066,782	2.6%
1970	36,394	7.8%	456,291	16.4%	7,168,164	18.3%
1980	33,775	-7.2%	471,650	3.4%	7,364,823	2.7%
1990	34,738	2.9%	502,824	6.6%	7,730,188	5.0%
2000	35,737	2.9%	508,932	1.2%	8,414,350	8.6%

Sources: Master Plan Reexamination for Pennsauken Township 1998 – Martin/DePallo Group – Table 1.

U.S. Census – www.census.gov



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SOURCE:
CAMDEN QUADRANGLE
7.5 MINUTE SERIES

U.S.G.S. QUADRANGLE MAP

MARCH 29, 2005

PENNSAUKEN TOWNSHIP

3.2 Land Use Characteristics

Pennsauken is a community with a good balance of residential and industrial development. There are four primary industrial areas in Pennsauken. The largest is located north of the Betsy Ross Bridge and Route 90. A smaller industrial area is located adjacent to the Cooper River, south and east of Route 38. Another industrial area is located south of the Route 90. A significant portion of Petty Island is industrially developed.

Because Pennsauken is a mature urbanized community, available undeveloped land for new housing is limited. According to the U.S. Census Bureau, Pennsauken experienced a slight but steady growth in the number of housing units over the past forty years. In 1970, there were 11,118 housing units, which increased to 11,537 in 1980, 12,715 in 1990 and 12,945 in 2000. These figures translate to a 16.4% increase in housing units from 1970 to 2000, well below the 44.3% increase recorded for Camden County. These population and housing trends indicate that the Township is near or has reached the full build-out stage of development with the exception of special areas such as Petty Island and sections of the Township's waterfront which are being considered for redevelopment. Development changed to the landscape, resulting in increased runoff and pollutant loading.

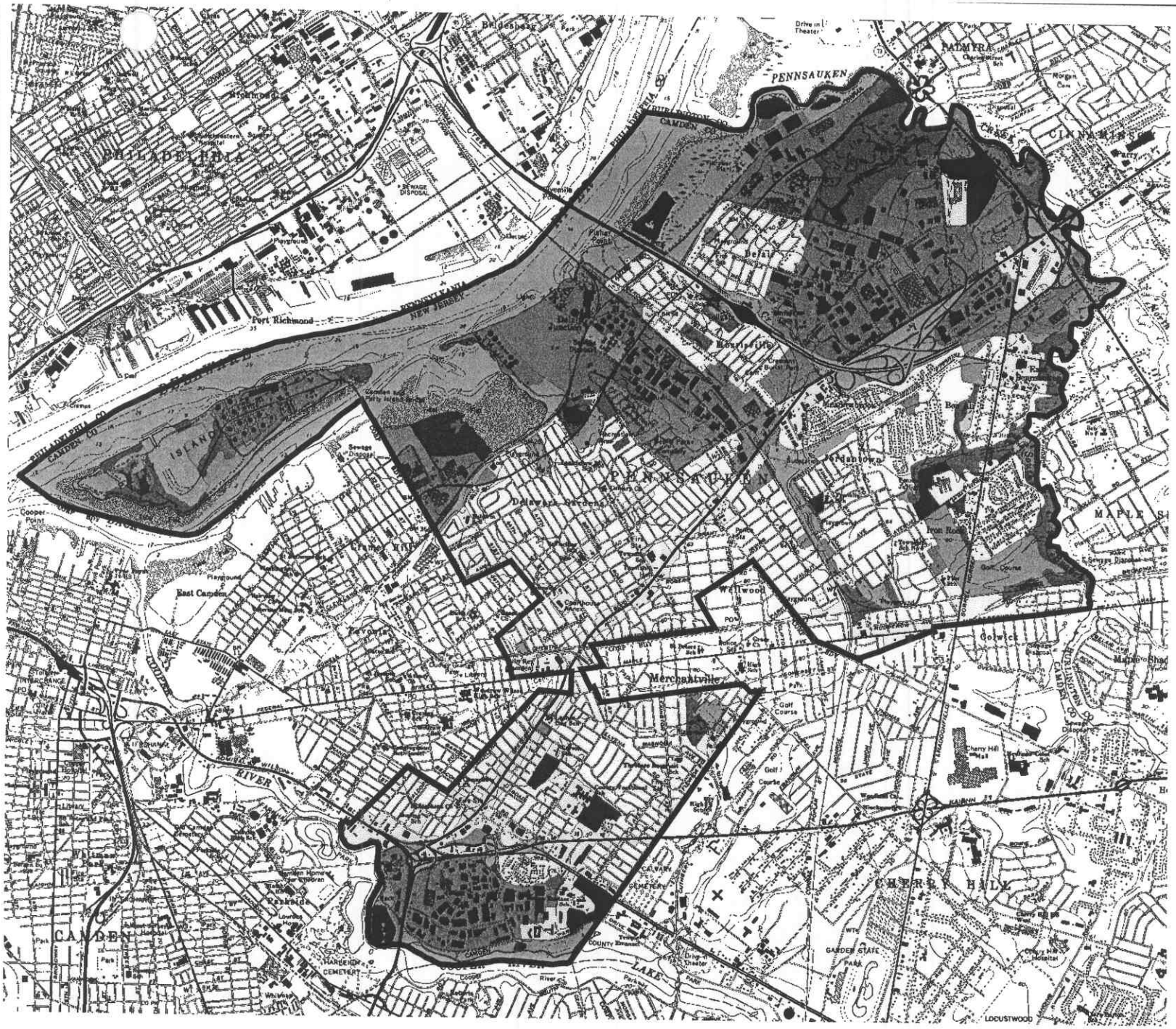
3.3 Waterways

Pennsauken borders three significant waterways, they include Delaware River to east, Pennsauken Creek to the north, and Cooper River to the south.

The Pennsauken Creek receives drainage from a 33 square mile watershed in southwestern Burlington County and northern Camden County and flows into the Delaware River near Palmyra. The North Branch of the Pennsauken Creek is in Burlington County, while the South Branch defines the boundary between Burlington County and Camden County. Both branches of Pennsauken Creek are tidally influenced from the mouth to several miles upstream. The Pennsauken Creek is classified as FW-2 Nontrout. The hydrologic unit code or HUC-11 code is 02040202100 (Delaware Valley Regional Planning Commission 2001).

The Cooper River is 16 miles long and the watershed encompasses an area of 40 square miles. The River flows through Camden County to the Delaware River at Camden City. The Cooper River and its tributaries are classified FW-2 Nontrout. The HUC-11 code is 02040202110 (Delaware Valley Regional Planning Commission 2001).

Pennsauken Township also has numerous public and privately maintained detention basins and structural stormwater facilities. In addition to these facilities, the Township has an extensive storm drainage collection system. Additional information on the Township's stormwater facilities and storm drainage collection system can be found in the Township's Stormwater Pollution Prevention Plan currently on file at the Township Engineer's Office



SOURCE:
CAMDEN QUADRANGLE, 7.5 MINUTE SERIES
NJDEP GIS RESOURCE DATA, SERIES 1, VOL. 1

LAND USE MAP

MARCH 29, 2005

PENNSAUKEN TOWNSHIP

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SOURCE:
CAMDEN QUADRANGLE, 7.5 MINUTE SERIES
NJDEP GIS RESOURCE DATA, SERIES 1, VOL. 1

WATERWAYS

MARCH 29, 2005

PENNSAUKEN TOWNSHIP

3.4 WATER QUALITY

The Ambient Biomonitoring Network (AMNET) was established by the New Jersey Department of Environmental Protection (NJDEP) to monitor and document the health of New Jersey's waterways. This statewide network of over 800 stations employs sampling and taxonomic analysis of in-stream macroinvertebrate communities to assess the ecological condition at each site. These bioassessments utilize several community "biometrics", such as pollution tolerances of individual taxa; the product of this multi-metric analysis assigns one of three biological "impairment" levels and rates a given site as non-impaired, moderately impaired or severely impaired (http://www.state.nj.us/dep)

Table 2: 2001 Water Quality Scores

Station	*Waterbody*	*NJ Impairment Score*	*Rating*
AN0181	North Branch Pennsauken Creek	0	Severely Impaired
AN0184	South Branch Pennsauken Creek	6	Severely Impaired
AN0185	South Branch Pennsauken Creek	0	Severely Impaired
AN0188	North Branch Cooper River	9	Moderately Impaired

Non-impaired – 24-30
Moderately Impaired – 9-21
Severely Impaired – 0-6

These water quality data are used by NJDEP to develop Total Daily Maximum Load (TMDL). TMDL is the quantity of a pollutant that can enter a waterbody without exceeding water quality standards or interfering with the ability to use the waterbody for its designated usage. Point and non-point pollution, surface water withdrawals, and natural background levels are included in the determination of a TMDL, as required by Section 303(d) of the Clean Water Act.

A point source of pollution is a readily identifiable input where waste is discharged to the receiving water from a pipe or drain. With few exceptions, these permitted discharges are regulated by the New Jersey Pollution Discharge Elimination System (NJPDES). Non-point sources of pollution refer to those inputs that occur over a wide area and are associated with particular land uses, as opposed to individual point source discharges. From an urban perspective, non-point sources may include stormwater runoff from street surfaces contaminated with car oil, heavy metals, animal feces, and construction site runoff carrying soil and sediment. (http://www.epa.vic.gov.au/Water/Threats/sources.asp, 2005)

TMDLs determine the allowable load from each source, with a factor of safety for the pollutant entering the waterbody. TMDLs can be used to prevent further deterioration of a waterbody, or to improve the current water quality.

The attached Well-head Protection Map indicates there are numerous potable wells within the Township with significant buffer areas. By complying with established TMDLs and stormwater regulations, the Township will help to protect drinking water quality and ground water supplies.

3.5 WATER QUANTITY

Stormwater also often causes water quantity issues. There are several flood prone areas in Pennsauken Township including, but not limited to, the following:

- Petty Island
- Areas along the Delaware River waterfront
- Areas along the Pennsauken Creek and its tributaries
- Areas along the Cooper River and its tributaries
- Impervious areas with undersized stormwater conveyances.

The Township is continually working to address these issues.

3.6 GROUNDWATER RECHARGE

Recharge is the process by which groundwater is replenished. A recharge area is a pervious area where stormwater is percolates downward to an aquifer. An aquifer may be either a consolidated (bedrock) unit or an unconsolidated (alluvium, glacial material) unit. Most surface areas, unless composed of solid rock outcroppings or occupied by development, allow a certain percentage of total precipitation to reach the water table. Areas that transmit the most precipitation are often referred to as "high" or "critical" recharge areas. Water infiltration and infiltration rates depends upon vegetation cover, slope, soil composition, depth to the water table, geology (i.e. presence or absence of confining beds, fractures, etc.) and climatic conditions (i.e. temperature). Natural vegetation cover, flat or undulating topography, permeable soils, deep water tables, and the absence of confining beds promote recharge.

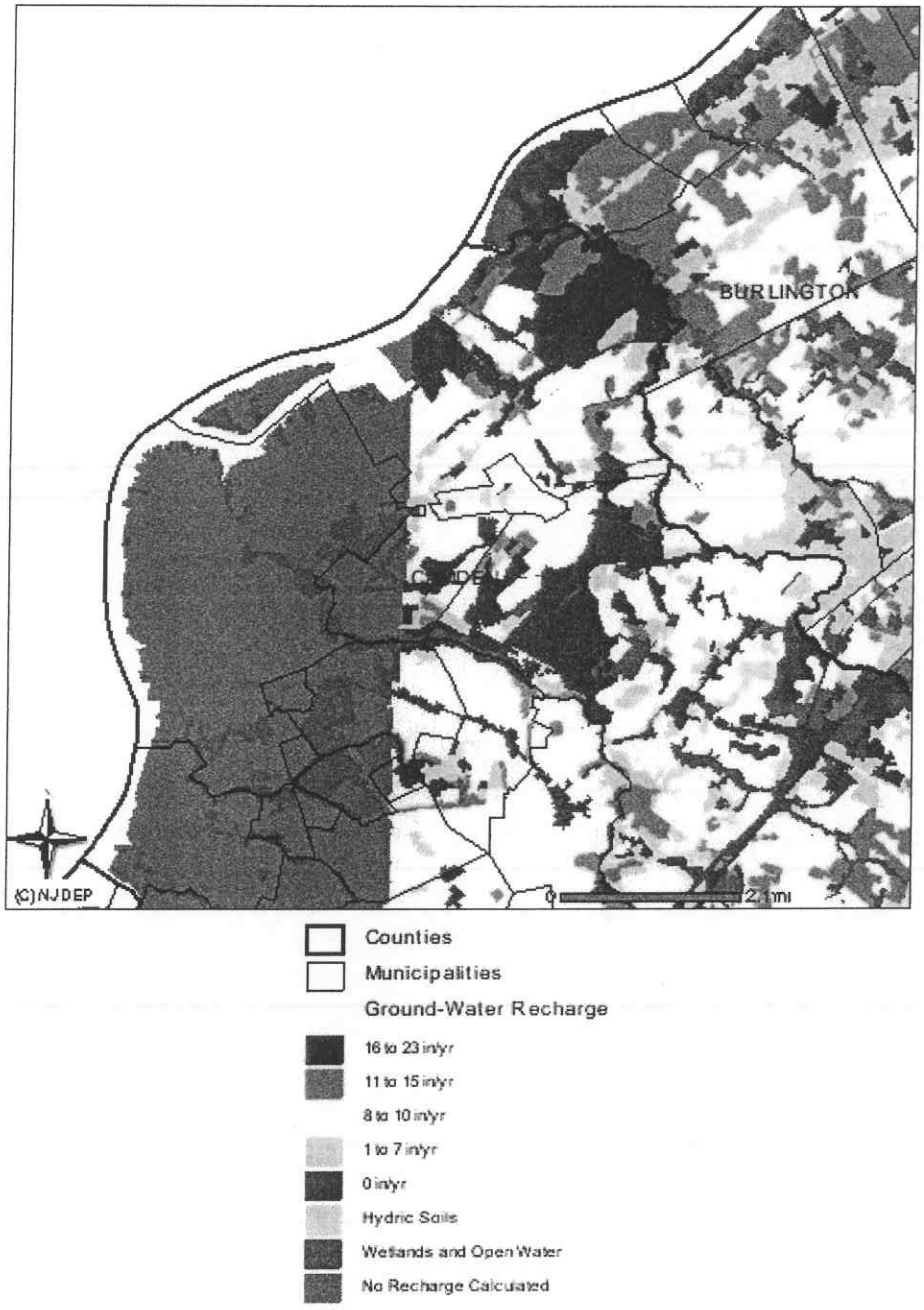
The Potomac-Raritan-Magothy (PRM) aquifer system and the Merchantville-Woodbury confining unit underlie Pennsauken Township. The Surficial Geology Map indicates that the PRM underlies more than 75% of the Township. The Merchantville-Woodbury confining unit underlies only the eastern section of the Township. The map on page 3-15 depicts the surficial geology throughout the Township.

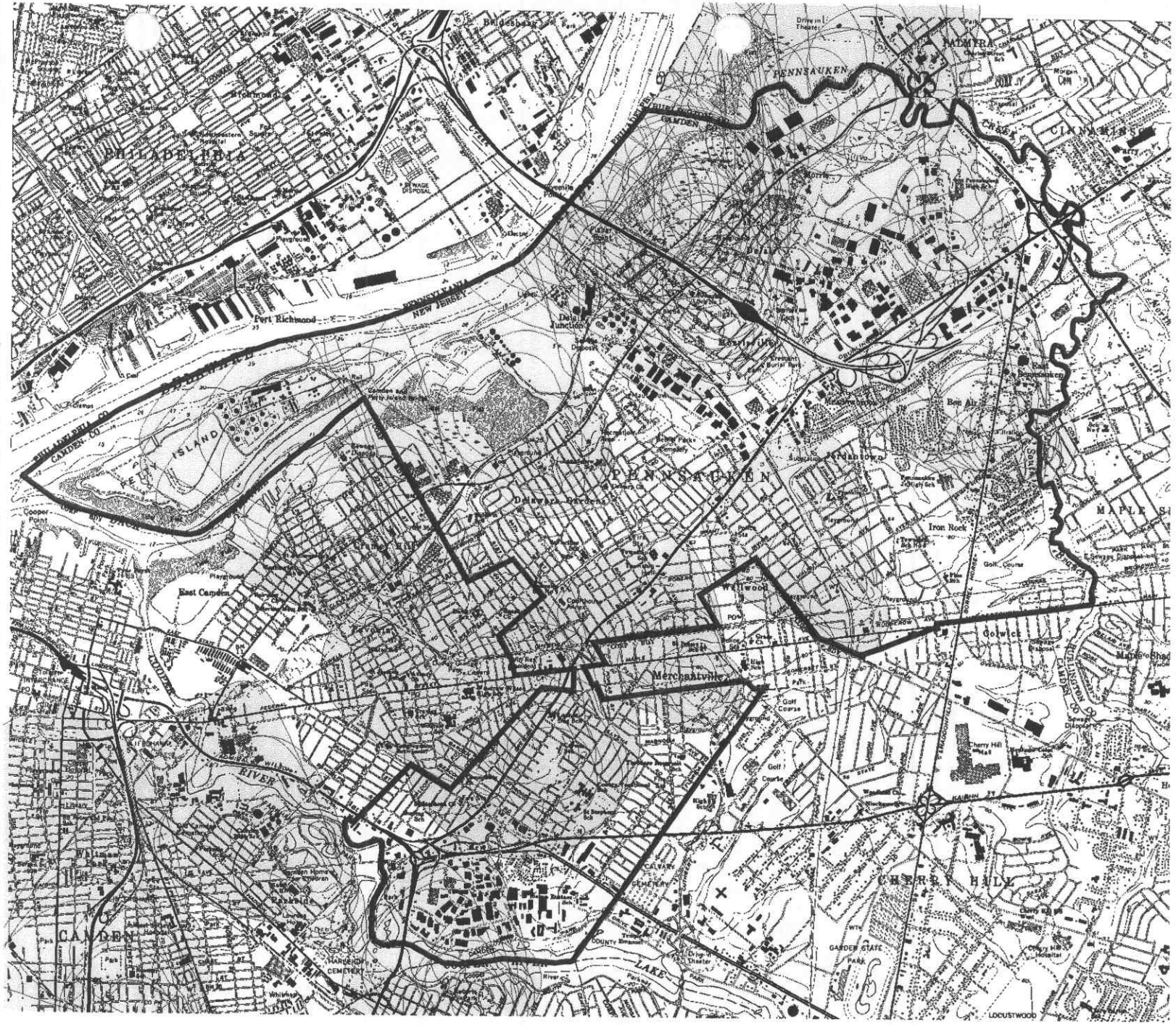
Impervious surface is increased as vacant sites are developed. Impervious surface is the portion of a site covered with structures and paving, which prevents the underlying soil from absorbing stormwater. As impervious surfaces increase, groundwater recharge areas and rates decrease. Additional stormwater runoff alters the floodplain and has adverse impacts on the stream and river ecosystems. As shown on the groundwater recharge map (3-12), most of the Township has a recharge rate of 8 to 10 inches per year. Protection of groundwater recharge areas is vital in preserving water quality and quantity.

The supplemental or base flow from groundwater discharge areas to surface waterbodies is the single most important factor maintaining surface flow during periods of annual low flow (hot, dry summer and early fall months) and during periods of drought. During these times, base flow of the stream is maintained via discharging groundwater. Maintenance of the quantity of

flow, quality of water, and the survival of aquatic and wetlands communities are directly dependent upon groundwater discharge.

Pennsauken Groundwater Recharge



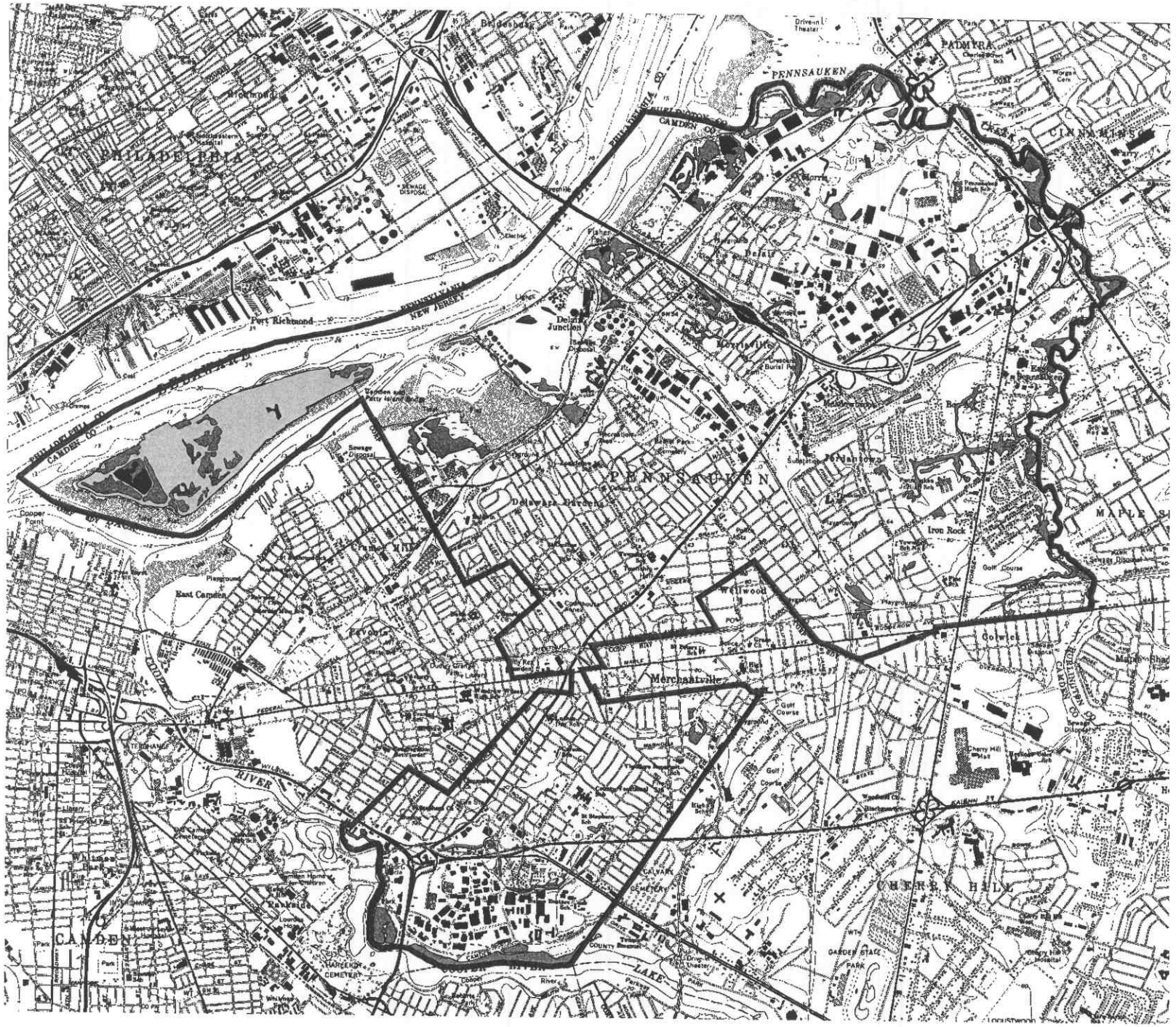


SOURCE:
CAMDEN QUADRANGLE, 7.5 MINUTE SERIES
NJDEP GIS DIGITAL DATA

WELL-HEAD PROTECTION AREAS

MARCH 29, 2005

PENNSAUKEN TOWNSHIP



FRESH WATER WETLANDS

- ARTIFICIAL LAKES
- DECIDUOUS SCRUB/SHRUB WETLANDS
- DECIDUOUS WOODED WETLANDS
- DISTURBED WETLANDS (MODIFIED)
- HERBACEOUS WETLANDS
- MANAGED WETLANDS (MODIFIED)
- UPLANDS
- TIDAL WATER
- WETLAND RIGHTS-OF-WAY (MODIFIED)
- FLOODPRONE AREA

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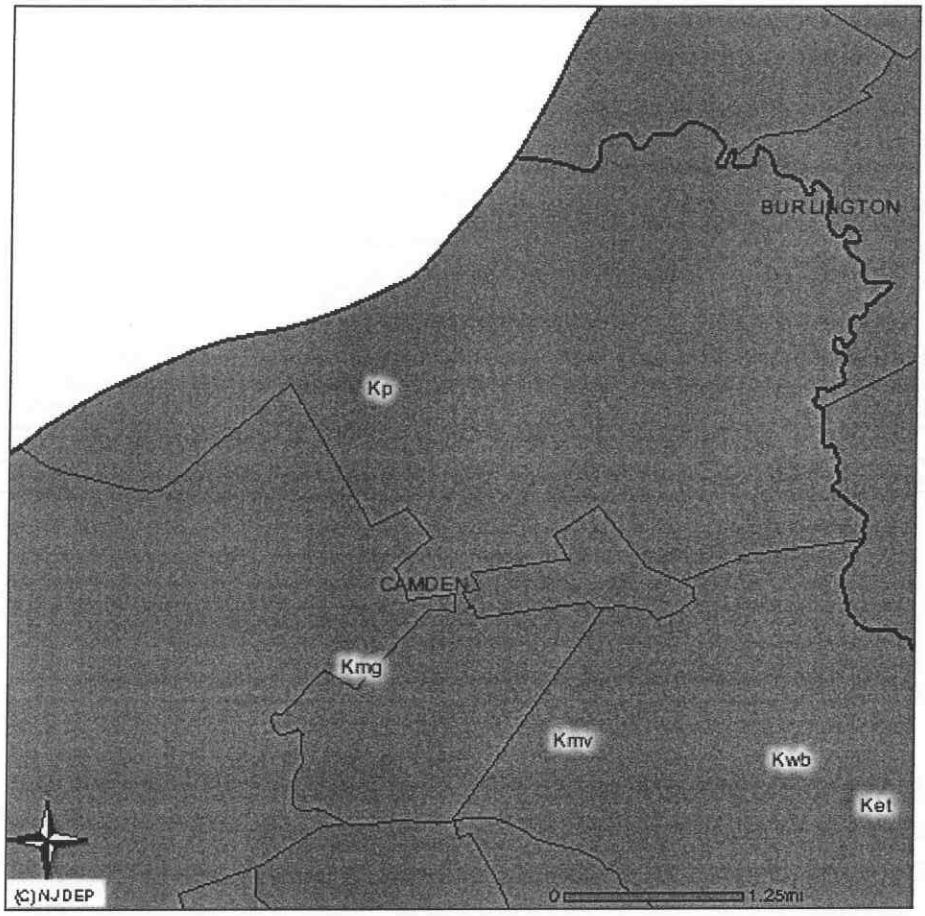
SOURCE:
CAMDEN QUADRANGLE, 7.5 MINUTE SERIES
NJDEP GIS RESOURCE DATA, SERIES 1, VOL. 1

FRESH WATER WETLANDS AND FLOODPRONE AREAS

MARCH 29, 2005

PENNSAUKEN TOWNSHIP

Pennsauken Surficial Geology



Bedrock Formations:

Kp – Potomac Formation

Kmg – Magothy Formation

Kmv – Merchantville Formation

Kwb – Woodbury Formation

Ket – Englishtown Formation

4.0 DESIGN AND PERFORMANCE STANDARDS

The Township should adopt applicable design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5 to reduce the negative impact of stormwater runoff on water quality and quantity. Section 6.0 of this Plan, entitled "Stormwater Management Strategies", indicates actions appropriate for various types of development in Pennsauken. Ultimately, design and performance standards should be created to contain the necessary language to maintain stormwater management measures consistent with applicable stormwater management rules at N.J.A.C. 7:8-5.8 - Maintenance Requirements. This includes language for safety standards consistent with N.J.A.C. 7:8-6 - Safety Standards for Stormwater Management Basins. The ordinances must be submitted to the county for review and approval within 12 months of the adoption of this plan.

Many stormwater management facilities may retain water for long periods of time and if improperly maintained may encourage mosquito breeding. New development and redevelopment activities should be coordinated with the Camden County Mosquito Commission so that stormwater facilities can be properly maintained.

Proper construction and maintenance are critical to the successful performance of a stormwater management system. During construction, Township inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and will function as designed.

The Township is also preparing a Stormwater Pollution Prevention Plan (SPPP) that establishes a maintenance schedule for all existing stormwater related maintenance requirements. The Township will also initiate a local education program to educate property owners on the control of household waste, fertilizers, solids, floatable controls, pesticides and other methods to reduce stormwater pollutants that may adversely affect the Township's waterways. For new development and redevelopment projects meeting the stormwater management threshold, the

Township will require an operation and maintenance plan in accordance with the DEP BMP manual. Copies of each maintenance plan will be filed with the Township. Township personnel will perform inspections during the first two years of operation or after significant storms to ensure that the system is functioning properly. After this, annual checks will be done to identify maintenance needs. As part of these inspections, blockages must be cleared from inlets and outlets. Unhealthy vegetation may need to be tended or replaced. The design of stormwater management practices for water quality improvement is based primarily on removal of sediment. Therefore, at some point, accumulated material must be removed. Township ordinances should indicate that the inspection of systems is permissible on private property, provided the necessary easements are in place, upon giving reasonable notice. Ordinances should also indicate a time frame for maintenance procedures to occur upon receiving notice from the Township that maintenance is required.

5.0 Plan Consistency

5.1 Regional Stormwater Management Plans

Currently, there are no adopted Regional Stormwater Management Plans (Regional Plans) developed for waters "within" the Township. This plan will be updated to be consistent with any Regional Plans or TMDLs that are established in the future. The Township plans to take part in the development of any Regional Plans that affect waterbodies within or adjacent to the municipality.

5.2 Total Maximum Daily Loads

Although, there are no stormwater TMDLs currently established for the Township, TMDL proposals have been made for the Delaware River, Cooper River and Pennsauken Creek. Monitoring has found that Cooper River is impaired by phosphorus and pH. The Pennsauken Creek is also impaired by phosphorus, Fish-PCB and Fish-Dioxin. Delaware River Zone 3, which includes Petty's Island and the Pennsauken waterfront, is impaired by 1,2-Dichloreothane, Tetrachlorethylene and PCBs. When TMDLs are established they will prevent further deterioration of the water bodies, and/or improve the current water quality. This plan will be updated to be compliant with any TMDLs issued in the future.

5.3 Residential Site Improvement Standards (RSIS)

This Municipal Stormwater Management Plan is consistent with regulations established under the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21, and will be updated to remain consistent with any future updates of RSIS. Additionally, the Township will use the latest version of the RSIS during its reviews of residential developments for stormwater management.

5.4 Soil Conservation

The Township's Stormwater Management Control Ordinance requires that all new development and redevelopment site plans and subdivisions, including renovations, comply with the Soil Erosion and Sediment Control Standards of New Jersey. In cooperation with Camden

County, Township inspectors will observe on-site soil erosion and sediment control measures as part of construction site inspections.

6.0 STORMWATER MANAGEMENT STRATEGIES

6.1 MASTER PLAN & ORDINANCE REVIEW

The Township will review its master plan and land use/zoning ordinances for consistency with the new stormwater regulations. The review will concentrate on areas pertaining to buffers, curbs and gutters, off-site and off-tract improvements, off-street parking and loading, performance standards, sidewalks, streets, groundwater protection and drainage, and stream corridors.

Revisions to sections of Township ordinances will allow the incorporation of the non-structural strategies. Drafts of the updated ordinances will be submitted to the County for review and approval within 12 months of plan adoption. A copy will be sent concurrently to the New Jersey Department of Environmental Protection.

6.2 NONSTRUCTURAL STRATEGIES

This Plan recommends the practical use of the following nonstructural strategies for all major developments in accordance with Subchapter 5 of the NJDEP BMP manual:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.
3. Maximize the protection of natural drainage features and vegetation.
4. Minimize the decrease in the pre-construction "time of concentration."
5. Minimize land disturbance, including clearing and grading.
6. Minimize soil compaction.
7. Provide vegetated open-channel conveyance systems that discharge into and through stable vegetated areas.
8. Provide preventative source controls. In addition, Subchapter 5 further requires an applicant seeking approval for a major development[i] to specifically identify how these nonstructural

strategies have been incorporated into the development's design. Finally, for each of those nonstructural strategies that could not be incorporated into the development's design due to engineering, environmental, or safety reasons, the applicant must provide a basis for this contention.

Recommended Measures

Recommendations in the BMP manual may be implemented through the use of:

Vegetated Filter Strips

Vegetated filter strips are engineered stormwater conveyance systems that treat small drainage areas. Generally, a vegetated filter strip consists of a level spreader and planted vegetation. The level spreader ensures uniform flow over the vegetation that filters out pollutants, and promotes infiltration of the stormwater.

Vegetated filter strips are best utilized adjacent to a buffer strip, watercourse or drainage swale since the discharge will be in the form of sheet flow, making it difficult to convey the stormwater downstream in a normal conveyance system (swale or pipe).

Stream Corridor Buffer Strips

Buffer strips are undisturbed areas between development and the receiving waters. There are two management objectives associated with stream and valley corridor buffer strips:

- To provide buffer protection along a stream and valley corridor to protect existing ecological form and functions; and
- To minimize the impact of development on the stream itself (filter pollutants, provide shade and bank stability, reduce the velocity of overland flow).

Buffers only provide limited benefits in terms of stormwater management; however, they are an integral part of a system of best management practices.

The Stabilization of Banks, Shoreline and Slopes

The root systems of trees, shrubs and plants effectively bind soils to resist erosion. Increasing the amount of required plant material for new and redeveloped residential and non-residential sites should be encouraged throughout the Township. Planting schemes should be designed by a certified landscape architect to combine plant species that have complementary rooting characteristics to provide long-term stability.

Pond Configuration

Several homes in Pennsauken have created ponds for aesthetic purposes. Some of these ponds are shallow and suffer from eutrophic conditions. This leads to large amount of weed and algae growth that depletes the amount of dissolved oxygen in the water. Through proper design, increases in water temperature during summer months can be minimized.

The configuration of a pond will affect its temperature. The width of the pond should be minimized to prevent the occurrence of large open areas of water that cannot be shaded by vegetation. The pond should provide one area at least 4 to 6 feet deep to keep pond waters cool and to maintain an area sustaining a fish population. The positioning of deciduous and coniferous trees along the edges of a pond, channel or wetland can assist in mitigating undesirable increases in water temperature and contribute to the maintenance of dissolved oxygen levels by inhibiting the growth of algae.

Deterrence of Geese and Deer

Maintaining or planting dense woody vegetation around the perimeter of a pond or wetland is the most effective means of deterring geese from taking over and contaminating local lakes and ponds. Minimizing the amount of land that is mowed will limit the preferred habitat for geese. Also the planting of deer-tolerant vegetation adjacent to waterbodies is a means of deterring deer by minimizing food sources. If however, these actions are not sufficient, the Township should investigate other means of deterrence.

Fertilizers

The use of fertilizers to create the "perfect lawn" is an increasingly common problem in many residential areas. Fertilizer run-off increases the level of nutrients in water bodies and can accelerate eutrophication[ii] in the lakes and rivers and continue on to the coastal areas. The excessive use of fertilizers causes nitrate contamination of groundwater and may lead to levels in drinking water that are above recommended safety levels. Good fertilizer maintenance practices help in reducing the amount of nitrates in the soil and thereby lower its content in the water. Initially, the Township should work with the NJDEP to educate homeowners of the impacts of the overuse of fertilizers. This discussion should include other techniques to create a "green lawn" without over-fertilizing. Almost as important as the use of fertilizer is the combination of over-fertilizing and over-watering lawns. In many cases this leads to nutrient rich runoff, which ultimately migrates to a nearby stream, lake or other waterbody. If fertilizer is applied correctly, the natural characteristics of the underlying soils will absorb or filter out the nutrients in the fertilizer.

Minimizing Lawns

Reducing the amount of manicured lawn area and increasing the amount of woods and native vegetation provides several benefits. Native vegetation requires less fertilizer, filters out more pollutants, and it promotes groundwater recharge.

Unpaved Roads and Driveways

While there are no unpaved public roads in the Township, there are a few privately maintained unpaved roads or driveways. There is a need to manage the runoff from these roadways. Poorly maintained roads and driveways may contribute to water quality problems, and erosion from unpaved roads may increase non-point source pollution. This Plan recommends utilizing Best Management Practices (BMPs) to properly manage existing unpaved roads.

6.3 STRUCTURAL STORMWATER MANAGEMENT[iii]

In Chapter 9 of its *Stormwater Management Best Management Practices* (BMP) manual, the Department of Environmental Protection identifies several structural stormwater management options. The Township recommends the following structural devices in accordance with the Township's Design and Performance Standards – Policy Implementation Table included in this Plan. Structural methods should be used only after all non-structural strategies are deemed impracticable or unsafe. Specifically, the Township encourages the use of structural stormwater management systems in a manner that maximizes the preservation of community character:

Bioretention Systems

A bioretention system consists of a soil bed planted with native vegetation located above an underdrained sand layer. It can be configured as either a bioretention basin or a bioretention swale. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system. Runoff storage depths above the planting bed surface are typically shallow. The adopted Total Suspended Solids (TSS) removal rate for bioretention systems is 90 %.

Constructed Stormwater Wetlands

Constructed stormwater wetlands are wetland systems designed to maximize the removal of pollutants from stormwater runoff through settling and both uptake and filtering by vegetation. Constructed stormwater wetlands temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants. The adopted removal rate for constructed stormwater wetlands is 90%.

Dry Wells

A dry well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through

infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. Due to the relatively low level of expected pollutants in roof runoff, a dry well cannot be used to directly comply with the suspended solids and nutrient removal requirements contained in the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. However, due to its storage capacity, a dry well may be used to reduce the total amount of stormwater runoff that a roof would ordinarily discharge to downstream stormwater management facilities. Care should be taken with the location and size of drywells due to potential adverse impacts on basements and foundations.

Extended Detention Basins

An extended detention basin is a facility constructed through filling and/or excavation that provides temporary storage of stormwater runoff. It has an outlet structure that detains and attenuates runoff inflows and promotes the settlement of pollutants. An extended detention basin is normally designed as a multistage facility that provides runoff storage and attenuation for both stormwater quality and quantity management. The adopted TSS removal rate for extended detention basins is 40 to 60 %, depending on the duration of detention time provided in the basin.

Infiltration Basins

An infiltration basin is a facility constructed within highly permeable soils that provides temporary storage of stormwater runoff. An infiltration basin does not normally have a structural outlet to discharge runoff from the stormwater quality design storm, but may require an emergency overflow for extraordinary storm events. Instead, outflow from an infiltration basin is through the surrounding soil. An infiltration basin may also be combined with an extended detention basin to provide additional runoff storage for both stormwater quality and quantity management. The adopted TSS removal rate for infiltration basins is 80 %.

Manufactured Treatment Devices

A manufactured treatment device is a pre-fabricated stormwater treatment structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to remove pollutants from stormwater runoff.

The TSS removal rate for manufactured treatment devices is based on the NJDEP certification of the pollutant removal rates on a case-by-case basis. Other pollutants, such as nutrients, metals, hydrocarbons, and bacteria can be included in the verification/certification process if the data supports their removal efficiencies.

Pervious Paving Systems

Pervious paving systems are paved areas that produce less stormwater runoff than areas paved with conventional paving. This reduction is achieved primarily through the infiltration of a greater portion of the rain falling on the area than would occur with conventional paving. This increased infiltration occurs either through the paving material itself or through void spaces between individual paving blocks known as pavers. Pervious paving systems are divided into three general types. Each type depends primarily upon the nature of the pervious paving surface course and the presence or absence of a runoff storage bed beneath the surface course. Porous paving and permeable pavers with storage bed systems treat the "stormwater quality" design storm runoff through storage and infiltration. Therefore, these systems have adopted TSS removal rates similar to infiltration structures. Care must be taken in the use of pervious systems to avoid subgrade instability and frost related deterioration. Pervious paving systems also require significant maintenance to maintain their designed porosity.

Sand Filters

A sand filter consists of a forebay and underdrained sand bed. It can be configured as either a surface or subsurface facility. Runoff entering the sand filter is conveyed first through the forebay, which removes trash, debris, and coarse sediment, and then through the sand bed to an outlet pipe. Sand filters use solids settling, filtering, and adsorption processes to reduce pollutant concentrations in stormwater. The adopted TSS removal rate for sand filters is 80 %.

Vegetative Filters

A vegetative filter is an area designed to remove suspended solids and other pollutants from stormwater runoff flowing through a length of vegetation called a vegetated filter strip. The

vegetation in a filter strip can range from turf and native grasses to herbaceous and woody vegetation, all of which can either be planted or indigenous. It is important to note that all runoff to a vegetated filter strip must both enter and flow through the strip as sheet flow. Failure to do so can severely reduce and even eliminate the filter strip's pollutant removal capabilities. The total suspended solid (TSS) removal rate for vegetative filters will depend upon the vegetated cover in the filter strip.

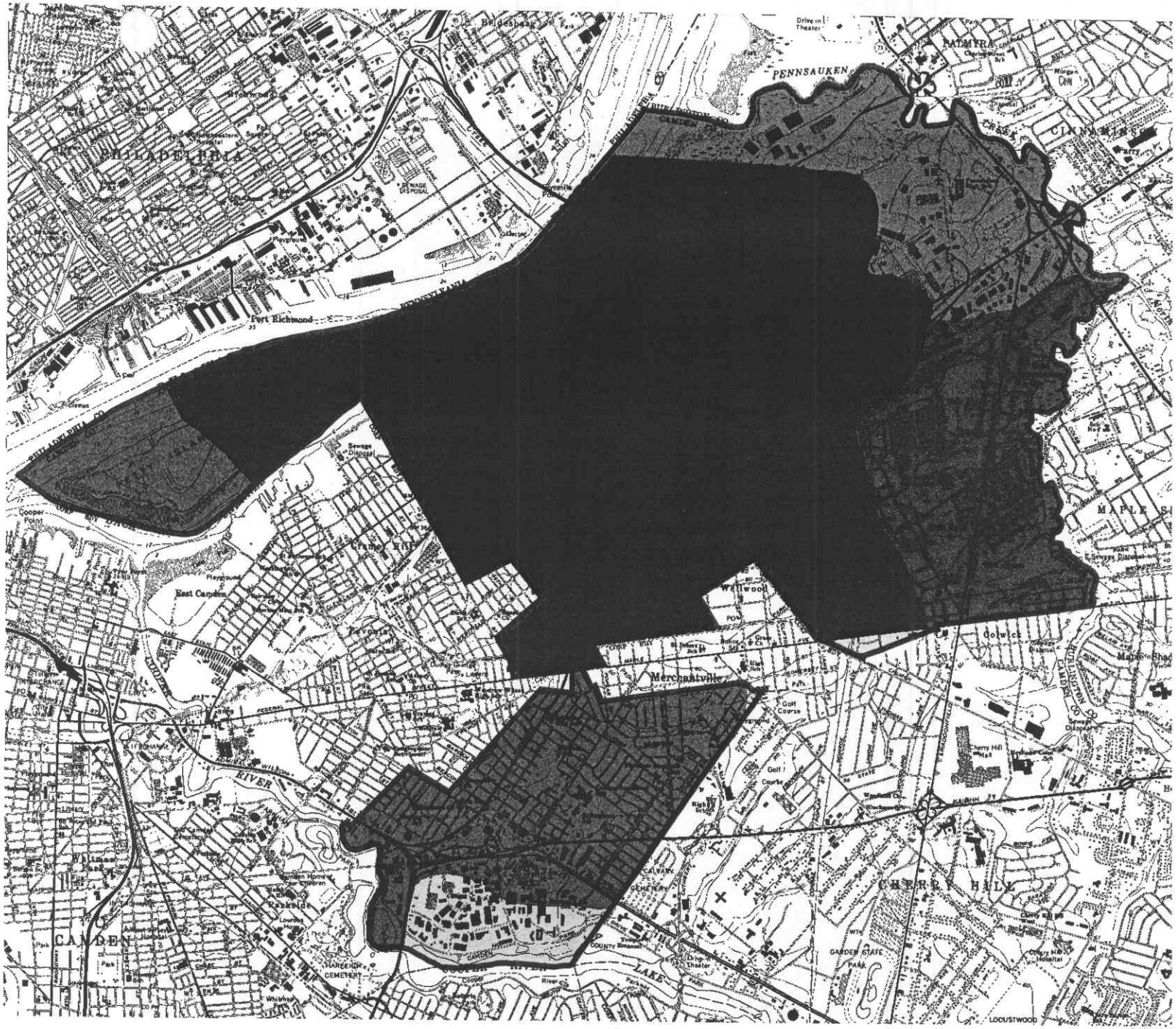
Wet Ponds

A wet pond is a stormwater facility constructed through filling and/or excavation that provides both permanent and temporary storage of stormwater runoff. It has an outlet structure that creates a permanent pool and detains and attenuates runoff inflows and promotes the settlement of pollutants. A wet pond, also known as a retention basin, can also be designed as a multi-stage facility that also provides extended detention for enhanced "stormwater quality" design storm treatment and runoff storage and attenuation for stormwater quantity management. The adopted TSS removal rate for wet ponds is 50 to 90 % depending on the permanent pool storage volume in the pond and the length of retention time provided by the pond.

Each of these structures has advantages and disadvantages to manage stormwater Table 3 Design and Performance Standards – Policy Implementation Table indicates the appropriateness of these structural stormwater management structures in Pennsauken.

7.0 LAND USE/BUILD-OUT ANALYSIS

Pennsauken Township does not have more than one square mile of vacant or developable land. As a result, a land use and build-out analysis is not required for this Stormwater Management Plan.



HUC14

- 020402021000**50**
- 020402021000**60**
- 020402021100**50**
- 020402021100**60**
- 020402021100**70**

NOTE:

HUC14 CODES ESTABLISHED BY U.S. GEOLOGIC SURVEY

N

0 1,000 2,000 4,000 6,000 8,000 Feet

SOURCE:
CAMDEN QUADRANGLE, 7.5 MINUTE SERIES
NJDEP GIS DIGITAL DATA

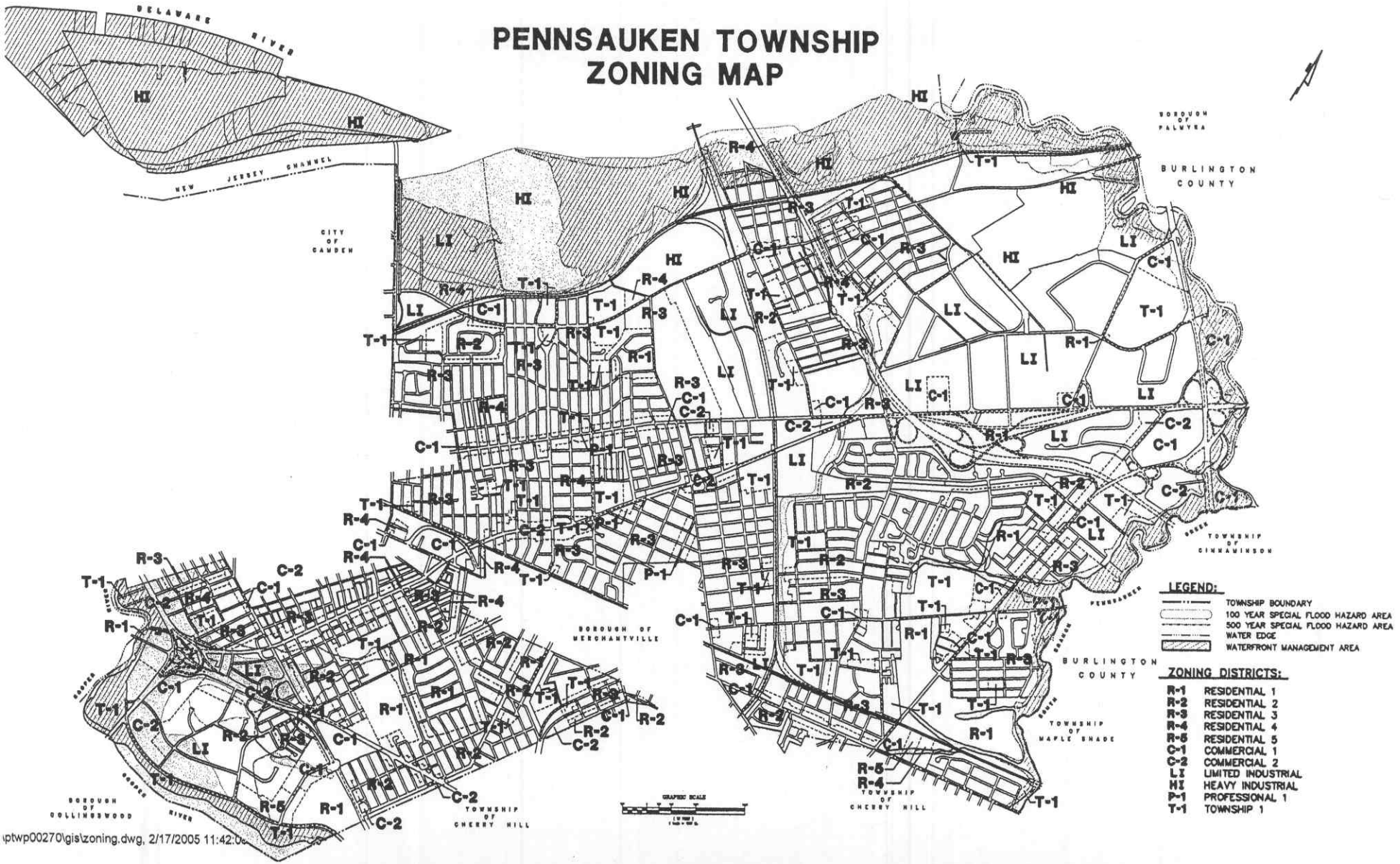
HYDROLOGIC UNIT CODE (HUC14)

SUBWATERSHEDS

MARCH 29, 2005

PENNSAUKEN TOWNSHIP

PENNSAUKEN TOWNSHIP
ZONING MAP



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8.0 MITIGATION PLAN

This mitigation plan is provided for proposed development that is granted a variance or exemption from stormwater management design and performance standards.

8.1 MITIGATION PROJECT CRITERIA

The developer must propose a mitigation project located in the same drainage basin as the proposed development. The mitigation project must provide additional groundwater recharge benefits, or protection from stormwater runoff quantity or quality from previously developed property that does not currently meet the design and performance standards outlined in this plan. The developer must ensure the long-term maintenance of the project including all maintenance required in Chapters 8 and 9 of the NJDEP Stormwater BMP Manual.

Projects must be proposed on an equivalent basis. Developers must propose a mitigation project that is equivalent to the type requested in the variance. This means a "stormwater quality" variance can only be mitigated by a "stormwater quality" mitigation project.

It is the developer's responsibility to provide a detailed study of any proposed mitigation project, and must provide the Township with a proposed mitigation plan for review and approval.

9.0 RECOMMENDATIONS

The 1998 Master Plan should be updated to incorporate the following recommendations.

Recommendation A: Review and update the existing elements of the Master Plan to implement the principals of non-structural and structural stormwater management strategies to reduce stormwater quantity, improve stormwater quality, and to maintain or increase groundwater recharge.

The Master Plan should be updated to comply with the recently adopted New Jersey Department of Environmental Protection (NJDEP) Stormwater Management Regulations and the NJDEP *Best Management Practices for the Control of Non-Point Source Pollution from Stormwater Manual.*

The Residential Site Improvement Standards (RSIS) require all residential developments with disturbance equal to or greater than 1 acre to comply with the NJDEP Stormwater Regulations. However, non-residential developments are currently exempt from the Stormwater Regulations. The Township should consider implementing regulations to require major development not regulated by the RSIS, such as non-residential development and building permit applications not regulated by site plan and/or subdivision, to comply with portions of the stormwater rules and regulations. These regulations should seek to achieve a balance between minimizing impact on stormwater quality, stormwater quantity and ground water recharge, while protecting private property rights.

Recommendation B: To improve stormwater management, water quantity and groundwater recharge, consider reducing permitted impervious coverage such as buildings and parking lots throughout the Township.

The Township should closely evaluate site plans for impervious surfaces such as oversized parking lots. Parking lots generate large volumes of stormwater. The Township should evaluate the existing parking requirement and design standards to prevent over-development of parking lots and to encourage the separation ("disconnection") of impervious areas with landscaping areas to collect stormwater and encourage groundwater recharge.

An evaluation of vacant sites throughout the Township should be performed to determine which sites have impervious coverage which are no longer in use and are not functional. They include areas such as abandoned parking lots and tennis courts. Additional impervious coverage contributes to additional stormwater runoff. The Township should investigate methods to remove abandoned impervious coverage and to replace it with vegetation to receive stormwater runoff.

Recommendation C: Explore and consider establishing a Stream Corridor Buffer Ordinance.

The NJDEP Stormwater Regulations requires any development with more than 1 acre of disturbance or ¼ acre of impervious coverage to provide a 300-foot Buffer along a Category-1 stream.

Recommendation D: Work with residents, property owners and businesses to encourage the installation of vegetation along stream corridors and within existing stormwater detention facilities.

Landscaping with native vegetation along stream corridors and within detention basins improves the quality of stormwater.

Recommendation E: Seek to limit encroachments into existing conservation easements.

Properties throughout the Township may have existing conservation easements.

Pennsauken Township should consider establishing a Conservation Easement Ordinance prohibiting the removal of trees and ground cover within a conservation easement. The Conservation Easement Ordinance would also prohibit the construction of any structures, walls, or fences within the easement.

Recommendation F: Educate residents on the impacts of the overuse of fertilizers and good fertilizer maintenance practices.

As stated in Section 6.2, the overuse of fertilizers has a significant detrimental impact on surface water bodies and groundwater. The Township should work with the NJDEP to educate residents on these impacts and encourage residents to use techniques to create a "green lawn" without over- fertilizing and/or to convert lawn areas to other kinds of vegetation that do not require fertilization and other chemical treatments. Many lawn services also "overspray" fertilizer onto roadways and adjacent properties. The Township should investigate methods to minimize the application of fertilizers beyond property lines.

Recommendation G: Educate residents on techniques to deter geese, deer, and other wildlife.

Geese population can take over and contaminate local water bodies. The planting of vegetation around the perimeter of a waterbody is an effective means of deterring geese.

Recommendation H: Consider implementing restrictions that limit the allowable disturbance of existing vegetated areas and removal of vegetation and woodlands.

The Ordinance may include regulations prohibiting clear-cutting, removal of trees on or adjacent to environmentally sensitive areas and/or the protection of specimen trees that are more stringent than State requirements or federal requirements.

Recommendation I: Seek to ensure the proper inspection, monitoring, and maintenance of all stormwater management facilities and develop strategies for all existing and future maintenance and improvements.

Stormwater facilities require regular maintenance to ensure effective and reliable performance. Failure to perform the necessary maintenance can lead to diminished performance, deterioration and failure. In addition, a range of health and safety problems, including mosquito breeding and the potential for drowning, can result from improperly maintained facilities. To minimize these risks, the Township should implement a procedure for regular inspection, monitoring, and maintenance of Township owned stormwater facilities.

Additionally, there are a number of privately maintained stormwater facilities within the Township. The Township should work with the various property owners, residents and business owners to identify maintenance and/or improvements needs and develop strategies for regular inspection and maintenance of these facilities.

The Township should also encourage the use of low impact design methods and non-structural strategies, which require less maintenance.

Recommendation J: Work with the County Mosquito Commission to monitor existing and proposed BMP's.

Many of the recommended non-structural and structural strategies are designed to retain water for a period of time to promote groundwater recharge. These conditions could be favorable to mosquito breeding habitats. To date there is no data relating mosquito breeding and best management practices. The Township should coordinate new development and redevelopment project using non-structural and structural strategies with the County Mosquito Commission so that these facilities can be periodically monitored, inspected and maintained. Developers and the Township should also solicit input from the County Mosquito Commission early in the design process for new facilities to obtain additional guidance and recommendations.

Recommendation K: Encourage existing storm drains to be replaced with bicycle safe grates and NJDEP approved inlet heads to prevent floatable and solid debris from entering the storm water conveyance system.

Typical roadway debris, such as bottles and cans, can easily enter stormwater conveyance systems through typical inlet openings. This debris is then transported downstream into the receiving water bodies. By replacing existing storm drain inlets with new inlet grates and inlet heads, which have a maximum opening size of 2-inches by 4-inches, the amount of debris entering the stream can be reduced, improving water quality. The Township Engineer reserves the right to utilize hydraulic performance and/or historic exemptions.

Recommendation L: Encourage regular street sweeping for public and private roads and parking lots.

Salt and sand are applied to roadways and paved areas in the winter months. This salt and sand is then washed into the storm drain conveyance system and then is transported to the receiving water body. This material silts and pollutes the Township streams. Frequent sweeping of streets and parking lots, particularly after winter storms, can minimize the impacts on water bodies.

Recommendation M: To reduce erosion and sedimentation in streams; encourage residents and property owners to minimize the amount of regrading.

During construction large amounts of disturbance can cause soil erosion. This can result in accumulation and/or sedimentation in streams and elevated amounts of Total Suspended Solids which can impact the existing vegetation and wildlife.

Recommendation N: Seek to limit erosion of acid producing soils, which can occur along stream corridors.

As reported in the Technical Manual for Stream Encroachment (NJDEP, revised 1988), iron sulfide minerals (pyrite or marcasite) exposed to oxygen from air or surface waters will oxidize and produce sulfuric acid. Geologic deposits which contain such minerals are called "acid producing deposits". The sulfuric acid increases the solubility of metals, which could reach concentrations that endanger aquatic flora and fauna or impact the potable water supply. The following geologic formations in Pennsauken Township have the potential to contain substantial acid-producing deposits:

- Magothy Formation
- Merchantville Formation
- Woodbury Clay formation
- Englishtown Sand formation

The Township should ensure that the New Jersey Standards for Soil Erosion and Sediment Control are followed for projects proposing to disturb deposits within these geologic formations.

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[i] Major Development – means any 'development' that provides for ultimately disturbing one or more acres of land. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of 'major development' but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development".

[i] Eutrophication – The normally slow aging process by which a lake evolves into a bog or marsh and ultimately assumes a completely terrestrial state and disappears. During the later stages of eutrophication the water body is overwhelmed by abundant plant life due to higher levels of nutritive compounds such as nitrogen and phosphorus. Human activities can accelerate the process.

[ii] Definitions provided in the NJDEP – Stormwater Best Management Practices Manual at: http://www.njstormwater.org/tier_A/bmp_manual.htm