for Greenwich

Greenwich Township
Municipal Stormwater Management Plan

prepared for

Greenwich Township
Cumberland County, New Jersey

November 2006

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Section 1. Introduction

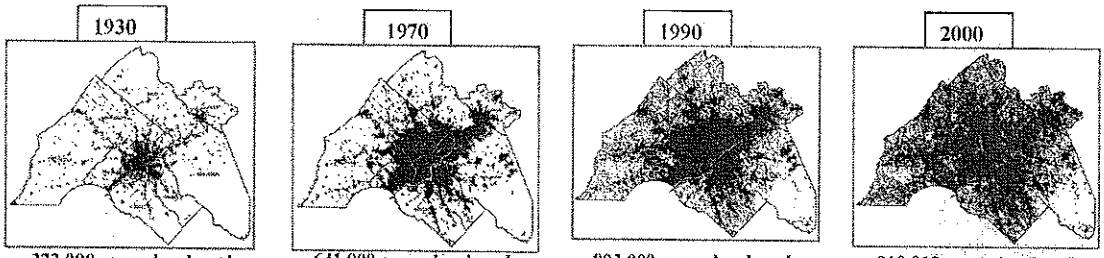
The New Jersey Department of Environmental Protection (NJDEP) initiated the Phase II Stormwater Management Permit Program when they adopted new stormwater management rules on January 5, 2004 that placed municipal storm sewer systems under the jurisdiction of the NJPDES permit program. The rules were published in the New Jersey Register on February 4, 2004, which is the rule's effective date.

All Cumberland County municipalities were required to submit a request for authorization (RFA) and an application for grant funds in March 2004. The NJDEP issued Phase II Stormwater General Permit Authorizations to municipalities in the spring of 2004. The permit becomes effective on the date when the municipality received its authorization, and virtually all of the deadlines for compliance are based on time from this Effective Date of Permit Authorization (EDPA).

Based on the 2000 census, 3 of the 14 municipalities in Cumberland County were designated as Tier A (urbanized) municipalities (Bridgeton, Millville and Vineland) and must comply with all Phase II Stormwater Management Program requirements. All of the other municipalities were designated Tier B (rural) municipalities, and their requirements are substantially reduced. The Tier B stormwater general permit authorization includes only two SBRs and does not require preparation of a Stormwater Pollution Prevention Plan.

A map of Greenwich Township (USGS quadrangle) is shown on Figure 1.

The NJDEP's new Stormwater Management Rules in N.J.A.C. 7:8 have been developed to address the adverse impacts that unmanaged land development can have on groundwater recharge and stormwater runoff quality and quantity. Figure 2 shows the expansion of development within the Delaware Valley during the 70 year period from 1930 through 2000. Along with this development has come a corresponding increase in stormwater runoff, and increased impacts associated with non-point source pollution.



Source: DVRPC

Figure 2. Delaware Valley Development Patterns (1930 – 2000)

Greenwich Township Municipal Stormwater Management Plan

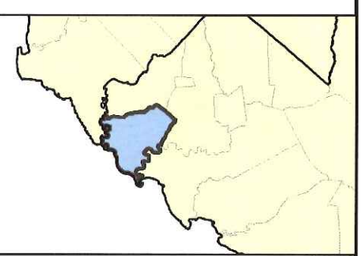
Cumberland County, NJ

Greenwich Township

Figure - 1

Legend

- Municipal Boundary
- County Boundary



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The Greenwich Township MSWMP was prepared for the Township by Churchill Consulting Engineers. The Sample Municipal Stormwater Management Plan included in Appendix C of the New Jersey Stormwater Best Management Practices Manual, dated February 2004, was utilized as a template for preparation of the plan.

The MSWMP provides strategies for Greenwich Township to follow in addressing stormwater management. The plan is required by N.J.A.C. 7:14A-25, the Municipal Stormwater Regulations, and contains the elements required by N.J.A.C. 7:8, the Stormwater Management Rules.

The MSWMP addresses groundwater recharge and stormwater quantity and quality, by incorporating the stormwater design and performance standards for new major development (defined as projects that disturb one or more acres of land or increase the amount of impervious surface by one-quarter acre or more). These standards are intended to minimize the adverse impact of stormwater runoff on water quality, and to address water quantity and the loss of groundwater recharge that provides base flow in receiving water bodies.

The MSWMP also includes:

- Long-term operation and maintenance measures for stormwater facilities associated with new major development projects.

- A "build-out" analysis that is based upon existing zoning and the land available for development.

- Changes that should be made to existing ordinances, the Master Plan, and other municipal land use planning documents, in order to allow various low impact development techniques (see also Appendix B Municipal Regulation Checklist).

- Mitigation strategies for variances or exemptions from the design and performance standards, including the implementation of specific mitigation projects to offset the effects of such variances or exemptions.

Section 2. Goals

The Greenwich Township MSWMP goals are:

1. The reduction of flood damage, including damage to life and property.

2. The minimization, to the extent practical, of increases in stormwater runoff from new development.

3. The reduction of soil erosion from construction activities.

4. The insurance of adequate stormwater facilities, including culverts, bridges, and other in-stream structures.

5. The maintenance of groundwater recharge.

6. The prevention, to the extent feasible, of non-point stormwater pollution.

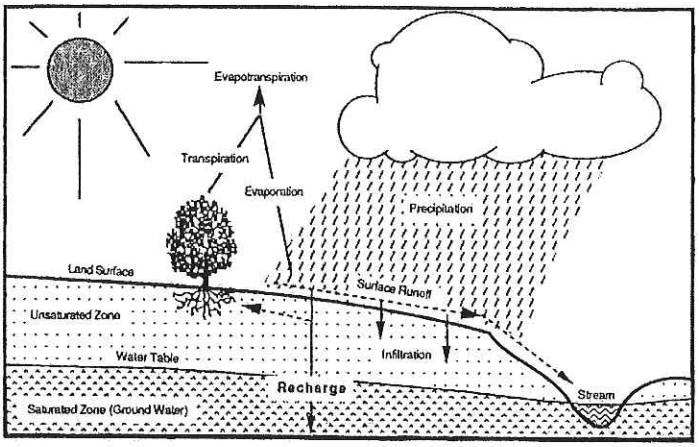
7. The maintenance of surface waters to ensure their biological and stormwater management functions, including the restoration, enhancement, and maintenance of their chemical, physical, and biological integrity, in order to protect public health and safeguard aquatic life; the preservation of their scenic and ecological values; and the enhancement of their domestic, municipal, recreational, industrial, and other uses.

8. The protection of public health and welfare, through the planning, engineering, operation and maintenance of stormwater systems.

The MSWMP outlines specific stormwater standards for new development and proposes stormwater management controls that address impacts from existing development. Preventative and corrective maintenance strategies are included to ensure the long-term effectiveness of stormwater management facilities. The MSWMP provides recommendations for stormwater systems to protect the public health and welfare.

Section 3. Stormwater and Development

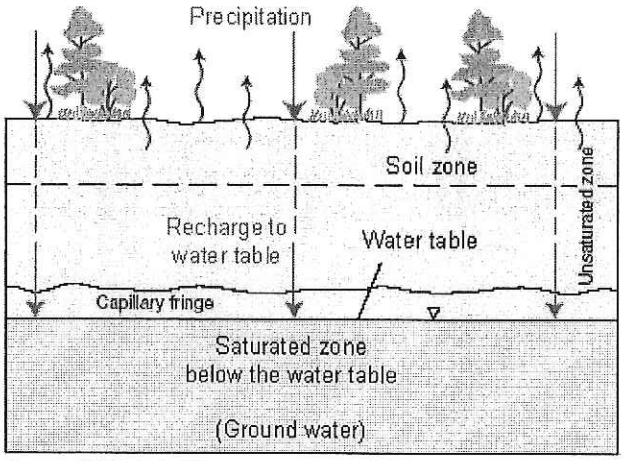
Water moves continuously through the hydrologic or water cycle (see Figure 3). Water evaporates from water bodies and the earth's surface and transpires from vegetation into the atmosphere (these components of the water cycle are jointly referred to as



Source: New Jersey Geological Survey Report GSR-32.

Figure 3. Groundwater Recharge in the Hydrologic Cycle

evapotranspiration). Water vapor in the atmosphere condenses to form clouds which produce precipitation that falls to the earth's surface. A small percentage of this precipitation falls over the land and runs off into streams and lakes flowing to the oceans.



Source: US Geological Survey

Figure 4. Subsurface Water

However, most of the precipitation that falls on land surfaces infiltrates into the ground (see Figure 4), where it either recharges shallow groundwater table aquifers and discharges to streams and springs, sustaining their base flow, or seeps into deeper

confined aquifers, where it is stored for long periods and discharges regionally (see Figure 5). Human activities and development of the land can interfere with the natural water cycle, and in doing so, impact a watershed in many ways.

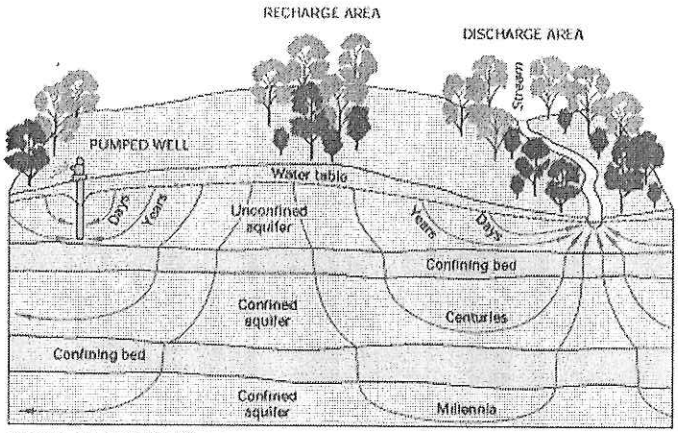


Figure 5. Groundwater Flow Paths

Development can remove beneficial vegetation; replacing it with lawns or impervious cover, thus reducing evapotranspiration and infiltration. Clearing and grading removes depressions that store rainfall and encourage infiltration. Construction activities can also compact the soil and diminish infiltration, resulting in increased volumes and rates of stormwater runoff.

Conversely, increased impervious areas that are connected to each other through gutters, channels, and storm sewers transport runoff more quickly than natural areas. Shortening runoff travel time increases the rainfall-runoff response in the watershed, causing flow in downstream waterways to reach peak rates faster and water levels to increase above natural conditions. These conditions aggravate downstream flooding and erosion and increase the quantity of sediment in stream flow and deposited in stream channels. Impervious areas and storm sewers reduce the potential for surface vegetation to filter and remove pollutants from runoff.

Increased impervious area from land development can also decrease infiltration, and in turn, reduce stream base flow and groundwater recharge. Reductions in stream base flow can dry up habitat in stream channels and adjacent wetlands, and in so doing, adversely impact the health of important biological communities that reside in or depend upon these stream channels and wetlands. Increased impervious area can also increase peak stream flow, channel erosion, and sedimentation and thus can destroy aquatic habitat.

Land development can result in the addition and accumulation of pollutants on the land surface. Runoff and infiltration can mobilize and transport these pollutants to groundwater and streams. Surfaces and cleared areas within a development can receive a variety of pollutants from the atmosphere and from runoff over land surfaces that mobilizes fertilizers, animal wastes, and leakage and corrosion from vehicles. The

pollutants may include suspended and dissolved solids containing metals, nutrients and other inorganic compounds; hydrocarbons, pesticides, herbicides and other organic compounds; and pathogens--all of which can become mobilized by precipitation falling on the land.

Land development can also adversely affect water quality and stream biota in subtle ways. Runoff stored in detention or retention basins can become heated, raising the temperature of the downstream waterway and adversely affecting cold water aquatic species, such as trout, and by providing conditions that support unwanted aquatic species. Additionally, development may remove trees along streams or cause stream bank instability that undermines nearby trees. These trees are valuable because they provide shade that maintains cooler water temperatures and increased dissolved oxygen levels during critical summer periods. Trees also help stabilize stream banks, preventing bank erosion, and their leaf litter provides habitat and food for aquatic communities.

Section 4. Background

Greenwich Township is located in southwestern Cumberland County along the Delaware Bay at the border with Salem County (see Figure 1). The Township's characteristics, as they relate to the stormwater management planning goals described in Section 2, are discussed in this background section of this MSWMP.

Greenwich Township is fully within New Jersey's Coastal Area Facilities Review Act (CAFRA) zone. The act regulates development in coastal areas of the state and establishes guidelines for development allowed in this coastal zone. CAFRA includes a permit review procedure to determine project suitability.

Zoning and Existing Land Use

In terms of both total area and land area (see Table 1), Greenwich Township is one of the smaller municipalities in Cumberland County (5th smallest of the 14 municipalities). Greenwich Township is a rural community of less than 1,000 people.

Table 1. Greenwich Township Area

	Area (sq. mi.)
Total	18.88
Land	18.16
Water	0.72

The existing zoning for the Township is shown on Figure 6, and the existing land use is shown on Figure 7.

Figure 8 (see Appendix A) provides an aerial photograph (2002) of Greenwich Township and depicts general land use and other planimetric relationships within the Township. It is a "birds-eye" view of the Township and allows a quick assessment of conditions at that time.

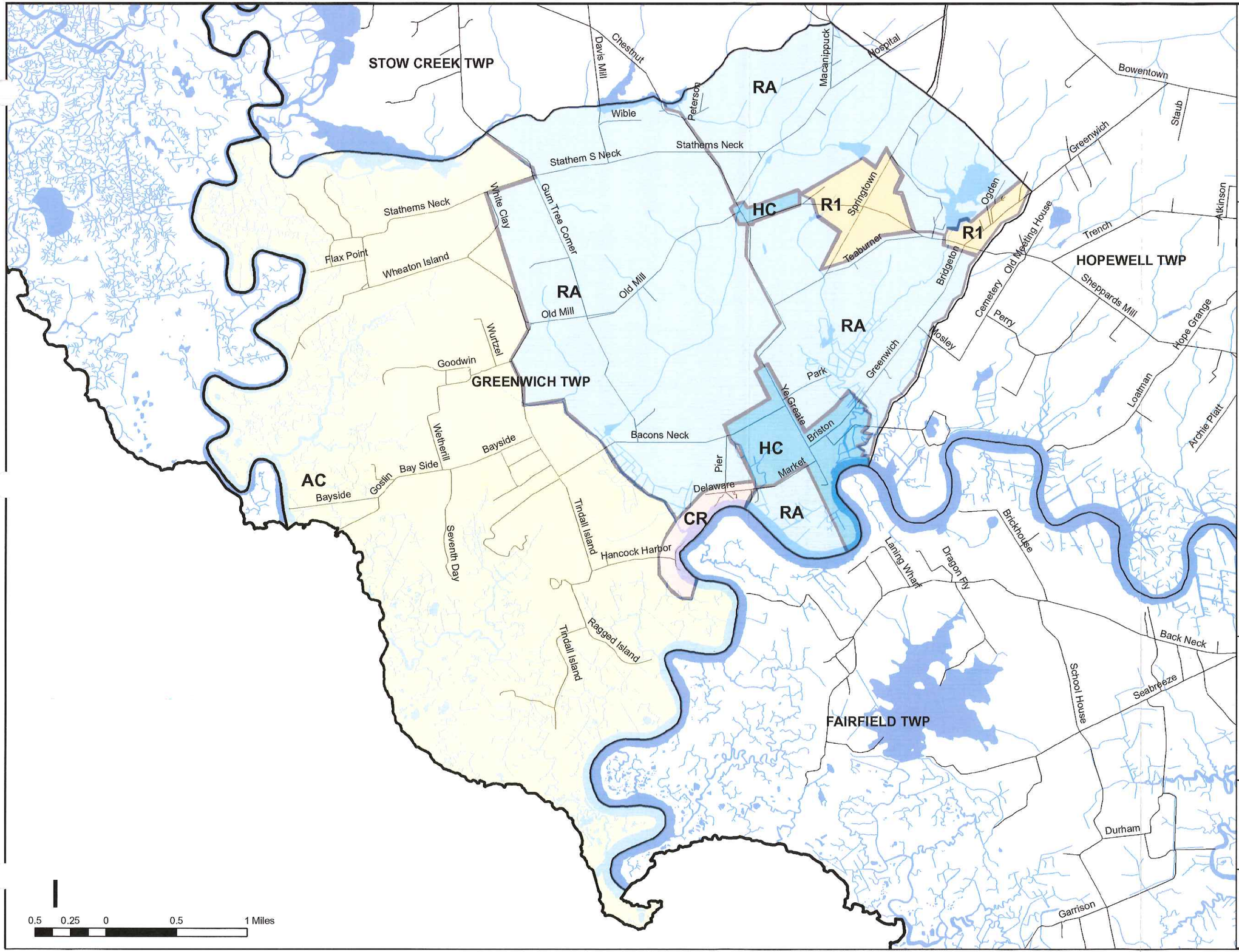
The rate of development in Greenwich Township is very low, and the projected build-out development in the Township is many decades, if not centuries, away, especially given its geographic location, its size, and the amount of undeveloped land in the Township.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

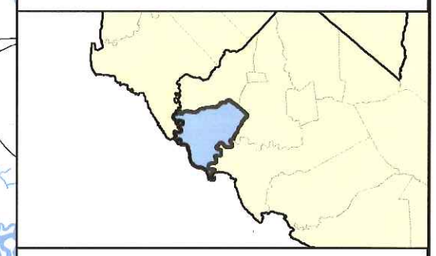
Zoning

Figure - 6



Legend

- County Boundary
- Municipal Boundary
- Lake
- Road
- Stream
- AC
- CR
- HC
- R1
- RA



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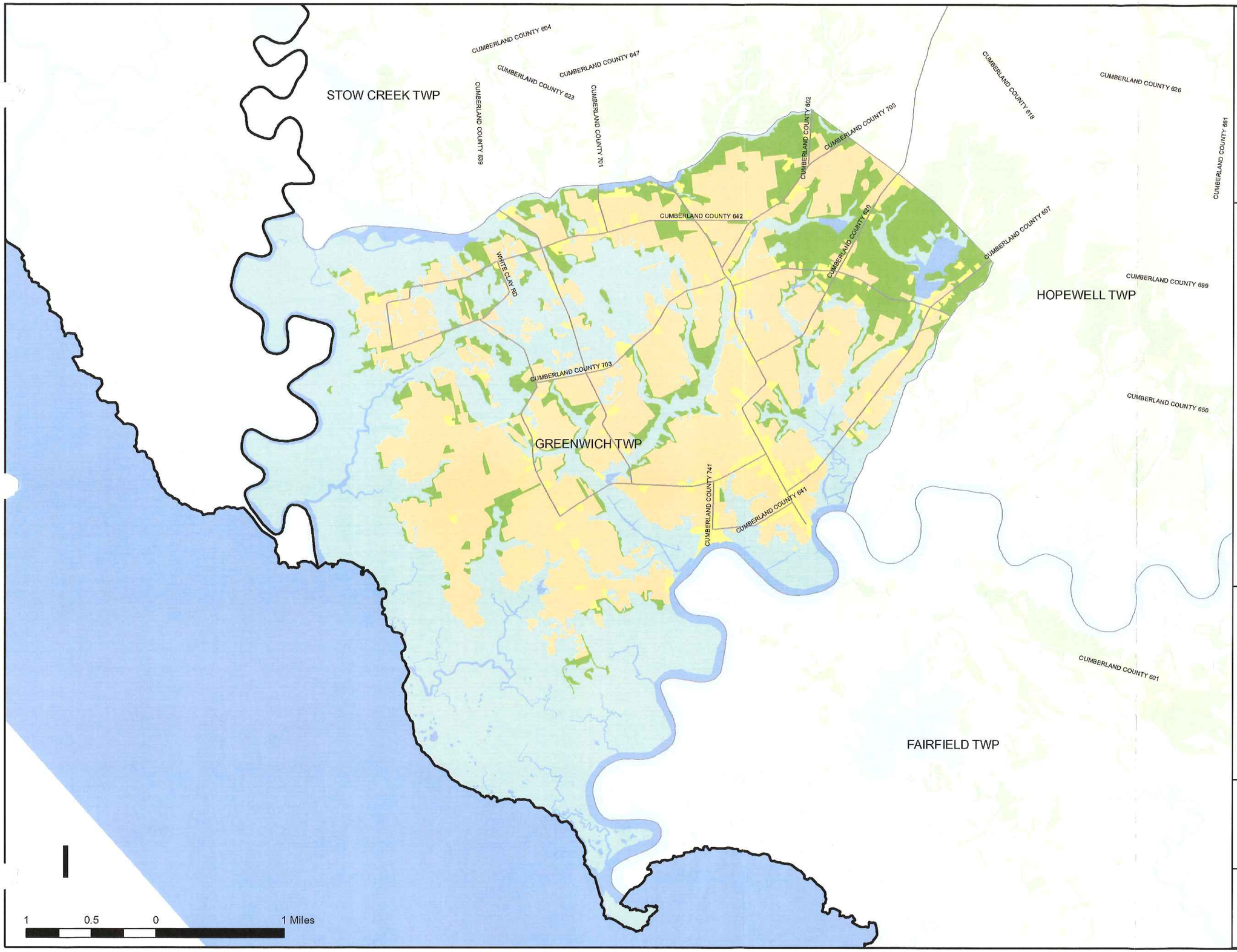
Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

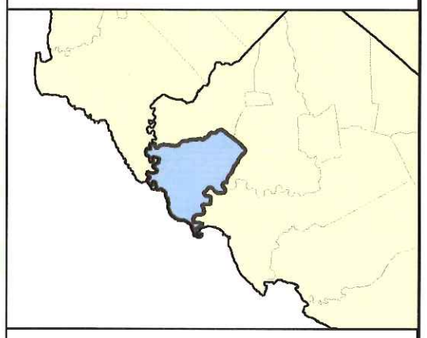
Land Use

Figure - 7



Legend

- County Boundary
- Municipal Boundary
- Roads
- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS



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Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

AERIAL LAND USE (2002)

Figure - 8

STOW CREEK TWP

GREENWICH TWP

HOPEWELL TWP

FAIRFIELD TWP

Legend

- County Boundary
- Municipal Boundary
- Lake
- Stream

0.5 0.25 0 0.5 1 Miles

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Population and Housing

The population of Greenwich Township (see Table 2) is the 2nd smallest total population in Cumberland County. Table 2 also provides a breakdown of the urban population and rural population. Greenwich Township is one of 13 municipalities in the County with housing units classified as rural.

Table 2. Greenwich Township Population and Housing (Year 2000)

	Population	Housing Units
Total	847	330
Urban	0	0
Rural	847	330

Source: U.S. Census Bureau

Greenwich Township is 2nd lowest of 14 municipalities in Cumberland County in terms of population density.

Table 3. Greenwich Township Population Density (1980 – 2004)

	Population	Population Density (persons/sq. mi.)
1980	973	53.6
1990	911	50.2
2000	847	46.6
2004	872	48.0

Source: U.S. Census Bureau and N.J. Department of Labor

Greenwich Township has a stable population. According to the US Census, between 1990 and 2000, Greenwich Township experienced a -7.6 percent growth (see Table 4). However, according to the New Jersey Department of Labor, the population increased by 25 people or 2.95 percent between 2000 and 2004.

Table 4. Greenwich Township Population Growth (1980 – 2004)

	Population	Population Change	Percent Growth
1980	973		
1990	911	-62	-6.4
2000	847	-64	-7.6
2004	872	25	3.0

Source: U.S. Census Bureau and N.J. Department of Labor

Topography and Hydrology

Figure 1 provides the USGS Quadrangle (topographic map) for the Township. Relief (elevation difference) within the Township is about 100 feet, with land surface elevations ranging from a low of about El. 10 to a high of about El. 110 feet above mean sea level. The lowest elevations (below El. 10) occur along the extensive waterways and wetlands adjoining Delaware Bay along the southwestern portions of the Township. Habitable land surface including Bayside, Bacons Neck and Greenwich (El. 10 to 15) adjoin these wetlands. The highest elevations in the Township occur in the northeastern portion, above Othello, Springtown and Sheppards Mill where elevations reach El. 100 to El. 110 on some hills.

The land surface elevations and relief in this Township have been sculpted by surface runoff and erosion of the unconsolidated coastal plain sediments at the land surface. Relief in the majority of the Township (the southwestern portion) is generally flat within the Delaware floodplain. But, in the northeastern corner of the Township, there are hilly land areas.

The surface drainage has eroded the land surface into dendritic drainage patterns that exhibit little structural control, because of the relatively uniform resistance to erosion by the underlying sediments. In the southwestern portion of the Township, the close proximity of the Delaware Bay base level, with its extensive flood plain and tidal effects, greatly influences drainage.

Generally, the smaller streams entering the Township consist of short straight sections connected by bends and kinks; stream channels are not heavily incised. Stow Creek and the Cohansey River meander extensively through the Bay's wetlands before reaching open water. All streams drain to the Bay, from northeast to southwest, and culminate in an extensive network of wetlands. The stream channels in the Township are near their ultimate base level and are generally graded; that is stream base level, gradient, channel section, sediment load and flow are in relative equilibrium.

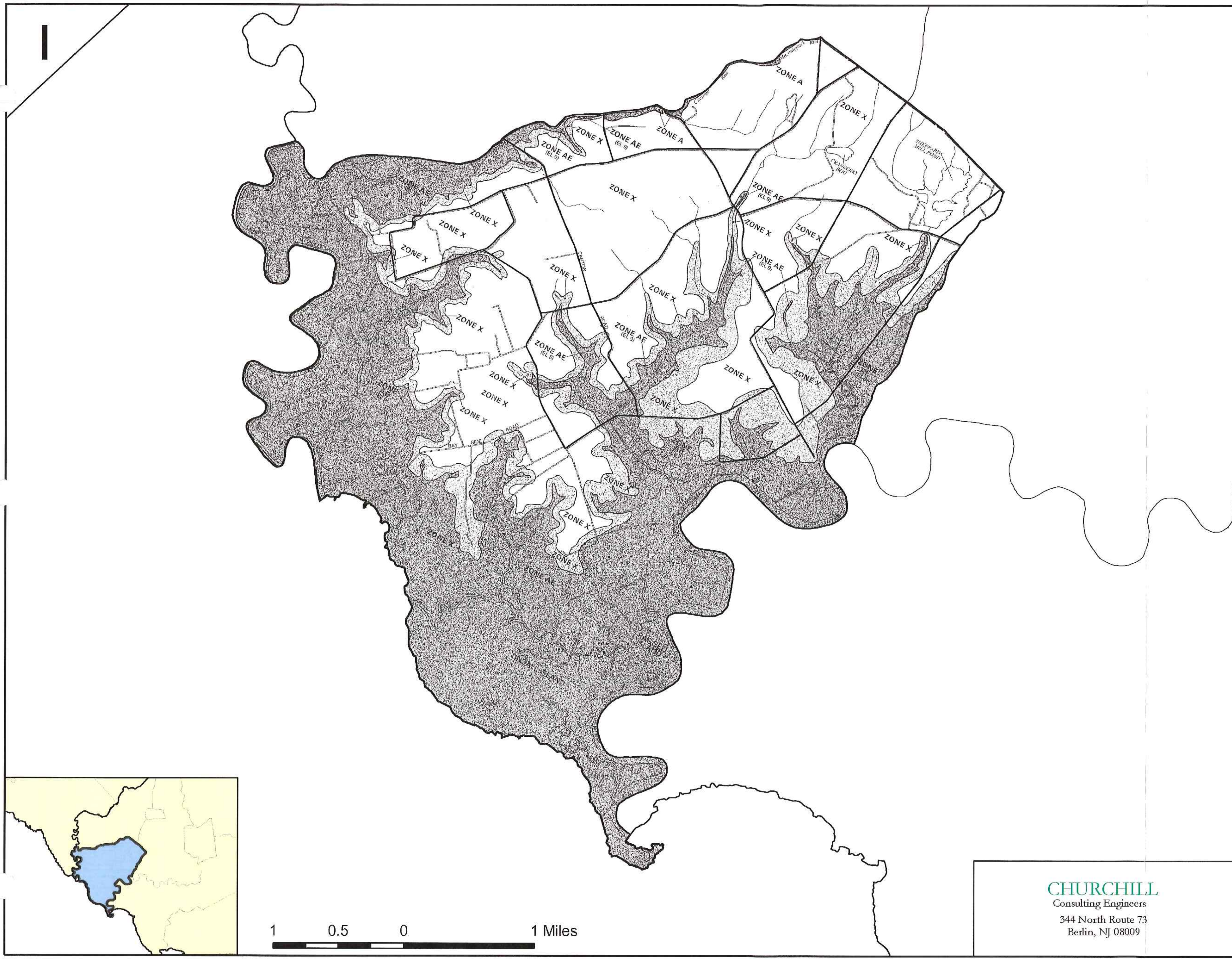
Figure 9 provides the current Federal Emergency Management Agency (FEMA) flood map for Greenwich Township, including 100 year and 500 year flood boundaries.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Flood Map

Figure - 9



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LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

	Floodplain Boundary
	Floodway Boundary
	Zone D Boundary
	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
513	Base Flood Elevation Line; Elevation in Feet*
D —— D	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7x	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for possible updated flood hazard information prior to use of this map for property purchase or construction purposes.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of special flood hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Surface Water

(a) Watersheds and Hydrologic Unit Codes (HUCs)

The NJDEP requires that municipalities evaluate the impacts of their small municipal separate storm sewer systems (small MS4s) on surface waters at the HUC14 sub-watershed level. Watershed and sub-watershed divisions were developed by the United States Geological Survey (USGS) using a coding system called Hydrological Unit Codes, or HUCs.

There are two HUC11 watersheds within Greenwich Township and these are listed in Table 6.

Table 5. Greenwich Township HUC11 Watersheds

HUC 11 Watershed	No.
Stow Creek	02040206070
Cohansey River	02040206090
Delaware Bay[1]	02040204910

[1] The Delaware Bay watershed is immediately adjoining, but not within, Greenwich Township.

Figure 10 shows the HUC11 watersheds and HUC14 subwatersheds located partially or entirely within or adjoining the municipal boundaries of Greenwich Township. The names of six HUC14 subwatersheds within the Township are shown in Table 6.

Table 6. Greenwich Township HUC14 Subwatersheds

Subwatersheds	HUC14 Sub-Watersheds	
	No.	Name
Stow Creek	02040206070090	Phillips Creek/Jacobs Creek
Stow Creek	02040206070080	Stow Creek (below Canton Rd.)
Stow Creek	02040206070070	Raccoon Ditch (Stow Creek)
Cohansey River	02040206090100	Cohansey River (below Greenwich)
Cohansey River	02040206090090	Pine Mount Creek
Cohansey River	02040206090080	Cohansey River (Greenwich to 75d 17m 50s)
Delaware Bay [1]	02040204910040	Delaware Bay (Cohansey R. to Fishing Ck.)

[1] The Delaware Bay subwatershed is immediately adjoining, but not within, Greenwich Township.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Watersheds

Figure - 10

02040206070070

02040206070080

02040206090090

02040206090080

02040206070090

02040206090100

SALEM CO

CUMBERLAND CO

Dunks Pt

Cohansey Pt

Cohansey Cove

GREENWICH

Greenwich

Othello

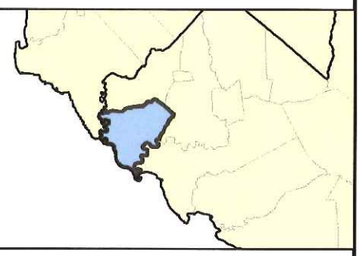
Springs

Neck

1 0.5 0 1 Miles

Legend

- Municipal Boundary
- Streams
- Lakes
- HUC 11
- HUC 14
- 02040206070090
- 02040206070080
- 02040206070070
- 02040206090090
- 02040206090100
- 02040206090080



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(b) New Jersey Surface Water Quality Standards

The Federal Clean Water Act requires that states maintain surface water quality in high quality waters and restore water quality in impaired waters. Surface Water Quality Standards (SWQS) have been developed by the NJDEP for all New Jersey surface waters and by the Delaware River Basin Commission (DRBC) for the Delaware River to accomplish this goal. These standards establish "designated uses" to be achieved for surface water bodies and then specify the water quality criteria necessary to achieve these uses.

Designated uses established by the NJDEP for New Jersey water bodies include potable water supply (drinking water use), propagation of fish and wildlife (aquatic life use), recreation in and on the water (primary and secondary contact), agricultural and industrial supplies, and navigation. The NJDEP has established stream classifications and antidegradation designations for all of the state's surface water bodies. New Jersey's Water Quality and Monitoring Standards homepage can be found at the following link:

http://www.state.nj.us/dep/wmm/

The Surface Water Quality Standards and criteria can be found in N.J.A.C. 7:9B at these web links:

http://www.state.nj.us/dep/wmm/sgwqt/swqsdocs.html; and
http://www.state.nj.us/dep/wmm/sgwqt/sgwqt.html.

In addition, because the Delaware River is an interstate water body, the Delaware River Basin Commission (DRBC) has established interstate zones, designated uses for each zone, and water quality standards to achieve the designated uses along the entire length of the river. Greenwich Township adjoins Zone 6. The DRBC's 2004 Delaware River and Bay Integrated List Water Quality Assessment Report contains the water quality standards for each zone (see Section 2.2), and the results of their 2004 Delaware River and Bay Water Quality Assessment. The Delaware River and Bay surface water quality Classifications and criteria can be found at the following web link:

http://www.state.nj.us/drbc/regs/WQRegs09262005.pdf

The Surface Water Quality Criteria for all classified waterways in the State depend on their designated uses and reflected Surface Water Classification. The Surface Water Quality Criteria are detailed in N.J.A.C. 7:9B-1.14 and in the Delaware River Basin Commission's "Administrative Manual, Part III, Water Quality Regulations," and are too voluminous to include in this report. (See web links above.)

(a) Surface Water Classifications

The surface waters in Greenwich Township are classified FW2-NT/SE1.

The designated uses for surface water classification FW2-NT/SE1 as described by the N.J.A.C. 7:9B-1.12 (a) and (d) are:

(a) In all FW1 waters the designated uses are:

1. Set aside for posterity to represent the natural aquatic environment and its associated biota;
2. Primary and secondary contact recreation;
3. Maintenance, migration and propagation of the natural and established biota; and
4. Any other reasonable uses.

(d) In all SE1 waters designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;
2. Maintenance, migration and propagation of the natural and established biota;
3. Primary and secondary contact recreation; and
4. Any other reasonable uses.

(b) Surface Water Quality Data

Ambient Biomonitoring Network - The NJDEP has established an Ambient Biomonitoring Network (AMNET) to document the health of the state's waterways. There are over 800 AMNET sampling sites throughout the state of New Jersey. These sites are sampled for benthic macroinvertebrates by the NJDEP on a five-year cycle. Streams are classified as non-impaired, moderately impaired, or severely impaired, based on the AMNET data. The data is used to generate a New Jersey Impairment Score (NJIS), which is based on a number of biometrics that are related to benthic macroinvertebrates community dynamics. The AMNET sites within the Township are shown in Figure 11.

Conventional Water Quality Data – The NJDEP utilizes conventional surface water quality data from a number of sources to bi-annually evaluate the impairment of surface water bodies. These water quality data include the federal Storage and Retrieval repository (STORET) data and other Existing Sources. The STORET and Existing Sources sampling locations within the Township are shown in Figure 11.

(c) Impaired Waters

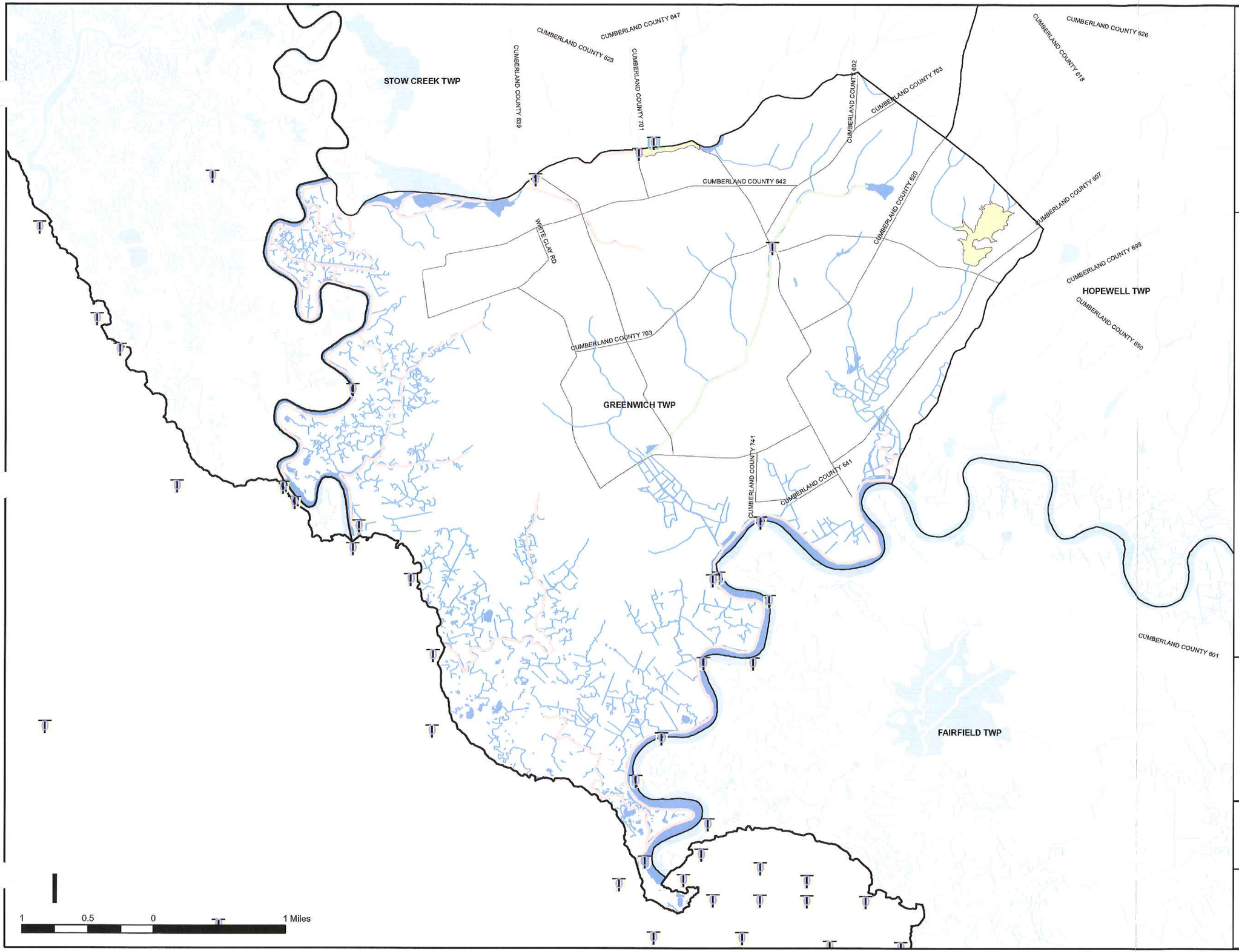
States are required to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet surface water quality standards (SWQS). This report is commonly referred to as the 303(d) list. In accordance with Section 305(b) of the CWA, the States are also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. Those water bodies, which are listed on the 303(d) list, are referred to as "water quality limited" water

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Water Quality

Figure - 11



Legend

- Ambient Monitoring Network Site
- Storet Quality Station
- County Boundary
- Municipal Boundary
- Road
- Stream

Inegrated Report Results for Rivers

- Fish Advisory Only
- Full Attain
- Insufficient
- List 4
- Non Attain
- Lake

Integrated Report Results for Lakes

- Fish Advisory Only
- Full Attain
- Insufficient
- List 4
- Non Attain

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bodies, and a total maximum daily load (TMDL) must be developed for each individual pollutant in these impaired water bodies.

In November 2001, the USEPA issued guidance that encouraged states to integrate 305(b) Report and the 303(d) List into one report. The New Jersey Department of Environmental Protection (NJDEP) chose to develop an Integrated Report for New Jersey starting in 2002. The 2006 Integrated List of Waterbodies combines these two assessments and assigns water bodies and their HUC14s to one of five sublists. Sublists 1 through 4 include water bodies that are generally unimpaired. Sublist 5 of the 2006 Report supersedes Sublist 5 of the 2004 Integrated List and the new sublist presents all water quality limited waters and includes waters for which TMDL development is occurring or will occur within two years. The Sublists of water bodies in New Jersey are categorized as follows.

Sublist 1 - water bodies that are attaining the water quality standards and no use is threatened.

Sublist 2 - water bodies that are attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened.

Sublist 3 - water bodies where there is insufficient or no data and information to determine if any designated use is attained.

Sublist 4 - water bodies that are impaired or threatened for one or more designated uses but do not require the development of a TMDL [for the reasons described in Sublists 4A, 4B and 4C below].

Sublist 4A. - TMDL has been completed.

Sublist 4B - other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.

Sublist 4C - impairment is not caused by a pollutant.

Sublist 5 - the water quality standard is not attained. The waterway is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL.

The link to the most recent 2006 NJDEP Integrated Water Quality and Assessment Report is:

http://www.state.nj.us/dep/wmm/sgwqt/wat/integratedlist/integratedlist.html

For the purpose of evaluating surface water quality in the Township, the NJDEP Integrated List (Sublists 1-5) were abridged and sorted to provide the locations of impaired waters and these are listed in Table 7. Figure 11 also shows the locations of impaired waters. All six of the HUC14 subwatersheds and two lakes in Greenwich

Township are considered impaired for their designated uses, because they do not meet their respective water quality standards for one or more pollutant parameters. The impaired parameters include: dissolved oxygen, PCBs, dioxins and fecal coliform.

Table 7. Greenwich Township Impaired Waters List

HUC14s/Lakes	Locations	Designated Uses									Non Attain. Param.
		Aquatic Life	Drinking Water	Prim. Contact Rec.	Sec. Contact Rec.	Ag. Water Supply	Ind. Water Supply	Shellfish Harv.	Lake Aesth.	Fish Cons.	
02040206070070	Raccoon Ditch (Stow Creek)	Sublist 5	Sublist 2	Sublist 3	Sublist 3	Sublist 2	Sublist 2	Sublist 2	N/A		Dissolved Oxygen, PCB, Dioxin
02040206070080	Stow Creek (below Canton Road)	Sublist 2	N/A	Sublist 3	Sublist 3	N/A	N/A	Sublist 2	N/A		PCB, Dioxin
02040206070090	Philips Creek/ Jacobs Creek	Sublist 2	N/A	Sublist 3	Sublist 3	N/A	N/A	Sublist 2	N/A		PCB, Dioxin
02040206090080	Cohansey River (Greenwich 75d17m50s)	Sublist 2	N/A	Sublist 3	Sublist 3	N/A	N/A	Sublist 2	N/A		PCB, Dioxin
02040206090090	Pine Mount Creek	Sublist 3	N/A	Sublist 3	Sublist 3	N/A	N/A	Sublist 2	N/A		PCB, Dioxin
02040206090100	Cohansey River (below Greenwich)	Sublist 2	N/A	Sublist 3	Sublist 3	N/A	N/A	Sublist 4	N/A		Fecal Coliform, PCB, Dioxin
Davis Millpond	Raccoon Ditch	Sublist 2	N/A	Sublist 3	N/A	N/A	N/A	N/A	Sublist 3	Sublist 3	
Sheppards Millpond	Mill Creek	Sublist 3	N/A	Sublist 2	N/A	N/A	N/A	N/A	Sublist 3	Sublist 3	

(d) Total Maximum Daily Loads (TMDLs)

TMDLs are required, under Section 303(d) of the federal Clean Water Act, for water bodies that cannot meet surface water quality standards after the implementation of "technology-based" effluent limitations. TMDLs may also be established to help maintain or improve water quality in waters that are not impaired. Based on the 2002 and 2004 integrated list, the NJDEP entered into a Memorandum of Agreement with USEPA that sets out a schedule for completion of TMDLs.

A TMDL allocates the load capacity to point sources in the form of waste load allocations (WLAs) and to non-point sources in the form of load allocations (LAs), and may also identify reserve capacity and a margin of safety. WLAs result in Water Quality Based Effluent Limits for point source Wastewater Treatment Plants and requirements based on Best Management Practices (BMPs) for regulated stormwater point sources, such as Combined Sewer Overflows (CSOs). Because non-point source pollution does not come from discrete sources, LAs generally identify broad categories of non-point sources that contribute to the parameters of concern. The LA then includes specific load reduction measures, through Best Management Practices (BMPs), that may include local ordinances for stormwater management and non-point source pollution control, headwaters protection practices, or other mechanisms for addressing the parameters of concern.

A separate TMDL calculation must be prepared for each pollutant listed for each impaired stream segment or lake. A TMDL is considered "proposed" when the NJDEP publishes the TMDL Report as a proposed Water Quality Management Plan Amendment in the New Jersey Register (NJR) for public review and comment. A TMDL is considered "established" when the NJDEP finalizes the TMDL Report and formally submits it to EPA Region 2 for a thirty (30)-day review and approval. The TMDL is considered "approved" when the NJDEP-established TMDL is approved by EPA Region 2. The TMDL is considered "adopted" when the EPA-approved TMDL is adopted by the NJDEP as a water quality management plan amendment and the adoption notice is published in the NJR. The link to New Jersey's TMDLs and their status is:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro

In the process of establishing a TMDL, an implementation plan is developed to identify how the various sources will be reduced to their designated allocations. Implementation strategies for non-point sources may include: improved stormwater management, the adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other Best Management Practices to control stormwater runoff loadings.

The NJDEP has prepared a proposed TMDL for Total Coliform in shellfish-impaired waters of the Lower Delaware, including Greenwich Township and the Cohansey River Estuary. The NJDEP TMDL report proposes 7 TMDLs, which if approved by USEPA

will amend the appropriate water quality management plans. The full text of this report and the TMDL proposals can be found and downloaded at the following link:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro .

This TMDL was proposed by the NJDEP in February 2006 and is based on the 2004 Integrated Report. It is designed to address Total Coliform shellfish-impaired waters in the Lower Delaware Bay and tributaries in the area of Greenwich Township, including the Cohansey River Estuary. Although the TMDLs have been proposed, they have not yet been established, approved or adopted.

(e) Category One Waters

The Stormwater Management Rule establishes an additional requirement (300 foot buffer) for projects that are located along a Category 1 stream and for those projects located upstream of a Category 1 segment or within the subwatershed (HUC 14). The Category 1 stream classifications and antidegradation designations are included in the New Jersey Surface Water Quality Standards. Figure 12 provides the NJDEP GIS coverage for Greenwich Township designed to assist public, DEP staff, property owners, builders and municipal officials in determining whether a property is located in an area of the State now subject to 300 foot buffers, as established by the new stormwater management rule. The HUC14s along the lower ends of both Stow Creek and the Cohansey River appear to be within stormwater rule areas that require a 300 foot buffer.

Ground Water

Cumberland County is located in the Atlantic Coastal Plain Physiographic Province. Beneath Cumberland County are a series of geologic units that form aquifers or aquifer systems and confining units (aquitards). These geologic units consist largely of layers of unconsolidated sediments (clays, silts, sands and gravels) deposited over many millions of years, and extending from the land surface, hundreds or thousands of feet to bedrock. These sand and gravel layers and units, when grouped together, form aquifers or aquifer systems, and the layers and units containing higher amounts of silts and clays, when grouped together, form confining units.

The surface and subsurface geologic units in the County dip gently to the south-east, outcropping in broad, irregular, northeast-southwest trending bands on the land surface. The oldest formations outcrop along and under the Delaware River, and progressively younger units outcrop in sequence, moving southeasterly towards the Atlantic Coast. Of these formations, only the Kirkwood and Cohansey formations outcrop in Cumberland County.

Minimizing the impacts of stormwater runoff on the ground water of Greenwich Township is a primary goal of this MSWMP, as is protecting Greenwich Township's surface waters.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Waterways & Buffers

Figure - 12

STOW CREEK TWP

GREENWICH TWP

HOPEWELL TWP

FAIRFIELD TWP

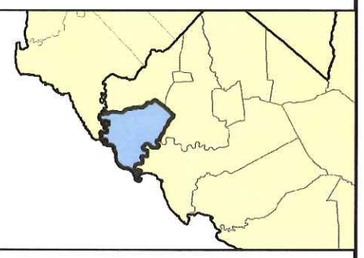
LAWRENCE TWP

CUMBERLAND COUNTY 604
CUMBERLAND COUNTY 647
CUMBERLAND COUNTY 623
CUMBERLAND COUNTY 639
CUMBERLAND COUNTY 701
CUMBERLAND COUNTY 602
CUMBERLAND COUNTY 703
CUMBERLAND COUNTY 626
CUMBERLAND COUNTY 618
CUMBERLAND COUNTY 695
CUMBERLAND COUNTY 642
CUMBERLAND COUNTY 620
CUMBERLAND COUNTY 607
CUMBERLAND COUNTY 699
CUMBERLAND COUNTY 651
WHITE CLAY RD
CUMBERLAND COUNTY 703
CUMBERLAND COUNTY 650
CUMBERLAND COUNTY 741
CUMBERLAND COUNTY 641
CUMBERLAND COUNTY 601

1 0.5 0 1 Miles

Legend

- County Boundary
- Municipal Boundary
- Road
- Stream
- Lake
- Stormwater Rule Buffer Area
- TMDL for Streams
- TMDL for Lakes
- Category One Stream Buffer



Note:
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(a) Stormwater Runoff and Ground Water Recharge

In New Jersey's Atlantic Coastal Plain, precipitation averages about 43.75 inches per year. On average, about 45 percent of the annual precipitation results in runoff (or about 19.75 inches per year); the remaining 55 percent of the precipitation is lost into the atmosphere as evapotranspiration. The infiltration, or groundwater recharge, component of runoff provides the base stream flow in the Atlantic Coastal Plain. At an average runoff rate of 19.75 inches per year and a maximum recharge rate of 15 inches per year, about 75 percent of runoff can recharge the ground water and result in stream base flow. The groundwater recharge rates for surface soils in Greenwich Township are shown on Figure 13.

In Greenwich Township the water table aquifer receiving recharge is the Kirkwood-Cohansey aquifer. In the western areas of the Township, immediately adjacent to Stow Creek, the Delaware Bay and the Cohansey River, the Shiloh Marl member (a marly-clay) of the Kirkwood Sand formation is present on the surface. Groundwater recharge in these marly-clay and primarily wetland areas is not possible.

In the central and northeastern portions of the Township, the Cohansey Sand formation (a medium to coarse grained quartz sand) is present at the surface. The Cohansey formation is a major source of water supply for the region, and residents, farms and other businesses in Greenwich Township may rely on individual private wells in this formation. However, water table aquifers are susceptible to ground water contamination, and protection of the Township's ground water is important.

Because the Cohansey Sand formation in Greenwich Township has the ability to transmit quantities of water downward, store the precipitation from individual storm events, and discharge the stored water as base flow to streams, and because Greenwich residents, farms and businesses may rely on the this surface aquifer, groundwater recharge in the Township is a significant and necessary stormwater management strategy. Streams in the northeastern portion of Greenwich Township may benefit from groundwater recharge for freshwater stream base flow maintenance. Furthermore, maintenance of freshwater in the water table is important to preventing saltwater encroachment form tidal water bodies into the water table aquifer in the Cohansey formation. For these reasons, stormwater management in new major development and redevelopment within the Township should incorporate measures that address and maximize potential groundwater recharge.

(b) Well head Protection Areas (WHPAs)

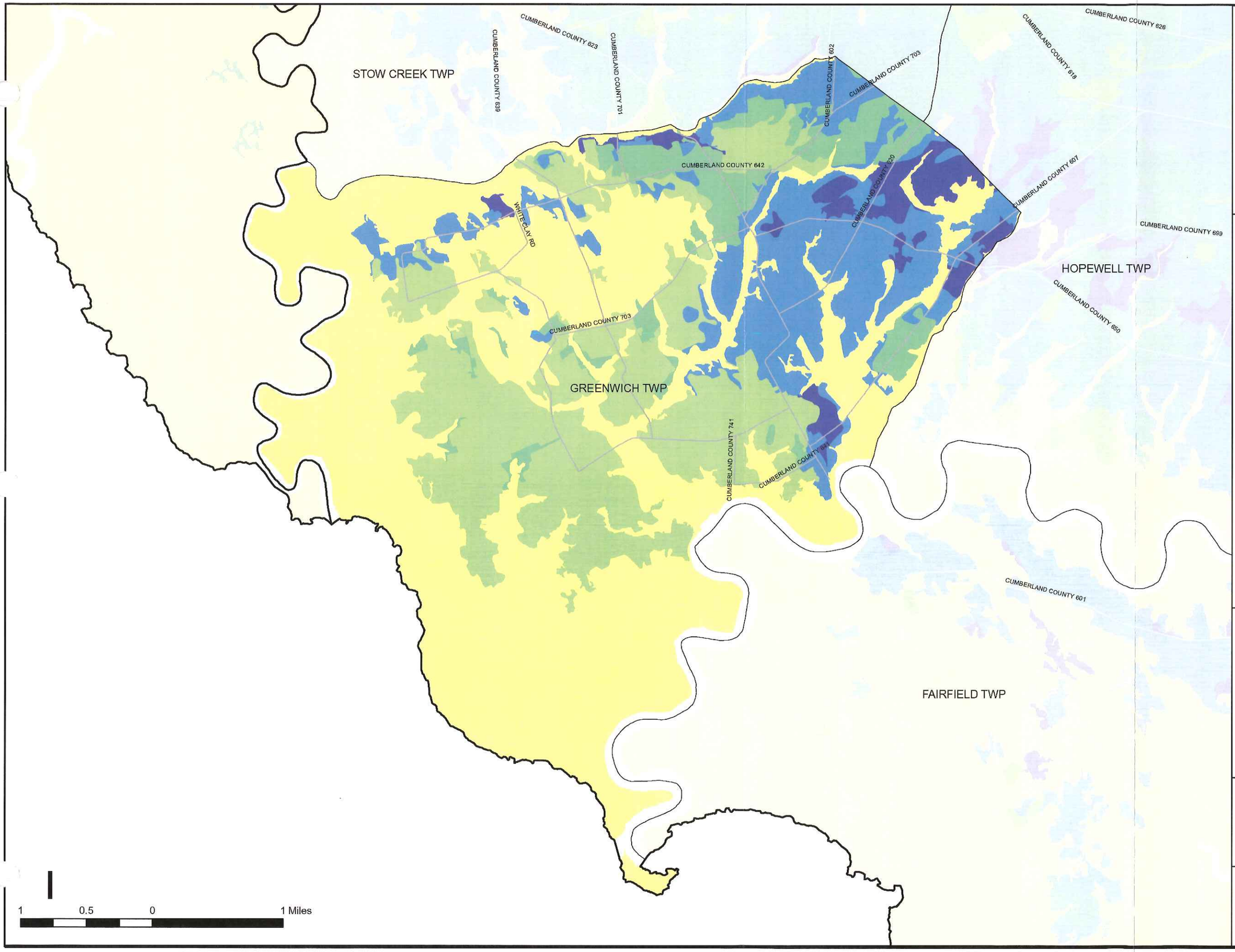
Water supply wells in exposed unconfined aquifers depend on surface recharge to maintain groundwater levels and groundwater quality, thereby directly linking stormwater management and recharge with water supply. Largely because of this linkage, unconfined public community water supply (PCWS) wells and public non-community water supply (PNCWS) wells have designated "wellhead protection areas" (WHPAs). Water supply wells in the confined portions of aquifers, away from the exposed outcrop area, are not directly linked to surface recharge, and have no WHPAs.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Groundwater Recharge Areas

Figure - 13

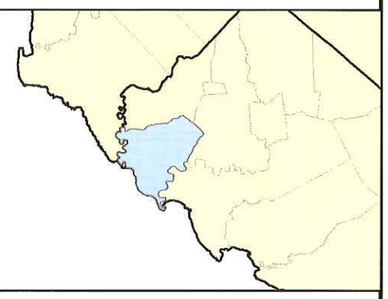


Legend

- County Boundary
- Municipal Boundary
- Road

Recharge (in/yr)

- 0 - 3
- 4 - 7
- 8 - 9
- 10 - 11
- 12 - 14



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WHPAs establish the approximate area within which contamination, released on the surface, will travel to the well head, over the prescribed period of time. WHPAs include three tiers; the inner boundary, Tier 1, includes an area with a 2 year travel time, the middle boundary, Tier 2, includes an area with a 5 year travel time and the outer boundary, Tier 3, and includes an area with a 12 year travel time. WHPAs serve as warning zones, within which high risk activities should be avoided, and further provide a prioritization for clean-up of surface and groundwater contamination that occurs within a WHPA.

Greenwich Township has no WHPAs, because there are no PCWS or PNCWS wells in the Township.

(c) New Jersey Groundwater Quality Standards

The NJDEP's has established Ground Water Quality Standards (GWQSs) for all of the ground waters in the State of New Jersey (N.J.A.C. 7:9-6). Like the SWQSs, the GWQSs establish the designated uses for the State's ground water, and specify the ground water quality criteria for specific constituents, including toxic pollutants, consistent with those designated uses.

The GWQSs establish classification areas according to the geographic extent (both vertical and horizontal) of geologic formations, or units, within which ground water is classified for the designated uses. Designated uses may include any human withdrawal of ground water (for example, for potable, agricultural or industrial water), the discharge of ground water to surface waters of the State which support human use or ecological systems, or the direct support of ecological systems.

The GWQSs include three major classes of ground water:

Class I	Ground Water of Special Ecological Significance
Class II	Ground Water for Potable Water Supply
Class III	Ground Water With Uses Other Than Potable Water Supply

Under the NJDEP GWQSs, the primary designated use for Class I ground waters is the maintenance of special ecological resources supported by the ground water within the classification area; secondary designated uses of Class I waters is use for potable water, agricultural water and industrial water, if these uses are viable using water of natural quality and do not impair the primary use (for example, by altering ground water quality).

Class I ground water is further designated as either Class I-A (Exceptional Ecological Areas) or Class I-PL (Pinelands). Ground water within watersheds of FW-1 surface waters (a Category One surface water classification), and certain "Natural Areas" designated by the NJDEP in the GWQSs, are designated as Class I-A ground waters.

Class III ground waters are ground waters that are not suitable for potable use due to their natural hydrogeologic characteristics, such as aquitards - Class III-A ground water, or due

to their natural water quality that is unsuitable for conversion to potable water, such as saline ground water (Class III-B).

All ground waters in New Jersey not designated as Class I or Class III are designated as Class II ground waters. Class II ground waters are further classified as either Class II-A or Class II-B. The designated uses of Class II-B waters are any reasonable use other than potable use; however, the NJDEP has not designated any ground waters as Class II-B.

Because of the different ground water quality criteria, the necessary stormwater management measures may vary among these areas. However, the three contaminants for which the NJDEP has required a projection of build-out stormwater pollutant loading are nitrogen, phosphorus and total suspended solids (see Section 5). These three pollutants are of particular significance with regard to surface water quality, but are not included in the list of constituent criteria for ground water. It is anticipated that ground water quality issues will not be a significant concern for new major development projects, if the projects comply with the new design and performance standards in N.J.A.C. 7:8.

Critical Habitats

The NJDEP Division of Fish and Wildlife Endangered Nongame Species Program developed a GIS called the *Landscape Project*, which is described as a "pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey." Version 2 of the Landscape project is now available interactively on the web and for download. According to the NJDEP's Metadata "Version 2 was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land Use/Land Cover update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation."

The NJDEP Division of Fish and Wildlife describes the *Landscape Project* and the importance of preserving natural habitat as follows:

> New Jersey is the most densely populated state in the nation. One of the consequences of this distinction is the extreme pressure that is placed on our natural resources. As the population grows, we continue to lose or impact the remaining natural areas of the state. As more and more habitat is lost, people are beginning to appreciate the benefits and necessity of maintaining land in its natural state.
>
> For example, we know that wetlands are critical for recharging aquifers, lessening the damage from flooding and naturally breaking down contaminants in the environment. Forests and grasslands protect the quality of our drinking water, help purify the air we breathe and provide important areas for outdoor recreation. Collectively, these habitats are of

critical importance to the diverse assemblage of wildlife found in New Jersey, including more than 70 species classified as threatened or endangered.

Many imperiled species require large contiguous tracts of habitat for survival. The consequence of the rapid spread of suburban sprawl is the loss and fragmentation of important wildlife habitat and the isolation and degradation of the smaller habitat patches that remain. Small patches of fields, forests and wetlands interspersed with development provide habitat for common species that do well living near humans, but do not provide the necessary habitat for most of our imperiled wildlife. We need to protect large, contiguous blocks of forest, grassland and wetlands to assure the survival of imperiled species over the long-term.

In addition to providing habitat for the conservation of imperiled species, protecting critical wildlife areas will result in more open space for outdoor recreation. Recent surveys by the U.S. Fish and Wildlife Service show that more than 60% of Americans participate in some form of wildlife-related recreation. Open spaces provide places where people can escape the confines of urban and suburban living.

Most critical habitats are supported in part or in total by the surrounding surface and ground water resources, and they are consequently impacted by development, non-point source pollution and stormwater runoff. Critical Habitats mapped by the NJDEP's Landscape Project within Greenwich Township are shown on Figure 14. The Critical Habitats within this watershed may include Grassland, Forest, Forested Wetland, Emerging Wetland, Beach, Bald Eagle Foraging, Urban Peregrine Falcon Nesting, and Wood Turtle habitats that should, to the extent practical, be conserved and protected from the adverse impacts caused by uncontrolled development and stormwater runoff.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

Landscape Figure

Figure - 14

STOW CREEK TWP

GREENWICH TWP

HOPEWELL TWP

FAIRFIELD TWP

LAWRENCE TWP

Legend

- County Boundary
- Municipal Boundary
- Road
- Bald Eagle Foraging

Grassland
RANK
- 1- Suitable Habitat
- 2- Priority Species
- 3- State Threatened
- 4- State Endangered
- 5- Federal Th. and En.

Forested Wetland
RANK
- 1
- 2
- 3
- 4
- 5

Forest
RANK
- 1
- 2
- 3
- 4
- 5

Emergent Wetland
RANK
- 1
- 2
- 3
- 4
- 5

Beach
RANK
- 1
- 3
- 4
- 5

1 0.5 0 1 Miles

Note:
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Section 5. Build-Out Analysis and Pollutant Loading Projections

Build-out analyses and pollutant loading projections have been prepared for Greenwich Township and each HUC14 within the Township, generally in accordance with the NJDEP's methodology described by their guidance and regulations. The build-out analyses and pollutant loading projections are tools to assess the potential impacts from development and stormwater runoff.

The build-out analyses and pollutant loading projections allow municipalities to quantifiably project the impacts from development on surface waters. Using this tool, municipalities are in a better position to develop strategies to minimize, manage and/or mitigate these impacts through improved stormwater management and construction practices and potentially through modifications to the land use and zoning, before build-out occurs.

Build-out analyses and pollutant loading projections are a tool and an initial step for assessing and quantifying adverse impacts from development and stormwater runoff. There are, however, a number of reservations associated with the NJDEP's build-out methodology, and with build-out and pollutant loading analyses in general.

1. The methodology over-simplifies the complex hydrologic and pollutant transport mechanisms associated with these processes and development.

2. The methodology does not account for the transient nature of development within a given municipality and watershed. It ignores the differences in time over which build-out will occur. For example, one municipality or portion of a watershed might take 10 years to essentially build-out, while another might take 100 years or more.

3. The impervious surface coverage analyses presume that all development within a zone occur at the maximum impervious coverage permitted within the zone. Although it would be reasonable to assume an average impervious coverage, the maximum permitted impervious coverage is the extreme. Furthermore, many municipal land use zones do not specify a maximum impervious coverage and an assumption must be used that may not be optimal.

4. The NJDEP presented very little information about the origin and conditions that apply to their land cover pollutant loading coefficients for total phosphorus, total nitrogen and total suspended solids. For example, what are the climatic, soils, hydrologic, geologic, topographic, and vegetative conditions that these coefficients represent, and even more importantly, what stormwater runoff controls were employed (if any) that generated these coefficients? Without this

information, it is not possible to fully understand the implications of pollutant loadings using these coefficients. The methodology is highly sensitive to these coefficients.

5. Because the NJDEP's methodology projects pollutant loadings for only three parameters, total phosphorus, total nitrogen and total suspended solids, the pollutant loading projections are biased against agricultural land uses. For example, changes in land use from agriculture to low density rural development may occur in Cumberland County. The NJDEP's pollutant loading coefficients for agriculture are two to three times greater than those for low density residential development. The resulting annual pollutant loadings will then be two to three times lower for land transitioning from agriculture to residential development.

   This might be misconstrued to imply that the loss of agricultural lands to residential development is somehow desirable. Furthermore, because of the significant amount of agricultural land in some municipalities and watersheds, the method makes residentially and commercially developed municipalities and watersheds appear less prone to the impacts of nonpoint source pollution, which is not the case.

   In Cumberland County and other similar areas in New Jersey, agriculture is recognized as being fundamentally important and vital to society.

6. The NJDEP's land cover coefficients do not appear to consider or incorporate the new stormwater management techniques now required by the New Jersey stormwater regulations and the new LID BMP strategies. Furthermore, most municipalities have required some form of stormwater runoff control in new development for 20 years or more. The NJDEP land cover coefficients may, therefore, be very conservative with respect to present development conditions and greatly overestimate the adverse impacts at build-out.

7. In addition to nitrogen, phosphorous and suspended solids there are a number of other pollutants associated with non-point source pollution and stormwater runoff from development. These include petroleum hydrocarbons, metals and pathogenic organisms, among other parameters, which are not currently accounted for by the NJDEP's methodology.

Despite these reservations, the build-out analyses and pollutant loading projections are valuable tools for assessing the potential impacts from development and stormwater runoff. The build out analyses and pollutant loading projections have been developed with the flexibility to easily adjust the pollutant loading coefficients, zoning and other elements of the analyses and projections. GIS data management and mapping software was used to perform these analyses.

The following GIS-based method was used for the build-out analyses and pollutant loading projections and to prepare the figures presented in this report.

1. Constrained areas were determined from the NJDEP's GIS coverages (see Figure 15), including surficial water bodies, wetland areas, Category One resource protection areas and their associated 300 foot buffers, designated open space and protected park areas. These were saved as GIS feature layers and integrated with the existing land use, HUC14 and municipal zoning feature layers. The build-out amount of impervious land coverage within each HUC14 and municipality was then calculated from the zoning layer.

   Build-out land areas available for new development and redevelopment were calculated by subtracting the constrained areas from the developable areas based on zoning for each HUC14, Watershed and municipality. In essence, the land available for new development is agricultural, forest and/or barren lands and the land available for redevelopment consists of the existing residential, commercial and industrially zoned areas.

2. The build-out (future) impervious surface coverage was calculated by multiplying build-out land areas available for new development and redevelopment by the maximum impervious surface coverage, using (whenever available) the maximum impervious surface coverage percentages specified within each municipal zoning ordinance for that area.

3. Pollutant loading projections were calculated for each HUC14, using the pollutant loading coefficients provided by the NJDEP Stormwater BMP Manual and shown in Table 8.

Table 8. Pollutant Loads For Various Land Cover Types

Land Cover	Total Phosphorus Load (lbs/acre/year)	Total Nitrogen Load (lbs/acre/year)	Total Suspended Solids Load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agricultural	1.3	10	300

Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

Source: NJDEP Stormwater BMP Manual 2004.

Build-Out, Impervious Cover and Pollutant Loading Projections

The results of the Greenwich Township Build-out analysis, including the existing and build-out (future) conditions, are presented in Table 9. This table provides the total area, constrained area, and developable area in acres for each HUC14 within Greenwich Township.

Table 9 also provides the impervious areas in acres and percent. In general, impervious percentages greater than about 10 to 15 percent may indicate potential watershed impairment from stormwater and development. The total pollutant loadings for phosphorous, nitrogen and total suspended solids are projected in pounds per year for the build-out conditions.

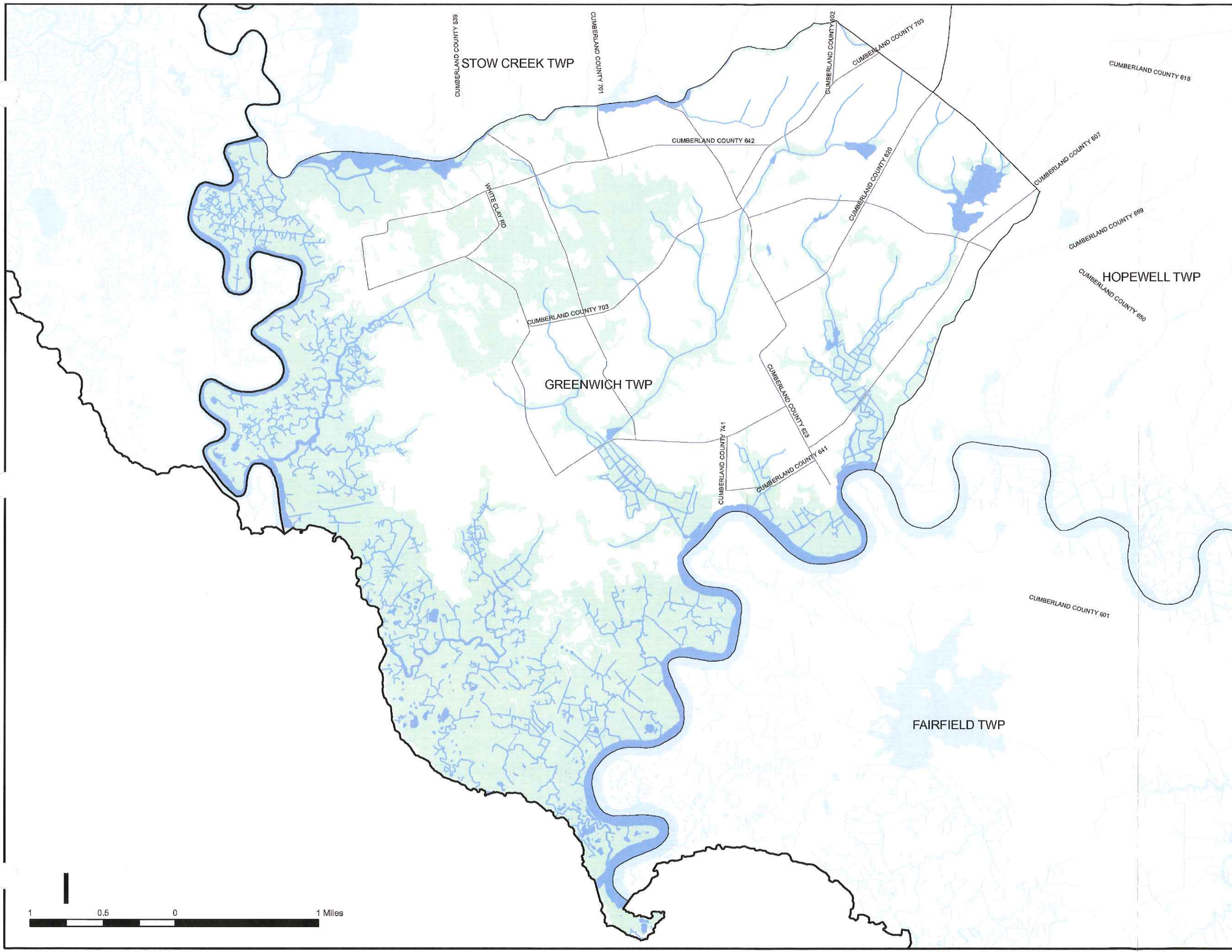
Included in this plan and in the New Jersey Stormwater Management Regulations and guidance are strategies to minimize, manage and/or mitigate build-out impacts, through improved stormwater management and construction practices. In addition, modifications to current land use and zoning will change the build-out impacts.

Greenwich Township Municipal Stormwater Management Plan

Cumberland County, NJ

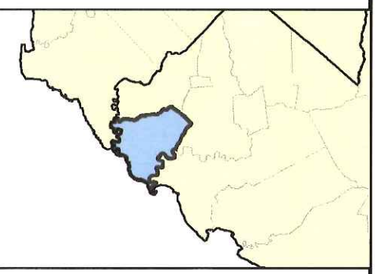
Constrained Areas

Figure - 15



Legend

- County Boundary
- Municipal Boundary
- Road
- Lakes
- Streams
- Wetlands



Note:
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Table 9. Greenwich Township Pollutant Loading Projections

Watershed	HUC14 Sub-Watershed		Area (Acres)			Impervious Area						
	No.	Name	Total	Constrained	Developable	Acres		Percent		Phosphorus	Nitrogen	Total Suspended Solids
						Existing	Build-Out	Existing	Build-Out	Build-Out	Build-Out	Build-Out
Stow Creek	02040206070070	Raccoon Ditch (Stow Creek)	1,463	600	863	10	172	0.70%	11.78%	1,121	8,620	258,605
	02040206070080	Stow Creek (below Canton Rd.)	668	612	56	0	12	0.02%	1.79%	78	597	17,910
	02040206070090	Phillips Creek/Jacobs Creek	3,530	2,405	1,126	4	226	0.10%	6.40%	1,468	11,295	338,850
		Sub-Total	**5,662**	**3,616**	**2,045**	**14**	**410**	**0.25%**	**7.25%**	**2,667**	**20,512**	**615,364**
Cohansey River	02040206090080	Cohansey River (Greenwich to 75d 17m 50s)	1,800	493	1,308	22	275	1.23%	15.25%	1,474	11,807	314,544
	02040206090090	Pine Mount Creek	3,032	851	2,181	30	433	0.98%	14.28%	2,823	21,870	644,514
	02040206090100	Cohansey River (below Greenwich)	1,450	1,144	307	20	59	1.36%	4.06%	431	4,008	68,360
		Sub-Total	**6,283**	**2,487**	**3,796**	**71**	**766**	**1.14%**	**12.20%**	**4,728**	**37,685**	**1,027,418**
		Total	**11,945**	**6,104**	**5,841**	**86**	**1,177**	**0.72%**	**9.85%**	**7,395**	**58,197**	**1,642,782**

Section 6. Design and Performance Standards

Greenwich Township must amend its land use ordinances to incorporate the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5, to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies. This requirement will be met by adopting a Municipal Stormwater Control Ordinance that meets these requirements or by amending an existing stormwater control ordinance to meet these requirements.

The design and performance standards in the adopted or amended ordinance must include the language for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 Maintenance Requirements, and language for safety standards consistent with N.J.A.C. 7:8-6 Safety Standards for Stormwater Management Basins.

After adoption or amendment of the ordinance, it must be submitted to the County, along with this MSWMP, for approval.

Furthermore, during construction of major development within Greenwich Township, municipal inspectors must observe the construction of stormwater management measures to ensure that they are constructed and function as designed.

The New Jersey stormwater design and performance standards represent an initial effort to control non-point sources of pollution and to improve groundwater recharge. The effective control of point sources of pollution took many years. The USEPA and the NJDEP believe that further water quality improvements can now best be achieved by controlling non-point sources of pollution and stormwater runoff.

New stormwater management measures and design and performance standards will emerge over the ensuing years. The stormwater rules, NJPDES stormwater permits, and municipal stormwater plans and ordinances will similarly evolve and require amendments. Municipalities will be expected to control stormwater runoff, to improve or maintain surface water quality and groundwater recharge and to continue to utilize appropriate stormwater design and performance standards to achieve this goal.

With the increasing emphasis on non-point source pollution and concerns over the adverse impacts of uncontrolled land development, effective alternatives to the centralized stormwater conveyance and treatment strategies have been developed that are the basis for many of the new stormwater management standards in the State. New strategies have been developed to minimize and even prevent adverse stormwater runoff impacts from occurring.

Such strategies, known collectively as Low Impact Development techniques or LIDs, reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic a site's natural or pre-developed hydrologic response to precipitation. These new stormwater management strategies are explained in more detail in Section 8 of this MSWMP.

Section 7. Plan Consistency

There are no approved Regional Stormwater Management Plans (RSWMPs) in Cumberland County at this time. If and when any future RSWMPs are approved by the appropriate regional water quality management planning agency and NJDEP, and adopted as part of the regional water quality management plan, the New Jersey stormwater management regulations require that municipal stormwater management plans be revised to provide consistency.

Presently, TMDLs have been proposed for certain surface water bodies in Cumberland County. Section 4 of this MSWMP addresses impaired surface waters, TMDLs and supporting surface water quality data. When these ongoing TMDL proposals or any future TMDLs proposals are finally approved, the New Jersey stormwater management regulations require that municipal stormwater management plans be revised to provide consistency.

The Greenwich Township MSWMP is consistent with the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21. Greenwich Township will utilize the most current update of the RSIS in the stormwater management review of residential areas. This Municipal Stormwater Management Plan will be updated to be consistent with any future updates to the RSIS.

Furthermore, Greenwich Township's stormwater management ordinance(s) will require all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards. During construction, municipal inspectors will observe on-site soil erosion and sediment control measures and report any inconsistencies to the County Soil Conservation District.

Section 8. Stormwater Management Strategies

Low Impact Development Techniques

The NJDEP's new Stormwater Management Rules include the specific provisions that must be addressed in a municipal stormwater management plan (N.J.A.C. 7:8-4.2(c)). One of these requirements is that the plan include an evaluation of the extent to which the master plan (including the land use element), official map, and development regulations (including zoning ordinances) implement the principles of the Stormwater Management Rules relating to nonstructural stormwater management strategies (N.J.A.C. 7:8-5.3(b)).

New stormwater management techniques have been developed that minimize and prevent adverse stormwater effects from land disturbance. These techniques are referred to by the NJDEP as Low Impact Development techniques (LIDs) and include both nonstructural and structural Best Management Practices (BMPs). LID-BMPs first minimize quantitative and qualitative changes to a site's pre-developed hydrology (i.e., employ nonstructural techniques first) and then provide stormwater management through smaller sized structural techniques distributed throughout the site. The link to the NJDEP website to download the BMP Manual is:

http://www.njstormwater.org/bmp_manual2.htm

Nonstructural LID-BMPs include such practices as minimizing site disturbance, preserving important site features, reducing and disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns and maintaining natural drainage features. It may be possible at some sites to satisfy all stormwater management requirements through nonstructural LID-BMPs. Structural BMPs are considered LIDs if they are located close to the source of runoff. Structural LID-BMPs include various types of basins, filters, devices and permeable surfaces located within residential lots and otherwise throughout residential, commercial, industrial or institutional development.

Because LIDs rely on nonstructural or relatively small structural BMPs distributed throughout a land development site, ownership and maintenance may be similarly distributed to an array of property owners. The new Stormwater Management rule requires the use of deed restrictions for LID-BMPs to ensure that property owners fully recognize, understand and support the continuing use of LID-BMPs for stormwater management.

The NJDEP believes that effective, state-wide use of such practices can best be achieved through modifications to municipal master plans and land use ordinances to include LID goals and to provide for the use of specific LID-BMPs. The Stormwater Management Rules require municipalities to review their master plans and ordinances in order to incorporate LID techniques to the maximum extent practicable.

The NJDEP Stormwater Management Rules (N.J.A.C. 7:8) require, in Section 5.2(a) that Major Development (disturbing one acre or more or increasing impervious surface by 1/4 acre) incorporate nonstructural stormwater management strategies "to the maximum extent practicable." Nonstructural LID-BMPs are to be given preference over structural BMPs. Where it is not possible to fully comply with the Stormwater Management Rules through nonstructural LIDs, structural LID-BMPs are to be used in conjunction with standard structural BMPs to meet the Rules' requirements.

N.J.A.C. 7:8-5 further requires that an applicant seeking approval for major development or redevelopment specifically identify which and how these nine nonstructural strategies are incorporated or provide an engineering, environmental, or safety reason for their non-incorporation.

The NJ BMP manual contains a LID checklist which planning boards and development applicants can use to ensure LID techniques are being applied. This checklist is available in Appendix D.

(a) Nonstructural LID-BMPs

The NJDEP's new Stormwater rule's design and performance standards require the maximum possible use of nine nonstructural strategies.

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 low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.
8. Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.
9. Provide preventative source controls.

The nonstructural LID-BMPs have been grouped by the NJDEP into four general categories:

I. **Vegetation and Landscaping** – reduces runoff volumes and peaks through infiltration, surface storage, and evapotranspiration, provides pervious surface for groundwater recharge and removes pollutants from stormwater. Key techniques include:

A. **Preservation of Natural Areas** – preserve areas with significant hydrologic functions including forested areas, riparian corridors and soils/geology with high recharge potential.
B. **Native Ground Cover** – reduce the use of turf grass and preserve areas that naturally minimize runoff.
C. **Vegetative Filters and Buffers** – provide native ground cover and grass areas to filter stormwater runoff from pervious areas and to provide locations for runoff to infiltrate.

II. Minimizing Land Disturbance – reduces runoff volume and pollutant loads and maintains existing recharge rates and other hydrologic functions. Key techniques include:

A. Planning and design to fit the development to the terrain, limiting clearing and grading.
B. Evaluating site conditions and constraints including soil types, geology, topography, slopes, drainage areas, wetlands, and floodplains to maintain high recharge areas and provide runoff storage areas.
C. Utilizing construction techniques that limit disturbance and soil compaction.
D. Restricting the future expansion of buildings and other improvements that will adversely affect runoff volumes and rates or recharge rates.

III. Impervious Area Management – reduces water quality impacts, runoff volume and peak rates, runoff velocity, erosion and flooding. Key techniques include:

A. **Streets** – use minimum acceptable pavement widths and incorporate pervious vegetated medians and islands with curb cuts for runoff access.
B. **Sidewalks** – use pervious pavement with infiltration storage beneath and disconnect from the street drainage system.
C. **Parking and Driveways** – use pervious pavement wherever practical **and** reduce parking space requirements by sharing requirements in mixed uses and by reducing parking space lengths by allowing for overhang into pervious areas.
D. **Pervious Paving Materials** – Use pervious materials in parking spaces, driveways, access roadways and sidewalks, including pavers, porous pavement and gravel.
E. **Unconnected Impervious Areas** – Disconnect impervious areas and runoff form the site's drainage system allowing the sheet flow to cross pervious areas through curb cuts or by eliminating curbing and using shoulders and swales.
F. **Vegetated Roofs** – install lightweight vegetative planting beds on new or existing roofs.

IV. **Time of Concentration Modification** – minimize reductions to the time of concentration caused by changes in hydrologic characteristics in order to minimize the peak runoff rate. Key techniques include:

A. **Surface Roughness Changes** – increase surface roughness through the use of land cover and decrease the amount of connected smooth surfaces in order to increase runoff travel time throughout the drainage area.
B. **Slope Reduction** – reduce slopes in graded areas and/or provide terraces and reduced slope channels to increase runoff travel length and time.
C. **Vegetated Conveyance** – use vegetated channels and swales to increase roughness and runoff travel time and to provide opportunities for runoff treatment and infiltration.

In order to assure to the maximum extent possible the use of Nonstructural LIDs in new major development, the NJDEP prepared a Nonstructural Strategies Evaluation Worksheet, and this worksheet is included in Appendix C.

(b) Structural LID-BMPs

In addition to these nonstructural LID-BMPs, structural stormwater management measures can be LID-BMPs. These structural BMPs become LID-BMPs by storing, infiltrating, and/or treating runoff close to the source of the stormwater. Unlike standard structural BMPs that are located along a site's drainage system, structural LID-BMPs are normally dispersed throughout a development and more closely mimic the hydrology. LID-BMPs are typically standard structural BMPs, but their location, closer to the runoff source, allows them to be smaller in size. Standard structural BMPs that can be implemented at a LID scale include: drywells, infiltration systems, bioretention basins, and both surface and subsurface detention basins; downsized, to address stormwater close to its source as LIDs.

There are a number of structural stormwater BMPs that may be used to address the groundwater recharge and stormwater quality and quantity requirements of the NJDEP Stormwater Management Rules in N.J.A.C. 7:8. The structural BMPs include the following techniques (see also *New Jersey Stormwater Best Management Practices Manual,* February 2004, which includes the planning, design, construction, and maintenance guidelines for these structural BMPs):

1. Bioretention Systems
2. Constructed Stormwater Wetlands
3. Dry Wells
4. Extended Detention Basins
5. Infiltration Basins
6. Manufactured Treatment Devices
7. Pervious Paving Systems
8. Rooftop Vegetated Cover
9. Sand Filters

10. Vegetative Filters
11. Wet Ponds

Other BMPs that possess similar levels of effectiveness, efficiency, and endurance may also be utilized, provided that such levels can be demonstrated.

Greenwich Township will review the Master Plan and local land use ordinances and incorporate structural stormwater management strategies (LID and standard structural stormwater BMPs) to the extent practicable and in accordance with sound planning, science, engineering and construction principles, as they apply to its unique environment.

Section 9. Mitigation Plans

Section 6 of this MSWMP addresses the design and performance standards for stormwater management measures applicable to major development projects. In some instances, however, site specific conditions may prevent strict compliance with these standards. In accordance with N.J.A.C. 7:8-4.2(c)11, such projects may be granted a variance or exemption from these standards by the Municipal Zoning Board or Planning Board, if a mitigation plan is approved by the Board and mitigation plan implementation is a condition of the major development project approval.

To the extent possible, a mitigation plan should offset the impacts on groundwater recharge, stormwater quantity control, and/or stormwater quality control that would be created by granting the variance or exemption to the development project. In addition, to the extent possible, the proposed mitigation project(s) should be located within the same HUC14 sub-drainage basin(s) as the major development project, and if not, within the same Watershed Management Area.

A mitigation plan may include more than one mitigation project, in order to achieve the objectives of location and/or impact offsets. The Municipal Stormwater Coordinator Public Works Director (if different), and Engineer (if different) will develop and maintain a list of mitigation projects that can be implemented in order to comply with the mitigation plan provisions of this MSWMP. A list of mitigation projects will be included as Appendix D. Included as part of the list of projects will be quantitative estimates of the offsets to groundwater recharge, stormwater quantity control, and/or stormwater quality control for each of the mitigation projects.

The mitigation plan must include a detailed plan and schedule for implementation of the mitigation project(s). Implementation may be accomplished as a part of the major development project, or the municipality may accept funding for the project(s), at the discretion of the municipality. If the municipality chooses to accept funding in lieu of implementation, such funding shall include any costs that must be incurred by the Municipality in implementing the mitigation project(s), including design, permitting, land and/or easement acquisition, construction, and provisions for the long-term operation and maintenance of the mitigation project(s).

A mitigation plan must clearly demonstrate that strict compliance with the design and performance standards for stormwater management measures cannot be achieved. Before submitting a mitigation plan that does not meet the objectives of the MSWMP with regard to mitigation project location and/or impact offsets, the developer shall request that the Municipality determine whether it can identify other projects, consistent with those objectives, that the Municipality can add to its list.

A mitigation plan that includes a mitigation project or projects not taken from the Municipality's list may be submitted for review by the Municipality. Such projects must be reviewed and accepted by the Municipality, before a mitigation plan including such projects can be submitted to the Zoning Board or Planning Board for review. A mitigation plan including projects not already listed by the Municipality must include quantitative estimates of the offsets to groundwater recharge, stormwater quantity control, and/or stormwater quality control for each of those unlisted mitigation projects.

The mitigation plan must include provisions for ensuring the long-term operation and maintenance of the mitigation project(s), by clearly identifying the party responsible for the operation and maintenance of each mitigation project. If the Municipality accepts a mitigation plan that designates the Municipality as the responsible party for mitigation project operation and maintenance, provisions for funding the associated costs by the developer shall be included in the mitigation plan.

If implementation of a mitigation plan is a condition of approval for a major development project by the Municipal Zoning Board or Planning Board, such approval shall also include the requirement that the developer execute a funding agreement with the Municipality for mitigation plan implementation, as a further condition of approval. The funding agreement, in form acceptable to the Municipality, shall provide for funding by the developer of all costs to implement the plan that will be incurred by the Municipality, including the cost of long-term operation and maintenance of any mitigation projects.

Section 10. Stormwater Management Program

The overall long term goal of stormwater management is to have all waters in New Jersey meet water quality standards for their designated uses. That is, ensure that our rivers, lakes and coastal waters are fishable, swimmable, and support healthy ecosystems. The *New Jersey Nonpoint Source and Stormwater Management Program Plan*, (NJDEP, December, 2000) indicates that "Nonpoint sources of pollution from stormwater runoff have long been thought to be major contributors to the degradation of water quality in New Jersey." It further states:

> The task ahead will not be easy. Controlling point sources of pollution took many years, many new governmental and private partners and billions of federal and private dollars. Successfully managing nonpoint sources of pollution and stormwater runoff can be expected to require a similar if not greater commitment.

APPENDIX A. METADATA (REFERENCES) FOR FIGURES

Appendix A
Metadata (References) for Figures

General Layers

1. Municipal Boundaries:

Originator: New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS).

Abstract: Municipal boundaries in New Jersey were gathered from USGS topoquads and other sources in 1987. Since that time, updates to the data have been limited to noting consolidations of boundaries. The scale of the original data varies, relying primarily on 1:24,000 topoquads. Changes were made when inconsistencies with other maps were found based on preponderance of data. In area where the line was labeled as approximate attempts were made to correctly locate the boundary. The 1986 photoquads were used to move the boundary lines to photo-identifiable features as needed. Changes less than 5 acres were not made. In July, 1997, the coverage was updated to reflect the consolidation of Pahaquarry Township with Hardwick Township. In March, 2000, the attributes were edited to properly label West Caldwell as a Township, as verified with the township clerk; it had been labeled as a borough.

In January 2003 the Census 2000 population information was assed to the former stmun coverage to create this data layer. Additional attributes included population density by square mile.

In May 2003 the FIPS codes and Township names were updated as identified. Essex Fells and North Caldwell were re-designated Boroughs in 1991 and Passaic Township is now Long Hill Township.

2. Streams:

Originator: NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA).

Abstract: This data represents the streams of Cumberland County, New Jersey. The hydrography stream network for this county was generated as a line ArcInfo coverage from USGS 1:24,000 Digital Line Graph(DLG) files, with subsequent editing and updating.

3. Lakes:

Originator: NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)
Abstract: This data contains all the open water areas for this county as of 1986. Open water areas such as as lakes, ponds, tidal waters, reservoirs, bays, etc., are included. This file was created by reselecting the water series out of its LULC (land use/land cover) data. The following reselect was performed on LULC in ArcView to create this data: land_use greater than 5000 and land_use less than 6000 (the numeric codes refer to the Anderson classification system, and represent all codes that refer to bodies of water). Non-open water wetlands polygons can be found in the county's "Wetlands" data and the streams in its "Streams" data.
The county's LULC data was created by combining two separate data sets, the land use/land cover layer from the Integrated Terrain Unit Maps (ITUM) and the freshwater wetlands (FWW) layer generated under the New Jersey Freshwater Wetlands Mapping Program.

The ITUM land use/land cover was photo interpreted from 1986 color infrared (CIR) 1:58000 aerial photos, and delineated using a modified Anderson et al. 1976, classification system to 1:24000 rectified photo-basemaps. These basemaps complied with National Map Accuracy Standards (NMAS) as individual quadrangles but were not produced from a sophisticated aero-triangulation photogrammetric solution. Minimum mapping unit = 2.5 acres. The ITUM land use/land cover was integrated with three other sources (soils, USGS floodprone areas, and 1906 Atlas Sheet Geology) based on coincident features. The four data layers have subsequently been split out into four separate themes for distribution and use. Beginning in 1998, the NJDEP does not support the data as a single integrated ITUM theme but rather as four separate themes.

Freshwater wetlands delineations were made on 1986 orthophoto quarterquad basemaps (1:12000) by photo interpretation of 1986 CIR photos. The classification system used was a modified Cowardin system (Cowardin, et al., 1979). All freshwater wetland polygons greater than 1 acre in area and all linear freshwater wetland features greater than 10 feet in width were mapped. Only polygons are included in county's wetlands shapefile, linear wetlands are also shown separately in their own shapefile. The 1986 quarterquad basemaps meet NMAS and are orthophotos.

4. Roads:

Originator: New Jersey Department of Transportation Geographic Information Systems

Abstract: All NJ roads above the municipal level.

Publication Date: 2004

Constrained Areas Figure

1. **Wetlands:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)
Abstract: This is a graphical representation of this county's wetlands data and it contains all the tidal and non-tidal wetlands as of 1986. It was created by reselecting wetlands out of this county's 1986 LULC (land use/land cover) data. This was done so that this new data would contain both tidal and non-tidal wetlands.

Groundwater Recharge Figure

1. **Recharge:**

Originator: New Jersey Geological Survey (NJGS)

Abstract: Ground-water recharge (GWR) is defined as the water that infiltrates the ground and reaches the water table regardless of the underlying geology. It supports aquifer recharge, stream baseflow and wetlands. It is estimated in New Jersey using the methodology outlined in NJ Geological Survey Report GSR-32, "A Method of Evaluating Ground-Water-Recharge Areas in New Jersey" by E. G. Charles and others (1993). Application of this method using the Arc/Info geographic information system (GIS) produced 19* county and 20* watershed management area (WMA) ground-water recharge, GIS coverages. The county recharge coverages were created by overlaying three coverages: 1) soils, 2) land use and land cover (LULC), and 3) municipalities. These three coverages provided the following attributes: soil series names, land-use and land-cover categories, and climate factors; respectively. These data were then used to calculate ground-water recharge values using the following equation for each area in the coverage:

ground-water recharge = (recharge factor x climate factor) - recharge constant

The recharge factor and constant are determined by the cross tabulation of LULC and soil series. The climate factor is determined using zonal statistics and is a ratio of precipitation over potential evapotranspiration.

Land Use Figure

1. **Land Use:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)

Abstract: This data was created by combining two separate data sets, the land use/land cover layer from the Integrated Terrain Unit Maps (ITUM) for this county and the freshwater wetlands (FWW) layer generated under the New Jersey Freshwater Wetlands Mapping Program. The Arc/INFO LULC coverage has been converted to an ArcView shapefile for distribution.

The ITUM land use/land cover was photo interpreted from 1986 color infrared (CIR) 1:58000 aerial photos, and delineated using a modified Anderson et al. 1976, classification system to 1:24000 rectified photo-basemaps. These basemaps complied with National Map Accuracy Standards (NMAS) as individual quadrangles but were not produced from a sophisticated aero-triangulation photogrammetric solution. Minimum mapping unit = 2.5 acres. The ITUM land use/land cover was integrated with three other sources (soils, USGS flood prone areas, and 1906 Atlas Sheet Geology) based on coincident features. The four data layers have subsequently been split out into four separate themes for distribution and use. Beginning in 1998, the NJDEP does not support the data as a single integrated ITUM theme but rather as four separate themes.

Freshwater wetlands delineations were made on 1986 orthophoto quarterquad basemaps (1:12000) by photo interpretation of 1986 CIR photos. The classification system used was a modified Cowardin system (Cowardin, et al., 1979). All freshwater wetland polygons greater than 1 acre in area and all linear freshwater wetland features greater than 10 feet in width were mapped. The 1986 quarterquad basemaps meet NMAS and are orthophotos.

Landscape Figure

1. Bald Eagle Foraging:

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)

Abstract: This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. All known bald eagle nests are recorded using GPS equipment. To run the model, all water polygons from the DEP LULC having an area greater than 8 hectares are converted to a 5 meter grid. A radius around the nest site is incrementally increased, one cell (5 m) at a time, until an area of 660 ha of open water has been identified. All emergent wetland patches within 90 meters of the identified water are selected. These emergent patches are merged with the identified open water to become the foraging habitat. A 90-meter buffer is applied to the identified foraging habitat to protect perching sites. In the previous version (1.0) all suitable habitat patches that intersected with the foraging habitat and 90-m buffer were designated as critical. In version 2.0 bald eagle foraging habitat, and its associated 90-meter buffer, is no longer used to value patches that intersect with it. The bald eagle foraging model is a stand-alone GIS layer.

2. **Grassland:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)

Abstract: The Grassland data depicts critical area maps for grassland dependent species which are generated by selecting specific land-use classes from the NJDEP's LULC data set. This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Version 1 was created by intersecting imperiled and priority species data with 1995 cover data derived from TM satellite imagery. This version (version 2) was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land use/Land cover Update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

3. **Forested Wetland:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)

Abstract: The Forested Wetland data depicts critical area maps for forested wetland dependent species which are generated by selecting specific land-use classes from the NJDEP's LULC data set. This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Version 1 was created by intersecting imperiled and priority species data with 1995 cover data derived from TM satellite imagery. This version (version 2) was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land use/Land cover Update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

4. **Forest:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)

Abstract: The Forest data depicts critical area maps for forest-dependent species which are generated by selecting specific land-use classes from the NJDEP's LULC data set. This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Version 1 was created by intersecting imperiled and priority

species data with 1995 cover data derived from TM satellite imagery. This version (version 2) was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land use/Land cover Update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

5. **Emergent Wetland:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)

Abstract: Emergent Wetland depicts critical area maps for dependent species which are generated by selecting specific land-use classes from the NJDEP's LULC data set. This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Version 1 was created by intersecting imperiled and priority species data with 1995 cover data derived from TM satellite imagery. This version (version 2) was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land use/Land cover Update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

6. **Beach:**

Originator: New Jersey Department of Environmental Protection, Division of Fish Wildlife, Endangered Nongame Species Program

Abstract: The Beach data set depicts critical area maps for beach dependent species which are generated by selecting specific land-use classes from the NJDEP's LULC data set. This data set is a product of the Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Version 1 was created by intersecting imperiled and priority species data with 1995 cover data derived from TM satellite imagery. This version (version 2) was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land use/Land cover Update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation.

Aerial Land Use Figure

1. **Orthophoto Quandrangles:**

Originator: U.S. Geological Survey

Abstract: Orthophotos combine the image characteristics of a photograph with the geometric qualities of a map. The primary digital orthophotoquad (DOQ) is a 1-meter ground resolution, quarter-quadrangle (3.75-minutes of latitude by 3.75-minutes of longitude) image cast on the Universal Transverse Mercator Projection (UTM) on the North American Datum of 1983 (NAD83).The geographic extent of the DOQ is equivalent to a quarter-quad plus The overedge ranges a minimum of 50 meters to a maximum of 300 meters beyond the extremes of the primary and secondary corner points. The overedge is included to facilitate tonal matching for mosaicing and for the placement of the NAD83 and secondary datum corner ticks. The normal orientation of data is by lines (rows) and samples (columns). Each line contains a series of pixels ordered from west to east with the order of the lines from north to south. The standard, archived digital orthophoto is formatted as four ASCII header records, followed by a series of 8-bit binary image data records. The radiometric image brightness values are stored as 256 gray levels ranging from 0 to 255. The metadata provided in the digital orthophoto contain a wide range of descriptive information including format source information, production instrumentation and dates, and data to assist with displaying and georeferencing the image. The standard distribution format of DOQs will be JPEG compressed images on CD-ROM by counties or special regions. The reconstituted image from the CD-ROM will exhibit some radiometric differences when compared to its uncompressed original but will retain the geometry of the uncompressed DOQ. Uncompressed DOQs are distributed on tape.

Topography and Watershed Areas

1. **Topographic Quandrangles:**

2. **HUC 11:**

Originator: Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS)

Abstract: Drainage basins are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles. The delineations have been developed for general purpose use by USGS District staff over the past 20 years. Arc and polygon attributes have been included in the coverage with basin names and ranks of divides, and 14-digit hydrologic unit codes. The New Jersey state boundary as originally defined in the USGS source coverage does not match that used by the NJDEP. Therefore the coverage was edited by the NJ Geological Survey to remove the USGS state boundary and insert the NJDEP state boundary, thus resolving most potential clipping errors.

Note: Some information in this metadata describes the DEPHUC 14 coverage instead of the DEPHUC 11 because DEPHUC 14 is more detailed. Most processes and procedures used are identical for both coverages.

3. **HUC 14:**

Originator: Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS)

Abstract: Drainage basins are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles. The delineations have been developed for general purpose use by USGS District staff over the past 20 years. Arc and polygon attributes have been included in the coverage with basin names and ranks of divides, and 14-digit hydrologic unit codes. The New Jersey state boundary as originally defined in the USGS source coverage does not match that used by the NJDEP. Therefore the coverage was edited by the NJ Geological Survey to remove the USGS state boundary and insert the NJDEP state boundary, thus resolving most potential clipping errors.

Water Quality Figure

1. **Ambient Monitoring Network Site:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Water Monitoring and Standards (WM&S), Bureau of Freshwater and Biological Monitoring (BFBM), Johannus Franken

Abstract: This data was created from the 95/97 LULC coverage created by the NJDEP. Natural and artificial lakes were selected from the coverage and then dissolved. Name attributes from the USGS coverage (lake) were attached via a centroid coverage. Other sources of lake names include non-digital lake monitoring data, atlases, digital datasets and a NJ dams coverage. The candidate lakes for the Ambient Lake Monitoring Network (ALMN) were then selected randomly using USEPA's probabilistic site selection methodology called the Generalized Random Tessellation Stratified or GRTS, but in a manner that equalizes selections over all Omernik Level III Ecoregions (6 in the state).

2. **Storet Quality Station:**

Originator: New Jersey Department of Environmental Protection (NJDEP), NJDEP Bureau of Freshwater Biological Monitoring

Abstract: The STORET data maintains the locations of water quality monitoring stations from NJDEP's NJ STORET (Modernized) database. A station is a location at which a data collection event takes place, such a collection of a field sample, measurement of field parameters or evaluation of environmental habitats. NJ STORET maintains NJDEP's water quality monitoring data from January 1, 1999 to the present. Note: water

quality monitoring data sampled prior to this date is stored in EPA's Legacy STORET database.

3. **Integrated Report Results for Rivers:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Water Assessment Team (WAT)

Abstract: This data represents rivers in the 2004 Integrated Report. There are 7,840 miles of rivers and streams in addition to 675 miles of canals in New Jersey. Of these, 6,330 miles (81%) are non-tidal rivers, 1,520 miles (19%) are tidal rivers, and 197 river miles share a border with a neighboring state.

4. **Integrated Report Results for Lakes:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Water Assessment Team (WAT)

Abstract: This data represents the 2004 Integrated Report final assessment results for aquatic life and recreation designated uses as well as fish advisories and eutrophication assessments of lakes. The assessments are based on data from the NJDEP Bureau of Freshwater Fisheries, local and county health departments, and NJDEP Clean Lakes Program.

Waterways Figure

1. **Stormwater Rule Area:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Division of Landuse Management (DLM), Bureau of Freshwater & Biological Monitoring (BFBM)

Abstract: ADVISORY: PLEASE READ. Please be advised that this layer is intended to be used as a GUIDE for finding areas that may be impacted by the stormwater rule. This GIS layer is ONLY A GUIDE and areas in question should be reviewed carefully. Case by case scrutiny may be necessary to determine whether an area is impacted. THIS LAYER IS ONLY A GUIDE.
On January 6, 2004 the NJDEP Commissioner adopted the Stormwater Management Rule (N.J.A.C. 7:15) which goes into effect on February 2, 2004. The rule establishes an additional requirement for projects which are located along a Category 1 stream and those projects located upstream of a Category 1 segment within the subwatershed or HUC 14. The stream classifications and antidegradation designations are established in the Surface Water Quality Standards. This coverage integrates the Surface Water Quality Standards, specifically the Category 1 streams with the GIS coverage for HUC 14's (Watershed - subwatershed name by DEPHUC14). This GIS coverage is designed to assist public, DEP staff, property owners, builders and municipal officials in determining

whether a property is located in an area of the State now subject to 300 foot buffers pursuant to the new stormwater management rule.

2. **TMDL for Streams:**

Originator: New Jersey Department of Environmental Protection (NJDEP), Bureau of Environmental Analysis and Restoration (BEAR)

Abstract: The pollutant of concern for these Stream TMDLs is pathogens, the presence of which is indicated by elevated concentrations of fecal coliform bacteria. Fecal coliform concentrations were found to exceed New Jersey's Surface Water Quality Standards (SWQS), published at N.J.A.C. 7-9B et seq., for the segments identified in the Reports. In accordance with Section 305(b) of the Federal Clean Water Act (CWA), the State of New Jersey developed the 2002 Integrated List of Water-bodies, addressing the overall water quality of the State's waters and identifying impaired water-bodies for which Total Maximum Daily Loads (TMDLs) may be necessary. As reported in the 2002 Integrated List of Water-bodies, also identified is the river miles and management response associated with each listed segment. All of these water-bodies have a high priority ranking, as described in the 2002 Integrated List of Water-bodies.

"Fecal coliform levels shall not exceed a geometric average of 200 CFU/100 ml nor should more than 10 percent of the total sample taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters." Nonpoint and stormwater point sources are the primary contributors to fecal coliform loads in these streams and can include storm-driven loads transporting fecal coliform form sources such as geese, farms, and domestic pets to the receiving water. Nonpoint sources also include steady-inputs from sources such as failing sewage conveyance systems and failing or inappropriately located septic systems. Because the total point sources contribution other than stormwater (i.e. Publicly-Owned Treatment Works, POTWs) is an insignificant fraction of a percent of the total load, these fecal coliform TMDLs will not impose any change in current practices for POTWs and will not result in changes to existing effluent limits. The TMDLs are derived from waste load allocations from point sources plus load allocation from non-point sources and plus a margin of safety in determine the TMDLs.

Using ambient water quality data monitoring, summer and all season geometric means were determined for each Category 5 listed segment (303(d) list). Given the two surface water quality criteria of 200 CFU/100 ml and 400 CFU/100 ml in FW2 waters, computations were necessary for both criteria and resulted in two values for percent reduction for each stream segment. The higher (more stringent) percent reduction value was selected as the TMDL and will be applied to nonpoint and stormwater point sources as a whole or apportioned to categories of nonpoint and stormwater point sources within the streamshed boundary. The extent to which nonpoint and stormwater point sources have been identified or need to be identified or verified varies by segment based on data availability, watershed size and complexity, and pollutant sources. Implementation strategies to achieve SWQS are addressed in the Reports.

3. TMDL for Lakes:

Originator: New Jersey Department of Environmental Protection (NJDEP), Bureau of Environmental Analysis and Restoration (BEAR)

Abstract: The pollutant of concern for the Eutrophic Lake TMDLs is phosphorus. Phosphorus is an essential nutrient for plants and algae, but is considered a pollutant when it stimulates excessive plant and algae growth. Overgrown vegetation and algae blooms in lakes can prevent recreational use for fishing and swimming. In severe cases, plant and algae die-off can deplete oxygen in the lake raising the potential for killing fish in the lake.

Potential sources of phosphorus include discharges from sewage treatment plants, combined sewer overflows and stormwater runofff. As stormwater flows over the land, it may pick up phosphorus. Phosphorus contributions to stormwater runoff are calculated based on land uses within the lake's watershed.

The State of New Jersey's 2002 Integrated List of Waterbodies identified several lakes as being eutrophic as a result of evaluations performed through the State's Clean Lakes Program. Indicators used to determine trophic status included elevated total phosphorus (TP), elevated chlorophyll-a, and/or macrophyte density. A UAL of 0.07 kg TP/ha/yr was used to estimate air deposition of phosphorus directly onto the lake surface. This value was developed from statewide mean concentrations of total phosphorus from the New Jersey Air Deposition Network (Eisenreich and Reinfelder, 2001). Land uses and calculated runoff loading rates for each of the lakes and estimates of loading rates from septic systems, waterfowl and from internal sources (sediment regeneration, macrophyte decomposition) where such estimates had already been developed previously for each of the lakes. Groundwater loads were estimated for lakes know to have a substantial groundwater flow component. The annual groundwater flow was multiplied by a phosphorus concentration of 0.1-mg TP/1 and then converted to kg TP/yr.

These TMDLs serve, as the foundation on which restoration plans will be developed to restore eutrophic lakes and thereby attain applicable surface water quality standards (SWQS). A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reduction for pollutants of concern as necessary to meet SWQS. The SWQS define both numerical and narrative criteria that address eutrophication in lakes due to overfertilization. Phosphorus sources were characterized on an annual scale (kg TP/yr) for both point and nonpoint sources. Runoff from land surfaces comprises a substantial source of phosphorus into lakes. An empirical model was used to relate annual phosphorus load and steady-state in-lake concentration of total phosphorus. To achieve the TMDLs, overall load reductions were calculated for at least eight and, depending on the amount of information available, up to 14 source categories. In order to track effectiveness of remediation measures (including TMDLs) and to develop baseline and trend information on lakes, the Department of Environment Protection will augment its ambient monitoring program to include lakes on a rotating schedule. The implementation plan also calls for the collection of additional

monitoring data and the development of a Lake Restoration Plan for each lake for which TMDLs are being established. These plans will consider what specific measures are necessary to achieve the nutrient reductions required by the TMDL, as well as what in-lake measurers need to be taken to supplement the nutrient reductions required by the TMDL.

4. Category One Stream Buffer:

Originator: New Jersey Department of Environmental Protection, Division of Landuse Management, Bureau of Freshwater & Biological Monitoring

Abstract: ADVISORY: Users should check back periodically for updated releases and attention to the information contained within this metadata record is important.
This data is a digital representation of New Jersey's Surface Water Quality Standards in accordance with "Surface Water Quality Standards for New Jersey Waters" as designated in N.J.A.C. 7:9 B. The Surface Water Quality Standards (SWQS) establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. These are reflected in use classifications assigned to specific waters. The line-work has been broken/altered to reflect the location written in the standards text. When interpreting the surface water quality standards, the Surface Water Quality Standards regulations at N.J.A.C. 7:9B always take precedence. The GIS layer is supplemental only and is not legally binding.

APPENDIX B. MUNICIPAL REGULATION CHECKLIST

New Jersey Stormwater
Best Management Practices Manual

February 2004

http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

A P P E N D I X B

Municipal Regulations Checklist

A checklist for incorporating nonstructural stormwater management strategies into local regulations

As part of the requirements for municipal stormwater management plans in the Stormwater Management Rules at N.J.A.C. 7:8-4, municipalities are required to evaluate the municipal master plan, and land use and zoning ordinances to determine what adjustments need to be made to allow the implementation of nonstructural stormwater management techniques, also called low impact development techniques, which are presented in *Chapter 2: Low Impact Development Techniques. Chapter 3: Regional and Municipal Stormwater Management Plans* provides information on the development of municipal stormwater management plans, including the evaluation of the master plan, and land use and zoning ordinances. This checklist was prepared to assist municipalities in identifying the specific ordinances that should be evaluated, and the types of changes to be incorporated to address the requirements of the Stormwater Management Rules.

Part 1: Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharge and stormwater runoff quality and quantity.

A. Preservation of Natural Areas

Municipal regulations should include requirements to preserve existing vegetated areas, minimize turf grass lawn areas, and use native vegetation.

❑ Yes ❑ No Are applicants required to provide a layout of the existing vegetated areas, and a description of the conditions in those areas?

❑ Yes ❑ No Does the municipality have maximum as well as minimum yard sizing ordinances?

❑ Yes ❑ No Are residents restricted from enlarging existing turf lawn areas?

❑ Yes ❑ No Do the ordinances provide incentives for the use of vegetation as filters for stormwater runoff?

❑ Yes ❑ No Do the ordinances require a specific percentage of permanently preserved open space as part of the evaluation of cluster development?

B. Tree Protection Ordinances

Municipalities often have a tree ordinance to minimize the removal of trees and to replace trees that are removed. However, while tree ordinances protect the number of trees, they do not typically address the associated leaf litter or smaller vegetation that provides additional water quality and quantity benefits. Municipalities should consider enhancing tree ordinances to a forest ordinance that would also maintain the benefits of a forested area.

❑ Yes ❑ No Does the municipality have a tree protection ordinance?

❑ Yes ❑ No Can the municipality include a forest protection ordinance?

❑ Yes ❑ No If forested areas are present at development sites, is there a required percentage of the stand to be preserved?

C. Landscaping Island and Screening Ordinances

Municipalities often have ordinances that require landscaping islands for parking areas. The landscaping islands can provide ideal opportunities for the filtration and disconnection of runoff, or the placement of small LID-BMPs. Screening ordinances limit the view of adjoining properties, parking areas, or loading areas. Low maintenance vegetation can be required in islands and areas used for screening to provide stormwater quality, groundwater recharge, or stormwater quantity benefits.

❑ Yes ❑ No Do the ordinances require landscaping islands in parking lots, or between the roadway and the sidewalk? Can the ordinance be adjusted to require vegetation that is more beneficial for stormwater quality, groundwater recharge, or stormwater quantity, but that does not interfere with driver vision at the intersections?

❑ Yes ❑ No Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

❑ Yes ❑ No Do the ordinances require screening from adjoining properties? Can the screening criteria require the use of vegetation to the maximum extent practicable before the use of walls or berms?

D. Riparian Buffers

Municipalities may have existing buffer and/or floodplain ordinances that require the protection of vegetation adjacent to streams. Municipalities should consult existing regulations adopted by the Department to ensure that riparian buffer or floodplain ordinances reflect the requirements of the Department within these areas. The municipality should consider conservation restrictions and allowable maintenance to ensure the preservation of these areas.

❑ Yes ❑ No Is there a stream buffer or floodplain ordinance in the community?

❑ Yes ❑ No Is the ordinance consistent with existing state regulatory requirements?

❑ Yes ❑ No Does the ordinance require a conservation easement, or other permanent restrictions on buffer areas?

❑ Yes ❑ No Does the ordinance identify or limit when stormwater outfall structures can cross the buffer?

❑ Yes ❑ No Does the ordinance give detailed information on the type of maintenance and/or activities that is allowed in the buffer?

Part 2: Minimizing Land Disturbance

The minimization of disturbance can be used at different phases of a development project. The goal is to limit clearing, grading, and other disturbance associated with development to protect existing features that provide stormwater benefits. Zoning ordinances typically limit the amount of impervious surfaces on building lots, but do not limit the amount of area that can be disturbed during construction. This strategy helps preserve the site's existing hydrologic character, as well as limiting the occurrence of soil compaction.

A. Limits of Disturbance

Designing with the terrain, or site fingerprinting, requires an assessment of the characteristics of the site and the selection of areas for development that would minimize the impact. This can be incorporated into the requirements for existing site conditions and the environmental impact statement. Limits of disturbance should be incorporated into construction plans reviewed and approved by the municipality. Setbacks should be evaluated to determine whether they can be reduced. The following maximum setbacks are recommended for low impact development designs:

- front yard – 20 feet;
- rear yard – 25 feet; and
- side yard – 8 feet.

❑ Yes ❑ No As part of the depiction of existing conditions, are environmentally critical and environmentally constrained areas identified? (Environmentally critical areas are areas or features with significant environmental value, such as steep slopes, stream corridors, natural heritage priority sites, and habitats of threatened and endangered species. Environmentally constrained areas are those with development restrictions, such as wetlands, floodplains, and sites of endangered species.)

❑ Yes ❑ No Can any of the existing setbacks be reduced?

❑ Yes ❑ No Are there maximum turf grass or impervious cover limits in any of the setbacks?

❑ Yes ❑ No Do the ordinances inhibit or prohibit the clearcutting of the project site as part of the construction?

❑ Yes ❑ No Is the traffic of heavy construction vehicles limited to specific areas, such as areas of proposed roadway? Are these areas required to be identified on the plans and marked in the field?

❑ Yes ❑ No Do the ordinances require the identification of specific areas that provide significant hydrologic functions, such as existing surface storage areas, forested areas, riparian corridors, and areas with high groundwater recharge capabilities?

❑ Yes ❑ No Does the municipality require an as-built inspection before issuing a certificate of occupancy? If so, does the inspection include identification of compacted areas, if they exist within the site?

❑ Yes ❑ No Does the municipality require the restoration to compacted areas in accordance with the Soil Erosion and Sediment Control Standards?

B. Open Space and Cluster Development

Open space areas are restricted land that may be set aside for conservation, recreation, or agricultural use, and are often associated with cluster development requirements. Since open space can have a variety of uses, the municipality should evaluate its open space ordinances to determine whether amendments are necessary to provide improved stormwater benefits.

❑ Yes ❑ No Are open space or cluster development designs allowed in the municipality?

❑ Yes ❑ No Are flexible site design incentives available for developers that utilize open space or cluster design options?

❑ Yes ❑ No Are there limitations on the allowable disturbance of existing vegetated areas in open space?

❑ Yes ❑ No Are the requirements to re-establish vegetation in disturbed areas dedicated for open space?

❑ Yes ❑ No Is there a maximum allowable impervious cover in open space areas?

Part 3: Impervious Area Management

The amount of impervious area, and its relationship to adjacent vegetated areas, can significantly change the amount of runoff that needs to be addressed by BMPs. Most of a site's impervious surfaces are typically located in the streets, sidewalks, driveway, and parking areas. These areas are further hampered by requirements for continuous curbing that prevent discharge from impervious surfaces into adjacent vegetated areas.

A. Streets and Driveways

Street widths of 18 to 22 feet are recommended for low impact development designs in low density residential developments. Minimum driveway widths of 9 and 18 feet for one lane and two lanes, respectively, are also recommended. The minimum widths of all streets and driveways should be evaluated to demonstrate that the proposed width is the narrowest possible consistent with safety and traffic concerns and requirements. Municipalities should evaluate which traffic calming features, such as circles, rotaries, medians, and islands, can be vegetated or landscaped. Cul-de-sacs can also be evaluated to reduce the radius area, or to provide a landscape island in the center.

❑ Yes ❑ No Are the street widths the minimum necessary for traffic density, emergency vehicle movement, and roadside parking?

❑ Yes ❑ No Are street features, such as circles, rotaries, or landscaped islands allowed to or required to receive runoff?

❑ Yes ❑ No Are curb cuts or flush curbs with curb stops an allowable alternative to raised curbs?

❑ Yes ❑ No Can the minimum cul-de-sac radius be reduced or is a landscaped island required in the center of the cul-de-sac?

❑ Yes ❑ No Are alternative turn-arounds such as "hammerheads" allowed on short streets in low density residential developments?

❑ Yes ❑ No Can the minimum driveway width be reduced?

❑ Yes ❑ No Are shared driveways permitted in residential developments?

B. Parking Areas and Sidewalks

A mix of uses at a development site can allow for shared parking areas, reducing the total parking area. Municipalities require minimum parking areas, but seldom limit the total number of parking spaces. Table 1 shows recommendations for minimum parking space ratios for low impact design:

Table 1: Low Impact Development Parking Space Ratios

Use	Parking Ratio per 1000 sq. ft. of Gross Floor Area
Professional office building	Less than 3.0
Shopping centers	Less than 4.5

❑ Yes ❑ No Can the parking ratios be reduced?

❑ Yes ❑ No Are the parking requirements set as maximum or median rather than minimum requirements?

❑ Yes ❑ No Is the use of shared parking arrangements allowed to reduce the parking area?

❑ Yes ❑ No Are model shared parking agreements provided?

❑ Yes ❑ No Does the presence of mass transit allow for reduced parking ratios?

❑ Yes ❑ No Is a minimum stall width of 9 feet allowed?

❑ Yes ❑ No Is a minimum stall length of 18 feet allowed?

❑ Yes ❑ No Can the stall lengths be reduced to allow vehicle overhang into a vegetated area?

❑ Yes ❑ No Do ordinances allow for permeable material to be used in overflow parking areas?

❑ Yes ❑ No Do ordinances allow for multi-level parking?

❑ Yes ❑ No Are there incentives to provide parking that reduces impervious cover, rather than providing only surface parking lots?

Sidewalks can be made of pervious material or disconnected from the drainage system to allow runoff to re-infiltrate into the adjacent pervious areas.

❑ Yes ❑ No Do ordinances allow for sidewalks constructed with pervious material?

❑ Yes ❑ No Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

C. Unconnected Impervious Areas

Disconnection of impervious areas can occur in both low density development and high density commercial development, provided sufficient vegetated area is available to accept dispersed stormwater flows. Areas for disconnection include parking lot or cul-de-sac islands, lawn areas, and other vegetated areas.

❑ Yes ❑ No Are developers required to disconnect impervious surfaces to promote pollutant removal and groundwater recharge?

❑ Yes ❑ No Do ordinances allow the reduction of the runoff volume when runoff from impervious areas are re-infiltrated into vegetated areas?

❑ Yes ❑ No Do ordinances allow flush curb and/or curb cuts to allow for runoff to discharge into adjacent vegetated areas as sheet flow?

Part 4: Vegetated Open Channels

The use of vegetated channels, rather than the standard concrete curb and gutter configuration, can decrease flow velocity, and allow for stormwater filtration and re-infiltration. One design option is for vegetated channels that convey smaller storm events, such as the water quality design storm, and provide an overflow into a storm sewer system for larger storm events.

❑ Yes ❑ No Do ordinances allow or require vegetated open channel conveyance instead of the standard curb and gutter designs?

❑ Yes ❑ No Are there established design criteria for vegetated channels?

APPENDIX C. LOW IMPACT DEVELOPEMNT CHECKLIST

New Jersey Stormwater
Best Management Practices Manual

February 2004

http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

APPENDIX A

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

According to the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the groundwater recharge, stormwater quality, and stormwater quantity standards established by the Rules for major land development projects must be met by incorporating nine specific nonstructural stormwater management strategies into the project's design to the maximum extent practicable.

To accomplish this, the Rules require an applicant seeking land development approval from a regulatory board or agency to identify those nonstructural strategies that have been incorporated into the project's design. In addition, if an applicant contends that it is not feasible to incorporate any of the specific strategies into the project's design, particularly for engineering, environmental, or safety reasons, the Rules further require that the applicant provide a basis for that contention.

This checklist has been prepared to assist applicants, site designers, and regulatory boards and agencies in ensuring that the nonstructural stormwater management requirements of the Rules are met. It provides an applicant with a means to identify both the nonstructural strategies incorporated into the development's design and the specific low impact development BMPs (LID-BMPs) that have been used to do so. It can also help an applicant explain the engineering, environmental, and/or safety reasons that a specific nonstructural strategy could not be incorporated into the development's design.

The checklist can also assist municipalities and other land development review agencies in the development of specific requirements for both nonstructural strategies and LID-BMPs in zoning and/or land use ordinances and regulations. As such, where requirements consistent with the Rules have been adopted, they may supersede this checklist.

Finally, the checklist can be used during a pre-design meeting between an applicant and pertinent review personnel to discuss local nonstructural strategies and LID-BMPs requirements in order to optimize the development's nonstructural stormwater management design.

Since this checklist is intended to promote the use of nonstructural stormwater management strategies and provide guidance in their incorporation in land development projects, municipalities are permitted to revise it as necessary to meet the goals and objectives of their specific stormwater management program and plan within the limits of N.J.A.C. 7:8.

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

Municipality: _____

County: _____ Date: _____

Review board or agency: _____

Proposed land development name: _____

Lot(s): _____ Block(s): _____

Project or application number: _____

Applicant's name: _____

Applicant's address: _____

_____

Telephone: _____ Fax: _____

Email address: _____

Designer's name: _____

Designer's address: _____

_____

Telephone: _____ Fax: _____

Email address: _____

Part 1: Description of Nonstructural Approach to Site Design

In narrative form, provide an overall description of the nonstructural stormwater management approach and strategies incorporated into the proposed site's design. Attach additional pages as necessary. Details of each nonstructural strategy are provided in Part 3 below.

Part 2: Review of Local Stormwater Management Regulations

Title and date of stormwater management regulations used in development design:

_____

Do regulations include nonstructural requirements? Yes: _____ No: _____

If yes, briefly describe: _____

_____

_____

List LID-BMPs prohibited by local regulations: _____

_____

_____

Pre-design meeting held? Yes: _____ Date: _____ No: _____

Meeting held with: _____

_____

_____

Pre-design site walk held? Yes: _____ Date: _____ No: _____

Site walk held with: _____

_____

_____

Other agencies with stormwater review jurisdiction:

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Part 3: Nonstructural Strategies and LID-BMPs in Design

3.1 Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharges and runoff quality and quantity. This section of the checklist helps identify the vegetation and landscaping strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to help maintain existing recharge rates and/or minimize or prevent increases in runoff quantity and pollutant loading.

A. Has an inventory of existing site vegetation been performed? Yes: _____ No: _____

If yes, was this inventory a factor in the site's layout and design? Yes: _____ No: _____

B. Does the site design utilize any of the following nonstructural LID-BMPs?

Preservation of natural areas? Yes: _____ No: _____ If yes, specify % of site: _____

Native ground cover? Yes: _____ No: _____ If yes, specify % of site: _____

Vegetated buffers? Yes: _____ No: _____ If yes, specify % of site: _____

C. Do the land development regulations require these nonstructural LID-BMPs?

Preservation of natural areas? Yes: _____ No: _____ If yes, specify % of site: _____

Native ground cover? Yes: _____ No: _____ If yes, specify % of site: _____

Vegetated buffers? Yes: _____ No: _____ If yes, specify % of site: _____

D. If vegetated filter strips or buffers are utilized, specify their functions:

Reduce runoff volume increases through lower runoff coefficient: Yes: _____ No: _____

Reduce runoff pollutant loads through runoff treatment: Yes: _____ No: _____

Maintain groundwater recharge by preserving natural areas: Yes: _____ No: _____

3.2 Minimize Land Disturbance

Minimizing land disturbance is a nonstructural LID-BMP that can be applied during both the development's construction and post-construction phases. This section of the checklist helps identify those land disturbance strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to minimize land disturbance and the resultant change in the site's hydrologic character.

A. Have inventories of existing site soils and slopes been performed? Yes: _____ No: _____

If yes, were these inventories factors in the site's layout and design? Yes: _____ No: _____

B. Does the development's design utilize any of the following nonstructural LID-BMPs?

Restrict permanent site disturbance by land owners? Yes: _____ No: _____

If yes, how: _____

_____

Restrict temporary site disturbance during construction? Yes: _____ No: _____

If yes, how: _____

_____

Consider soils and slopes in selecting disturbance limits? Yes: _____ No: _____

If yes, how: _____

_____

C. Specify percentage of site to be cleared: _____ Regraded: _____

D. Specify percentage of cleared areas done so for buildings: _____

For driveways and parking: _____ For roadways: _____

E. What design criteria and/or site changes would be required to reduce the percentages in C and D above?

_____

_____

_____

F. Specify site's hydrologic soil group (HSG) percentages:

HSG A: _____ HSG B: _____ HSG C: _____ HSG D: _____

G. Specify percentage of each HSG that will be permanently disturbed:

HSG A: _____ HSG B: _____ HSG C: _____ HSG D: _____

H. Locating site disturbance within areas with less permeable soils (HSG C and D) and minimizing disturbance within areas with greater permeable soils (HSG A and B) can help maintain groundwater recharge rates and reduce runoff volume increases. In light of the HSG percentages in F and G above, what other practical measures if any can be taken to achieve this?

_____

_____

_____

I. Does the site include Karst topography? Yes: _____ No: _____

If yes, discuss measures taken to limit Karst impacts:

_____

_____

_____

_____

_____

_____

3.3 Impervious Area Management

New impervious surfaces at a development site can have the greatest adverse effect on groundwater recharge and stormwater quality and quantity. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into a proposed development's design to comprehensively manage the extent and impacts of new impervious surfaces.

A. Specify impervious cover at site: Existing: _____ Proposed: _____

B. Specify maximum site impervious coverage allowed by regulations: _____

C. Compare proposed street cartway widths with those required by regulations:

Type of Street	Proposed Cartway Width (feet)	Required Cartway Width (feet)
Residential access – low intensity		
Residential access – medium intensity		
Residential access – high intensity with parking		
Residential access – high intensity without parking		
Neighborhood		
Minor collector – low intensity without parking		
Minor collector – with one parking lane		
Minor collector – with two parking lanes		
Minor collector – without parking		
Major collector		

D. Compare proposed parking space dimensions with those required by regulations:

Proposed: _____ Regulations: _____

E. Compare proposed number of parking spaces with those required by regulations:

Proposed: _____ Regulations: _____

F. Specify percentage of total site impervious cover created by buildings:

By driveways and parking: _____ By roadways: _____

G. What design criteria and/or site changes would be required to reduce the percentages in F above?

_____

_____

_____

_____

H. Specify percentage of total impervious area that will be unconnected:

Total site: _____ Buildings: _____ Driveways and parking: _____ Roads: _____

I. Specify percentage of total impervious area that will be porous:

Total site: _____ Buildings: _____ Driveways and parking: _____ Roads: _____

J. Specify percentage of total building roof area that will be vegetated: _____

K. Specify percentage of total parking area located beneath buildings: _____

L. Specify percentage of total parking located within multi-level parking deck: _____

3.4 Time of Concentration Modifications

Decreasing a site's time of concentration (Tc) can lead directly to increased site runoff rates which, in turn, can create new and/or aggravate existing erosion and flooding problems downstream. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to effectively minimize such Tc decreases.

When reviewing Tc modification strategies, it is important to remember that a drainage area's Tc should reflect the general conditions throughout the area. As a result, Tc modifications must generally be applied throughout a drainage area, not just along a specific Tc route.

A. Specify percentage of site's total stormwater conveyance system length that will be:

Storm sewer: _____ Vegetated swale: _____ Natural channel: _____

Stormwater management facility: _____ Other: _____

Note: the total length of the stormwater conveyance system should be measured from the site's downstream property line to the downstream limit of sheet flow at the system's headwaters.

B. What design criteria and/or site changes would be required to reduce the storm sewer percentages and increase the vegetated swale and natural channel percentages in A above?

_____

_____

_____

C. In conveyance system subareas that have overland or sheet flow over impervious surfaces or turf grass, what practical and effective site changes can be made to:

Decrease overland flow slope: _____

_____

_____

Increase overland flow roughness: _____

_____

_____

3.5 Preventative Source Controls

The most effective way to address water quality concerns is by pollution prevention. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to reduce the exposure of pollutants to prevent their release into the stormwater runoff.

A. Trash Receptacles

Specify the number of trash receptacles provided: _____

Specify the spacing between the trash receptacles: _____

Compare trash receptacles proposed with those required by regulations:

Proposed: _____ Regulations: _____

B. Pet Waste Stations

Specify the number of pet waste stations provided: _____

Specify the spacing between the pet waste stations: _____

Compare pet waste stations proposed with those required by regulations:

Proposed: _____ Regulations: _____

C. Inlets, Trash Racks, and Other Devices that Prevent Discharge of Large Trash and Debris

Specify percentage of total inlets that comply with the NJPDES storm drain inlet criteria: _____

D. Maintenance

Specify the frequency of the following maintenance activities:

Street sweeping: Proposed: _____ Regulations: _____

Litter collection: Proposed: _____ Regulations: _____

Identify other stormwater management measures on the site that prevent discharge of large trash and debris:

_____

_____

E. Prevention and Containment of Spills

Identify locations where pollutants are located on the site, and the features that prevent these pollutants from being exposed to stormwater runoff:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Part 4: Compliance with Nonstructural Requirements of NJDEP Stormwater Management Rules

1. Based upon the checklist responses above, indicate which nonstructural strategies have been incorporated into the proposed development's design in accordance with N.J.A.C. 7:8-5.3(b):

No.	Nonstructural Strategy	Yes	No
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 low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.		
8.	Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.		
9.	Provide preventative source controls.		

2. For those strategies that have not been incorporated into the proposed development's design, provide engineering, environmental, and/or safety reasons. Attached additional pages as necessary.

APPENDIX D. GREENWICH TOWNSHIP MITIGATION PROJECTS