Municipal Stormwater Management Plan

for the

Borough of Hawthorne
Passaic County, New Jersey

Prepared by:

Boswell Engineering

330 Phillips Avenue
South Hackensack, New Jersey

File No. HW-558B

July 2021

BOSWELL ENGINEERING

EST. 1924

ENGINEERS - SURVEYORS - PLANNERS - SCIENTISTS
330 PHILLIPS AVENUE, SOUTH HACKENSACK, N.J. 07606
TEL: (201) 641-0770 • FAX: (201) 641-1831

To Whom it May Concern:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Sincerely,

Stephen T. Boswell, Ph.D, P.E., P.P., LSRP, SECB
Professional Engineer
NJ License No. 34680

TABLE OF CONTENTS

APPENDICES

I. Introduction

This Municipal Stormwater Management Plan (MSWMP) documents the strategy for the Borough of Hawthorne (the Borough) to address stormwater-related impacts. The creation of this Plan is required by N.J.A.C. 7:14A-25 Municipal Stormwater Regulations. This Plan contains the required elements described in N.J.A.C. 7:8 Stormwater Management Rules. The Plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major developments. As per the Borough's Stormwater Control Ordinance, a "Major Development" means:

> An individual "development," as well as multiple developments that individually or collectively result in:
>
> 1. The disturbance of one or more acres of land since February 2, 2004;
> 2. The creation of one-quarter acre or more of "regulated impervious surface" since February 2, 2004;
> 3. The creation of one-quarter acre or more of "regulated motor vehicle surface" since December 2, 2021; or
> 4. A combination of 2 and 3 above that totals an area of one-quarter acre or more. The same surface shall not be counted twice when determining if the combination area equals one-quarter acre or more.
>
> Major development includes all developments that are part of a common plan of development or sale (for example, phased residential development) that collectively or individually meet any one or more of paragraphs 1, 2, 3, or 4 above. Projects undertaken by any government agency that otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."

These standards are intended to minimize the adverse impact of stormwater runoff on water quality, water quantity, and the loss of groundwater recharge that provides baseflow in receiving water bodies.

As per Appendix C of the New Jersey Best Management Practices Manual last revised in March of 2020, municipalities with less than one square mile of vacant or agricultural lands are not required to complete a "build-out" analysis. Therefore, this plan does not require a "build-out" analysis as the Borough of Hawthorne contains 0.085 sq. mi. of vacant land and no of agricultural land. The Plan also addresses the review and update of existing ordinances, the Borough Master Plan, and other planning documents to allow for project designs that include low-impact development techniques. The Borough Master Plan was last reviewed August 16, 2011. The final component of this Plan is a proposed mitigation strategy to be reviewed by Hawthorne's governing body for future variances or exemptions of the design and performance standards. As part of the mitigation section of the stormwater plan, specific stormwater management measures are identified to lessen the impact of existing development.

This plan utilizes existing regulatory framework and technical guidance documents, along with the Borough of Hawthorne's Stormwater Control Ordinance. This MSWMP shall be reviewed and updated as necessary and as a component of the reexamination of the Borough's municipal Master Plan every 10 years.

II. Goals

The goals of this MSWMP as well as a brief description of the Borough's strategies to implement the goals are as follows:

- ***Reduce flood damage, including damage to life and property.***

  The Borough has incorporated green infrastructure and several non-structural stormwater strategies into their Zoning and Site Plan ordinances. The purpose of some of these non-structural strategies is to reduce damage to life and property by minimizing flooding. New major developments are reviewed for compliance with the Stormwater Management Rules at N.J.A.C. 7:8. To achieve this reduction the Borough maintains a street sweeping schedule and inspects, cleans, and maintains catch basins and storm drain inlets as required by the Borough's Stormwater Pollution Prevention Plan (SPPP) and New Jersey Pollutant Discharge Elimination System (NJPDES) permit (NJG0149616).

- ***Minimize, to the extent practical, any increase in stormwater runoff from any new development.***

  The Borough is implementing the current Residential Site Improvement Standards (RSIS) which require a reduction in runoff during all rain events for residential developments and commercial developments will be required to follow all regulations in N.J.A.C. 7:8 and 7:15 to minimize any increase in stormwater runoff. Additionally, the Borough is reviewing and updating existing ordinances to incorporate requirements for low-impact development.

- ***Reduce soil erosion from any development or construction project.***

  As per The Standards for Soil Erosion and Sediment Control in New Jersey (SESC) last revised in January of 2014, a "Project" is defined as:

  > Any disturbance of more than 5,000 square feet of the surface area of land (1) for the accommodation of construction for which the State Uniform Construction Code would require a construction permit, except that the construction of a single-family dwelling unit shall not be deemed a 'project' under this act unless such unit is part of a proposed subdivision, site plan, conditional use, zoning variance, planned development or construction permit application involving two or more such single-family dwelling units; (2) for the demolition of one or more structures; (3) for the construction of a parking lot; (4) for the construction of a public facility; (5) for the operation of any mining or quarrying activity; or (6) for the clearing or grading of any land for other than agricultural or horticultural purposes.

  Currently all development projects meeting this definition are required to obtain approval from the Hudson Essex Passaic Soil Conservation District (HEPSCD).

- ***Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures.***

  Proposed culverts and bridges and other in-stream structures will be reviewed for compliance with the NJDEP Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A and the Flood Hazard Control Act Rules at N.J.A.C. 7:13. Existing in-stream structures are maintained and inspected a minimum of once a year. As part of this inspection, the Borough performs an outfall condition assessment that includes searching for signs of scour and illicit discharge during dry weather conditions as defined within Chapter 3.6: MS4 Outfall Pipe Mapping and Illicit

Discharge and Scour Detection and Control of the Tier A Municipal Stormwater Guidance Document.

- ***Maintain groundwater recharge.***

  As per N.J.A.C. 7:8-5.4(b)2, groundwater recharge is not required for projects within the "urban redevelopment area" which include areas delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA 1), Designated Centers, Cores or Nodes; designated as CAFRA Centers, Cores, or Nodes; designated as Urban Enterprise Zones; and designated as Urban Coordinating Council Empowerment Neighborhoods. The entirety of the Borough lies within the Metropolitan Planning Area (PA 1); therefore, the groundwater recharge standard is not applicable. The Borough enforces existing ordinances to limit disturbance associated with development. Through restricting the allowable impervious cover, groundwater recharge can be maintained or increased.

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

  Nonpoint source (NPS) pollution is water generated by everyday activities, such as fertilizing lawns, walking pets, changing motor oil or gasoline, and littering. NPS pollution is caused when contaminants deposited on the land surface are washed off and carried into nearby waterways or ground water. To limit the discharge of these common pollutants the Borough has adopted and maintains several ordinances with applicable fines. These ordinances include the following: litter, wildlife feeding, pet waste, and yard waste management. Additionally, the Borough inspects, cleans, maintains, and retrofits existing inlets to reduce litter and prevent blockages within the system.

- ***Maintain the integrity of stream channels for their biological functions, as well as for drainage.***

  Biological integrity is the ability to support and maintain a balanced, integrated adaptive assemblage of organisms having species composition, diversity, and functional organization comparable to that of the natural habitat of the region. Changes that result from human activities cause a divergence from biological integrity resulting in a decline in biological condition. The ecology of streams and rivers is intimately linked with and reflective of the watersheds they drain.

  The efficacy of drainage provided by streams is dependent on channel form. Sedimentation and erosion of stream channels associated with stormwater runoff and discharge, result in an increase in severity and frequency of floods as well as the displacement and destruction of habitat for fish and other water dependent species, and a decrease in base flows in watercourses. The most significant effect of stormwater runoff on channel form is the increased frequency of smaller floods that approach or exceed bank-full. Therefore, in highly developed areas, while armoring of channels may provide short-term control of bed and bank erosion, dispersed management of runoff from impervious surfaces may be the most effective approach to controlling erosion and sedimentation of stream channels.

  The Borough seeks to maintain stream channel integrity for both biological and drainage functions through the adoption of the Borough's Stormwater Control Ordinance. This ordinance will govern stormwater quantity, stormwater quality, and groundwater recharge thereby reducing pollutants within the flow which affect biological function and drainage conveyance ability of stream channels. Additionally, the adoption of this ordinance will reduce the introduction of pollutants allowed to reach the Borough's waterways and assist in reducing or preventing TMDL's. During the Borough's outfall condition assessment, a physical inspection is performed for all outfall pipes, signs of scour and illicit discharges are reported and handled in accordance with the Borough's SPPP.

- ***Minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, and other uses of water.***

  The Borough utilizes public education and facility inspections to limit pollutants in stormwater runoff from new and existing developments. During the review process of applications for major development, the Borough enforces their Stormwater Control Ordinance (Ord. 2262-20) as it pertains to Section 437-4. "Stormwater Management Requirements for Major Development" *(Appendix A)*. These requirements include stipulations to satisfy the green infrastructure, groundwater recharge, stormwater runoff quality, and stormwater runoff quantity standards identified within the ordinance. As per the Borough's NJPDES permit (NJG0149616) and as specified within the SPPP, private stormwater facilities are inspected annually to ensure functionality and notices are issued to ensure compliance. Additionally, the Borough issues educational material and conducts educational outreach to inform residents concerning the consequences of pollution to the Borough's waterways.

- ***Protect public safety through the proper design and operation of stormwater basins.***

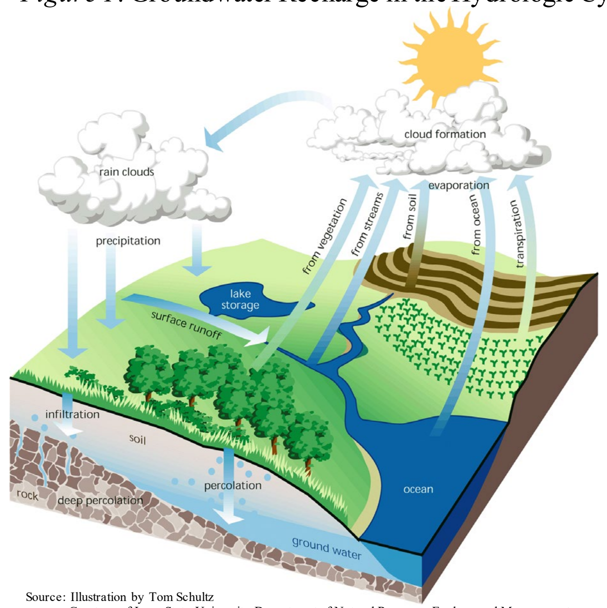
  The Borough reviews applications for major development to ensure that projects meet and comply with the standards within the Stormwater Management Rules at N.J.A.C. 7:8, Safety Standards for Stormwater Management Basins as outlined in N.J.A.C. 7:8-6, The Standards for Soil Erosion and Sediment Control in New Jersey, and the New Jersey Stormwater Best Management Practices Manual. The Borough is currently in the process of implementing a stormwater facility maintenance program to ensure adequate long-term cleaning, operation, and maintenance of all municipally owned or operated stormwater facilities, along with stormwater facilities not owned or operated by the municipality.

To achieve these goals, this Plan outlines specific stormwater design and performance standards for new development. Additionally, the plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the plan to ensure long-term effectiveness of stormwater management facilities. The plan also outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

III. Stormwater Discussion

Land development can dramatically alter the hydrologic cycle *(**Figure 1**)* of a site and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or draw that portion that has infiltrated into the ground and return it to the atmosphere through evapotranspiration.

Figure 1: Groundwater Recharge in the Hydrologic Cycle



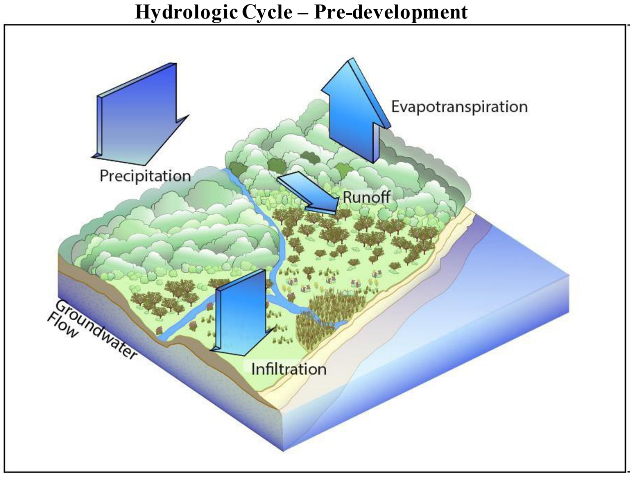
Source: Illustration by Tom Schultz
Courtesy of Iowa State University Department of Natural Resource Ecology and Management

Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates. Clearing and grading a site can remove depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site.

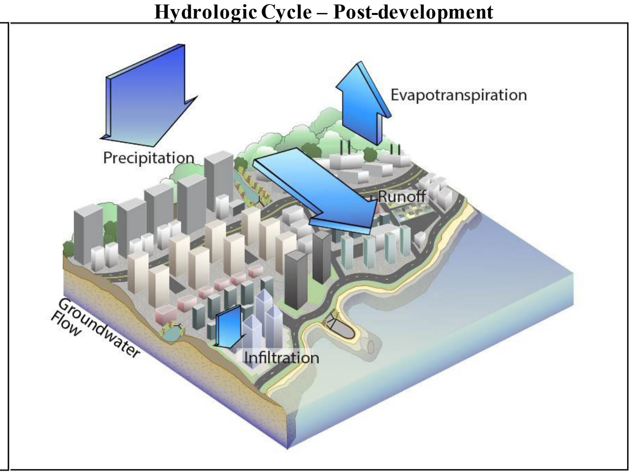
Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than natural areas *(**Figure 2**)*. This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the channel.

Figure 2: **Comparing Pre- and Post-Development Hydrologic Cycles**

Hydrologic Cycle – Pre-development



Hydrologic Cycle – Post-development



Source: New Jersey Stormwater Best Management Practices Manual
Chapter 1 Impacts of Development on Runoff

Filtration of runoff and removal of pollutants by surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into a stream. Increases in impervious area can also decrease opportunities for infiltration which, in turn, reduces stream base flow and groundwater recharge. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced base flows can also negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on base flows. Finally, erosion and sedimentation can destroy habitat from which some species cannot adapt.

In addition to increases in runoff peaks, volumes, and loss of groundwater recharge, land development often results in the accumulation of pollutants on the land surface that runoff can mobilize and transport to streams. New impervious surfaces and cleared areas created by development can accumulate a variety of pollutants from the atmosphere, fertilizers, animal wastes, and leakage and wear from vehicles. Pollutants can include metals, suspended solids, hydrocarbons, pathogens, and nutrients.

In addition to increased pollutant loading, land development can adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along stream banks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community.

Additional information regarding stormwater please refer to the NJDEP Stormwater in New Jersey webpage located at https://njstormwater.org/. For additional information regarding stormwater within the Borough of Hawthorne please visit the municipal website at https://www.hawthornenj.org/or request documentation from the current Superintendent of the Department of Public Works.

IV. Background

The Borough of Hawthorne encompasses 3.363-square miles in northeastern Passaic County, New Jersey. The Borough is primarily comprised of residential and commercial properties, as depicted on the Zoning Map ***(Figure 3)***. The Borough is largely built-out with only 0.085 sq. mi. (54.454 acres) of remaining developable open space, equating to approximately 2.53% of Hawthorne's total area ***(Figure 4)***. Borough is serviced completely by sanitary sewers, which are separated from the stormwater system. The Borough lies entirely within the Passaic Valley Sewerage Commission sewer service area ***(Figure 5)***. The Borough receives nearly 100% of its water supply from the Hawthorne Water Department ***(Figure 6)***. It is expected that a number of individual residences utilize groundwater wells. There are 22 potable public supply wells within the Borough, therefore a wellhead protection area map has been prepared ***(Figure 7)***. Hawthorne's waterways are depicted in ***Figure 8*** while ***Figure 9*** depicts the Borough's location on the United States Geological Survey (USGS) Quadrangle Maps.

Table 1: **Borough of Hawthorne Private Community Wells**

Well ID	Owner	Well Name	Well Address
1604001	Hawthorne Borough	Bamford Avenue Well (High School)	Bamford Avenue
1604001	Hawthorne Borough	Utter Avenue Well	Utter Avenue & Victor Place
1604001	Hawthorne Borough	Grand Avenue Well (Borough Hall)	Grand Avenue & Warburton Avenue
1604001	Hawthorne Borough	Goffle Hill Well	Goffle Hill Road & Sunrise Drive
1604001	Hawthorne Borough	Cedar Avenue Well	Cedar Avenue & May Street
1604001	Hawthorne Borough	First Avenue Well	First Avenue
1604001	Hawthorne Borough	Rea Avenue Well	Rea Avenue
1604001	Hawthorne Borough	Maitland Avenue Well	Maitland Avenue
1604001	Hawthorne Borough	Goffle Road Well 1	Goffle Road & Lafayette Extension
1604001	Hawthorne Borough	Goffle Road Well 3	Goffle Road & Goffle Hill Road
1604001	Hawthorne Borough	Goffle Road Well 4	Goffle Road & Lafayette Extension
1604001	Hawthorne Borough	Goffle Road Well 5	Alexander Avenue
1604001	Hawthorne Borough	Goffle Road Well 6	Douglas Avenue
1604001	Hawthorne Borough	Wagaraw Well 3	Wagaraw Avenue
1604001	Hawthorne Borough	Wagaraw Well 4	Wagaraw Avenue
1604001	Hawthorne Borough	Wagaraw Well 5	Wagaraw Avenue
1604001	Hawthorne Borough	Wagaraw Well 6	Wagaraw Avenue
1604001	Hawthorne Borough	Wagaraw Well 7	Wagaraw Avenue
1604001	Hawthorne Borough	Wagaraw Well 8	Wagaraw Avenue
1604001	Hawthorne Borough	South Wagaraw Well 10	Wagaraw Avenue
1604001	Hawthorne Borough	South Wagaraw Well 12	Wagaraw Avenue
1604001	Hawthorne Borough	South Wagaraw Well 15	Wagaraw Avenue

Hawthorne is bordered to the north by the Village of Ridgewood with the remaining 1.42 miles being shared with the Township of Wyckoff which extends 0.47 miles along the western boundary, the remainder of the western border is shared by the Boroughs of North Haledon (2.13 miles) and Prospect Park (0.93 miles), the City of Paterson to the south, the Boroughs of Fair Lawn (0.48 miles) and Glen Rock (1.28 miles) to the east. The entirety of the Borough lies within the Metropolitan Planning Area (PA 1) ***(Figure 10)***.

The Borough's population steadily increased from 1940 through 1970, however the population was in decline from 1970 through 1990. The population then significantly increased from 2000 through 2010, however, as of 2019 the population has declined 0.2% since 2010 before rebounding to 19,637 in 2020, as demonstrated in ***Table 1.*** Furthermore, as the population has fluctuated throughout the years, new development has continued through this time period. According to the United States Census Bureau, Population division, 7,118 households were reported for 2015-2019.

Table 1: **Borough of Hawthorne Resident Population Estimates**

Municipality	Census 1940	Census 1950	Census 1960	Census 1970	Census 1980	Census 1990	Census 2000	Census 2010	Census 2019	Census 2020
Borough of Hawthorne	12,610	14,816	17,735	19,173	18,200	17,084	18,218	18,786	18,753	19,637
Source: NJSDC 2000 Census Publication, New Jersey Population Trends 1790 to 2000 & U.S. Census Bureau, Population Division, May 2020										

Hawthorne is a primarily developed community, increased stormwater runoff volumes and pollutant loadings have likely impacted the Borough's waterways. Dwelling units constructed since the 1980s implement some of the new performance standards and best management practices (BMP) to alleviate increased stormwater runoff and pollutant loadings. Approximately 1.623 sq. mi. (48.26%)) of the Borough is considered impervious ***(Figure 11)***.

The State Planning Commission adopted the most recent State Development and Redevelopment Plan in March of 2001, effectively replacing the previous version adopted in 1992. The new State Plan delineates Planning Areas on the basis of natural and constructed characteristics and establishes the State's vision for future development. The State has defined five (5) planning areas which are listed from the most highly to least developed. These Planning Areas are as follows: the Metropolitan Planning Area (PA 1), the Suburban Planning Area (PA 2), Fringe Planning Area (PA 3), Rural Planning Area (PA 4), and the Environmentally Sensitive Planning Area (PA 5).

There are many environmentally sensitive features and landscapes of historic or aesthetic significance that are less than one square mile in extent or whose configuration does not readily permit application of the Policy Objectives of the previously established Planning Areas. Additionally, many sites of historic, cultural, scenic, or environmental sensitivity lie within developed areas or within Metropolitan, Suburban, or Fringe Planning Areas. Therefore, an additional ten planning areas are assigned to Critical Environmental Sites (CES) and Historic and Cultural Sites (HCS). These designations are as follows: Environmentally Sensitive Barrier Island Planning Area (PA 5B); Parkland, Openspace from Cross-Acceptance (PA 6); Federal Park (PA 7); State Park (PA8); New Jersey Meadowlands Area (PA 9); NJ Pinelands (PA 10); Water Bodies (PA 11); Military Bases (PA 12); Highlands Preservation Area (PA 13); and Ellis Island, NY Portions (PA 99).

The Borough lies entirely within the Metropolitan Planning Area (PA 1). This planning area is designated to regions that are considered Urban Redevelopment Areas and are not subject to groundwater recharge requirements. However, the Borough contains areas designated under Groundwater Recharge Rank A (16 to 23 in/yr), B (12 to 15 in/yr), C (8 to 10 in/yr), D (1 to 7 in/yr), E (0 in/yr), L (hydric soil with no calculated recharge value), and W (wetlands and open water with no calculated recharge value) as shown in ***Figure 12***. ***Figure 10*** depicts the planning areas in the Borough of Hawthorne.

Table 2 describes the definitions of the surface water classifications. In ***Figure 8***, "category" is shown, which is a compendium of all surface water classification designations for a given water body. Category describes a stream's surface water classification in terms of its general surface water class, its trout water status, and its antidegradation status. The surface waters within Hawthorne are categorized and located as follows:

- FW2-NT:
  - Passaic River (Permanent Identifier – 167722499)
    - The Passaic River defines the Borough's southern border with the City of Patterson and is found on Sublist 5 of the New Jersey Integrated List of Impaired Waterways *(see pages 14-15)*.
  - Goffle Brook (Permanent Identifier – 167724231, 167722512, 167732086, 167720543, 167731354, 167731359, 167724224, 167722505, 167722539, 167731494, 167731514, 167731515, 167731519, 167731523, 167731535, 167732087, 167731533, 167731716, and 167731717)
    - Goffle Brook runs from the northern boundary to the southern border to its confluence with Passaic River, effectively bisecting the municipality and is found on Sublist 5 of the New Jersey Integrated List of Impaired Waterways *(see page 14-15)*.
  - Goffle Brook Tributary (Permanent Identifier – 167731287, 167731288)
    - Two small unnamed tributaries, with a cumulative length of 0.10 miles, flow into the Goffle Brook along its length within the central portion of the Borough.
  - Deep Brook (Permanent Identifier – 167731498, 167731495, 167731525, 167731500, 167731528, 16773172, and 167740001)
    - Deep Brook flows approximately 0.93 miles primarily from north to south from the Borough's northern border to its confluence with the Saddle River.
  - Un-Coded Tributary (Permanent Identifier – 16773134, 167731343)
    - This tributary runs into un-coded tributary which leads into a lake/pond in the northern portion of the Borough.

Table 2: **Surface Water Quality Standards Classification**

Category	Definition
Freshwater General Surface Water Class	
FW1	**FW1** means those fresh waters, as designated in N.J.A.C. 7:9B-1.15(j), that are to be maintained in their natural state of quality (set aside for posterity) and not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities. These waters are set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s).
FW2	**FW2** means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters. In all FW2 waters the designated uses are: 1. Maintenance, migration and propagation of the natural and established biota; 2. Primary contact recreation; 3. Industrial and agricultural water supply; 4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and 5. Any other reasonable uses.

Trout Water Status - this is for information only and does not affect the water quality criteria for those waters.	
TP	***Trout production*** means waters designated at N.J.A.C. 7:9B-1.15I through (i) for use by trout for spawning or nursery purposes during their first summer.
TM	***Trout maintenance*** means waters designated at N.J.A.C. 7:9B-1.15I through (i) for the support of trout throughout the year.
NT	***Non-trout waters*** means fresh waters that have not been designated in N.J.A.C. 7:9B-1.15I through (h) as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.
Antidegradation	
ONRW	***Outstanding National Resource Waters*** means high quality waters that constitute an outstanding national resource (for example, waters of National/State Parks and Wildlife Refuges and waters of exceptional recreational or ecological significance). Waters classified as FW1 waters and Pinelands waters are Outstanding National Resource Waters.
FW1/Non-degradation	***Non-degradation waters*** means those waters set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, or exceptional water supply significance. These waters include all waters designated as FW1.
C1	***Category one waters*** means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (i), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions).
C2	***Category two waters*** means those waters not designated as Outstanding National Resource Waters or Category One at N.J.A.C. 7:9B-1.15 for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d).
Saline Waters	
SC	***Coastal saline waters*** means the general surface water classification applied to coastal saline waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(g). SE waters have the following designated uses: 1. Shellfish harvesting in accordance with N.J.A.C. 7:12; 2. Primary contact recreation; 3. Maintenance, migration and propagation of the natural and established biota; and 4. Any other reasonable uses.
SE	***Saline estuary waters*** means the general surface water classification applied to saline waters of estuaries.
SE1	***Saline estuary waters*** means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(d). SE1 waters have the following designated uses: 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 contact recreation; and 4. Any other reasonable uses.
SE2	***Saline estuary waters*** means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(e). SE2 waters have the following designated uses: 1. Maintenance, migration and propagation of the natural and established biota; 2. Migration of diadromous fish; 3. Maintenance of wildlife; 4. Secondary contact recreation; and 5. Any other reasonable uses.
SE3	***Coastal saline waters*** means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(f). SE2 waters have the following designated uses: 1. Secondary contact recreation; 2 Maintenance and migration of fish populations; 3 Migration of diadromous fish; 4. Maintenance of wildlife; and 5. Any other reasonable uses
Source: NJDEP Land Use Management, N.J.A.C. 7:9B Surface Water Quality Standards, April 6, 2020	

As of March 4, 2019, the NJDEP proposed reclassifying 749 miles of waterways to category one (C1) status. These include watercourses that are designated for protection from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources to protect their aesthetic value and ecological integrity as stated in *Table 2* above. As of 2020, the Borough does not contain any C1 designated waterways.

The Borough of Hawthorne lies within Watershed Management Area 4 (WMA-4), Lower Passaic, Saddle. WMA-4 is divided into smaller sub-watersheds assigned 14-digit Hydrologic Unit Codes (HUC-14) of which 2.554 sq. mi. (75.94%) of the Borough is within the Goffle Brook sub-watershed (02030103120050), 0.714 sq. mi. (21.22%) of the Borough is within the Passaic River Lower (Fair Lawn Avenue to Goffle) sub-watershed (02030103120070), 0.029 sq. mi. (0.86%) of the Borough is within the Molly Ann Brook sub-watershed (02030103120040), while the remaining 0.067 sq. mi. (1.98%) is within the Passaic River Lower (Goffle Brook to pump station) sub-watershed (02030103120110), as shown in ***Figure 13***.

The New Jersey Department of Environmental Protection (NJDEP) has established an Ambient Biomonitoring Network (AMNET) to document the health of the State's waterways at over 800 sites throughout New Jersey. These sites are sampled for benthic macroinvertebrates by the NJDEP on a 5-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 related to benthic macroinvertebrate community dynamics. WMA-4 includes a total of 26 AMNET sites in the Deepavaal Brook, Diamond Brook, Goffle Brook, Ho-Ho-Kus Brook, Molly Ann Brook, Passaic River, Peckman River, Preakness Brook, Ramsey Brook, Saddle River, and Third River watersheds, in Bergen, Essex, and Passaic Counties. Based on the NJDEP Water Monitoring and Standards, Ambient Biomonitoring Network, Summaries for WMA-4 as of 2012 are as follows: 7.7% (2 sites) "good", 73.1% (19 sites) "fair", and 19.2% (5 sites) "poor". The Borough contains one (1) active AMNET monitoring point (AN0277) as seen in ***Table 7*** and ***Figure 14***.

Table 7: **Borough of Hawthorne AMNET Monitoring Points**

WMA	WMA Name	Site Number	Impairment	Water	Location	Active
4	Lower Passaic and Saddle	AN0277	Fair	Goffle Brook	Wagaraw Road	✓
Source: NJDEP Bureau of GIS, Ambient Biomonitoring Network (AMNET) of New Jersey, December 2020						

In addition to the AMNET data, the NJDEP and other regulatory agencies collect water quality chemical data on the streams in the state. The NJDEP requires the development of a Total Maximum Daily Load (TMDL) for waterways, or portions thereof, that are found impaired by pollutants. A TMDL is the amount of a pollutant that can be accepted by a waterbody without causing an exceedance of water quality standards or interfering with the ability to use a waterbody for one or more of its designated uses. The allowable load is assigned to the various sources of the pollutant, such as stormwater and wastewater discharges, which require an NJPDES permit to discharge, and nonpoint source, which includes stormwater runoff from agricultural areas and residential areas, along with a margin of safety. Provisions may also be made for future sources in the form of reserve capacity. An implementation plan is developed to identify how the various sources will be reduced to the designated allocations. Implementation strategies may include improved stormwater treatment plants, adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other BMPs. According to the NJDEP, Bureau of Nonpoint Pollution Control, Hawthorne has two listed TMDLs for the following: instream levels of fecal coliform within Diamond Brook and Goffle Brook and instream levels of total phosphorus within Goffle Brook, Molly Ann Brook, Passaic River Lower (Fair Lawn Avenue to Goffle), and Passaic River Lower (Goffle Brook to Pompton River) ***(Appendix B)***. These exceedances are potentially due to stormwater runoff, soil erosion, bank erosion, decomposing plant materials, fertilizer, geese, and wildlife.

The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) (Integrated List) is required by the federal Clean Water Act to be prepared biennially and is a valuable source of water quality information. This combined report presents the extent to which New Jersey waters are attaining water quality standards and identifies waters that are impaired. Sublist 5 of the Integrated List identifies waters impaired or threatened by pollutants, for which one (1) or more TMDLs are needed. As per Appendix B of the 2016 New Jersey Integrated Water Quality Assessment Report published in December 2019, Sublist 5 lists several low and medium-ranking priority TMDL parameters for stations AN0277, AN0277A, FIBI035a, and 01389850 of Goffle Brook, 01389895, Passaic River at Elmwood Park, AN0278, FIBI503, and NJHDG-3 of Passaic River Lower (Fair Lawn Ave to Goffle), 01389745, 01389785, and AN0276 of Molly Ann Brook; and 01389500, Passaic River at Elmwood Park, AN0274, NJHDG-2 of Passaic River Lower (Goffle Bk to pump station), as shown in *Tables 3* through *6*.

Table 3: **303(d) Sublist 5 Subparts and Priority Ranking for Goffle Brook**

WMA	HUC	Parameter	Cycle 1st Listed	Designated Use	Sublist 5 Subpart (A,R,L)	Priority Ranking for TMDL
4	02030103120050	Biological-Cause Unknown	2010	Aquatic Life General		Low
4	02030103120050	Total Dissolved Solids (TDS)	2006	Public Water Supply		Medium
Source: NJDEP Division of Water Monitoring Standards, December 2019						

Table 4: **303(d) Sublist 5 Subparts and Priority Ranking for Passaic River Lower (Fair Lawn Avenue to Goffle)**

WMA	HUC	Parameter	Cycle 1st Listed	Designated Use	Sublist 5 Subpart (A,R,L)	Priority Ranking for TMDL
4	02030103120070	Arsenic	2006	Public Water Supply		Low
4	02030103120070	Chlordane in Fish Tissue	2006	Fish Consumption	L	Low
4	02030103120070	DDT in Fish Tissue	2006	Fish Consumption	L	Low
4	02030103120070	Biological-Cause Unknown	2016	Aquatic Life General		Low
4	02030103120070	Mercury in Fish Tissue	2006	Fish Consumption		Low
4	02030103120070	PCBs in Fish Tissue	2006	Fish Consumption	L	Low
4	02030103120070	PH	2014	Aquatic Life General		Medium
Source: NJDEP Division of Water Monitoring Standards, December 2019						

Table 5: **303(d) Sublist 5 Subparts and Priority Ranking for Molly Ann Brook**

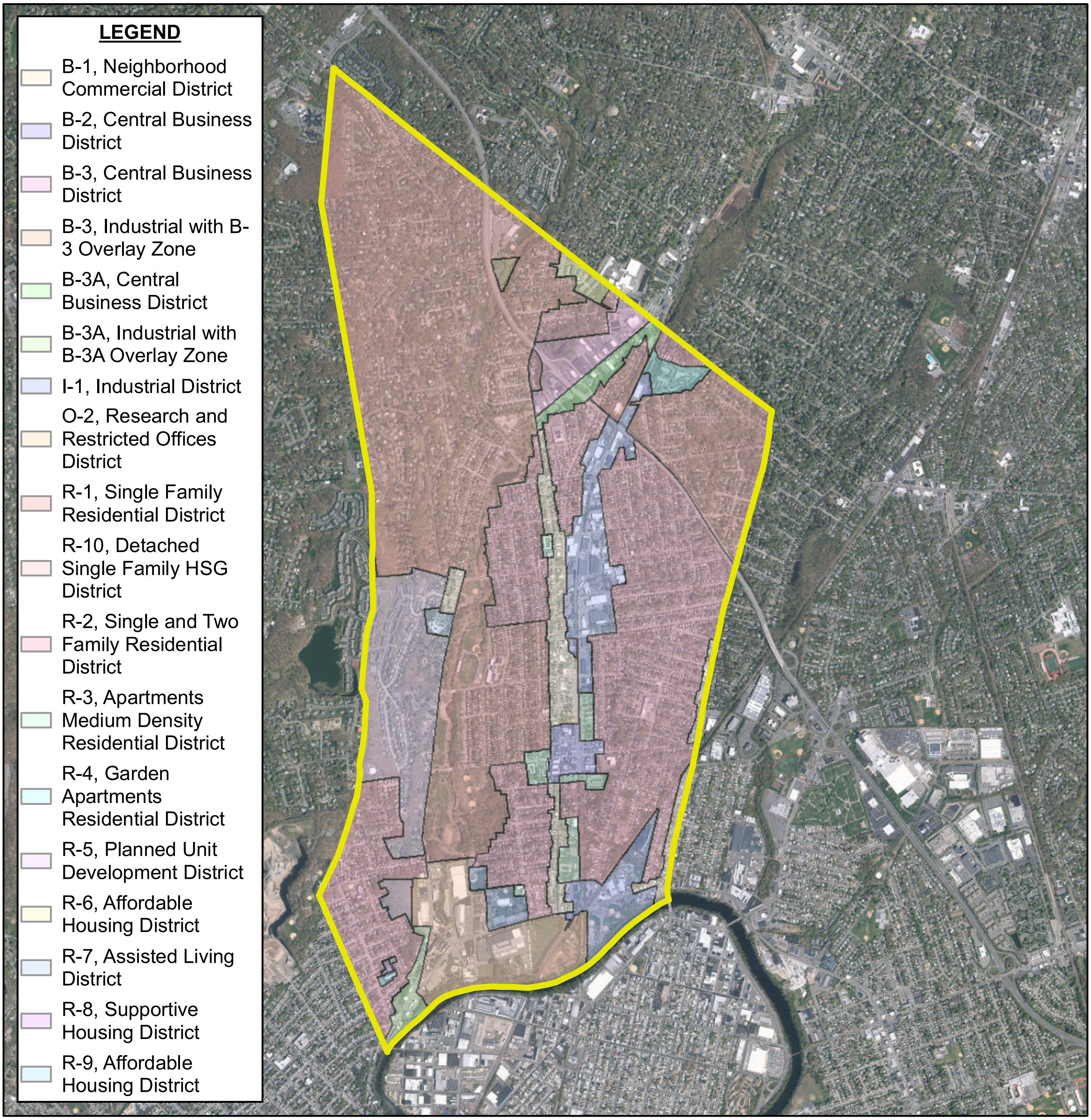
WMA	HUC	Parameter	Cycle 1st Listed	Designated Use	Sublist 5 Subpart (A,R,L)	Priority Ranking for TMDL
4	02030103120040	Arsenic	2012	Public Water Supply		Low
4	02030103120040	Biological-Cause Unknown	2006	Aquatic Life General		Low
4	02030103120040	Total Dissolved Solids (TDS)	2008	Public Water Supply		Medium
Source: NJDEP Division of Water Monitoring Standards, December 2019						

Table 6: **303(d) Sublist 5 Subparts and Priority Ranking for Passaic River Lower (Goffle Brook to pump station)**

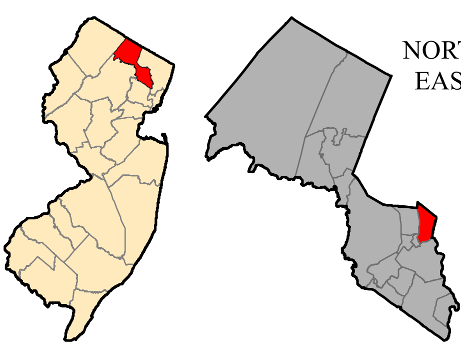
WMA	HUC	Parameter	Cycle 1st Listed	Designated Use	Sublist 5 Subpart (A,R,L)	Priority Ranking for TMDL
4	02030103120110	Arsenic	1998	Public Water Supply		Low
4	02030103120110	Chlordane in Fish Tissue	2010	Fish Consumption	L	Low
4	02030103120110	DDT in Fish Tissue	2010	Fish Consumption	L	Low
4	02030103120110	Biological-Cause Unknown	2016	Aquatic Life General		Low
4	02030103120110	Mercury in Fish Tissue	2010	Fish Consumption		Low
4	02030103120110	PCBs in Fish Tissue	2006	Fish Consumption	L	Low
4	02030103120110	PH	2014	Aquatic Life General		Medium
Source: NJDEP Division of Water Monitoring Standards, December 2019						

At locations throughout the Borough water quantity problems include flooding and stream bank erosion. In addition to the aforementioned water quality concerns, the Borough is subject to bank flooding along several watercourses during periods of heavy rain. The surrounding areas fall within the 100-yr and 500-yr floodplains and floodway (***Figure 15***).

Lastly, portions of the Borough contain or lie within wellhead protection areas. A wellhead protection area is divided into three (3) tiers. The 2-year (Tier 1), 5-year (Tier 2) and 12-year (Tier 3) are intended to represent the time of travel (TOT), a groundwater contaminant in the zones could be expected to reach a municipal potable supply well. The NJDEP then prioritizes the investigation and remediation of contaminated sites within the 2 and 5-year tiers. Wellhead protection areas are shown in ***Figure 7***. The Borough may wish to adopt specific ordinances to further protect wellhead protection areas and minimize the infiltration of pollutants into aquifers.



SOURCE: BOROUGH OF HAWTHORNE 2016 ZONING DATALAYER



NORTHING: 724,642
EASTING: 545,901

N W E S

0 1,300 2,600 5,200
FEET

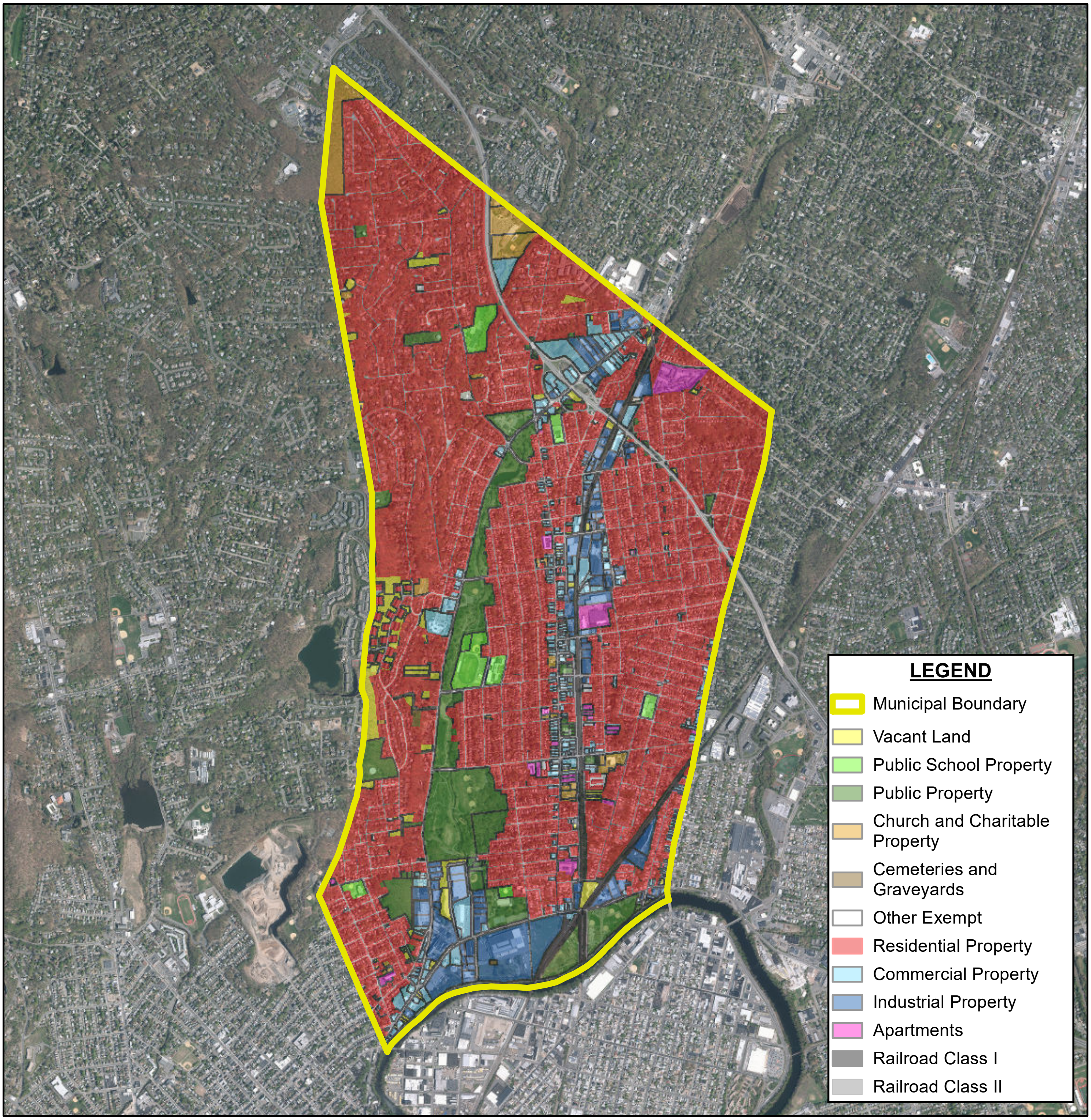
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

ZONING MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

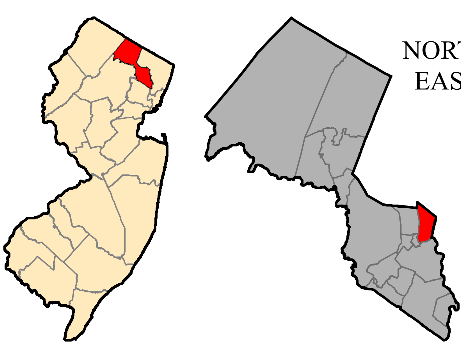
BOROUGH OF HAWTHORNE

PASSAIC COUNTY | NEW JERSEY

DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 3



SOURCE: PASSAIC COUNTY TAX PARCEL DATALAYER



NORTHING: 774,414
EASTING: 587,068

N W E S

0 1,300 2,600 5,200
FEET

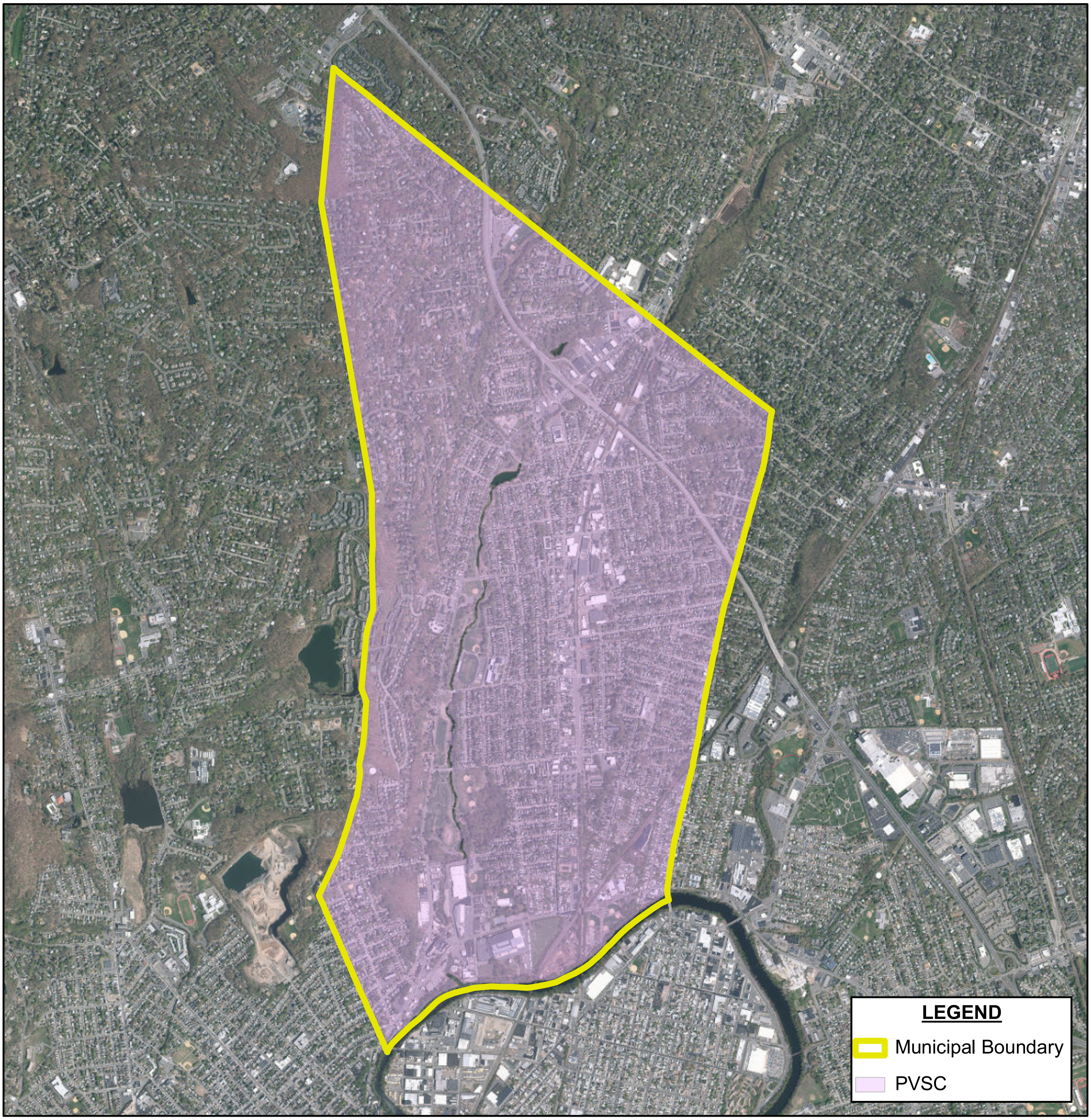
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

PROPERTY CLASSIFICATION MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

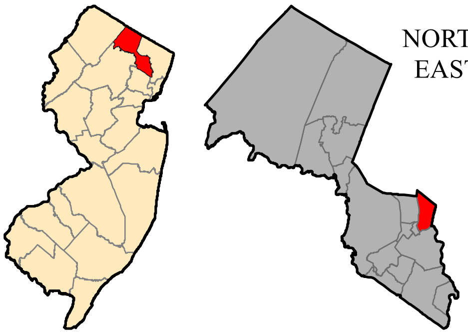
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 4



SOURCE: NJDEP STATEWIDE SEWER SERVICE AREAS DATALAYER



NORTHING: 774,414
EASTING: 587,068

N
W E
S

0 1,300 2,600 5,200
FEET

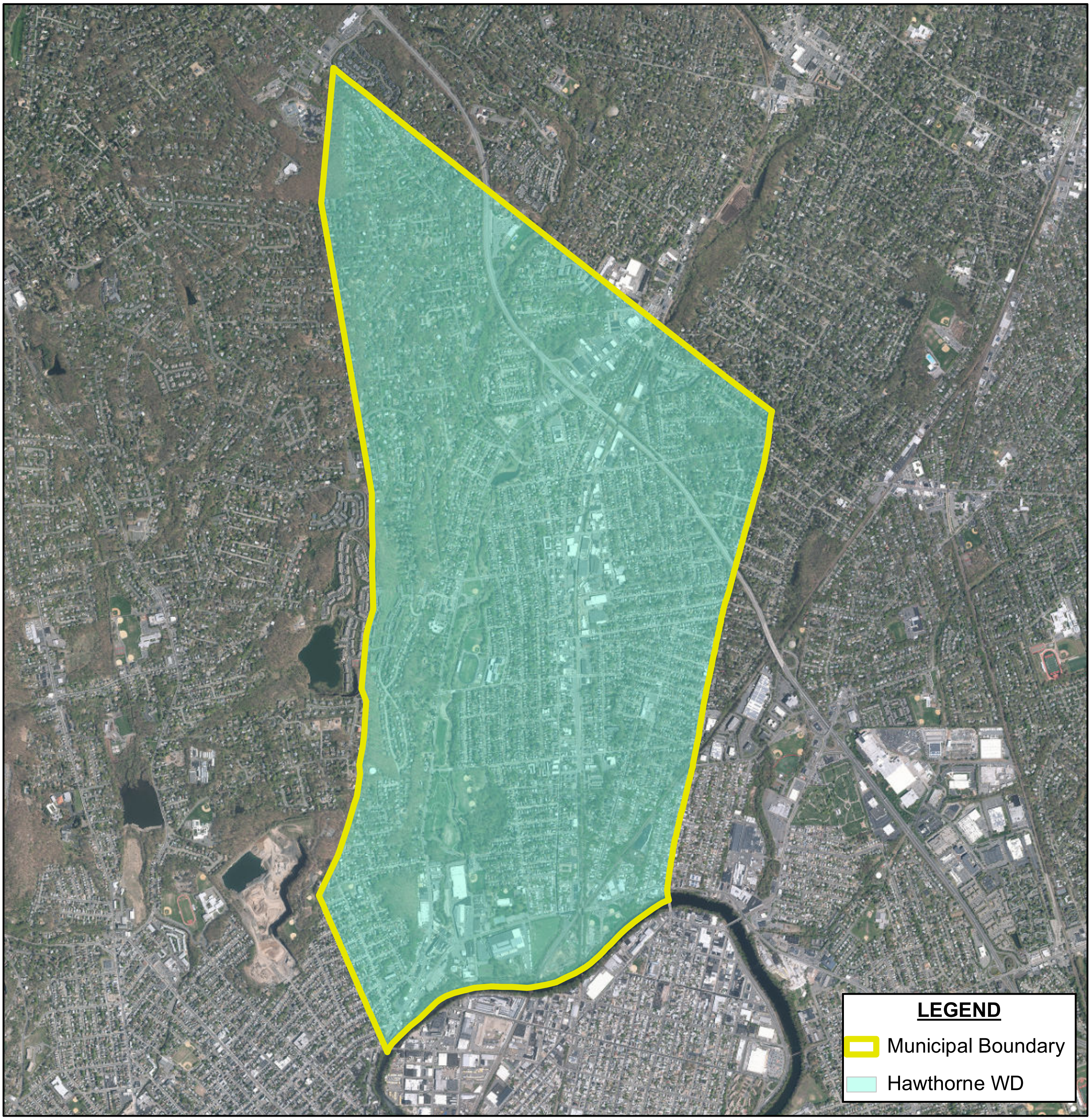
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

SEWER SERVICE AREA MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

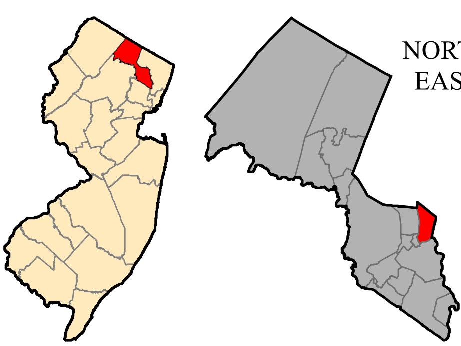
BOROUGH OF HAWTHORNE

PASSAIC COUNTY NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 5



SOURCE: NJDEP WATER PURVEYOR SERVICE AREA DATALAYER



NORTHING: 774,414
EASTING: 587,068

0 1,300 2,600 5,200
FEET

N
W E
S

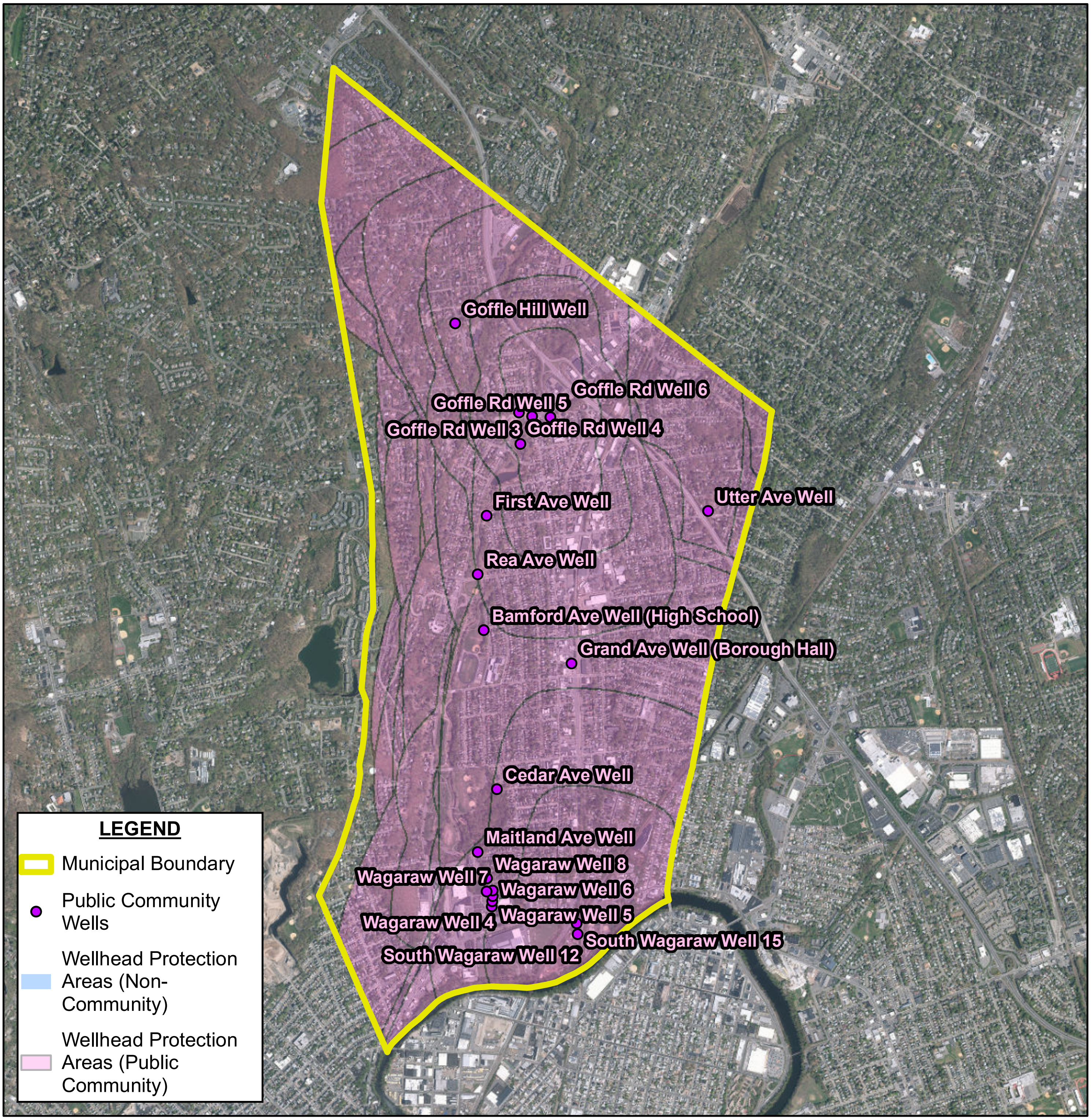
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

WATER PURVEYOR SERVICE AREA MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

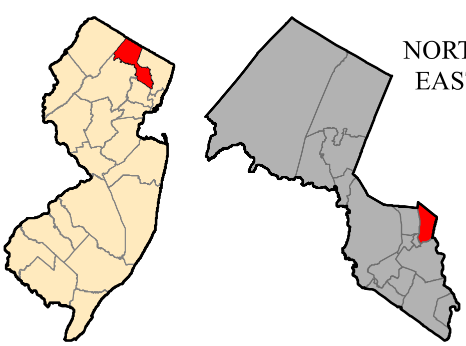
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 6



SOURCE: NJDEP PUBLIC COMMUNITY WELLS AND WELLHEAD PROTECTION DATALAYERS



NORTHING: 774,414
EASTING: 587,068

N
W E
S

0 1,300 2,600 5,200
FEET

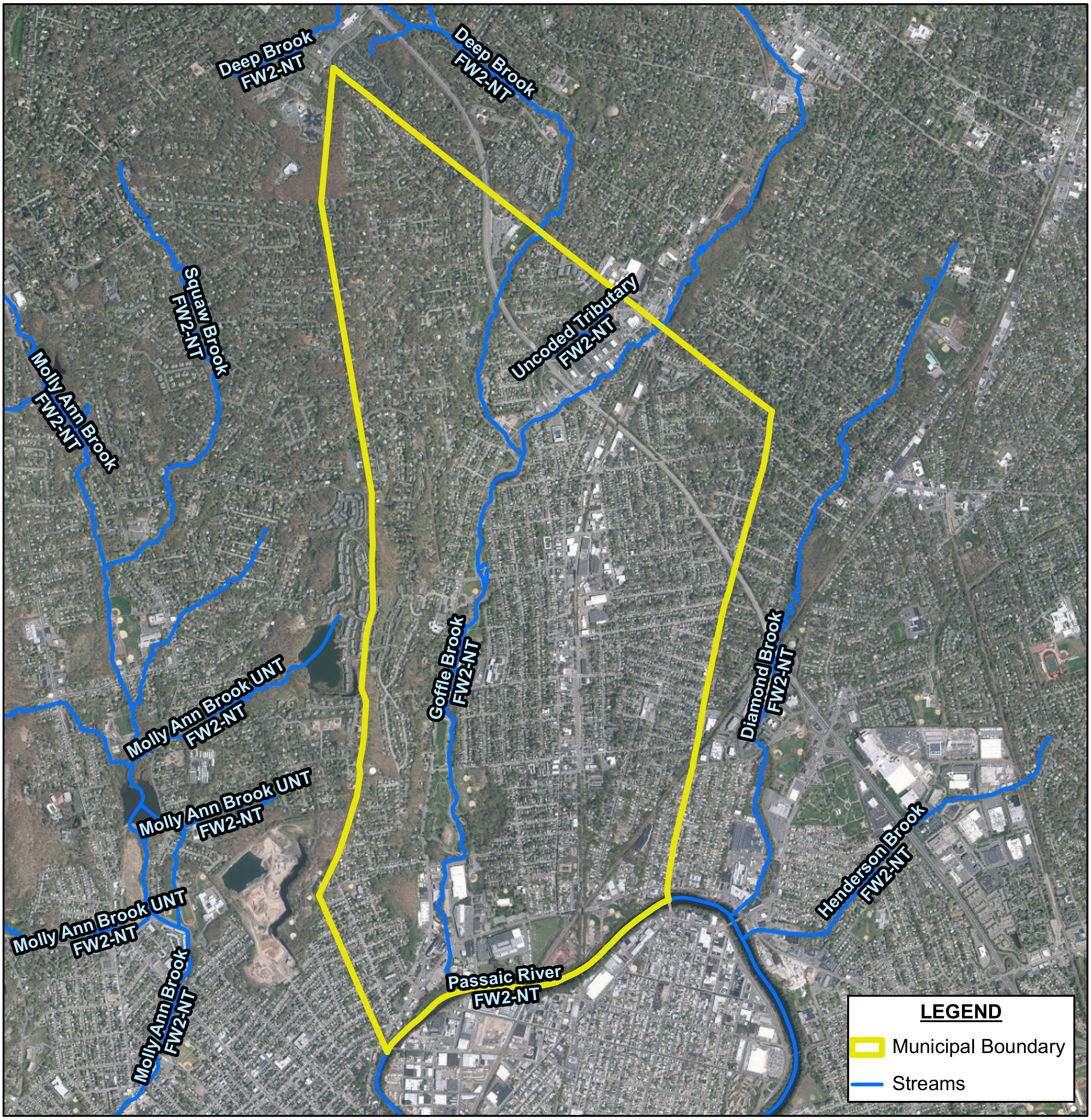
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

WELLHEAD PROTECTION AREA MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

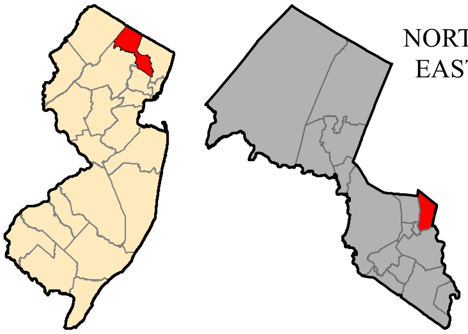
BOROUGH OF HAWTHORNE

PASSAIC COUNTY NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 7



SOURCE: NJDEP SURFACE WATER QUALITY STANDARDS DATALAYER



NORTHING: 774,414
EASTING: 587,068

0 1,300 2,600 5,200
FEET

N S W E

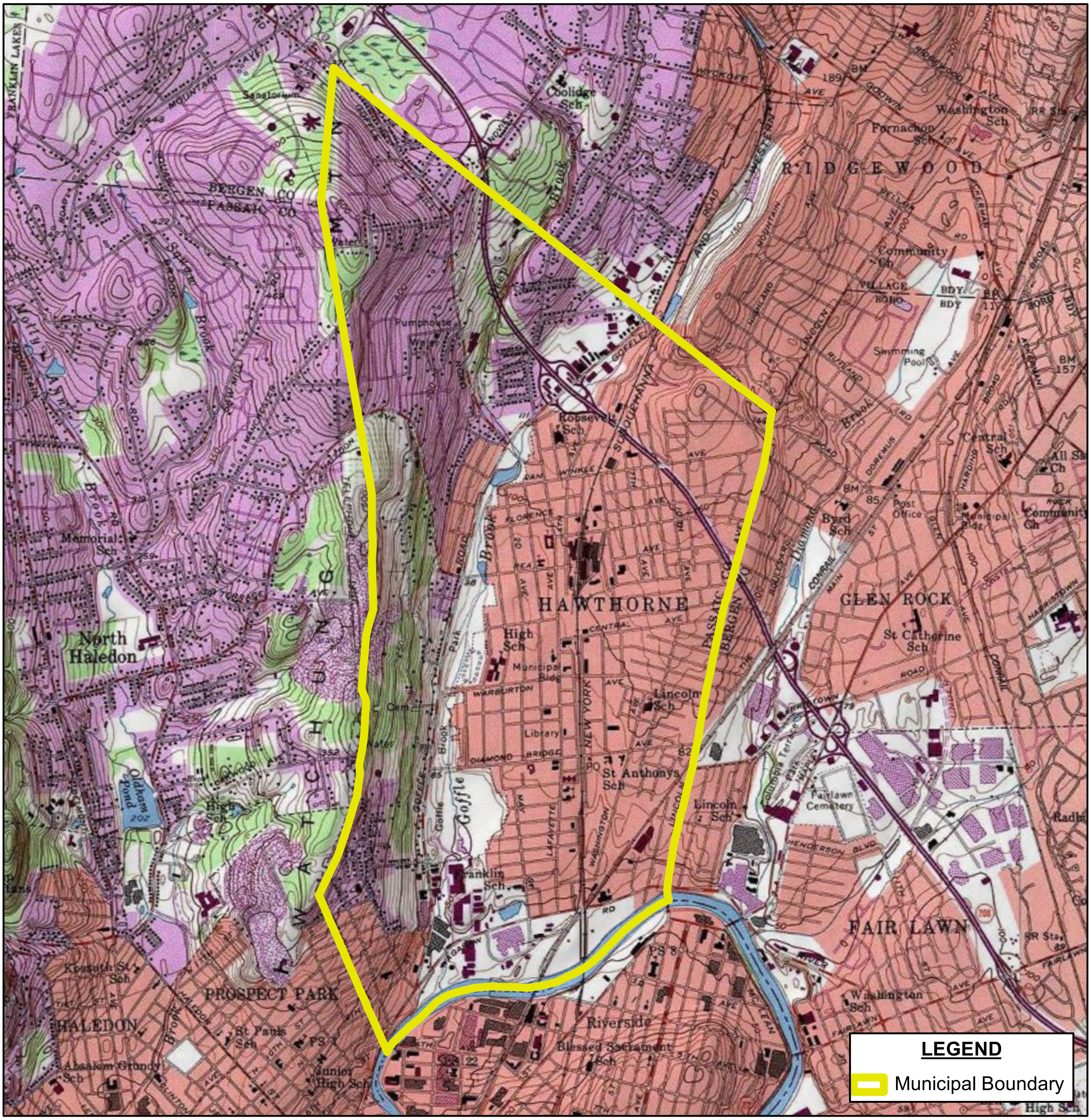
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

SURFACE WATER QUALITY STANDARDS MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

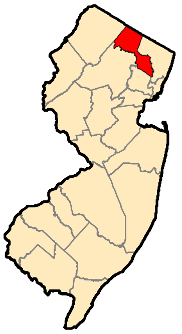
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 8



SOURCE: UNITED STATES GEOLOGICAL SURVEY (USGS) PATERSON QUADRANGLE



NORTHING: 774,414
EASTING: 587,068

N W E S

0 1,300 2,600 5,200
FEET

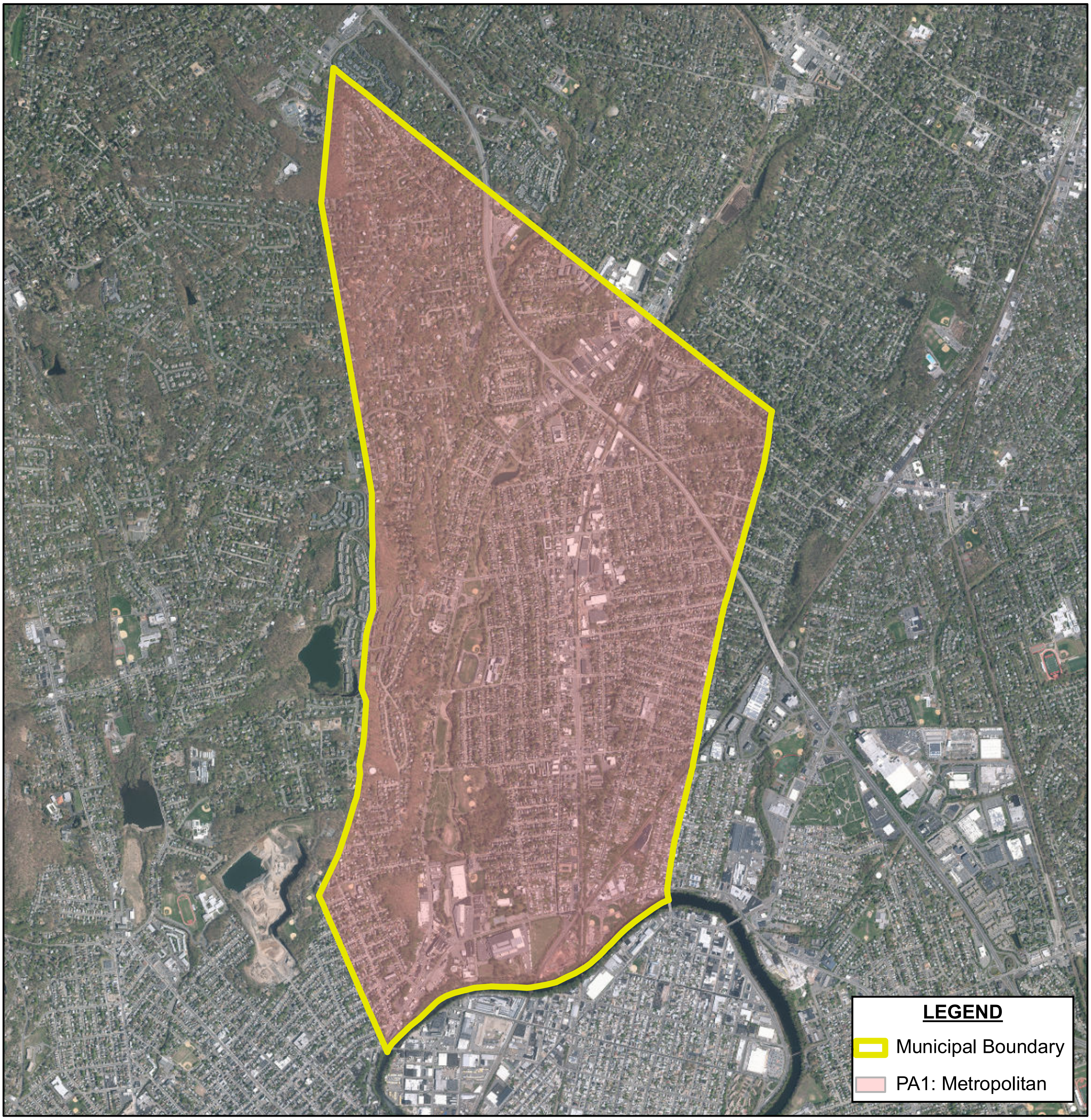
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

USGS TOPOGRAPHIC MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

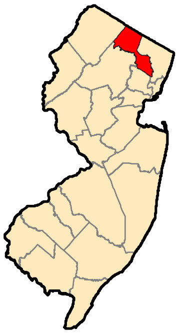
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 9



SOURCE: NEW JERSEY PLANNING MANAGEMENT AREAS DATALAYER



NORTHING: 774,414
EASTING: 587,068

0 1,300 2,600 5,200

FEET

N S E W

BOSWELL ENGINEERING

330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

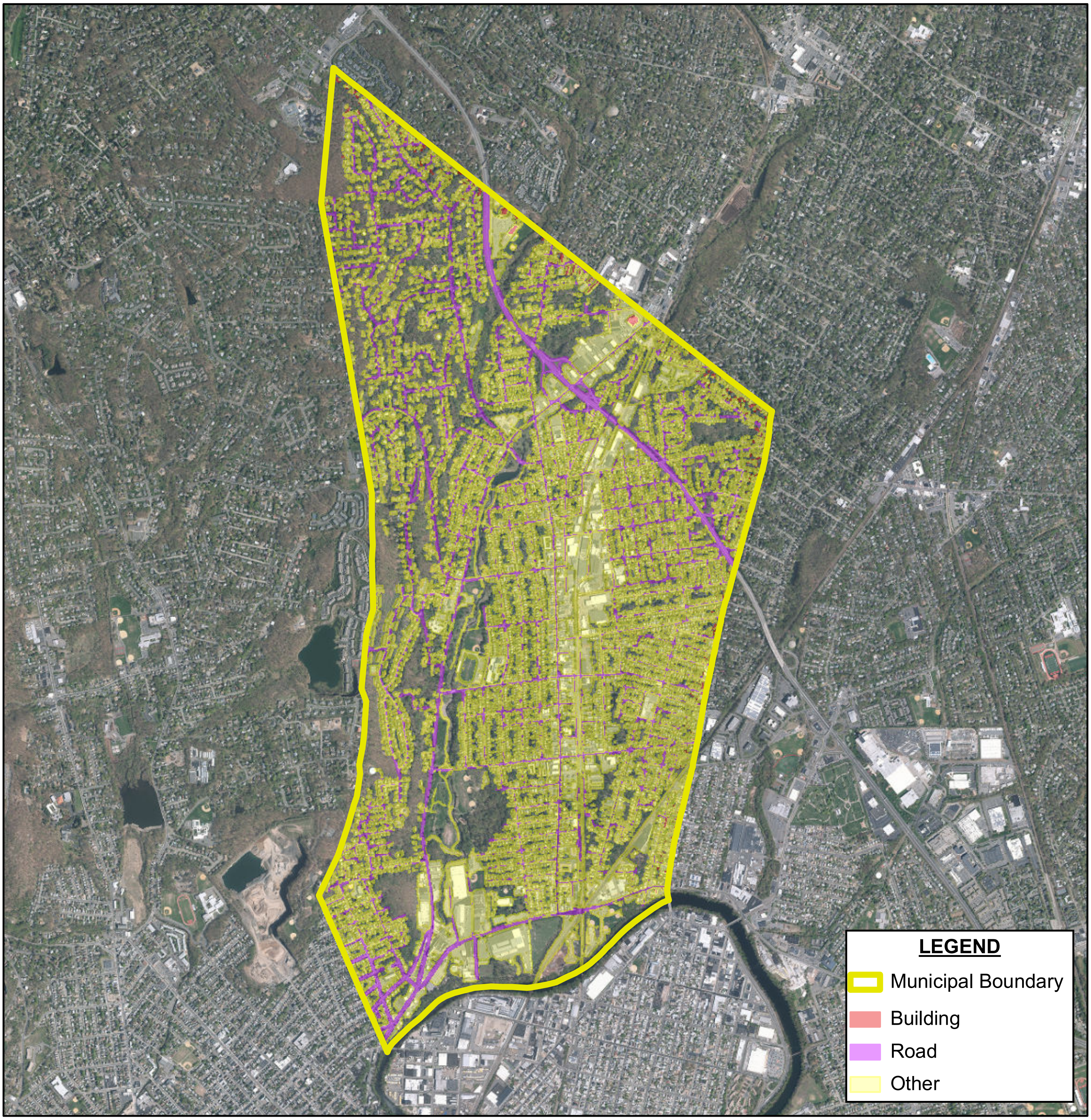
STATE PLANNING AREA MAP

MUNICIPAL STORMWATER MANAGEMENT PLAN

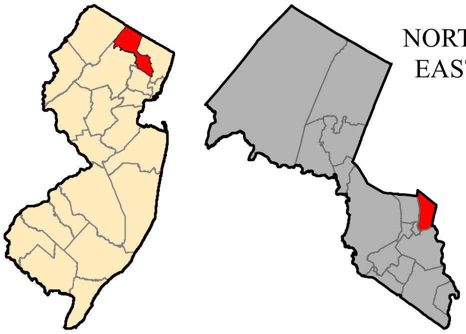
BOROUGH OF HAWTHORNE

PASSAIC COUNTY NEW JERSEY

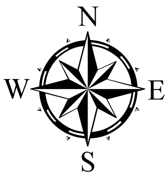
DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 10

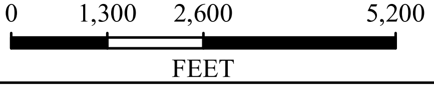


SOURCE: NJDEP LAND USE/LAND COVER IMPERVIOUS SURFACE 2015 DATALAYER



NORTHING: 774,414
EASTING: 587,068





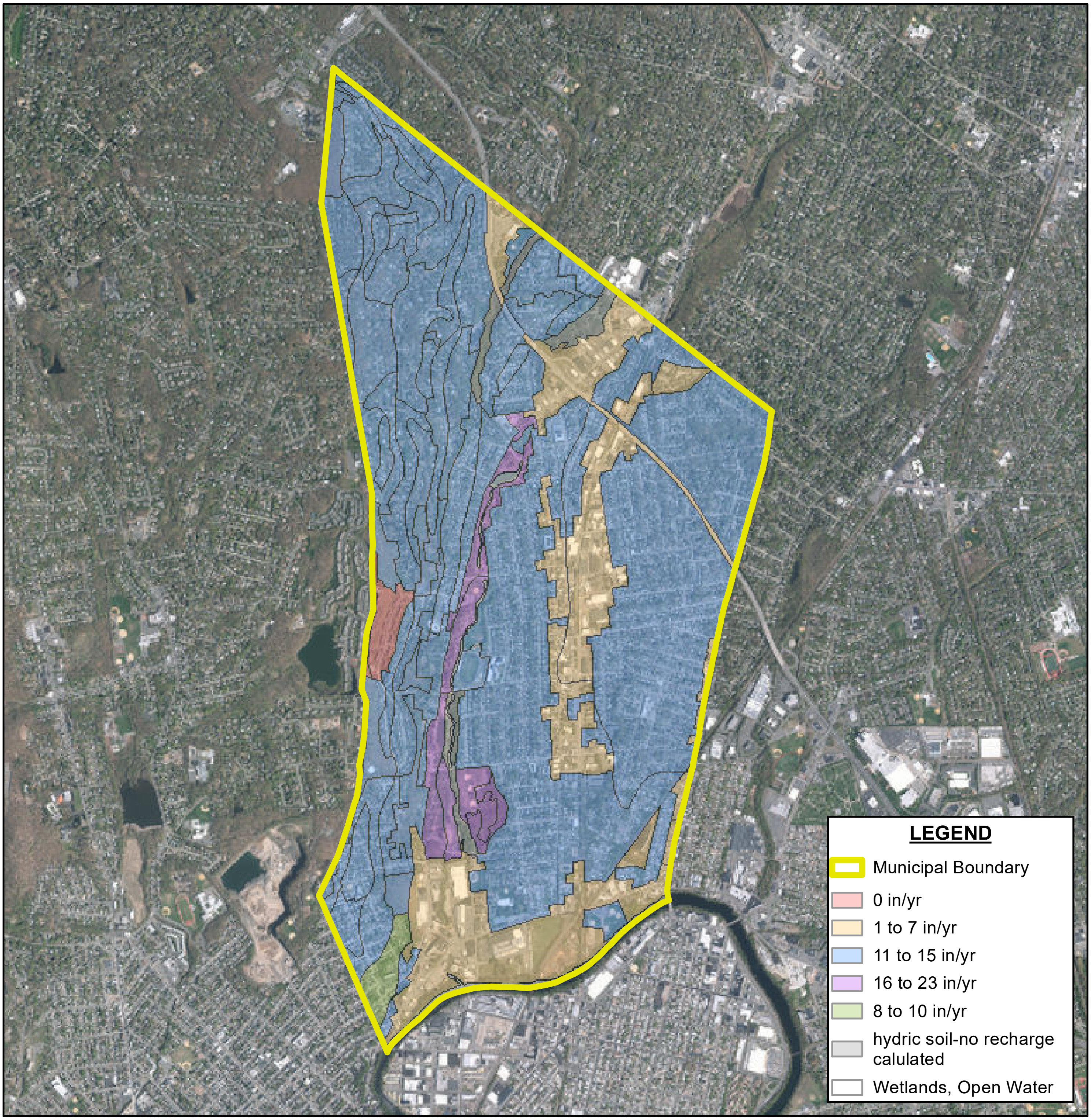
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

LAND USE IMPERVIOUS SURFACE MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

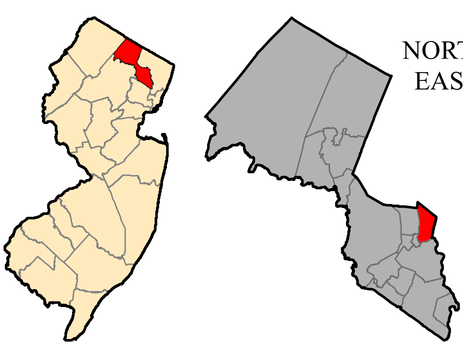
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

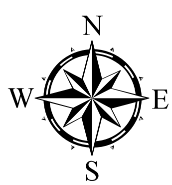
DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 11



SOURCE: NJDEPBGIS GROUNDWATER RECHARGE AREA DATA LAYER



NORTHING: 774,414
EASTING: 587,068



0 1,300 2,600 5,200
FEET

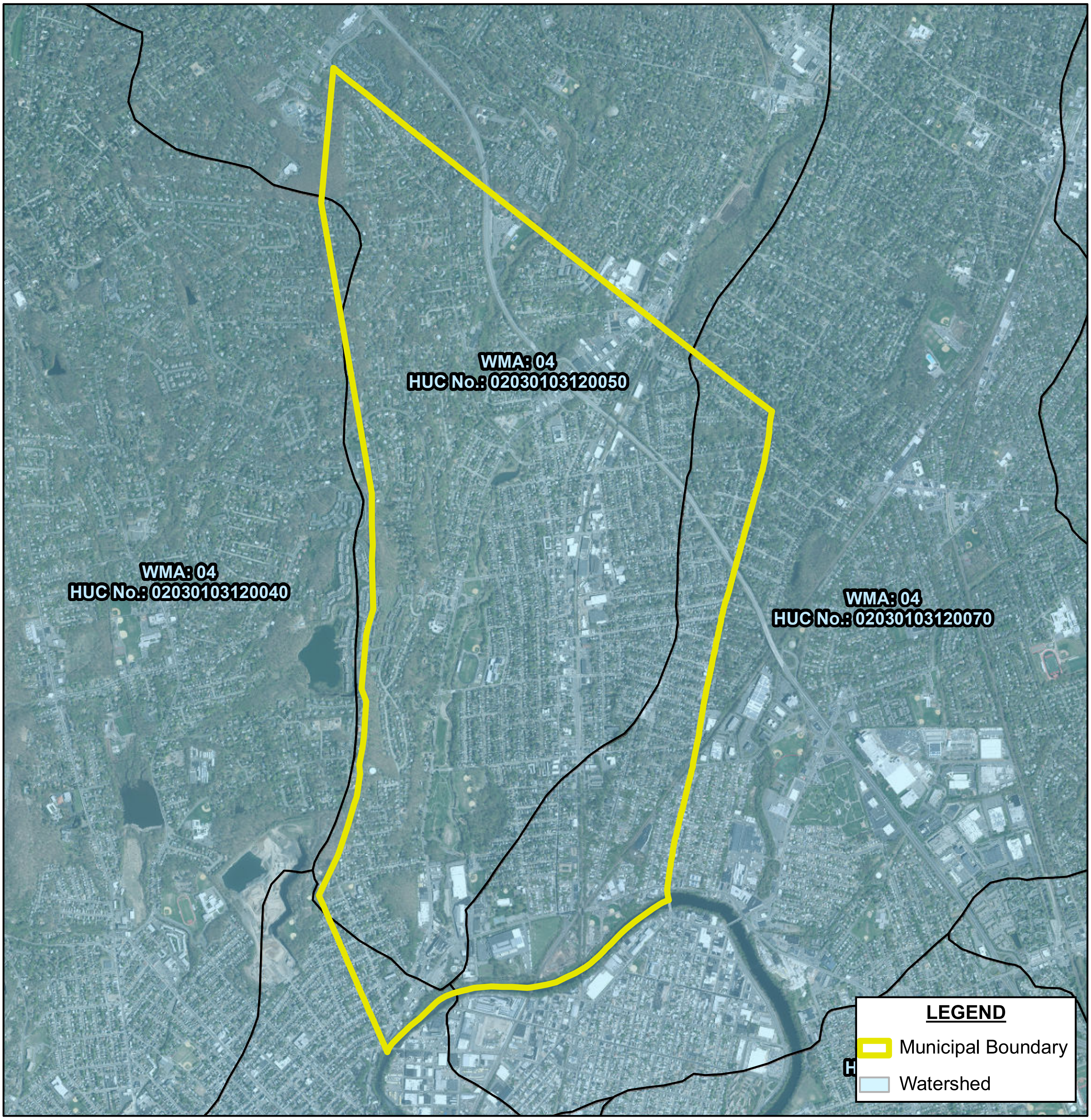
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

GROUNDWATER RECHARGE MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

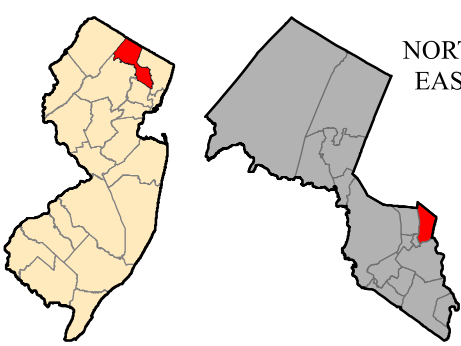
BOROUGH OF HAWTHORNE

PASSAIC COUNTY NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: OCTOBER 2021	JOB NO. HW-558 FIGURE 12



SOURCE: NJDEP WATERSHED MANAGEMENT AREA DATALAYER



NORTHING: 774,414
EASTING: 587,068

0 1,300 2,600 5,200
FEET

N W E S

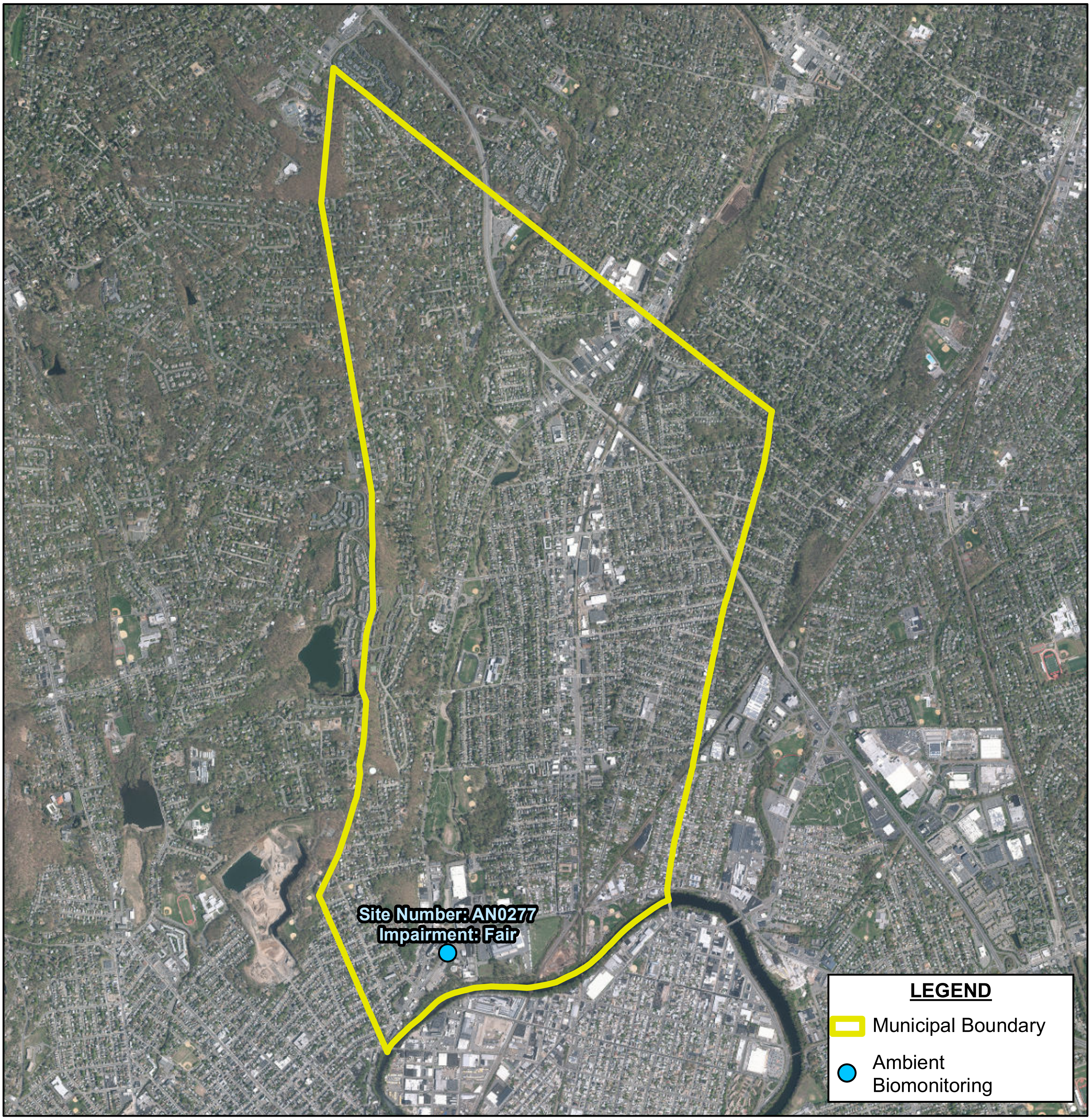
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

WATERSHED MANAGEMENT AREA MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

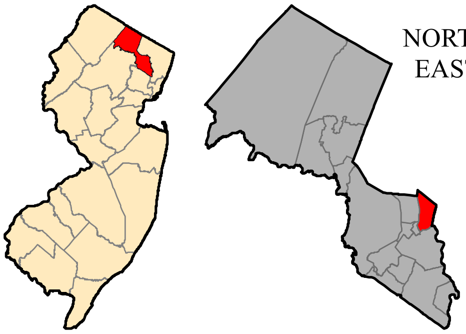
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

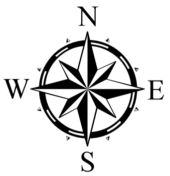
DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 13

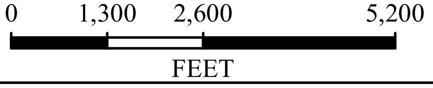


SOURCE: NJDEP AMBIENT BIOMONITORING NETWORK(AMNET) DATALAYER



NORTHING: 774,414
EASTING: 587,068





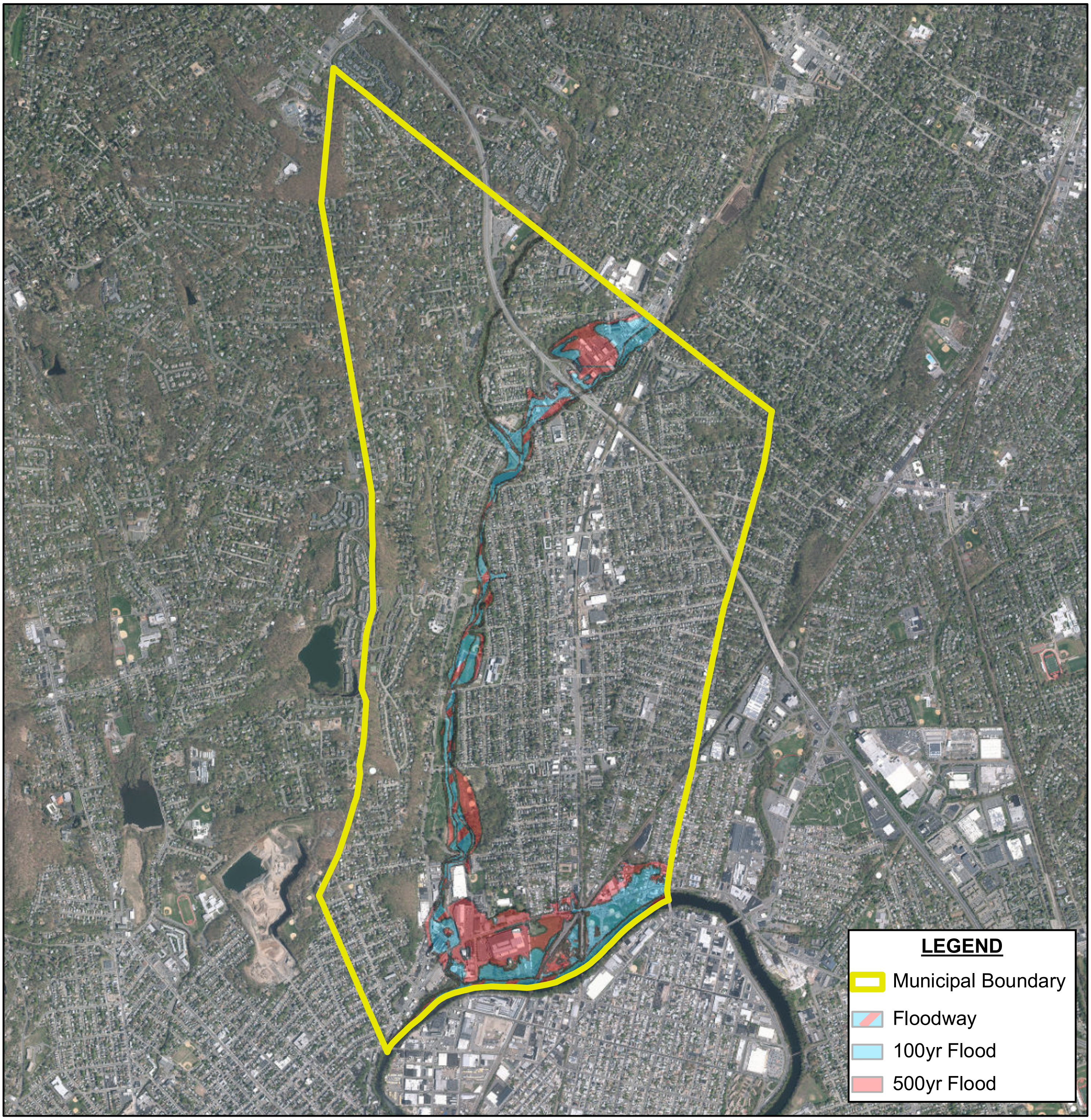
BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

AMBIENT BIOMONITORING NETWORK MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

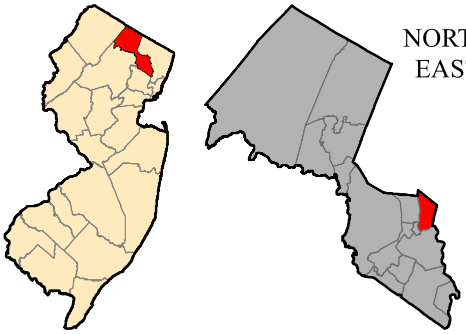
BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW CKD. BY: FJR	SCALE: 1 IN = 2,600 FT DATE: JULY 2021	JOB NO. HW-558B FIGURE 14



SOURCE: PASSAIC COUNTY FEMA FLOOD DATA LAYER



NORTHING: 774,414
EASTING: 587,068

0 1,300 2,600 5,200
FEET

N W E S

BOSWELL ENGINEERING
330 PHILLIPS AVE., SOUTH HACKENSACK, N.J. 07606

FEMA FLOOD MAP
MUNICIPAL STORMWATER MANAGEMENT PLAN

BOROUGH OF HAWTHORNE

PASSAIC COUNTY — NEW JERSEY

DR. BY: JMW	SCALE: 1 IN = 2,600 FT	JOB NO. HW-558B
CKD. BY: FJR	DATE: JULY 2021	FIGURE 15

V. Design and Performance Standards

The Borough has reviewed its existing ordinances and adopted 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. The design and performance standards include 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 the safety standards consistent with N.J.A.C. 7:8-6 Safety Standards for Stormwater Management Basins.

The Borough aims for non-structural measures to be considered first and shall include site design and preventive source controls. To confirm the effectiveness of such measures, applicants must verify the control of stormwater quantity impacts as detailed in the Stormwater Management Rules and the Borough's Stormwater Control Ordinance.

The Stormwater Management Rules detail the general standards for structural measures which shall be incorporated as needed to meet the soil erosion, infiltration, and runoff quantity standards as identified in the Borough's Stormwater Control Ordinance. The design standards for the use of structural stormwater management measures are identified within the New Jersey Stormwater Best Management Practices Manual and other designs or practices may only be used upon approval from the Hudson Essex Passaic Soil Conservation District (HEPSCD). The design and construction of such facilities must comply with the NJ Soil Erosion and Sediment Control Standards as well as any other applicable State regulations including the Freshwater Wetland Protection Act rules, the Flood Hazard Control Rules, the Surface Water Quality Standards, and the Dam Safety rules. Stormwater runoff quality controls for total suspended solids and nutrient load shall meet the design and performance standards as specified in the Stormwater Management Rules.

The Soil Erosion and Sediment Control Act of 1976 stipulates that any project proposing more than 5,000 square feet of soil disturbance must have a Soil Erosion and Sediment Control (SESC) Plan certified by the local district. Prior to any construction, the Building Department will review the application and, where applicable, require submission to the Hudson Essex Passaic Soil Conservation District to obtain a certification of approval prior to issuance of any construction permits.

In addition to the adoption of the above performance standards, during construction the Borough inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed. The Borough assumes responsibility for the operation and maintenance of municipally owned stormwater management facilities. Additionally, as per the Stormwater Control Ordinance, the Borough requires the maintenance of privately owned stormwater facilities and ensures compliance through annual inspections.

VI. Plan Consistency

The Borough is not within a Regional Stormwater Management Planning Area; therefore, this Plan does not need to be consistent with any Regional Stormwater Management Plans (RSWMP). As previously stated, according to the NJDEP Bureau of Nonpoint Pollution Control, Hawthorne has two listed TMDLs for the following: instream levels of fecal coliform within Diamond Brook and Goffle Brook; and instream levels of total phosphorus within Goffle Brook, Molly Ann Brook, Passaic River Lower (Fair Lawn Ave to Goffle), and Passaic River Lower (Goffle Brook to Pompton River) *(Appendix B)*. At this time, the Borough's MSWMP is consistent with the current reported TMDLs, if any RSWMPs or TMDLs are developed in the future, this MSWMP will be updated as necessary to ensure consistency.

As previously stated, the Borough has incorporated green infrastructure and several non-structural stormwater strategies into their Zoning and Site Plan ordinances. The design of any development that disturbs at least 1 acre of land, increases impervious surface by at least 1/4 acre, creates 1/4 acre or more of "regulated motor vehicle surface"; or a combination of the aforementioned that totals an area of one-quarter acre or more must incorporate nonstructural stormwater management strategies "to the maximum extent practicable." The purpose of some of these non-structural strategies is to reduce damage to life and property by minimizing flooding. New major developments are reviewed for compliance with the Stormwater Management Rules at N.J.A.C. 7:8.

The MSWMP is consistent with the Residential Site Improvement Standards (RSIS) detailed at N.J.A.C. 5:21. The Borough will utilize the most current RSIS during the stormwater management review of residential development. This MSWMP will be updated to be consistent with any future changes to the RSIS.

The Borough's existing ordinances also require new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards as well as the requirements of all other applicable regulations. Any project with over 5,000 square feet of disturbance will require approval from the Hudson Essex Passaic Soil Conservation District. Projects disturbing one or more acres of land will require submission of a Request for Authorization (RFA) to the NJDEP Bureau of Non-Point Pollution Control. Additionally, all projects must be in compliance with the Passaic County Stormwater Management Guidance Manual which is in accordance with the New Jersey County Planning Enabling statutes (N.J.S.A. 40:27-1 et seq.). Approval of construction permits shall not be issued until all required approvals are received from the necessary districts, departments, and agencies.

Due to Hawthorne containing lands classified as PA 1 the Borough defers to the New Jersey State Development and Redevelopment Plan adopted March 1, 2001 as it pertains to development and redevelopment.

Furthermore, Hawthorne will refer to the Green Stormwater Infrastructure Element of the Passaic County Master Plan adopted November 29, 2018 for guidance pertaining to stormwater management. Hawthorne specifically will refer to Appendix A1 Passaic County Stormwater Management Guidance Manual in regards to detailed information on the use of stormwater best management practices (BMPs), and to ensure developers will utilize Green Stormwater Infrastructure (GSI) techniques that comply with the County's requirements for land development activities.

VII. Nonstructural Stormwater Management Strategies

Nonstructural measures are utilized in low impact development to reduce stormwater runoff impacts. The NJDEP Stormwater Management Rules at N.J.A.C. 7:8-2.4 require the design of any development that disturbs at least 1 acre of land, increases impervious surface by at least 1/4 acre, creates 1/4 acre or more of "regulated motor vehicle surface"; or a combination of the aforementioned that totals an area of one-quarter acre or more must incorporate nonstructural stormwater management strategies "to the maximum extent practicable." N.J.A.C. 7:8-2.4(g) identifies the following nonstructural stormwater management 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 "time of concentration" from pre-construction to postconstruction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;
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 discharging into and through stable vegetated areas; and
9. Provide other source controls to prevent or minimize the use or exposure of pollutants from development sites in order to prevent or minimize the release of those pollutants into stormwater runoff. These source controls include, but are not limited to:

   i. Development design features that help to prevent accumulation of trash and debris in drainage systems;

   ii. Development design features that help to prevent discharge of trash and debris from drainage systems; iii. Development design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

   iv. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

The above referenced measures can be grouped into four general categories:

1. Vegetation and Landscaping
2. Minimizing Site Disturbance
3. Impervious Area Management;
4. Time of Concentration Modifications

The Borough's Stormwater Control Ordinance has been updated to incorporate the Stormwater Management Rule amendments for March 2021. All relevant Borough ordinances, including the Zoning Ordinance and the most recent Master Plan reexamination, are under review to update verbiage to encourage the implementation of nonstructural stormwater management measures. This MSWMP has been developed pursuant to N.J.A.C. 7:8-3 and 4. The following assessment of the current ordinances and documents has been prepared for future revisions regarding the four general categories mentioned above:

Vegetation and Landscaping

Existing and proposed vegetation at a land development site can significantly reduce the site's impact on downstream waterways and water bodies. To better manage stormwater runoff as it pertains to vegetation the Borough has identified the following potential improvements.

- All future developments shall be reviewed with a focus on preserving natural vegetative cover. Applications will require a plan showing natural vegetated areas on the pre-developed site and a narrative to be accompanied with photographs describing each area's vegetated and hydrologic characteristics. The Borough is considering the establishment of easements or deed restrictions on specific portions of parcels and lots to prohibit any future disturbance or alteration to vegetated areas.
- Disturbed sites within the Borough shall utilize native plants to reduce potential runoff from fabricated surfaces including pavement and turf fields. The Borough is considering the incorporation of native ground cover requirements for proposed development projects.
- The Borough plans to review the existing impervious surface cover within the municipality to determine where the implementation of vegetative filters located immediately downstream of impervious surfaces such as roadways and parking lots to achieve pollutant removal, groundwater recharge, and runoff volume reduction. Additionally, vegetated buffers may be utilized adjacent to streams, creeks, and other waterways and water bodies can also help mitigate thermal runoff impacts, provide wildlife habitat, and increase site aesthetics.

Minimizing Land Disturbance

The Borough of Hawthorne's recommendations are similar to those for low impact development. Therefore, for all phases of development, the Borough will consider the New Jersey Geological Survey's recommendations as listed below: The Borough of Hawthorne will consider reviewing projects for low impact development as per the standards listed below:

1. Do not concentrate flows.
2. Minimize grading.
3. Build within landscape (design around existing topography).
4. Do not alter natural drainage areas.
5. Minimize the amount of imperviousness.
6. Increased structural loads at the site can contribute to ground failures.
7. Changes to existing soil profile, including cuts, fills, and excavations, should be minimized.

The Borough will also refer to the additional information on development found in Appendix A-10 of the New Jersey Department of Agriculture's Soil Erosion and Sediment Control Standards or from either the State Soil Conservation Committee (SSCC) or the New Jersey Geological Survey

(NJGS). Additionally, the Borough will consider the implementation of deed restrictions as it pertains to redevelopment and post-construction to limit the expansion of impervious cover.

Impervious Area Management

Impervious areas within watersheds can have significant impacts on stream health. Increased stormwater runoff often results in degradation of water quality; increased waterway velocities, erosion, and flooding; and nonpoint source pollution. Comprehensive management of impervious cover can help reduce these impacts on watercourses and waterbodies and help to increase surface storage, infiltration and groundwater recharge, lessen stormwater runoff, and reduced storm sewer construction, maintenance, and repair costs. Impervious area management is significant as 1.623 sq. mi. (48.26%) of the Borough is classified as impervious as of 2015 ***(Figure 11)***. With consideration to the overall benefits of impervious surface reduction and the regulations set forth in N.J.A.C. 5:21 RSIS the Borough is considering ordinance modifications discussed below.

During the design process, time of concentration modifications to support low impact development will be considered to avoid or decrease the time of concentration by controlling the site factors that impact the rate of runoff. Specific factors include surface roughness changes, slope reduction, and vegetated conveyance.

Borough Code and Ordinance Analysis

To manage stormwater and protect the public interest, the Borough of Hawthorne has implemented a number of ordinances and regulations that incorporate nonstructural stormwater management requirements. The Borough Code and Ordinances were reviewed with regard to incorporating nonstructural stormwater management strategies. A summary of the of the pertinent provisions is presented below:

Chapter 450 of the Borough Code, entitled Subdivision of Land was reviewed with regard to incorporating nonstructural stormwater management strategies. Several changes will be made to Article V, entitled Design Standards to incorporate these strategies, as follows:

<u>Section 450-14</u>. Streets:

This section describes the requirements for streets in the Borough. This section will be amended to encourage developers to limit on-street parking to allow for narrower paved widths.

Ordinance No. 2262-20, entitled Stormwater Control, was reviewed with regard to incorporating nonstructural stormwater management strategies. Through the adoption of the new Stormwater Control Ordinance; to repeal and replace Chapter 437, entitled Stormwater Management of the code; several changes have been made to incorporate nonstructural stormwater management strategies, as follows:

<u>Section 437-2.</u> Definitions:

The definition of "Major Development" has been updated to incorporate the creation of one-quarter acre or more of "regulated motor vehicle surface" to include more projects to which these rules apply.

Including the updated definition of major development mentioned above, definitions have been included within this section to clarify and define various areas that pertain to nonstructural stormwater management strategies that include, but are not limited to, the following: "Regulated Impervious Surface", "Regulated Motor Vehicle Surface", "Green Infrastructure", "New Jersey Stormwater BMP Manual", etc.

Section 437-4. Stormwater Management Requirements for Major Development:

The Borough has adopted changes to apply the total suspended solids (TSS) removal requirement to the runoff from motor vehicles surfaces.

Ordinance No. 2262-20 above was adopted and implemented based on the New Jersey Department of Environmental Protection (NJDEP)'s model ordinance found at Appendix D of the BMP Manual. The Borough is currently considering adopting standards stronger than the statewide minimum requirements following the Watershed Institute Enhanced Model ordinance. The Watershed Institute Enhanced Stormwater Management Ordinance includes the following provisions: A reduced threshold definition for major development; Requirements for major developments to treat runoff from all impervious surfaces for water quality; Requirements for stormwater management for minor developments over 250 square feet; Requirements that address redevelopment; Requirements for Low Impact Development techniques to be utilized; and the inclusion of maintenance reporting requirements. Additionally, the Borough is considering adopting a zoning ordinance to specifically address stormwater management requirements for minor development.

The Borough will also be considering a new ordinance to provide protection to the lands surrounding the public well fields. The ordinance standards will limit the use of specific potential hazardous materials within wellhead protection areas. Additionally, Best Management Practice procedures will be implemented for other potential pollutant sources in the wellhead protection areas.

As mentioned previously, the Borough contains and lies within several wellhead protection areas. A wellhead protection area is divided into three (3) tiers; the 2-year (Tier 1), 5-year (Tier 2), and 12-year (Tier 3); are intended to represent the time of travel (TOT) a groundwater contaminant in the zones could be expected to reach a municipal potable supply well. The NJDEP then prioritizes the investigation and remediation of contaminated sites within the 2 and 5-year tiers. Wellhead protection areas are shown in ***Figure 7***. The Borough may also wish to adopt specific ordinances to further protect wellhead protection areas and minimize the infiltration of pollutants into aquifers.

In conclusions, the Borough will refer to the New Jersey Stormwater Best Management Practices Chapter 2 "Low Impact Development Techniques" during the review and adoption process of the amendments mentioned above.

VIII. Land Use/Build-Out Analysis

As previously stated, Appendix C of the New Jersey Best Management Practices Manual last revised in March of 2020 outlines that municipalities with less than one square mile of vacant or agricultural lands are not required to complete a "build-out" analysis. Therefore, this plan does not require a "build-out" analysis as the Borough of Hawthorne contains 0.085 sq. mi. (54.454 acres) of vacant land and no agricultural land as depicted in ***Figure 4***.

A record search identified vacant property in the Borough as shown below:

Table 5: **Vacant Properties Within the Borough of Hawthorne**

Block	Lot	Owner	Parcel Size (Acres)
1	1	SILVESTRI, DOMENIC ET ALS	0.175
1	4	TZI CORP. C/O P&A M. MACULA	0.064
2	1.01	TORRES, BRIGSY	0.138
6	2	BRIDGEMOHAN, STEVEN	0.078
6	5	KNIGHT, WILLIAM	0.104
7	6	VIRUET, ENRIQUE & JUDITH	0.0494
7	10	GALLOZA, HORLANDO	0.048
9	4	TZI CORP. C/O P&A M. MACULA	0.104
9	6	MDL REALTY, LLC	0.205
9	7	MDL REALTY, LLC	0.237
9	13	2 WAGARAW ROAD HAWTHORNE, LLC	0.214
9	14	2 WAGARAW ROAD HAWTHORNE, LLC	0.145
10	5.01	BUONO REALTY ASSOC., LLC	0.031
11	12	EST OF JERRY WLODARCZYK C/O GERALD	0.1148
11	13	EST OF JERRY WLODARCZYK C/O GERALD	0.3444
11	14	O'BRYAN, KEVIN	0.0574
12	8	NEWCOWAGARAW, LLC	8.78
12.01	9.01	WAGARAW RAIL, LLC	0.153
17	9.01	UNKNOWN	0.0299
17	25.01	ONE LORETTO AVE REALTY ASSOC	0.0574
17.01	1.01	ONE LORETTO AVE REALTY ASSOC	0.03
19	5	VISH DEV STAR, LLC	0.5279
19	11	MOHAMAD & CAROL ALLAHYARI, LLC	0.0574
19	17	VISH DEV STAR, LLC	0.123
19	18	VISH DEV STAR, LLC	0.18
24	13.04	BERGER, EDWARD III	0.043
28.01	1	EBURY RE, LLC	1.047
28.02	6	VEALE HOLDINGS AT HAWTHORNE, LLC	0.1664

Block	Lot	Owner	Parcel Size (Acres)
28.02	6.01	VEALE HOLDINGS AT HAWTHORNE, LLC	0.1779
29	4	ROYAL REALTY, LLC	1.333
47	21.04	PRT REALTY, L.P.	0.505
48	4	LEET HOUSE, LP	0.098
48	4.01	TJM PROPERTIES II LLC, ETALS	0.015
48	4.03	BUONO SALES INC	0.1343
48	6.05	BUONO SALES, INC	0.366
48	10.02	PRT REALTY, L.P.	1.982
48	10.05	PRT REALTY, L.P.	5.38
49	10	MISSONELLIE, JEFFREY,GREGORY,FRANCIS	0.1228
49	17	MISSONELLIE, JEFFREY C	0.26
50	2	ALONSO, MIGUEL	0.0574
76	2	MAZZOLA, STEVEN & CATHERINE	0.142
76	8	DUELTGEN, DARRYL W. & STEPHANIE	0.1137
80	8.03	MISSONELLIE, LINDA	0.622
82	1	WOOLDRIDGE, PHYLLIS	0.112
82	10	69 MAZUR PLACE, LLC	0.681
82	11.04	HKA HOMES, LLC	0.429
84	2.03	HKA HOMES, LLC	0.159
86	12	WARREN BROTHERS C/O TILCON	0.127
87	1	YANG, GUANG	0.828
88	36	HIGHVIEW AT HAWTHORNE ASSOC, INC.	6.807
88.01	21	HIGHVIEW AT HAWTHORNE ASSOC, INC.	0
88.02	5	WESTWOOD BUILDERS, L.P.	0.192
88.02	21	WESTWOOD BUILDERS, L.P.	0.679
89	6	NEW DOVER HOMES, LLC	0.577
90	1	NEW DOVER HOMES, LLC	2.766
90	2.01	NEW DOVER HOMES, LLC	2.384
90	2.02	NEW DOVER HOMES, LLC	0.635
90	14	HIGHVIEW AT HAWTHORNE ASSOC, INC.	0.049
90	28	HIGHVIEW AT HAWTHORNE ASSOC, INC.	0.438
90	29	HIGHVIEW AT HAWTHORNE ASSOC, INC.	0.224
90.01	17	HIGHVIEW AT HAWTHORNE ASSOC, INC.	2.767
104	29	BREVET, KURT D.	0.0413
113	13.01	JONALISA CONSTRUCTION, LLC	0.124

Block	Lot	Owner	Parcel Size (Acres)
130	1.04	UNKNOWN	0
134	7	421 AND 425 LAFAYETTE AVENUE, LLC	0.149
147	4	HIGHVIEW AT HAWTHORNE ASSOC, INC.	3.027
147	5	HIGHVIEW AT HAWTHORNE ASSOC, INC.	5.779
165	5	TD BANK	0.0861
167	6.02	VAN DEN BERG DEVELOPMENT, LLC	0.143
173	1	HAWTHORNE PROPERTIES LLC	0.305
178	21	GORGA, A., B., V., & C.	0.046
181	40	32 PARKER, LLC	0.215
202	5	ESTATE OF ROBERT VAN LENTEN	0.1148
217	6.01	D & L HOLDINGS, LLC	0.1354
224.01	7	UNKNOWN	0.146
229	24.01	UNKNOWN	0
236	1	PUBLIC SERV ELEC & GAS CO	0.065
244.01	1.01	COMMERCIAL PRODUCTS CO. INC.	0.492
252	15	HAWTHORNE AUTOMOBILE SALES COMPANY	0.044
252	16	FROHLICH, ERIC & LONGO, ROSALIE	0.2486
252	17	1173 GOFFLE ROAD, LLC	0.318
253	1	RT.208 & GOFFLE, HAWTHORNE, L.P.	0.912
253.01	5.01	HARRAN REALTY CO	0.135
253.01	6.01	HARRAN REALTY CO	0.173
276.03	5	MRAK, JOSEPH & CHARLOTTE	0.034
276.03	5.01	JOHNSON, JACQUELINE W	0.535
276.03	7	KRIEGER, LOUIS R.& GLORIA	0.053
276.03	8	HANI, LUTZIM & SUZANA	0.161
276.03	18	TORABI, SASHA & MONICA M.	0.053
276.03	19	MELE, JOSEPH A. & EUGENE, H.	0.129
276.03	19.01	HOMESTEAD BUILDERS COMP., LLC	0.201
276.03	20.02	MORZETTA, ANDREA & ANTONINA	0.062
281	14.01	ROONEY, MARK J. & PAMELA	0.1567
281.02	19.01	GAIA REAL ESTATE, LLC	0.583
281.02	19.02	COSMAN SAMUEL P	0.2626
286	2	HASCO, LLC	0.042
286	3.02	PRECISION MULTIPLE CONTROLS INC	0.028
286	3.05	HASCO, LLC	0.009

Block	Lot	Owner	Parcel Size (Acres)
287	6.03	53 BRAEN AVENUE, LLC	0.1492
287	8	53 BRAEN AVENUE, LLC	1.4
289	14	CHAFITELLI, DONNA & MUNGENAST, P.	0.143
289.01	3	HAWTHORNE GOSPEL CHURCH	5.46
290.01	2.02	HOOGERHYDE, DUANE & KAREN	0.132
290.01	3	SCROFANI, RICHARD & MICHELE	0.765
290.01	5	LEARY, VERONICA ANN	0.388
290.01	48	VAN DEN BERG REALTY, LLC	0.726
290.01	52	ORTH, DAVID M.& MARY ANN B.	0.01
292	7.01	MARKOVIC, JOHN & COLETTE	0.3444
292	12.03	DIMINNI, DOMENICK	0.304
292	14.01	DIMINNI, DOMENICK	2.177
293.08	28	ALMONTE, KEVIN & ALTAGRACIA MAYI	0.321
297.01	1	PELLEGRINO, PAUL	0.032

IX. Mitigation Plans

Upon review by the Borough's governing body, Hawthorne may utilize the following mitigation plan in the future. However, at this time the municipality is not granting variances or waivers from the conditions set forth within the adopted Stormwater Control Ordinance. Approval of the option to utilize a mitigation plan and choice of mitigation plan shall be under the sole discretion of the Borough agency providing review, i.e. Board of Adjustment, Planning Board, Borough Council, and the Borough Engineer.

This mitigation plan is provided for potential future implementation as it pertains to a proposed development that is granted a variance or exemption from the stormwater management design and performance standards. Presented below is a hierarchy of options acceptable for review by the Borough.

Mitigation Project Criteria

1. The mitigation project must be implemented in the same drainage area as the proposed development and provide additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed property. The mitigation project shall treat runoff that does not currently meet the design and performance standards outlined in the Municipal Stormwater Management Plan. The developer must ensure the long-term maintenance of the project, including the maintenance requirements under Chapters 8 and 9 of the NJDEP Stormwater BMP Manual.

   The applicant can propose the utilization of one of the following projects to compensate for the deficit of the performance standards resulting from the proposed project. More detailed information on the projects can be obtained from the Borough Engineer. Listed below are specific projects that can be used to address the mitigation requirement.

   Groundwater Recharge

   - Retrofit existing detention basins to provide additional cubic feet of average annual groundwater recharge.
   - Replace existing deteriorated, impervious overflow parking lots with permeable paving to provide additional cubic feet of average annual groundwater recharge.

   Water Quality

   - Retrofit existing stormwater management facilities to provide the removal of 90 percent of total suspended solids (TSS) from the parking lot in question.

   Water Quantity

   - Install stormwater management measures in open spaces within various developments to reduce the peak flow from the upstream development on the receiving stream for the 2, 20, and 100-year storms.

2. If a suitable site cannot be located in the same drainage area as the proposed development, as discussed in Option 1, the proposed project may provide mitigation that is not equivalent to the impacts for which the variance or exemption is sought, but that addresses the same issue. For example, if a variance is given because the 90 percent TSS requirement is not met, the selected project may address water quality impacts due to applicable TMDLs.

Only a brief description of a potential project is presented here, it is important that the Borough has sufficient information on each project, including size of the project, permit requirements, land ownership, and estimated project costs (i.e., permitting fees, engineering costs, construction costs, and maintenance costs).

The Borough may allow a developer to provide funding or partial funding to the municipality for an environmental enhancement project that has been identified in a Municipal Stormwater Management Plan, or towards the development of a Regional Stormwater Management Plan. The funding must be equal to or greater than the cost to implement the mitigation outlined above, including costs associated with purchasing the property or easement for mitigation, and the cost associated with the long-term maintenance requirements of the mitigation measure.

Appendix A

Stormwater Control Ordinance

ORDINANCE 2262-20
AN ORDINANCE TO REPEAL AND REPLACE CHAPTER 437 STORM WATER MANAGEMENT

BE IT ORDAINED by the Municipal Council of the Borough of Hawthorne, in the County of Passaic and State of New Jersey, that:

Chapter 437 Storm Water Management, is hereby repealed and replaced, with the revised Chapter to read as follows:

§ 437-1. Scope and Purpose:

A. Policy Statement

Flood control, groundwater recharge, and pollutant reduction shall be achieved through the use of stormwater management measures, including green infrastructure Best Management Practices (GI BMPs) and nonstructural stormwater management strategies. GI BMPs and low impact development (LID) should be utilized to meet the goal of maintaining natural hydrology to reduce stormwater runoff volume, reduce erosion, encourage infiltration and groundwater recharge, and reduce pollution. GI BMPs and LID should be developed based upon physical site conditions and the origin, nature and the anticipated quantity, or amount, of potential pollutants. Multiple stormwater management BMPs may be necessary to achieve the established performance standards for water quality, quantity, and groundwater recharge.

B. Purpose

The purpose of this ordinance is to establish minimum stormwater management requirements and controls for "major development," as defined below in Section II.

C. Applicability

1. This ordinance shall be applicable to the following major developments:

a. Non-residential major developments; and

b. Aspects of residential major developments that are not pre-empted by the Residential Site Improvement Standards at N.J.A.C. 5:21.

2. This ordinance shall also be applicable to all major developments undertaken by the Borough of Hawthorne.

3. This ordinance shall be applicable in part to single-family and multi-family construction or improvements in accordance with Section 437-11 hereunder.

D. Compatibility with Other Permit and Ordinance Requirements

Development approvals issued pursuant to this ordinance are to be considered an integral part of development approvals and do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare.

This ordinance is not intended to interfere with, abrogate, or annul any other ordinances, rule or regulation, statute, or other provision of law except that, where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, the more restrictive provisions or higher standards shall control.

§ 437-2. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory. The definitions below are the same as or based on the corresponding definitions in the Stormwater Management Rules at N.J.A.C. 7:8-1.2.

"CAFRA Centers, Cores or Nodes" means those areas with boundaries incorporated by reference or revised by the Department in accordance with N.J.A.C. 7:7-13.16.

"CAFRA Planning Map" means the map used by the Department to identify the location of Coastal Planning Areas, CAFRA centers, CAFRA cores, and CAFRA nodes. The CAFRA Planning Map is available on the Department's Geographic Information System (GIS).

"Community basin" means an infiltration system, sand filter designed to infiltrate, standard constructed wetland, or wet pond, established in accordance with N.J.A.C. 7:8- 4.2(c)14, that is designed and constructed in accordance with the New Jersey Stormwater Best Management Practices Manual, or an alternate design, approved in accordance with N.J.A.C. 7:8-5.2(g), for an infiltration system, sand filter designed to infiltrate, standard constructed wetland, or wet pond and that complies with the requirements of this chapter.

"Compaction" means the increase in soil bulk density.

"Contributory drainage area" means the area from which stormwater runoff drains to a stormwater management measure, not including the area of the stormwater management measure itself.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"County review agency" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

1. A county planning agency or
2. A county water resource association created under N.J.S.A 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

"Department" means the Department of Environmental Protection.

"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"Design engineer" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

“Development” means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlarge- enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 *et seq*.

In the case of development of agricultural land, development means: any activity that requires a State permit, any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act , N.J.S.A 4:1C-1 et seq.

“Disturbance” means the placement or reconstruction of impervious surface or motor vehicle surface, or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Milling and repaving is not considered disturbance for the purposes of this definition.

“Drainage area” means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

“Environmentally constrained area” means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

“Environmentally critical area” means an area or feature which is of significant environmental value, including but not limited to: stream corridors, natural heritage priority sites, habitats of endangered or threatened species, large areas of contiguous open space or upland forest, steep slopes, and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department’s Landscape Project as approved by the Department’s Endangered and Nongame Species Program.

“Empowerment Neighborhoods” means neighborhoods designated by the Urban Coordinating Council “in consultation and conjunction with” the New Jersey Redevelopment Authority pursuant to N.J.S.A 55:19-69.

“Erosion” means the detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

“Green infrastructure” means a stormwater management measure that manages stormwater close to its source by:

1. Treating stormwater runoff through infiltration into subsoil;
2. Treating stormwater runoff through filtration by vegetation or soil; or
3. Storing stormwater runoff for reuse.

"HUC 14" or "hydrologic unit code 14" means an area within which water drains to a particular receiving surface water body, also known as a subwatershed, which is identified by a 14-digit hydrologic unit boundary designation, delineated within New Jersey by the United States Geological Survey.

“Impervious surface” means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

“Infiltration” is the process by which water seeps into the soil from precipitation.

“Lead planning agency” means one or more public entities having stormwater management planning authority designated by the regional stormwater management planning committee pursuant to N.J.A.C. 7:8-3.2, that serves as the primary representative of the committee.

“Major development” means an individual “development,” as well as multiple developments that individually or collectively result in:

1. The disturbance of one or more acres of land since February 2, 2004;
2. The creation of one-quarter acre or more of “regulated impervious surface” since February 2, 2004;
3. The creation of one-quarter acre or more of “regulated motor vehicle surface” since December 2, 2020; or
4. A combination of 2 and 3 above that totals an area of one-quarter acre or more. The same surface shall not be counted twice when determining if the combination area equals one-quarter acre or more.

Major development includes all developments that are part of a common plan of development or sale (for example, phased residential development) that collectively or individually meet any one or more of paragraphs 1, 2, 3, or 4 above. Projects undertaken by any government agency that otherwise meet the definition of “major development” but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered “major development.”

“Motor vehicle” means land vehicles propelled other than by muscular power, such as automobiles, motorcycles, autocycles, and low speed vehicles. For the purposes of this definition, motor vehicle does not include farm equipment, snowmobiles, all-terrain vehicles, motorized wheelchairs, go-carts, gas buggies, golf carts, ski-slope grooming machines, or vehicles that run only on rails or tracks.

“Motor vehicle surface” means any pervious or impervious surface that is intended to be used by “motor vehicles” and/or aircraft, and is directly exposed to precipitation including, but not limited to, driveways, parking areas, parking garages, roads, racetracks, and runways.

“Municipality” means any city, borough, town, township, or village.

“New Jersey Stormwater Best Management Practices (BMP) Manual” or “BMP Manual” means the manual maintained by the Department providing, in part, design specifications, removal rates, calculation methods, and soil testing procedures approved by the Department as being capable of contributing to the achievement of the stormwater management standards specified in this chapter. The BMP Manual is periodically amended by the Department as necessary to provide design specifications on additional best management practices and new information on already included practices reflecting the best available current information regarding the particular practice and the Department’s determination as to the ability of that best management practice to contribute to compliance with the standards contained in this chapter. Alternative stormwater management measures, removal rates, or calculation methods may be utilized, subject to any limitations specified in this chapter, provided the design engineer demonstrates to the municipality, in accordance with Section IV.F. of this ordinance and N.J.A.C. 7:8-5.2(g), that the proposed measure and its design will contribute to achievement of the design and performance standards established by this chapter.

“Node” means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

“Nutrient” means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

“Person” means any individual, corporation, company, partnership, firm, association, political subdivision of this State and any state, interstate or Federal agency.

“Pollutant” means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. §§ 2011 *et seq*.)), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. “Pollutant” includes both hazardous and nonhazardous pollutants.

“Recharge” means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

“Regulated impervious surface” means any of the following, alone or in combination:

1. A net increase of impervious surface;
2. The total area of impervious surface collected by a new stormwater conveyance system (for the purpose of this definition, a “new stormwater conveyance system” is a stormwater conveyance system that is constructed where one did not exist immediately prior to its construction or an existing system for which a new discharge location is created);
3. The total area of impervious surface proposed to be newly collected by an existing stormwater conveyance system; and/or
4. The total area of impervious surface collected by an existing stormwater conveyance system where the capacity of that conveyance system is increased.

“Regulated motor vehicle surface” means any of the following, alone or in combination:

1. The total area of motor vehicle surface that is currently receiving water;
2. A net increase in motor vehicle surface; and/or

quality treatment either by vegetation or soil, by an existing stormwater management measure, or by treatment at a wastewater treatment plant, where the water quality treatment will be modified or removed.

“Sediment” means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

“Site” means the lot or lots upon which a major development is to occur or has occurred.

“Soil” means all unconsolidated mineral and organic material of any origin.

“State Development and Redevelopment Plan Metropolitan Planning Area (PA1)” means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the State’s future redevelopment and revitalization efforts.

“State Plan Policy Map” is defined as the geographic application of the State Development and Redevelopment Plan’s goals and statewide policies, and the official map of these goals and policies.

“Stormwater” means water resulting from precipitation (including rain and snow) that runs off the land’s surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

"Stormwater management BMP" means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management BMP may either be normally dry (that is, a detention basin or infiltration system), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

"Stormwater management measure" means any practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

"Stormwater management planning agency" means a public body authorized by legislation to prepare stormwater management plans.

"Stormwater management planning area" means the geographic area for which a stormwater management planning agency is authorized to prepare stormwater management plans, or a specific portion of that area identified in a stormwater management plan prepared by that agency.

"Tidal Flood Hazard Area" means a flood hazard area in which the flood elevation resulting from the two-, 10-, or 100-year storm, as applicable, is governed by tidal flooding from the Atlantic Ocean. Flooding in a tidal flood hazard area may be contributed to, or influenced by, stormwater runoff from inland areas, but the depth of flooding generated by the tidal rise and fall of the Atlantic Ocean is greater than flooding from any fluvial sources. In some situations, depending upon the extent of the storm surge from a particular storm event, a flood hazard area may be tidal in the 100-year storm, but fluvial in more frequent storm events.

"Urban Coordinating Council Empowerment Neighborhood" means a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

"Urban Enterprise Zones" means a zone designated by the New Jersey Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et. seq.

"Urban Redevelopment Area" is defined as previously developed portions of areas:

1. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;
2. Designated as CAFRA Centers, Cores or Nodes;
3. Designated as Urban Enterprise Zones; and
4. Designated as Urban Coordinating Council Empowerment Neighborhoods.

"Water control structure" means a structure within, or adjacent to, a water, which intentionally or coincidentally alters the hydraulic capacity, the flood elevation resulting from the two-, 10-, or 100-year storm, flood hazard area limit, and/or floodway limit of the water. Examples of a water control structure may include a bridge, culvert, dam, embankment, ford (if above grade), retaining wall, and weir.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Wetlands" or "wetland" means an area that is inundated or saturated by surface water or ground water at

a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically
adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

§ 437-3. Design and Performance Standards for Stormwater Management Measures

A. Stormwater management measures for major development shall be designed to provide erosion control, groundwater recharge, stormwater runoff quantity control, and stormwater runoff quality treatment as follows:

1. The minimum standards for erosion control are those established under the Soil and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules at N.J.A.C. 2:90.
2. The minimum standards for groundwater recharge, stormwater quality, and stormwater runoff quantity shall be met by incorporating green infrastructure.

B. The standards in this ordinance apply only to new major development and are intended to minimize the impact of stormwater runoff on water quality and water quantity in receiving water bodies and maintain groundwater recharge. The standards do not apply to new major development to the extent that alternative design and performance standards are applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules.

§ 437-4. Stormwater Management Requirements for Major Development

A. The development shall incorporate a maintenance plan for the stormwater management measures incorporated into the design of a major development in accordance with Section 437-10.

B. Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department's Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).

C. The following linear development projects are exempt from the groundwater recharge, stormwater runoff quality, and stormwater runoff quantity requirements of Section IV.P, Q and R:

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;
2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and
3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

D. A waiver from strict compliance from the green infrastructure, groundwater recharge, stormwater runoff quality, and stormwater runoff quantity requirements of Section IV.O, P, Q and R may be obtained for the enlargement of an existing public roadway or railroad; or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;
2. The applicant demonstrates through an alternatives analysis, that through the use of stormwater management measures, the option selected complies with the requirements of Section IV.O, P, Q and R to the maximum extent practicable;
3. The applicant demonstrates that, in order to meet the requirements of Section IV.O, P, Q and R, existing structures currently in use, such as homes and buildings, would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under IV.D.3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate the requirements of Section IV.O, P, Q and R that were not achievable onsite.

E. Tables 1 through 3 below summarize the ability of stormwater best management practices identified and described in the New Jersey Stormwater Best Management Practices Manual to satisfy the green infrastructure, groundwater recharge, stormwater runoff quality and stormwater runoff quantity standards specified in Section IV.O, P, Q and R. When designed in accordance with the most current version of the New Jersey Stormwater Best Management Practices Manual, the stormwater management measures found at N.J.A.C. 7:8-5.2 (f) Tables 5-1, 5-2 and 5-3 and listed below in Tables 1, 2 and 3 are presumed to be capable of providing stormwater controls for the design and performance standards as outlined in the tables below. Upon amendments of the New Jersey Stormwater Best Management Practices to reflect additions or deletions of BMPs meeting these standards, or changes in the presumed performance of BMPs designed in accordance with the New Jersey Stormwater BMP Manual, the Department shall publish in the New Jersey Registers a notice of administrative change revising the applicable table. The most current version of the BMP Manual can be found on the Department's website at:

https://njstormwater.org/bmp_manual2.htm.

F. Where the BMP tables in the NJ Stormwater Management Rule are different due to updates or amendments with the tables in this ordinance the BMP Tables in the Stormwater Management rule at N.J.A.C. 7:8-5.2(f) shall take precedence.

Table 1
Green Infrastructure BMPs for Groundwater Recharge, Stormwater Runoff Quality, and/or Stormwater Runoff Quantity

Best Management Practice	Stormwater Runoff Quality TSS Removal Rate (percent)	Stormwater Runoff Quantity	Groundwater Recharge	Minimum Separation from Seasonal High Water Table (feet)
Cistern	0	Yes	No	--
Dry Well[(a)]	0	No	Yes	2
Grass Swale	50 or less	No	No	2(e) 1(f)
Green Roof	0	Yes	No	--
Manufactured Treatment Device(a) (g)	50 or 80	No	No	Dependent upon the device
Pervious Paving System[(a)]	80	Yes	Yes(b) No(c)	2(b) 1(c)
Small-Scale Bioretention Basin[(a)]	80 or 90	Yes	Yes(b) No(c)	2(b) 1(c)

Small-Scale Infiltration Basin[(a)]	80	Yes	Yes	2
Small-Scale Sand Filter	80	Yes	Yes	2
Vegetative Filter Strip	60-80	No	No	--

(Notes corresponding to annotations (a) *through* (g) *are found on Page D-15)*

Table 2
Green Infrastructure BMPs for Stormwater Runoff Quantity (or for Groundwater Recharge and/or Stormwater Runoff Quality with a Waiver or Variance from N.J.A.C. 7:8-5.3)

Best Management Practice	Stormwater Runoff Quality TSS Removal Rate (percent)	Stormwater Runoff Quantity	Groundwater Recharge	Minimum Separation from Seasonal High Water Table (feet)
Bioretention System	80 or 90	Yes	Yes(b) No(c)	2(b) 1(c)
Infiltration Basin	80	Yes	Yes	2
Sand Filter[(b)]	80	Yes	Yes	2
Standard Constructed Wetland	90	Yes	No	N/A
Wet Pond[(d)]	50-90	Yes	No	N/A

(Notes corresponding to annotations (b) *through* (d) *are found on Page D-15)*

Table 3
BMPs for Groundwater Recharge, Stormwater Runoff Quality, and/or Stormwater Runoff Quantity only with a Waiver or Variance from N.J.A.C. 7:8-5.3

Best Management Practice	Stormwater Runoff Quality TSS Removal Rate (percent)	Stormwater Runoff Quantity	Groundwater Recharge	Minimum Separation from Seasonal High Water Table (feet)
Blue Roof	0	Yes	No	N/A

Extended Detention Basin	40-60	Yes	No	1
Manufactured Treatment Device[h]	50 or 80	No	No	Dependent upon the device
Sand Filter[c]	80	Yes	No	1
Subsurface Gravel Wetland	90	No	No	1
Wet Pond	50-90	Yes	No	N/A

Notes to Tables 1, 2, and 3:
(a) subject to the applicable contributory drainage area limitation specified at Section IV.O.2;
(b) designed to infiltrate into the subsoil;
(c) designed with underdrains;
(d) designed to maintain at least a 10-foot wide area of native vegetation along at least
50 percent of the shoreline and to include a stormwater runoff retention component designed to capture stormwater runoff for beneficial reuse, such as irrigation;
(e) designed with a slope of less than two percent;
(f) designed with a slope of equal to or greater than two percent;
(g) manufactured treatment devices that meet the definition of green infrastructure at Section II;
(h) manufactured treatment devices that do not meet the definition of green infrastructure at Section II.

G. An alternative stormwater management measure, alternative removal rate, and/or alternative method to calculate the removal rate may be used if the design engineer demonstrates the capability of the proposed alternative stormwater management measure and/or the validity of the alternative rate or method to the municipality. A copy of any approved alternative stormwater management measure, alternative removal rate, and/or alternative method to calculate the removal rate shall be provided to the Department in accordance with Section VI.B. Alternative stormwater management measures may be used to satisfy the requirements at Section IV.O only if the measures meet the definition of green infrastructure at Section II. Alternative stormwater management measures that function in a similar manner to a BMP listed at Section O.2 are subject to the contributory drainage area limitation specified at Section O.2 for that similarly functioning BMP. Alternative stormwater management measures approved in accordance with this subsection that do not function in a similar manner to any BMP listed at Section O.2 shall have a contributory drainage area less than or equal to 2.5 acres, except for alternative stormwater management measures that function similarly to cisterns, grass swales, green roofs, standard constructed wetlands, vegetative filter strips, and wet ponds, which are not subject to a contributory drainage area limitation. Alternative measures that function similarly to standard constructed wetlands or wet ponds shall not be used for compliance with the stormwater runoff quality standard unless a variance in accordance with N.J.A.C. 7:8-4.6 or a waiver from strict compliance in accordance with Section IV.D is granted from Section IV.O.

H. Whenever the stormwater management design includes one or more BMPs that will infiltrate stormwater into subsoil, the design engineer shall assess the hydraulic impact on the groundwater table and design the site, so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table, so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems or other subsurface structures within the zone of influence of the groundwater mound, or interference with the proper functioning of the stormwater management measure itself.

I. Design standards for stormwater management measures are as follows:

1. Stormwater management measures shall be designed to take into account the existing site conditions, including, but not limited to, environmentally critical areas; wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability, and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone);
2. Stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure, as appropriate, and shall have parallel bars with one-inch spacing between the bars to the elevation of the water quality design storm. For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than one-third the width of the diameter of the orifice or one-third the width of the weir, with a minimum spacing between bars of one inch and a maximum spacing between bars of six inches. In addition, the design of trash racks must comply with the requirements of Section VIII.C;
3. Stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement;
4. Stormwater management BMPs shall be designed to meet the minimum safety standards for stormwater management BMPs at Section VIII; and
5. The size of the orifice at the intake to the outlet from the stormwater management BMP shall be a minimum of two and one-half inches in diameter.

J. Manufactured treatment devices may be used to meet the requirements of this subchapter, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department. Manufactured treatment devices that do not meet the definition of green infrastructure at Section II may be used only under the circumstances described at Section IV.O.4.

K. Any application for a new agricultural development that meets the definition of major development at Section II shall be submitted to the Soil Conservation District for review and approval in accordance with the requirements at Sections IV.O, P, Q and R and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For purposes of this subsection, "agricultural development" means land uses normally associated with the production of food, fiber, and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacture of agriculturally related products.

L. If there is more than one drainage area, the groundwater recharge, stormwater runoff quality, and stormwater runoff quantity standards at Section IV.P, Q and R shall be met in each drainage area, unless the runoff from the drainage areas converge onsite and no adverse environmental impact would occur as a result of compliance with any one or more of the individual standards being determined utilizing a weighted average of the results achieved for that individual standard across the affected drainage areas.

M. Any stormwater management measure authorized under the municipal stormwater management plan or ordinance shall be reflected in a deed notice recorded in the Office of the Passaic County Clerk. A form of deed notice shall be submitted to the reviewing agency having jurisdiction in the Borough of Hawthorne and submitted to the municipality for approval prior to filing. The deed notice shall contain a description of the stormwater management measure(s) used to meet the green infrastructure, groundwater recharge, stormwater runoff quality, and stormwater runoff quantity standards at Section IV.O, P, Q and R and shall identify the location of the stormwater management measure(s) in NAD 1983 State Plane New Jersey FIPS 2900 US Feet or Latitude and Longitude in decimal degrees. The deed notice shall also reference the maintenance plan required to be recorded upon the deed pursuant to Section X.B.5. Prior to the commencement of construction, proof that the above required deed notice has been filed shall be submitted to the municipality. Proof that the required information has been recorded on the deed shall be in the form of either a copy of the complete recorded document or a receipt from the clerk or other proof of recordation provided by the recording office. However, if the initial proof provided to the municipality is not a copy of the complete recorded document, a copy of the complete recorded document shall be provided to the municipality within 180 calendar days of the authorization granted by the municipality.

N. A stormwater management measure approved under the municipal stormwater management plan or ordinance may be altered or replaced with the approval of the municipality, if the municipality determines that the proposed alteration or replacement meets the design and performance standards pursuant to Section IV of this ordinance and provides the same level of stormwater management as the previously approved stormwater management measure that is being altered or replaced. If an alteration or replacement is approved, a revised deed notice shall be submitted to the municipality for approval and subsequently recorded with the Office of the Clerk of the County of Passaic and shall contain a description and location of the stormwater management measure, as well as reference to the maintenance plan, in accordance with M above. Prior to the commencement of construction, proof that the above required deed notice has been filed shall be submitted to the municipality in accordance with M above.

O. Green Infrastructure Standards

1. This subsection specifies the types of green infrastructure BMPs that may be used to satisfy the groundwater recharge, stormwater runoff quality, and stormwater runoff quantity standards.

2. To satisfy the groundwater recharge and stormwater runoff quality standards at Section IV.P and Q, the design engineer shall utilize green infrastructure BMPs identified in Table 1 at Section IV.F. and/or an alternative stormwater management measure approved in accordance with Section IV.G. The following green infrastructure BMPs are subject to the following maximum contributory drainage area limitations:

Best Management Practice	**Maximum Contributory Drainage Area**
Dry Well	1 acre
Manufactured Treatment Device	2.5 acres
Pervious Pavement Systems	Area of additional inflow cannot exceed three times the area occupied by the BMP
Small-scale Bioretention Systems	2.5 acres
Small-scale Infiltration Basin	2.5 acres
Small-scale Sand Filter	2.5 acres

3. To satisfy the stormwater runoff quantity standards at Section IV.R, the design engineer shall utilize BMPs from Table 1 or from Table 2 and/or an alternative stormwater management measure approved in accordance with Section IV.G.

4. If a variance in accordance with N.J.A.C. 7:8-4.6 or a waiver from strict compliance in accordance with Section IV.D is granted from the requirements of this subsection, then BMPs from Table 1, 2, or 3, and/or an alternative stormwater management measure approved in accordance with Section IV.G may be used to meet the groundwater recharge, stormwater runoff quality, and stormwater runoff

quantity standards at Section IV.P, Q and R.

5. For separate or combined storm sewer improvement projects, such as sewer separation, undertaken by a government agency or public utility (for example, a sewerage company), the requirements of this subsection shall only apply to areas owned in fee simple by the government agency or utility, and areas within a right- of-way or easement held or controlled by the government agency or utility; the entity shall not be required to obtain additional property or property rights to fully satisfy the requirements of this subsection. Regardless of the amount of area of a separate or combined storm sewer improvement project subject to the green infrastructure requirements of this subsection, each project shall fully comply with the applicable groundwater recharge, stormwater runoff quality control, and stormwater runoff quantity standards at Section IV.P, Q and R, unless the project is granted a waiver from strict compliance in accordance with Section IV.D.

P. Groundwater Recharge Standards

1. This subsection contains the minimum design and performance standards for groundwater recharge as follows:
2. The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at Section V, either:

i. Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or
ii. Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated.

3. This groundwater recharge requirement does not apply to projects within the "urban redevelopment area," or to projects subject to 4 below.
4. The following types of stormwater shall not be recharged:

i. Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and
ii. Industrial stormwater exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

Q. Stormwater Runoff Quality Standards

1. This subsection contains the minimum design and performance standards to control stormwater runoff quality impacts of major development. Stormwater runoff quality standards are applicable when the major development results in an increase of one-quarter acre or more of regulated motor vehicle surface.
2. Stormwater management measures shall be designed to reduce the post- construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm as follows:

i. Eighty percent TSS removal of the anticipated load, expressed as an annual average shall be achieved for the stormwater runoff from the net increase of motor vehicle surface.
ii. If the surface is considered regulated motor vehicle surface because the water quality treatment for an area of motor vehicle surface that is currently receiving water quality treatment either by vegetation or soil, by an existing stormwater management measure, or by treatment at a wastewater treatment plant is to be modified or removed, the project shall maintain or increase the existing TSS removal of the anticipated load expressed as an annual average.

3. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. Every major development, including any that discharge into a combined sewer system, shall comply with 2 above, unless the major development is itself subject to a NJPDES permit with a numeric effluent limitation for TSS or the NJPDES permit to which the major development is subject exempts the development from a numeric effluent limitation for TSS.
4. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 4, below. The calculation of the volume of runoff may take into account the implementation of stormwater management measures.

TABLE 4 – WATER QUALITY DESIGN STORM DISTRIBUTION

5.If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

R = A + B – (A *x* B) / 100,

Where

R = total TSS Percent Load Removal from application of both BMPs, and A = the TSS Percent Removal Rate applicable to the first BMP
B = the TSS Percent Removal Rate applicable to the second BMP.

6.Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include green infrastructure BMPs that optimize nutrient removal while still achieving the performance standards in Section IV.P, Q and R.
7.In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.
8.The Flood Hazard Area Control Act Rules at N.J.A.C. 7:13-4.1(c)1 establish 300-foot riparian zones along Category One waters, as designated in the Surface Water Quality Standards at N.J.A.C. 7:9B, and certain upstream tributaries to Category One waters. A person shall not undertake a major development that is located within or discharges into a 300-foot riparian zone without prior authorization from the Department under N.J.A.C. 7:13.
9.Pursuant to the Flood Hazard Area Control Act Rules at N.J.A.C. 7:13-11.2(j)3.i, runoff from the water quality design storm that is discharged within a 300-foot riparian zone shall be treated in accordance with this subsection to reduce the post- construction load of total suspended solids by 95 percent of the anticipated load from the developed site, expressed as an annual average.
10. This stormwater runoff quality standards do not apply to the construction of one individual single-family dwelling, provided that it is not part of a larger development or subdivision that has received preliminary or final site plan approval prior to December 3, 2018, and that the motor vehicle surfaces are made of permeable material(s) such as gravel, dirt, and/or shells.

R. Stormwater Runoff Quantity Standards

1. This subsection contains the minimum design and performance standards to control stormwater runoff quantity impacts of major development.
2. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at Section V, complete one of the following:

i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 2-, 10-, and 100- year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;
ii. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2-, 10- and 100-year storm events and that the increased volume or change in timing of stormwater

runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

iii. Design stormwater management measures so that the post-construction peak runoff rates for the 2-, 10- and 100-year storm events are 70, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed; or

iv. In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with 2.i, ii and iii above is required unless the design engineer demonstrates through hydrologic and hydraulic analysis that the increased volume, change in timing, or increased rate of the stormwater runoff, or any combination of the three will not result in additional flood damage below the point of discharge of the major development. No analysis is required if the stormwater is discharged directly into any ocean, bay, inlet, or the reach of any watercourse between its confluence with an ocean, bay, or inlet and downstream of the first water control structure.

3. The stormwater runoff quantity standards shall be applied at the site's boundary to each abutting lot, roadway, watercourse, or receiving storm sewer system.

§ 437-5. Calculation of Stormwater Runoff and Groundwater Recharge:

A. Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

i. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Chapters 7, 9, 10, 15 and 16 Part 630, Hydrology National Engineering Handbook, incorporated herein by reference as amended and supplemented. This methodology is additionally described in *Technical Release 55 - Urban Hydrology for Small Watersheds* (TR-55), dated June 1986,

incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the Natural Resources Conservation Service website at:

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf

or at United States Department of Agriculture Natural Resources Conservation Service, 220 Davison Avenue, Somerset, New Jersey 08873; or

ii. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations. The rational and modified rational methods are described in "Appendix A-9 Modified Rational Method" in the Standards for Soil Erosion and Sediment Control in New Jersey, January 2014. This document is available from the State Soil Conservation Committee or any of the Soil Conservation Districts listed at N.J.A.C. 2:90-1.3(a)3. The location, address, and telephone number for each Soil Conservation District is available from the State Soil Conservation Committee, PO Box 330, Trenton, New Jersey 08625. The document is also available at:

http://www.nj.gov/agriculture/divisions/anr/pdf/2014NJSoilErosionControlStandardsComplete.pdf.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition. The term "runoff coefficient" applies to both the NRCS methodology above at Section V.A.1.i and the Rational and Modified Rational Methods at Section

V.A.1.ii. A runoff coefficient or a groundwater recharge land cover for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of application. If more than one land cover have existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good hydrologic condition and conservation treatment (if the land use type is cultivation).

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from unconnected impervious cover, urban impervious area modifications as described in the NRCS *Technical Release 55 – Urban Hydrology for Small Watersheds* or other methods may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

B. Groundwater recharge may be calculated in accordance with the following:

The New Jersey Geological Survey Report GSR-32, A Method for Evaluating Groundwater-Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at the New Jersey Geological Survey website at:

https://www.nj.gov/dep/njgs/pricelst/gsreport/gsr32.pdf

or at New Jersey Geological and Water Survey, 29 Arctic Parkway, PO Box 420 Mail Code 29-01, Trenton, New Jersey 08625-0420.

§ 437-6. Sources for Technical Guidance:

A. Technical guidance for stormwater management measures can be found in the documents listed below, which are available to download from the Department's website at:

http://www.nj.gov/dep/stormwater/bmp_manual2.htm.

1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, as amended and supplemented. Information is provided on stormwater management measures such as, but not limited to, those listed in Tables 1, 2, and 3.

2. Additional maintenance guidance is available on the Department's website at:

https://www.njstormwater.org/maintenance_guidance.htm.

B. Submissions required for review by the Department should be mailed to:

The Division of Water Quality, New Jersey Department of Environmental Protection, Mail Code 401-02B, PO Box 420, Trenton, New Jersey 08625-0420.

§ 437-7. Solids and Floatable Materials Control Standards:

A. Site design features identified under Section IV.F above, or alternative designs in accordance with Section IV.G above, to prevent discharge of trash and debris from drainage systems shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this paragraph, "solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see Section VII.A.2 below.

1. Design engineers shall use one of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

i. The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines; or
ii. A different grate, if each individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than 0.5 inches across the smallest dimension.

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater system floors used to collect stormwater from the surface into a storm drain or surface water body.

iii. For curb-opening inlets, including curb-opening inlets in combination inlets, the clear space in that curb opening, or each individual clear space if the curb opening has two or more clear spaces, shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

2. The standard in A.1. above does not apply:

i. Where each individual clear space in the curb opening in existing curb-opening inlet does not have an area of more than nine (9.0) square inches;
ii. Where the municipality agrees that the standards would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets;
iii. Where flows from the water quality design storm as specified in N.J.A.C. 7:8 are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

a. A rectangular space four and five-eighths (4.625) inches long and one and one-half (1.5) inches wide (this option does not apply for outfall netting facilities); or
b. A bar screen having a bar spacing of 0.5 inches.

Note that these exemptions do not authorize any infringement of requirements in the Residential Site Improvement Standards for bicycle safe grates in new residential development (N.J.A.C. 5:21-4.18(b)2 and 7.4(b)1).

iv. Where flows are conveyed through a trash rack that has parallel bars with one- inch (1 inch) spacing between the bars, to the elevation of the Water Quality Design Storm as specified in N.J.A.C. 7:8; or

v. Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4- 7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

§ 437-8. Safety Standards for Stormwater Management Basins:

A. This section sets forth requirements to protect public safety through the proper design and operation of stormwater management BMPs. This section applies to any new stormwater management BMP.

B. The provisions of this section are not intended to preempt more stringent municipal or county safety requirements for new or existing stormwater management BMPs. Municipal and county stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management BMPs to be retrofitted to meet one or more of the safety standards in Section VIII.C.1, VIII.C.2, and VIII.C.3 for trash racks, overflow grates, and escape provisions at outlet structures.

C. Requirements for Trash Racks, Overflow Grates and Escape Provisions

1. A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the Stormwater management BMP to ensure proper functioning of the BMP outlets in accordance with the following:

i. The trash rack shall have parallel bars, with no greater than six-inch spacing between the bars;
ii. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure;
iii. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack; and
iv. The trash rack shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 pounds per square foot.

2. An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, such grate shall meet the following requirements:

i. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance.
ii. The overflow grate spacing shall be no less than two inches across the smallest dimension
iii. The overflow grate shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 pounds per square foot.

3. Stormwater management BMPs shall include escape provisions as follows:

i. If a stormwater management BMP has an outlet structure, escape provisions shall be incorporated in or on the structure. Escape provisions include the installation of permanent ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management BMPs. With the prior approval of the municipality pursuant to VIII.C, a free-standing outlet structure may be exempted from this requirement;

ii. Safety ledges shall be constructed on the slopes of all new stormwater management BMPs having a permanent pool of water deeper than two and one-half feet. Safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one- half feet below the permanent water surface, and the second step shall be located one to one and one-half feet above the permanent water surface. See VIII.E for an illustration of safety ledges in a stormwater management BMP; and

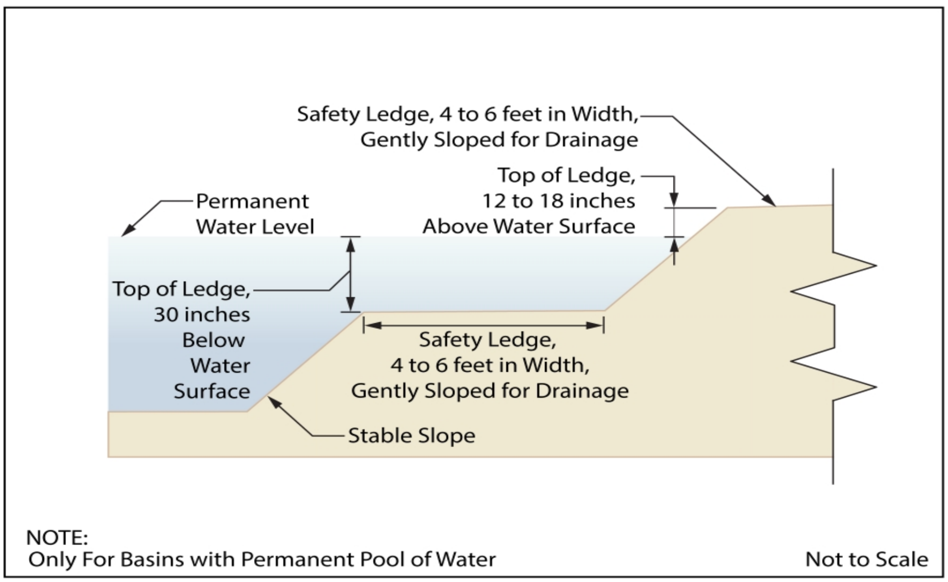
iii. In new stormwater management BMPs, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than three horizontal to one vertical.

D. Variance or Exemption from Safety Standard

A variance or exemption from the safety standards for stormwater management BMPs may be granted only upon a written finding by the municipality that the variance or exemption will not constitute a threat to public safety.

E. Safety Ledge Illustration

Elevation View –Basin Safety Ledge Configuration



§ 437-9. Requirements for a Site Development Stormwater Plan:

A. Submission of Site Development Stormwater Plan

1. Whenever an applicant seeks municipal approval of a development subject to this ordinance, the applicant shall submit all of the required components of the Checklist for the Site Development Stormwater Plan at Section IX.C below as part of the submission of the application for approval.

2. The applicant shall demonstrate that the project meets the standards set forth in this ordinance.

B. Checklist Submission

1. The applicant shall submit 10 copies of the materials listed in the checklist for site development stormwater plans in accordance with Section IX.C of this ordinance.

C. Site Development Stormwater Plan Approval

The applicant's Site Development project shall be reviewed as a part of the review process by the municipal board or official from which municipal approval is sought. That municipal board or official shall consult the municipality's review engineer to determine if all of the checklist requirements have been satisfied and to determine if the project meets the standards set forth in this ordinance.

D. Submission of Site Development Stormwater Plan

The following information shall be required:

1. Topographic Base Map

The reviewing engineer may require upstream tributary drainage system information as necessary. It is recommended that the topographic base map of the site be submitted which extends a minimum of 200 feet beyond the limits of the proposed development, at a scale of 1"=200' or greater, showing 2-foot contour intervals. The map as appropriate may indicate the following: existing surface water drainage, shorelines, steep slopes, soils, erodible soils, perennial or intermittent streams that drain into or upstream of the Category One waters, wetlands and flood plains along with their appropriate buffer strips, marshlands and other wetlands, pervious or vegetative surfaces, existing man-made structures, roads, bearing and distances of property lines, and significant natural and manmade features not otherwise shown.

2. Environmental Site Analysis

A written and graphic description of the natural and man-made features of the site and its surroundings should be submitted. This description should include a discussion of soil conditions, slopes, wetlands, waterways and vegetation on the site. Particular attention should be given to unique, unusual, or environmentally sensitive features and to those that provide particular opportunities or constraints for development.

3. Project Description and Site Plans

A map (or maps) at the scale of the topographical base map indicating the location of existing and proposed buildings roads, parking areas, utilities, structural facilities for stormwater management and sediment control, and other permanent structures. The map(s) shall also clearly show areas where alterations will occur in the natural terrain and cover, including lawns and other landscaping, and seasonal high groundwater elevations. A written description of the site plan and justification for proposed changes in natural conditions shall also be provided.

4. Land Use Planning and Source Control Plan

This plan shall provide a demonstration of how the goals and standards of Sections III through V are being met. The focus of this plan shall be to describe how the site is being developed to meet the objective of controlling groundwater recharge, stormwater quality and stormwater quantity problems at the source by land management and source controls whenever possible.

5. Stormwater Management Facilities Map

The following information, illustrated on a map of the same scale as the topographic base map, shall be included:

i. Total area to be disturbed, paved or built upon, proposed surface contours, land area to be occupied by the stormwater management facilities and the type of vegetation thereon, and details of

the proposed plan to control and dispose of stormwater.
ii. Details of all stormwater management facility designs, during and after construction, including discharge provisions, discharge capacity for each outlet at different levels of detention and emergency spillway provisions with maximum discharge capacity of each spillway.

6. Calculations

i. Comprehensive hydrologic and hydraulic design calculations for the pre- development and post-development conditions for the design storms specified in Section IV of this ordinance.
ii. When the proposed stormwater management control measures depend on the hydrologic properties of soils or require certain separation from the seasonal high water table, then a soils report shall be submitted. The soils report shall be based on onsite boring logs or soil pit profiles. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soils present at the location of the control measure.

7. Maintenance and Repair Plan

The design and planning of the stormwater management facility shall meet the maintenance requirements of Section 437-10.

8. Waiver from Submission Requirements

The municipal official or board reviewing an application under this ordinance may, in consultation with the municipality's review engineer, waive submission of any of the requirements in Section IX.C.1 through IX.C.6 of this ordinance when it can be demonstrated that the information requested is impossible to obtain or it would create a hardship on the applicant to obtain and its absence will not materially affect the review process.

§ 437-10. Maintenance and Repair:

A. Applicability

Projects subject to review as in Section I.C of this ordinance shall comply with the requirements of Section 437.B and 437.C.

B. General Maintenance

1. The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

2. The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). The plan shall contain information on BMP location, design, ownership, maintenance tasks and frequencies, and other details as specified in Chapter 8 of the NJ BMP Manual, as well as the tasks specific to the type of BMP, as described in the applicable chapter containing design specifics.

3. If the maintenance plan identifies a person other than the property owner (for example, a developer, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's or entity's agreement to assume this responsibility, or of the owner's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

4. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project. The individual property owner may be assigned incidental tasks, such as weeding of a green infrastructure BMP, provided the individual agrees to assume these tasks; however, the individual cannot be legally responsible for all of the maintenance required.

5. If the party responsible for maintenance identified under Section 437-10.B.3 above is not a public agency, the maintenance plan and any future revisions based on Section 437-10.B.7 below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

6. Preventative and corrective maintenance shall be performed to maintain the functional parameters (storage volume, infiltration rates, inflow/outflow capacity, etc.) of the stormwater management measure, including, but not limited to, repairs or replacement to the structure; removal of sediment, debris, or trash; restoration

of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of non-vegetated linings.

7. The party responsible for maintenance identified under Section 437-10.B.3 above shall perform all of the following requirements:

i. maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders;
ii. evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed; and
iii. retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by Section 437-10.B.6 and B.7 above.

8. The requirements of Section 437-10.B.3 and B.4 do not apply to stormwater management facilities that are dedicated to and accepted by the municipality or another governmental agency, subject to all applicable municipal stormwater general permit conditions, as issued by the Department. In such event, a two-year maintenance bond, as required by NJSA 40:55D-53 shall be required, in accordance with Section C, below.

9. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need of maintenance or repair, the municipality shall so notify the responsible person in writing. Upon receipt of that notice, the responsible person shall have fourteen (14) days to effect maintenance and repair of the facility in a manner that is approved by the municipal engineer or his designee. The municipality, in its discretion, may extend the time allowed for effecting maintenance and repair for good cause. If the responsible person fails or refuses to perform such maintenance and repair, the municipality or County may immediately proceed to do so and shall bill the cost thereof to the responsible person. Nonpayment of such bill may result in a lien on the property.

C. Nothing in this subsection shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

§ 437-11 Stormwater Management Requirements for Minor Subdivisions and Individual Single and Multi-Family Properties.

A. Purpose.

It is the purpose of this Section to establish minimum stormwater management requirements and controls for development not regulated by Sections 437-1 through 437-10 above.

B. Applicability.

This Section shall apply to:

1. All development pertaining to residential minor subdivisions approved by the Planning Board or Zoning Board of Adjustment.

2. All applications for building permits for enlargement or addition to an existing single-family or multi-family home.

3. Any application whereby additional impervious surfaces are being added, or the grade of the property is being altered or modified, or which involves soil movement including, but not limited to, porches, decks, driveways, retaining walls, swimming pools, etc., except as exempted in subsection C, below.

C. Exemptions.

Applications whereby proposed impervious surfaces are being added, as referened is Subsection B3 above, shall be exempted from the requirements of this article, provided that the application conforms to all of the following criteria:

1. The new impervious surface does not exceed one hundred fifty (150) square feet in area.

2. The new impervious surface to be added is not located within the side or rear yard of the principal structure.

3. The downgradient ground surface from the new impervious surface to the nearest property line is stabilized by lawn of good quality or exists as an undisturbed wooded area.

4. The downgradient ground surface from the new impervious surface to the nearest property line has an existing grade so as to provide sheet flow for surface runoff, rather than channelized flow towards the property line.

5. The new impervious surfaces shall not cause adverse drainage impact to the neighboring property.

D. General Standards.

1. All applications for building permits or grading plan approval for properties subject to this section shall contain a plan or certification providing for zero (0) percent increase in stormwater run-off for the completed project.

2. Stormwater run-off quantities shall be calculated based upon the criteria contained in the Residential Site Improvement Standards (RSIS) at NJAC 5:21.

3. Zero (0) percent increase in run-off shall be accomplished by implementing stormwater management techniques as contained in RSIS at NJAC 5:21 or the New Jersey Department of

Environmental Protection Best Management Practices Manual available at www.njstormwater.org.

§ 437-12. Penalties.

Any person(s) who erects, constructs, alters, repairs, converts, maintains, or uses any building, structure or land in violation of this ordinance, or any person who shall fail to maintain a system in accordance with Section 437:10, shall be subject to the following penalties: a fine, in sum not exceed $2,000 for a first offense and not to exceed $2,000 per day for any subsequent offense.

§ 437-13. Severability.

Each section, subsection, sentence, clause and phrase of this Ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

§ 437-14. Effective Date.

This Ordinance shall be in full force and effect from and after its adoption and any publication as required by law.

FRANK E. MATTHEWS, Council President

Attest:
Lori Fernandez, RMC, CMC
Borough Clerk

NOTICE OF PENDING ORDINANCE

The Ordinance published herewith was introduced and passed upon first reading at a meeting of the Municipal Council of the Borough of Hawthorne, in the County of Passaic, New Jersey, held on November 16, 2020. It will be further considered for final passage after public hearing thereon, at a meeting of said Municipal Council to be held in the Municipal Building, 445 Lafayette Avenue, in said Borough, or by way of virtual platform, on December 2, 2020, at 7:00 p.m., at which time and place all interested members of the public who desire will be given an opportunity to be heard in connection with said Ordinance, and during the week prior to and up to and including the date of such meeting, copies of said Ordinance will be made available on the borough website, www.hawthornenj.org, and at the Clerk's Office in said Municipal Building to the members of the general public who shall request the same.

Lori Fernandez, RMC, CMC, Borough Clerk

THIS IS TO CERTIFY THAT THE FOREGOING IS A TRUE AND EXACT COPY OF AN ORDINANCE INTRODUCED BY THE MUNICIPAL COUNCIL OF THE BOROUGH OF HAWTHORNE AT A REGULAR MEETING ON NOVEMBER 16, 2020.

ATTEST:

Frank E. Matthews, Council President **Lori Fernandez, RMC, CMC, Borough Clerk**

APPROVED:________________________
Richard S. Goldberg, Mayor

Appendix B

Amendment to the
Northeast Water Quality Management Plan

Total Maximum Daily Loads for
Fecal Coliform to Address 32 Streams in the
Northeast Water Region

Amendment to the Northeast Water Quality Management Plan

Total Maximum Daily Loads for Fecal Coliform to Address 32 Streams in the Northeast Water Region

Watershed Management Area 3
(Pompton, Pequannock, Wanaque, and Ramapo Rivers)
Watershed Management Area 4
(Lower Passaic and Saddle Rivers)
Watershed Management Area 5
(Hackensack River, Hudson River, and Pascack Brook)
Watershed Management Area 6
(Upper & Middle Passaic, Whippany, and Rockaway Rivers)

Proposed:	January 21, 2003
Established:	March 28, 2003
Approved (by EPA Region 2):	July 29, 2003
Adopted:	June 6, 2013

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

Contents

Figures

Tables

1.0 Executive Summary

In accordance with Section 305(b) of the Federal Clean Water Act (CWA), the State of New Jersey developed the *2002 Integrated List of Waterbodies*, addressing the overall water quality of the State's waters and identifying impaired waterbodies for which Total Maximum Daily Loads (TMDLs) may be necessary. The *2002 Integrated List of Waterbodies* identified several waterbodies in the Northeast Water Region as being impaired by pathogens, as indicated by the presence of fecal coliform concentrations in excess of standards. This report, developed by the New Jersey Department of Environmental Protection (NJDEP), establishes 32 TMDLs addressing fecal coliform loads to the waterbodies identified in Table 1.

Table 1 Fecal coliform-impaired stream segments in the Northeast Water Region, identified in Sublist 5 of the 2002 Integrated List of Waterbodies, for which fecal coliform TMDLs are being established.

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	3	Macopin River at Macopin Reservoir	01382450	Passaic	1.8
2	3	Wanaque River at Highland Avenue	01387010	Passaic	1.5
3	3	Ramapo River Near Mahwah	01387500	Passaic and Bergen	17.7
4	4	Passaic R. below Pompton R. at Two Bridges	01389005	Passaic	1.83
5	4	Preakness Brook Near Little Falls	01389080	Passaic	8.9
6	4	Deepavaal Brook at Fairfield	01389138	Essex	6.3
7	4	Passaic River at Little Falls	01389500	Passaic and Essex	15.0
8	4	Peckman River at West Paterson	01389600	Passaic and Essex	7.7
9	4	Goffle Brook at Hawthorne	01389850	Passaic and Bergen	10.5
10	4	Diamond Brook at Fair Lawn	01389860	Passaic and Essex	2.5
11	4	WB Saddle River at Upper Saddle River	01390445	Bergen	2.4
12	4	Saddle River at Ridgewood	01390500	Bergen	24.0
13	4	Ramsey Brook at Allendale	01390900	Bergen	6.4
14	4	HoHoKus Brook at Mouth at Paramus	01391100	Bergen	6.2
15	4	Saddle River at Fairlawn	01391200	Bergen	5.0
16	4	Saddle River at Lodi	01391500	Bergen	3.8
17	5	Hackensack River at River Vale	01377000	Bergen	10.0
18	5	Musquapsink Brook at River Vale	01377499	Bergen	7.3
19	5	Pascack Brook at Westwood	01377500	Bergen	6.6
20	5	Tenakill Brook at Cedar Lane at Closter	01378387	Bergen	10.2
21	5	Coles Brook at Hackensack	01378560	Bergen	11.1
22	6	Black Brook at Madison	01378855	Morris	2.4
23	6	Passaic River near Millington	01379000	Morris and Somerset	5.2
24	6	Dead River near Millington	01379200	Somerset	21.9
25	6	Passaic River near Chatham	01379500	Somerset, Union, Essex, and Morris	25.2
26	6	Canoe Brook near Summit	01379530	Essex	17.6
27	6	Rockaway River at Longwood Valley	01379680	Sussex and Morris	11.6
28	6	Rockaway River at Blackwell Street	01379853	Morris	3.5
29	6	Beaver Brook at Rockaway	01380100	Morris	17.0
30	6	Stony Brook at Boonton	01380320	Morris	13.1
31	6	Rockaway River at Pine Brook	01381200	Morris	6.8

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
32	6	Passaic River at Two Bridges	01382000	Morris and Essex	14.1
Total River Miles:					305.0

These thirty-two TMDLs will serve as management approaches or restoration plans aimed at identifying the sources of fecal coliform and for setting goals for fecal coliform load reductions in order to attain applicable surface water quality standards (SWQS).

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey Surface Water Quality Standards, "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 contributor to FC loads in these streams and can include storm-driven loads transporting fecal coliform from 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 source 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.

Using ambient water quality data monitoring conducted during the water years 1994-2000, summer and all season geometric means were determined for each Category 5 listed segment. 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 sources as a whole or apportioned to categories of nonpoint and stormwater sources within the study area. The extent to which nonpoint and stormwater sources have been identified and the process by which they will become identified will vary by study area based on data availability, watershed size and complexity, and pollutant sources. Implementation plans for activities to be established in these watersheds are addressed in this report.

Each TMDL shall be proposed and adopted by the Department as an amendment to the appropriate area wide water quality management plan(s) in accordance with N.J.A.C. 7:15-3.4(g).

This TMDL Report is consistent with EPA's May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Suftin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs.

2.0 Introduction

Sublist 5 (also known as List 5 or, traditionally, the 303(d) List) of the State of New Jersey's proposed *2002 Integrated List of Waterbodies* identified several waterbodies in the Northeast Water Region as being impaired by pathogens, as evidenced by the presence of high fecal coliform concentrations. This report establishes 32 TMDLs, which address fecal coliform loads to the identified waterbodies. These TMDLs serve as management approaches or restoration plans aimed toward reducing loadings of fecal coliform from various sources in order to attain applicable surface water quality standards for the pathogen indication. Several of these waterbodies are listed in Sublist 5 for impairment cause by other pollutants. These TMDLs address only fecal coliform impairments. Separate TMDL evaluations will be developed to address the other pollutants of concern. The waterbodies will remain on Sublist 5 until such time as TMDL evaluations for all pollutants have been completed and approved by the United States Environmental Protection Agency (USEPA).

3.0 Background

3.1. 305(b) Report and 303(d) List

In accordance with Section 305(b) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required to biennially prepare and submit to the United States Environmental Protection Agency (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.

In accordance with Section 303(d) of the CWA, the State is also required to biennially prepare and submit to USEPA a report that identifies waters that do not meet or are not expected to meet surface water quality standards (SWQS) after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. The listed waterbodies are considered water quality-limited and require total maximum daily load (TMDLs) evaluations. For waterbodies identified on the 303(d) List, there are three possible scenarios that may result in a waterbody being removed from the 303(d) List:

Scenario 1: A TMDL is established for the pollutant of concern;
Scenario 2: A determination is made that the waterbody is meeting water quality standards (no TMDL is required); or
Scenario 3: A determination is made that a TMDL is not the appropriate mechanism for achieving water quality standards and that other control actions will result in meeting standards

Where a TMDL is required (Scenario 1), it will: 1) specify the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards**;** and 2) allocate pollutant loadings among point and nonpoint pollutant sources.

Recent EPA guidance (Suftin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for USEPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that this TMDL report, which includes thirty-two TMDLs, addresses the following items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.
4. Load allocations.
5. Wasteload allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.
12. Submittal letter.

3.2. Integrated List of Waterbodies

In November 2001, USEPA issued guidance that encouraged states to integrate the 305(b) Report and the 303(d) List into one report. This integrated report assigns waterbodies to one of five categories. In general, Sublists 1 through 4 include waterbodies that are unimpaired, have limited assessment or data availability or have a range of designated use impairments, whereas Sublist 5 constitutes the traditional 303(d) List for waters impaired or threatened by a pollutant for which one or more TMDL evaluations are needed. Where more than one pollutant is associated with the impairment for a given waterbody, that waterbody will remain in Sublist 5 until one of the three possible delisting scenarios are completed. In the case of an Integrated List, however, the waterbody is not delisted but moved to one of the other categories.

Following USEPA's guidance, the Department chose to develop an Integrated Report for New Jersey. New Jersey's proposed *2002 Integrated List of Waterbodies* is based upon these five categories and identifies water quality limited surface waters in accordance with N.J.A.C. 7:15-6 and Section 303(d) of the CWA. These TMDLs address fecal coliform impairments, as listed on Sublist 5 of the State of New Jersey's proposed *2002 Integrated List of Waterbodies.*

3.3. Total Maximum Daily Loads (TMDLs)

A Total Maximum Daily Load (TMDL) represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point and nonpoint sources in the form of wasteload allocations (WLAs), load allocations (LAs), and a margin of safety. A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reductions for pollutants of concern as necessary to meet the SWQS.

Once one of the three possible delisting scenarios, noted above, is completed, states have the option to remove the waterbody and specific pollutant of concern from Sublist 5 of the *2002 Integrated List of Waterbodies* or maintain the waterbody in Sublist 5 until SWQS are achieved. The State of New Jersey will be removing the waterbodies for fecal impairment from Sublist 5 once these TMDLs are approved by USEPA.

4.0 Pollutant of Concern and Area of Interest

The pollutant of concern for these TMDLs is pathogens, the presence of which is indicated by the elevated concentration of fecal coliform bacterial. Fecal coliform concentrations have been found to exceed New Jersey's Surface Water Quality Standards (SWQS) published at N.J.A.C. 7-9B et seq. As reported in the proposed *2002 Integrated List of Waterbodies*, the New Jersey Department of Environmental Protection (NJDEP) identified waterbodies as being impaired by fecal coliform. The Northeast Water Region listings for fecal coliform impairment are identified in Table 2. Also identified in Table 2 are the river miles and management response associated with each listed segment. All of these waterbodies have a high priority ranking, as described in the *2002 Integrated List of Waterbodies*.

Table 2 Abridged Sublist 5 of the 2002 Integrated List of Waterbodies, listed for fecal coliform impairment in the Northeast Water Region.

TMDL No.	WMA	Station Name/Waterbody	Site ID	River Miles	Management Response
1	3	Macopin River at Macopin Reservoir	1382450	**1.8**	establish TMDL
	3	Pequannock River at Macopin Intake Dam	1382500	**19.1**	none; Re-assessment shows non-impairment
	3	Wanaque River at Wanaque	1387000	**0.6**	water quality monitoring needed to identify if an impairment exists
2	3	Wanaque River at Highland Ave.	1387010	**1.5**	establish TMDL
3	3	Ramapo River near Mahwah	1387500	**17.7**	establish TMDL
4	4	Passaic River below Pompton River at Two Bridges	1389005	**1.8**	establish TMDL
5	4	Preakness Brook Near Little Falls	1389080	**8.9**	establish TMDL
6	4	Deepavaal Brook at Fairfield	1389138	**6.3**	establish TMDL
7	4	Passaic River at Little Falls	1389500	**15.0**	establish TMDL
8	4	Peckman River at West Paterson	1389600	**7.7**	establish TMDL
9	4	Goffle Brook at Hawthorne	1389850	**10.5**	establish TMDL
10	4	Diamond Brook at Fair Lawn	1389860	**2.5**	establish TMDL

TMDL No.	WMA	Station Name/Waterbody	Site ID	River Miles	Management Response
	4	Passaic River at Elmwood Park	1389880	**13.8**	CSO influence
11	4	WB Saddle River at Upper Saddle River	1390445	**2.4**	establish TMDL
12	4	Saddle River at Ridgewood	1390500	**24.0**	establish TMDL
13	4	Ramsey Brook at Allendale	1390900	**6.4**	establish TMDL
14	4	HoHoKus Brook at Mouth at Paramus	1391100	**6.2**	establish TMDL
15	4	Saddle River at Fairlawn	1391200	**5.0**	establish TMDL
16	4	Saddle River at Lodi	1391500	**3.8**	establish TMDL
17	5	Hackensack River at River Vale	1377000	**10.0**	establish TMDL
18	5	Musquapsink Brook at River Vale	1377499	**7.3**	establish TMDL
19	5	Pascack Brook at Westwood	1377500	**6.6**	establish TMDL
20	5	Tenakill Brook at Cedar Lane at Closter	1378387	**10.2**	establish TMDL
	5	Hackensack River at New Milford	1378500	**1.1**	water quality monitoring needed to identify if an impairment exists
21	5	Coles Brook at Hackensack	1378560	**11.1**	establish TMDL
22	6	Black Brook at Madison	1378855	**2.4**	establish TMDL
23	6	Passaic River near Millington	1379000	**5.2**	establish TMDL
24	6	Dead River Near Millington	1379200	**21.1**	establish TMDL
25	6	Passaic River near Chatham	1379500	**25.2**	establish TMDL
26	6	Canoe Brook near Summit	1379530	**17.6**	establish TMDL
27	6	Rockaway River at Longwood Valley	1379680	**11.6**	establish TMDL
28	6	Rockaway River at Blackwell Street	1379853	**3.5**	establish TMDL
29	6	Beaver Brook at Rockaway	1380100	**17.0**	establish TMDL
30	6	Stony Brook at Boonton	1380320	**13.1**	establish TMDL
31	6	Rockaway River at Pine Brook	1381200	**6.8**	establish TMDL
	6	Whippany River at Morristown	1381500	**6.6**	TMDL completed in 1999
	6	Whippany River near Pine Brook	1381800	**6.6**	TMDL completed in 1999
32	6	Passaic River at Two Bridges	1382000	**14.1**	establish TMDL

These thirty-two TMDLs will address 305 river miles or approximately 87% of the total river miles impaired by fecal coliform (352 total FC impaired river miles) in the northeast watershed region. Based on the detailed county hydrography stream coverage, 847 stream miles, or 47% of the stream segments in the northeast region (1800 total miles) are directly affected by the 32 TMDLs due to the fact that the implementation plans cover entire watersheds; not just impaired waterbody segments.

Table 2 identifies six segments for which TMDLs will not be developed at this time based on investigations following the *2002 Integrated List of Waterbodies* proposal. These segments, which are identified as requiring a management response other than "establish TMDL," are discussed in Appendix A along with the listing Sublist to which they will be moved.

These include: #01382500, Pequannock River at Macopin Intake Dam, #01387000, Wanaque River at Wanaque, #01378500, Hackensack River at New Milford, #01381500, Whippany

River at Morristown, #01381800, Whippany River near Pine Brook, and #01389880, Passaic River at Elmwood Park. For each of these segments an explanation of the management response is provided in Appendix A.

4.1. Description of the Northeast Water Region and Sublist 5 Waterbodies

4.1.1. Watershed Management Area 3

Watershed Management Area 3 (WMA 3) includes watersheds that receive water from the Highlands portion of New Jersey. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton River. The Pompton River is, in turn, a major tributary to the Upper Passaic River. WMA 3 contains some of the State's major water supply reservoir systems including the Wanaque Reservoir, the largest surface water reservoir in New Jersey. There are four watersheds in WMA 3: Pompton, Ramapo, Pequannock and Wanaque River Watersheds. WMA 3 lies mostly in Passaic County but also includes parts of Bergen, Morris, and Sussex Counties.

The **Pequannock River Watershed** is 30 miles long and has a drainage area of 90 square miles. The headwaters are in Sussex County and the Pequannock River flows east, delineating the Morris/Passaic County boundary line. The Pequannock River joins the Wanaque River and flows to the Pompton River in Wayne Township. Some of the major impoundments within this watershed are Kikeout Reservoir, Lake Kinnelon Reservoir, Clinton Reservoir, Canistear Reservoir, Oak Ridge Reservoir, and Echo Lake Reservoir. The great majority of the land within this watershed is forested and protected for water supply purposes and parklands.

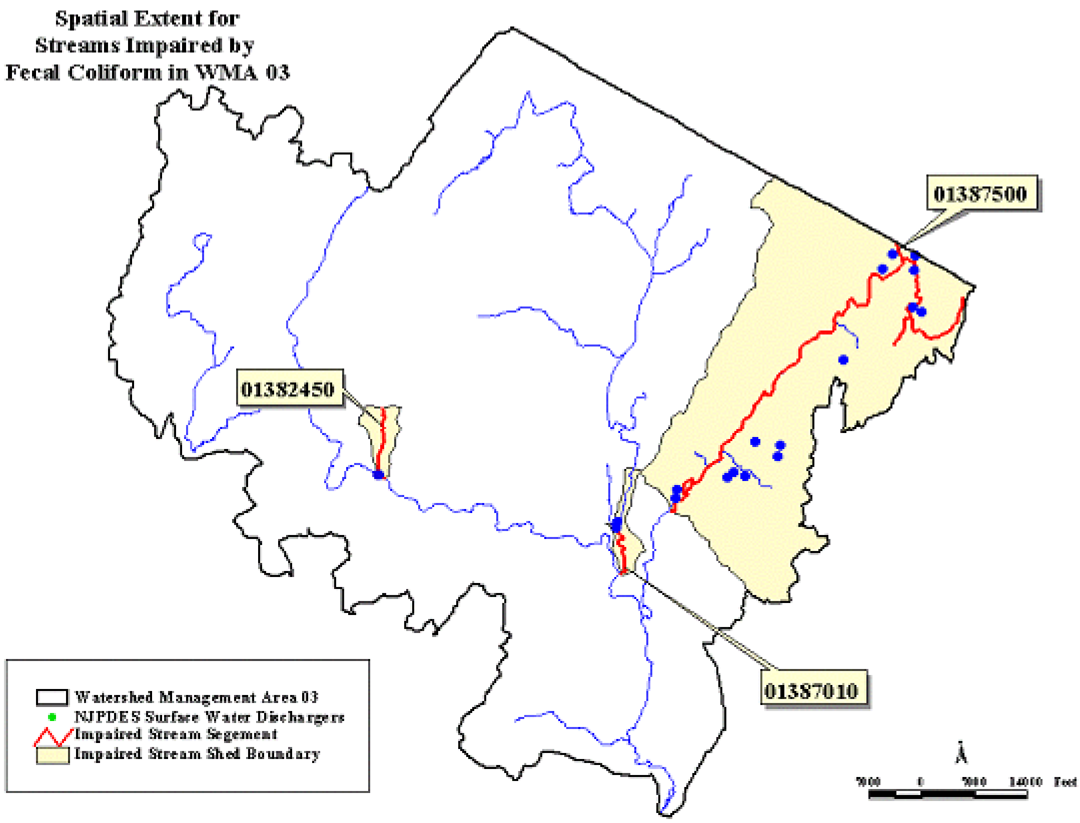
The **Ramapo River and Pompton River Watersheds** comprise a drainage area of about 160 square miles; 110 square miles of which are in New York State. The Ramapo River flows from New York into Bergen County and enters the Pequannock River to form the Pompton River in Wayne Township. The Ramapo River is 15 miles long on the New Jersey side. The Pompton River, a tributary to the Passaic River, is 7 miles long. Some of the major impoundments within this watershed include Point View Reservoir #1, Pompton Lakes, and Pines Lake. Over one-half of this watershed is undeveloped; however, new development is extensive in many areas.

The **Wanaque River Watershed** has a total drainage area of 108 square miles. The headwaters of the river lie within New York State as a minor tributary to Greenwood Lake (located half in New Jersey and half in New York). The New Jersey portion lies in West Milford, Passaic County. The Wanaque River joins up with the Pequannock River in Riverdale Township. The Wanaque River is 27 miles in length. Some of the major impoundments and lakes with this watershed are the Wanaque Reservoir, Greenwood Lake, Arcadia Lake and Lake Inez. Most of the land in this watershed is undeveloped, consisting of vacant lands, reservoirs, parks and farms.

Sublist 5 Waterbodies in WMA 3

Three river segments of the thirty-two impaired segments addressed in this report, the Macopin River (#01382450), Wanaque River (#01387010), and Ramapo River (#01387500) are located in WMA 3. The spatial extent of each segment is identified in Figure 1. River miles, watershed sizes and land use\land cover by percent area associated with each segment are listed in Table 3.

Figure 1 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 3



Segment #01382450, the Macopin River at Macopin Reservoir, has a watershed area of approximately 1.1 mi^2. Water quality from stations #01382410 and #01382450 were used in assessing the status and spatial extent of bacterial contamination. The length of the impaired stream segment is approximately 1.8 miles and is located on the Macopin River upstream of the confluence of the Macopin and the Pequannock Rivers. A total of 1.9 stream miles (based on county hydrologic stream coverage) are located within its watershed and will be included in the implementation plan.

Table 3 River miles, Watershed size, and Anderson Landuse classification for three Sublist 5 segments, listed for fecal coliform, in WMA 3.

	Segment ID		
	1382450	**1387010**	**1387500**
Sublist 5 impaired river miles (miles)	1.8	1.5	17.7
Total river miles within watershed and included in the implementation plan (miles)	1.9	4.0	87.8
Watershed size (acres)	711	708	26084
Landuse/Landcover			
Agriculture	0.00%	0.00%	0.43%
Barren Land	0.15%	0.17%	0.78%
Forest	89.74%	29.65%	51.20%
Urban	4.11%	55.19%	37.64%
Water	1.97%	4.71%	3.05%
Wetlands	4.04%	10.29%	6.89%

Segment #01387010, the Wanaque River at Highland Avenue at Wanaque, is located on the Wanaque River from the inlet of the Wanaque River at Inez Lake to the confluence of the Wanaque and Pequannock Rivers. Water quality from stations #01387014 and #01387041 were used in assessing the spatial extent of bacterial contamination. The stream segment length is approximately 1.5 miles with a watershed area of approximately 708 acres or 1.1 mi^2.

Segment #01387500, the Ramapo River near Mahwah, is located on the Ramapo River between the NJ-NY borders to the inlet at Pompton Lake. Water quality from station #01387500 was used to assess the spatial extent of bacterial contamination. The impaired stream segment length is approximately 17.7 miles. A total of 87.8 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 26084 acres or 40.8 mi^2.

4.1.2. Watershed Management Area 4

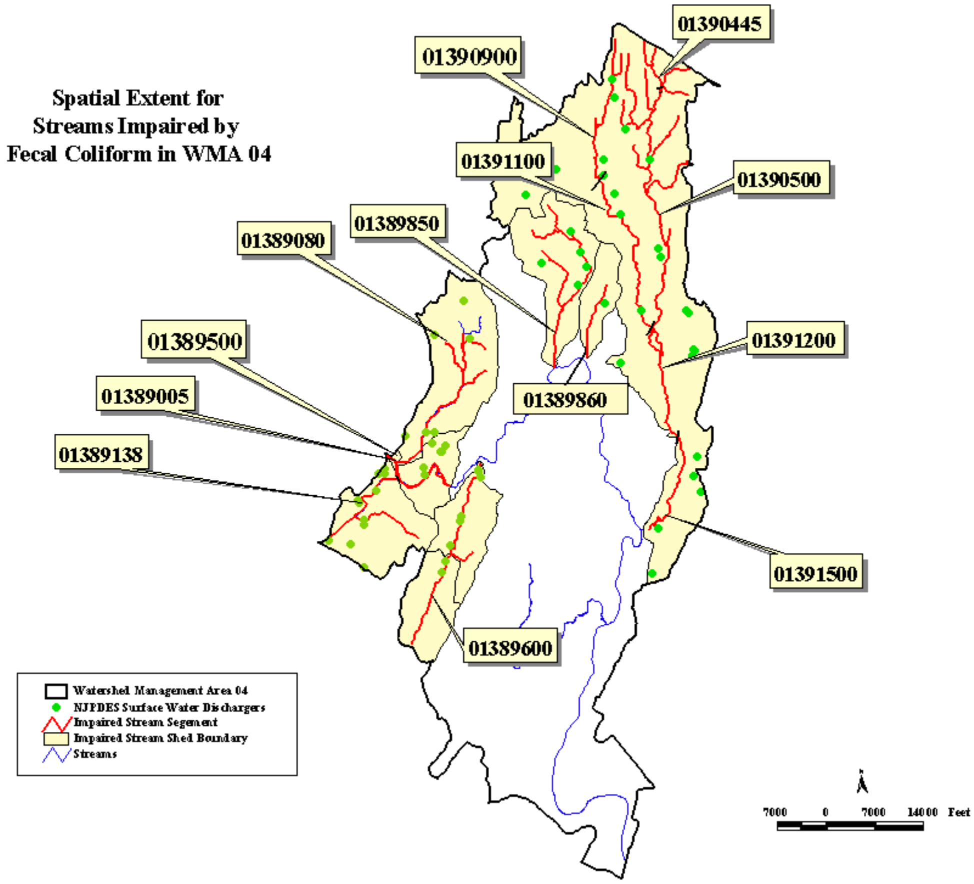
Watershed Management Area 4 (WMA 4) includes the Lower Passaic River (from the Pompton River confluence downstream to the Newark Bay) and its tributaries, including the Saddle River. The WMA 4 drainage area is approximately 180 square miles and lies within portions of Passaic, Essex, Hudson, Morris and Bergen Counties.

Two watersheds comprise WMA 4: the Lower Passaic River Watershed and Saddle River River Watershed. The **Lower Passaic River Watershed** originates from the confluence of the Pompton River downstream to the Newark Bay. This 33-mile section meanders through Bergen, Hudson, Passaic, and Essex Counties and includes a number of falls, culminating with the Great Falls at Paterson. This watershed has a drainage area of approximately 129 square miles. The major tributaries to this section of the Passaic River are the Saddle River, Preakness Brook, Second River, and Third River. The Saddle River is one of the larger tributaries to the Lower Passaic River. The **Saddle River Watershed** has a drainage area of approximately 51 square miles. Land in this watershed is extensively developed and contains many older cities and industrial centers including Newark, Paterson, Clifton, and East Orange.

Sublist 5 Waterbodies inWMA 4

Thirteen of the thirty-two TMDLs in the Northeast region are located in WMA 4. Included are several segments of the Saddle River (#01390500, #01391200 and #01391500), West Branch of the Saddle River (#01390445), Ramsey Brook (#01390900), Hohokus Brook (#01391100), the Passaic River (#01389005 and #01389500), Preakness Brook (#01389080), Deepavaal Brook (#01389138), Diamond Brook (#01389860), Goffle Brook (#01389850), and the Peckman River (#01389600). Several of these stream segments are geographically located in close proximity, thus, when these segments were found to contain similar levels of bacteria contamination (geometric means value), water quality data from these segments were grouped when calculating the TMDL. The spatial extent of each segment is identified in Figure 2. River miles, watershed sizes and land use\land cover by percent area associated with each segment are listed in Table 4.

Figure 2 **Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 4**



Given the proximity and similarity in impairment of several stations in the Saddle River watershed, six segments were grouped for the purposes of this report. These segments include: the West Branch Saddle River at Upper Saddle River (#01390445), Saddle River at Ridgewood (#01390500), Ramsey Brook at Allendale (#01390900), Hohokus Brook at Paramus (#01391100), Saddle River at Fairlawn (#01391200), and the Saddle River at Lodi (#01391500). These stream segments extend from the New York-New Jersey border to the confluence of the Saddle and Passaic Rivers and is contained within a 32933 acres, or 51.5 mi^2, watershed. The combined six stream segments total a length of 45.7 miles. The implementation plan will address all of streams located in this watershed (97.3 miles). Stations #01390445, #01390470, #01390510, #01390518, #01390900, #01391100, #01391490, and #01391500 were used to assess the status and spatial extent of bacterial contamination.

Table 4 **River miles, Watershed size, and Anderson Landuse classification for thirteen Sublist 5 segments, listed for fecal coliform, in WMA 4.**

	Segment ID		
	1390445, 1390500, 1390900, 1391100, 1391200, 1391500	**1389005,1389500, 1389080, 1389138,1389600**	**1389850,1389860**
Sublist 5 impaired river miles (miles)	45.7	29.8	10.5
Total river miles within watershed and included in the implementation plan (miles)	97.3	56.1	13.3
Watershed size (acres)	32933	14450	7590
<u>Landuse/Landcover</u>			
Agriculture	0.51%	0.12%	0.07%
Barren Land	0.20%	0.79%	0.27%
Forest	10.59%	20.81%	7.96%
Urban	81.89%	69.81%	88.51%
Water	1.06%	1.59%	0.46%
Wetlands	5.75%	6.88%	2.74%

Five Sublist 5 segments, the Passaic River below Pompton River at Two Bridges (#01389005), Passaic River at Little Falls (#1389500), Preakness Brook near Little Falls (#1389080), Deepavaal Brook at Fairfield (#01389138) and Peckman River at West Paterson (#01389600) were grouped based on similarities in geography and bacterial concentrations. Water quality from stations #01389500, #01389080, #01389138, #01382000, and #01389600 were used to assess the status and spatial extent of bacterial contamination. The combined length of the impaired stream segments is approximately 29.8 miles. A total of 56.1 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 14450 acres, or 22.6 mi^2.

Stream segments #01389850 and #01389860 were also grouped in calculating the TMDL percent reduction. Segment #01389850, Goffle Brook at Hawthorne, consists of the entire length of Goffle Brook to the confluence of Goffle Brook with the Passaic River. Segment #01389860, Diamond Brook at Fair Lawn, consists of the entire length of Diamond Brook to the confluence of Diamond Brook with the Passaic River. Water quality from stations #01389850 and #01389860 were used in assessing the status and spatial extent of bacterial contamination for these segments. The length of the impaired #01389850 stream segment is approximately 10.5 miles in a watershed area of approximately 5658 acres or 8.8 mi^2. A total of 13.3 river miles are in the watershed and will be included in the implementation plan. The length of the impaired #01389860 stream segment is approximately 2.5 miles in a watershed area of approximately 1932 acres or 3.0 mi^2.

4.1.3. Watershed Management Area 5

Watershed Management Area 5 (WMA 5) includes parts of Hudson and Bergen Counties and has a watershed area of approximately 165 square miles. WMA 5 is comprised of three watersheds: Hackensack River Watershed, Hudson River Watershed and Pascack Brook Watershed. The Hackensack River originates in New York State and flows south to the Newark Bay. New Jersey's portion of the river is 31 miles long. The Hackensack River Watershed is approximately 85 square miles. Major tributaries include the Pascack Brook, Berry's Creek, Overpeck Creek, and Wolf Creek. The **Pascack Brook Watershed** has a drainage area of approximately 51 square miles.

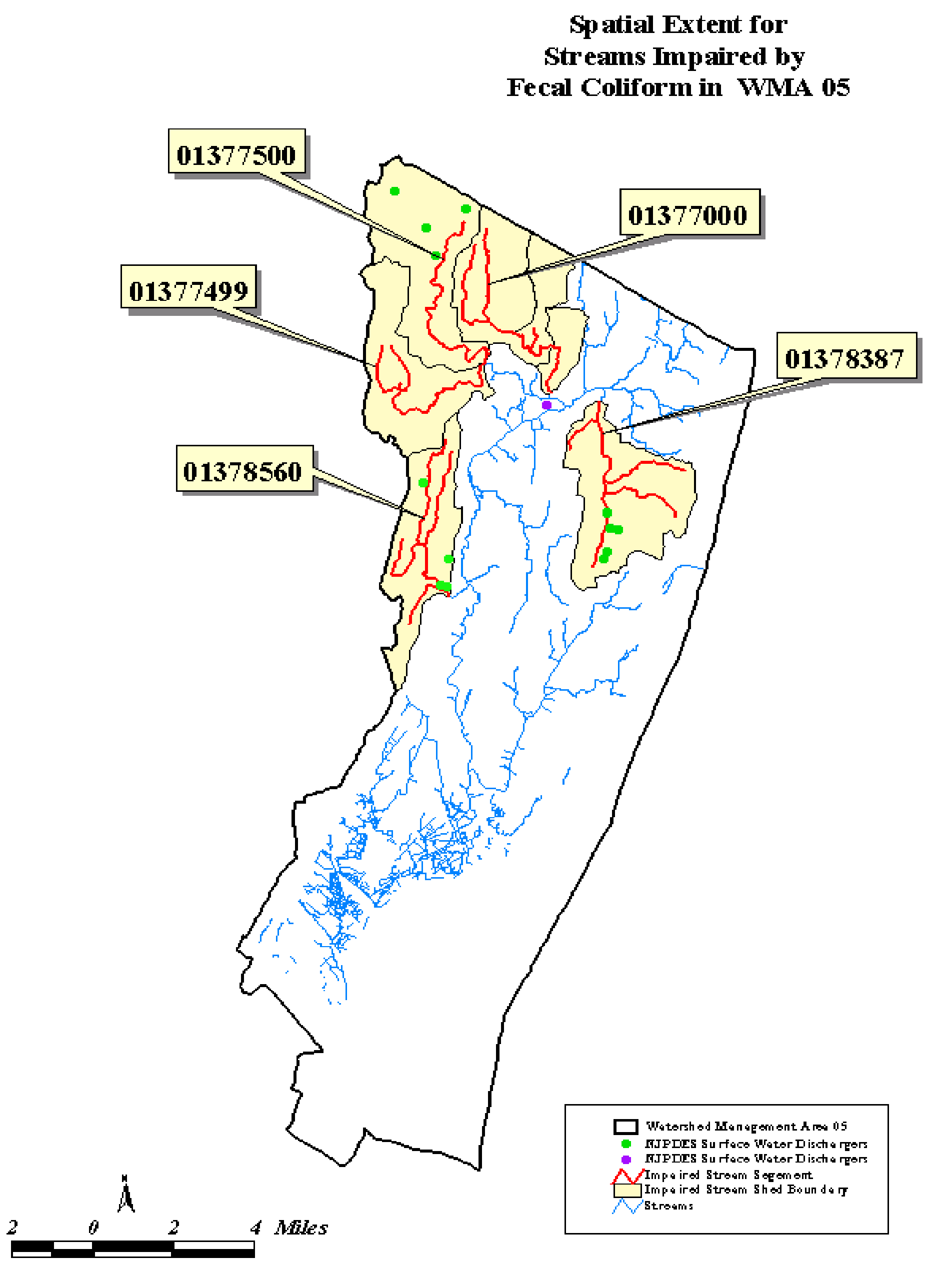
The New Jersey portion of the Hudson River is 315 miles long and begins in New York State at Lake Tear of the Clouds on the southwest side of Mount Marcy, New York's highest peak. The New Jersey portion of the **Hudson River Watershed** is approximately 29 square miles. The Hudson River forms the boundary between New Jersey and New York States.

Although WMA 5 is the most populated of all the WMAs, approximately 50% of the land is still undeveloped, with more than 30% residential development. The remaining developed land is commercial/industrial use. Much of the lower **Hackensack River Watershed** is tidal marsh known as the Hackensack Meadowlands. The Meadowlands are home to more than 700 plant and animal species including several rare and threatened species

Sublist 5 Waterbodies in WMA 5

Five of the thirty-two TMDLs in this report are located in WMA 5. Included are segments in the Hackensack River (#01377000), Pascack Brook (#01377500), Musquapsink Brook (#01377499), Tenakill Brook (#01378387), and Coles Brook (#01378560). The spatial extent of each segment is identified in Figure 3. River miles, watershed size and land use\land cover by percent area associated with each segment are listed in Table 5.

Figure 3 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 5



Hackensack River at River Vale, (segment #01377000) flows across the New Jersey/New York State line in River Vale/Old Tappan and extends to the inlet of the Oradell Reservoir. Water quality from stations #01377000 and #01376970 (Hackensack River at Old Tappan) were used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 10.0 miles in a watershed area of approximately 5912 acres or 9.2 mi^2, however a total of 20.3 river miles are located in the watershed and will be included in the implementation plan.

Table 5 River miles, Watershed size, and Anderson Landuse classification for five Sublist 5 segments, listed for fecal coliform, in WMA 5.

	Segment ID			
	1377000	**1377499, 1377500**	**1378387**	**1378560**
Sublist 5 impaired river miles (miles)	10.0	13.8	10.2	11.1
Total river miles within watershed and included in the implementation plan (miles)	20.3	33.3	10.8	14.8
Watershed size (acres)	5902	10430	5626	4241
Landuse/Landcover				
Agriculture	0.07%	0.95%	0.17%	0.00%
Barren Land	0.42%	0.30%	0.13%	0.18%
Forest	13.85%	11.53%	11.32%	4.98%
Urban	65.52%	79.72%	84.43%	91.80%
Water	12.09%	2.31%	0.44%	0.19%
Wetlands	8.05%	5.18%	3.51%	2.84%

Pascack Brook at Westwood, segment #01377500, and Musquapsink Brook at River Vale segment #01377500, were also grouped based on similarities in geography and extent of bacterial contamination. Water quality from stations #01377499 and #01377500 were used in assessing the status and spatial extent of bacterial contamination for these segments. The combined length of the impaired stream segments is approximately 13.8 miles in a watershed area of approximately 10429 acres or 16.3 mi^2, however a total of 33.3 river miles are located within the watershed and will be included in the implementation plan.

Tenakill Brook at Cedar Lane at Closter, segment #01378387, consists of the entire length of Tenakill Brook upstream of USGS station #01378387. Water quality from this station #01378387 was used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 10.2 miles in a watershed area of approximately 5625 acres or 8.8 mi^2. A total of 10.8 river miles are included in this watershed and will be included in the implementation plan

Coles Brook at Hackensack, segment #01378560, consists of the entire length of Coles Brook upstream of USGS station #01378560. Water quality from station #01378560 was used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 11.1 miles in a watershed area of approximately 4240 acres or 6.6 mi^2. A total of 14.8 river miles are included in this watershed and will be included in the implementation plan.

4.1.4. Watershed Management Area 6

Watershed Management Area 6 (WMA 6) represents the area drained by waters from the upper reaches of the Passaic River Basin including the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. Extensive suburban development and reliance upon ground water sources for water supply characterize WMA 6. WMA 6 lies in portions of Morris, Somerset, Sussex and Essex counties and includes the Upper & Middle Passaic River, Whippany River and Rockaway River Watersheds.

The **Upper Passaic River Watershed** is approximately 50 miles long and consists of a drainage area approximately 200 square miles in portions of Somerset, Morris, and Essex Counties. This section of the Passaic River is a significant source of drinking water for a much of northeastern New Jersey. Major tributaries to the Upper Passaic River include the Dead River, Rockaway River, Whippany River, and Black Brook. The Great Swamp National Wildlife Refuge is located within the Upper Passaic River Watershed. Approximately one-half of this watershed is undeveloped or vacant, with the remainder primarily residential and commercial; however, this watershed is facing significant development in the vacant areas. This watershed is subject to frequent flooding.

The **Middle Passaic River Watershed** includes Great Piece Meadows and Deepavaal Brook. The Great Piece Meadows is a freshwater wetland with a drainage area of approximately 12 square miles and is prone to flooding. Various owners privately own the Great Piece Meadows.

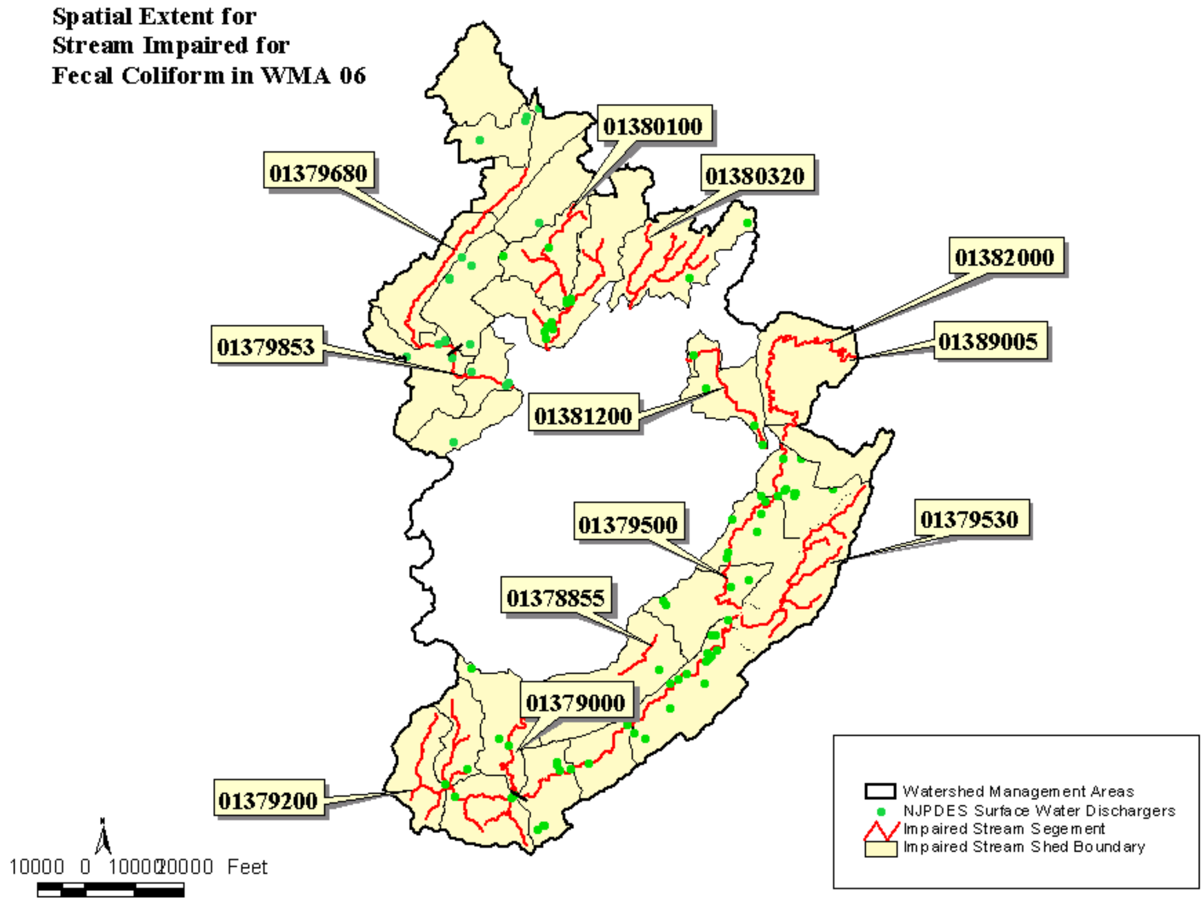
The **Rockaway River Watershed** has a drainage area of approximately 133 square miles and is approximately 37 miles long. The Rockaway River flows east to its confluence with the Whippany River at Pine Brook. Major tributaries include Stone Brook, Mill Brook, Beaver Brook, and Den Brook. The land use patterns in this area are complex and include vacant areas, parklands, residential development and industrial/commercial uses.

The **Whippany River Watershed** drains approximately 69 square miles and is located entirely within Morris County. The river is approximately 18 miles long and flows to the Passaic River. Two major tributaries are Black Brook and Troy Brook. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

Sublist 5 Waterbodies WMA 6

Eleven of the thirty-two TMDLs in this report are located in WMA 6. Included are segments in the Black Brook (#01378855), Dead River (#01379200), Passaic River (#01379000, #01379500, and #01382000), Rockaway River (#01379680, #01379853, and #01381200), Canoe Brook (#01379530), Beaver Brook (#01380100), and Stony Brook (#01380320). The spatial extent of each segment is identified in Figure 4. River miles, watershed size and land use\land cover by percent area associated with each segment are listed in Table 6.

Figure 4 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 6



Five segments, the Black Brook at Madison (#01378855), Passaic River near Millington (#01379000), Dead River near Millington (#01379200), the Passaic River near Catham (#01379500), and Canoe Brook near Summit (#01379530), comprise a large portion of the Passaic River headwater region and were grouped based on geographical similarities and bacterial geometric mean concentrations. Water quality from stations #01378855, #01379000, #01379200, #001379500, and #01379530 were used to assess the status and spatial extent of bacterial contamination. The combined length of the impaired stream segments is approximately 71.0 miles. A total of 204.8 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 66,759 acres, or 104.3 mi^2.

Table 6 **River miles, Watershed size, and Anderson Landuse classification for eleven Sublist 5 segments, listed for fecal coliform, in WMA 6.**

	Segment ID					
	1378855,1379000, 1379200,1379500, 1379530	**1379680 1379853**	**1380100**	**1380320**	**1381200**	**1382000**
Sublist 5 impaired river miles (miles)	71.0	15.1	16.9	13.1	6.8	14.9
Total river miles within watershed and included in the implementation plan (miles)	204.8	105.8	43.0	25.0	18.4	53.0
Watershed size (acres)	66759	39246	14528	7864	4861	11019
<u>Landuse/Landcover</u>						
Agriculture	2.23%	0.36%	0.16%	2.00%	1.44%	0.52%
Barren Land	0.90%	1.23%	2.66%	0.36%	1.62%	0.51%
Forest	19.21%	55.51%	63.14%	62.92%	13.07%	11.83%
Urban	51.57%	27.70%	17.22%	21.24%	66.79%	42.42%
Water	1.45%	3.75%	7.08%	4.03%	2.14%	3.00%
Wetlands	24.65%	11.44%	9.74%	9.46%	14.94%	41.72%

Rockaway River at Longwood Valley, (#01379680), and Rockaway River at Blackwell St. (#01379853) were grouped based on similarities in geography and bacterial contamination. Water quality from stations #01379680, #01379700 and #01379853 were used in assessing the spatial extent of bacterial contamination for these segments. The combined length of the impaired stream segments is approximately 15.1 miles in a watershed area of approximately 39246 acres or 61.3 mi^2. A total of 105.8 river miles are located within the watershed and will be included in the implementation plan.

Beaver Brook at Rockaway, segment #01380100, consists of the entire Beaver Brook to the confluence of Beaver Brook and the Rockaway River. Water quality from station #01380100 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 16.9 miles. A total of 43.0 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 14528 acres or 22.7 mi^2.

Segment #01380320, Stony Brook at Boonton, consists of the entire Stony Brook to the confluence of Stony Brook and the Rockaway River. Water quality from station #01380100 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 13.1 miles. A total of 25.0 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 7864 acres or 12.3 mi^2.

Segment #01381200, Rockaway River at Pine Brook, is located on the downstream portion of the Rockaway River between the outlet of the Boonton Reservoir and the confluence of the

Rockaway and the Whippany Rivers. Water quality from station #01381200 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 6.8 miles. A total of 18.4 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 4861 acres or 7.6 mi^2.

Segment #01382000, Passaic River at Two Bridges, is located on the Passaic River between the confluence of the Whippany and Passaic Rivers to the confluence of the Passaic and Pompton Rivers. Water quality from station #01382000 was used to assess the status and spatial extent of bacterial contamination. This segment was not grouped with other segments based on its relatively lower bacterial concentrations compared with those found in up and downstream on the Passaic River. The impaired stream segment length is approximately 14.9 miles in a drainage area of approximately 11019 acres or 17.2 mi^2. A total of 53.0 stream miles are located within its watershed and will be included in the implementation plan.

4.2. Data Sources

The Department's Geographic Information System (GIS) was used extensively to describe northeast watershed characteristics. In concert with USEPA's November 2001 listing guidance, the Department is using Reach File 3 (RF3) in the 2002 Integrated Report to represent rivers and streams. The following is general information regarding the data used to describe the watershed management area:

- Land use/Land cover information was taken from the 1995/1997 Land Use/Land cover Updated for New Jersey DEP, published 12/01/2000 by Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), delineated by watershed management area.
- 2002 Assessed Rivers coverage, NJDEP, Watershed Assessment Group, unpublished coverage.
- County Boundaries: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), "NJDEP County Boundaries for the State of New Jersey." Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip
- Detailed stream coverage (RF3) by County: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). "Hydrography of XXX County, New Jersey (1:24000)." Online at: http://www.state.nj.us/dep/gis/digidownload/zips/strm/
- NJDEP 14 Digit Hydrologic Unit Code delineations (DEPHUC14), published 4/5/2000 by Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS) Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip
- NJPDES Surface Water Discharges in New Jersey, (1:12,000), published 02/02/2002 by Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1).

5.0 Applicable Water Quality Standards

5.1. New Jersey Surface Water Quality Standards for Fecal Coliform

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey SWQS, the following are the criteria for freshwater fecal coliform:

> "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".

All of the waterbodies covered under these TMDLs have a FW1 or FW2 classification (NJAC 7:9B-1.12). The designated use, i.e. surface water uses, both existing and potential, that have been established by the Department for waters of the State, for all of the waterbodies in the Northeast Water Region is as stated below:

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 aquatic biota; and
4. Any other reasonable uses.

In all FW2 waters, the designated uses are:
1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

5.2. Pathogen Indicators in New Jersey's Surface Water Quality Standards (SWQS)

A subset of total coliform, fecal coliform, originates from the intestines of warm-blooded animals. Therefore, because they do not include organisms found naturally in soils, fecal coliform is preferred over total coliform as a pathogen indicator. In 1986, USEPA published a document entitled *"Implementation Guidance for Ambient Water Quality Criteria for Bacteria – 1986"* that contained their recommendations for water quality criteria for bacteria to protect bathers from gastrointestinal illness in recreational waters. The water quality criteria established levels of indicator bacteria *Escherichia coli* (*E. coli*) for fresh recreational water and enterococci for fresh and marine recreational waters in lieu of fecal coliforms. Historically, the New Jersey has listed water bodies for exceedances of the fecal coliform criteria.

Therefore, the Department is obligated to develop TMDLs for Sublist 5 water bodies based upon fecal coliform, at least until New Jersey has the transition to *E. coli* and enterococci in the Department's SWQS and until sufficient data have been collected to either develop a TMDL or to support a proposal to move the waterbodies to one of the other four categories.

6.0 Source Assessment

In order to evaluate and characterize fecal coliform loadings in the waterbodies of interest in these TMDLs, and thus propose proper management responses, source assessments are warranted. Source assessments include identifying the types of sources and their relative contributions to fecal coliform loadings, in both time and space variables.

6.1. Assessment of Point Sources other than Stormwater

All point sources of fecal coliform other than stormwater for these TMDLs are listed in Appendix B. These point sources include all municipal wastewater treatment plants (Major and Minor Industrial discharges) as will as industrial treatment plants that also treat domestic wastewater (Major and Minor Industrial discharges that have limits for bacterial quality indicators in their permits). Municipal treatment plants and industrial treatment plants that may include domestic wastewater in their effluent are required to disinfect effluent prior to discharge and to meet surface water quality criteria for fecal coliform in their effluent. In addition, New Jersey's urface Water Quality Standards at N.J.A.C. 7:9B-1.(c)4 reads "No mixing zones shall be permitted for indicators of bacterial quality including, but not limited to, fecal coliforms and enterococci". This mixing zone policy is applicable to both municipal and industrial treatment plants.

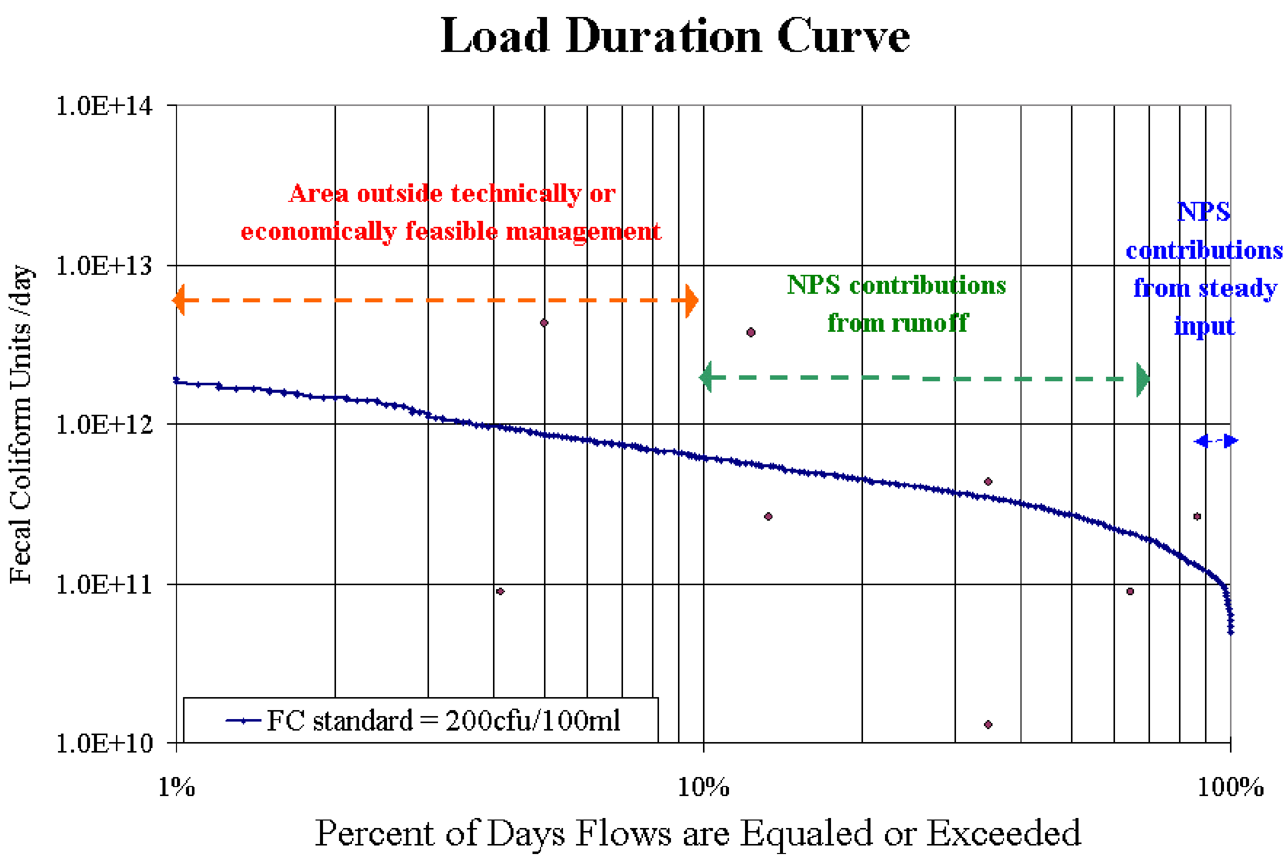
Since POTWs and industrial treatment plants routinely achieve essentially complete disinfection (less than 20 CFU/100ml), the requirement to disinfect is, in effect, more stringent than the fecal coliform effluent criteria. The percent of the total point source contribution is an insignificant fraction of the total load. Consequently, these fecal coliform TMDLs will not impose any change in current practices for POTWs and industrial treatment plants and will not result in changes to existing effluent limits. The methodology used in this report is inappropriate for use in areas affected by combined sewer overflows (CSOs) or in areas influenced by tidal action. Therefore, stream segments falling into these two categories will be excluded from the discussion of TMDLs in this report.

6.2. Assessment of Nonpoint and Stormwater Sources

Nonpoint and stormwater sources include storm-driven loads such as runoff from various land uses that transport fecal coliform from sources such as geese, farms, and domestic pets to the receiving water. Domestic pet waste, geese waste, as well as loading from storm water detention basins will be addressed by the Phase II MS4 program. Nonpoint sources also include steady-inputs from "illicit" sources such as failing sewage conveyance systems, sanitary sewer overflows (SSOs), and failing or inappropriately located septic systems. When "illicit" sources are identified, appropriate enforcement measures will be taken to eliminate them.

When streamflow gauge information is available, a load duration curve (LDC) is useful in identifying and differentiating between storm-driven and steady-input sources. As an example, Figure 5 represents a LDC using the 200 CFU/100 ml criterion.

Figure 5 Example Load Duration Curve (LDC)



The load duration curve method is based on comparison of the frequency of a given flow event with its associated water quality load. A LDC can be developed using the following steps:

1. Plot the Flow Duration Curve, Flow vs. % of days flow exceeded.
2. Translate the flow-duration curve into a LDC by multiplying the water quality standard, the flow and a conversion factor, the result of this multiplication is the maximum allowable load associated with each flow
3. Graph the LDC, maximum allowable load vs. percent of time flow is equaled or exceeded
4. Water quality samples are converted to loads (sample water quality data multiplied by daily flow on the date of sample).
5. Plot the measured loads on the LDC.

Values that plot below the LDC represent samples below the concentration threshold whereas values that plot above represent samples that exceed the concentration threshold. Loads that plot above the curve and in the region between 85 and 100 percent of days in which flow is exceeded indicate a steady-input source contribution. Loads that plot in the region between 10 and 70 percent suggest the presence of storm-driven source contributions. A combination of both storm-driven and steady-input sources occurs in the transition zone between 70 and 85 percent. Loads that plot above 99 percent or below 10 percent represent values occurring during either extreme low or high flows conditions and are thus considered to be outside the region of technically and economically feasible management. In this report, LDCs are used only for TMDL implementation and not in calculating TMDLs.

7.0 Water Quality Analysis

Relating pathogen sources to in-stream concentrations is distinguished from quantifying that relationship for other pollutants given the inherent variability in population size and dependence not only on physical factors such as temperature and soil characteristics, but also on less predictable factors such as re-growth media. Since fecal coliform loads and concentrations can vary many orders of magnitude over short distances and over time at a single location, dynamic model calibrations can be very difficult to calibrate. Options available to control non-point sources of fecal coliform typically include measures such as goose management strategies, pooper-scooper ordinances, and septic system maintenance. However, the effectiveness of these control measures is not easily measured. Given these considerations, detailed water quality modeling may not provide adequate insight or guidance toward the development of implementation plans for fecal coliform reductions.

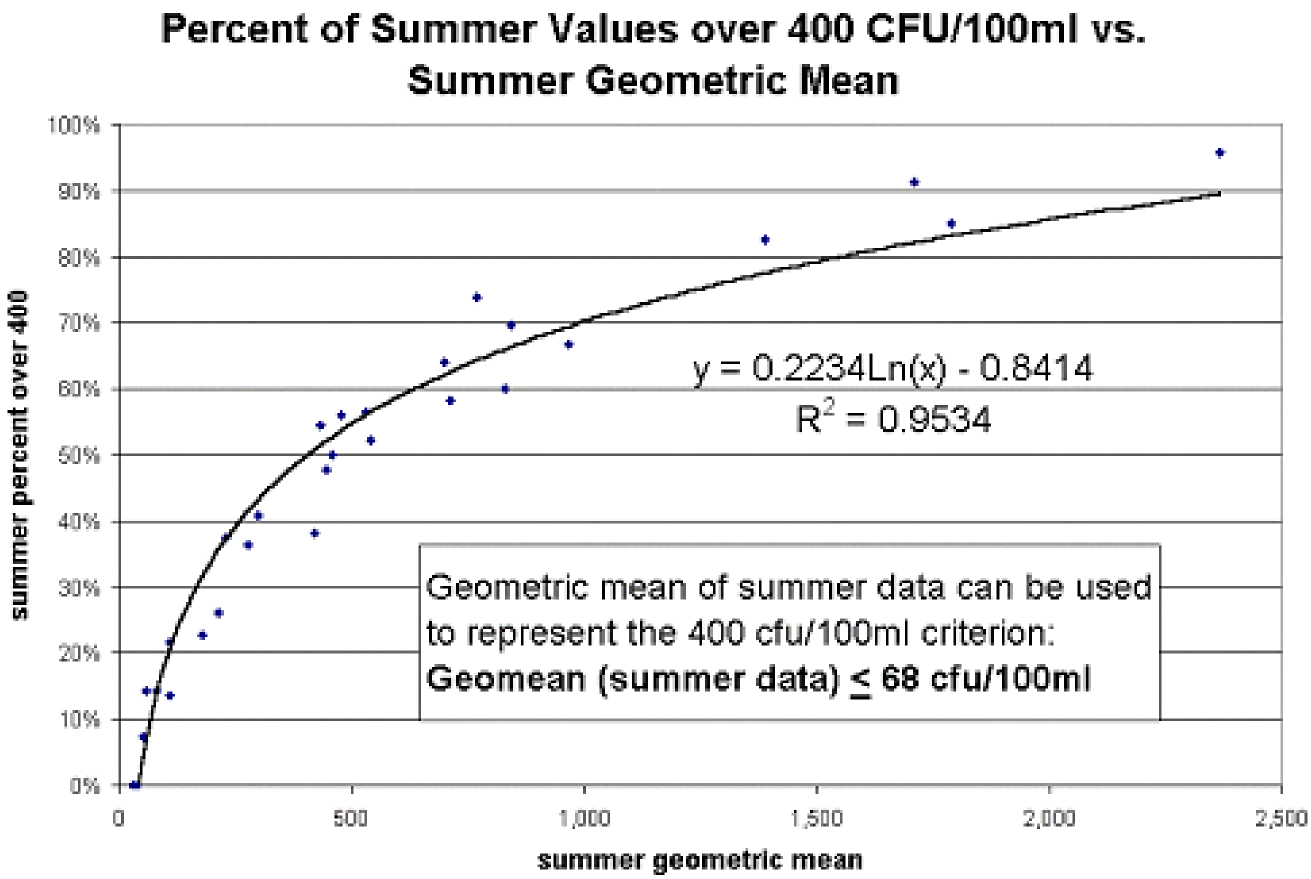
As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 C.F.R. 130.2). The loadings are required to be expressed as either mass-per-time, toxicity, or other appropriate measures (40 C.F.R. 130.2(i)). For these TMDLs, the load capacity is expressed as a concentration set to meet the state water quality standard. For bacteria, it is appropriate and justifiable to express the components of a TMDL as percent reduction based on concentration. The rationale for this approach is that:

- expressing a bacteria TMDL in terms of concentration provides a direct link between existing water quality and the numeric target;
- using concentration in a bacteria TMDL is more relevant and consistent with the water quality standards, which apply for a range of flow and environmental conditions; and
- follow-up monitoring will compare concentrations to water quality standards.

Given the two criteria of 200 CFU/100 ml and 400 CFU/100 ml in FW2 waters, computations were necessary for both criteria and resulted in two percent reduction values. The higher percent reduction value was applied in the TMDL so that both the 200 CFU/100 ml and 400 CFU/100 ml criteria were satisfied.

To satisfy the 200 CFU/100ml criteria, the geometric mean of all available data between water years 1994-2000 was compared to an adjusted target concentration. The adjusted target accounts for an explicit margin of safety and is equal to 200 minus the margin of safety. A calculation incorporating all available data is generally conservative since most samples are taken during the summer when fecal coliform is generally higher. A geometric mean of summer data was used to develop a percent reduction to satisfy the 400 CFU/100 ml criteria. A summer geometric mean can be used to represent the 400 criteria by regressing the percent over 400 CFU/100 ml against the geometric mean (Figure 6). Thus, each datapoint on Figure 6 represents all the data from one individual monitoring station. Sites with 20 or more summer data points were used to develop this regression, in order to make use of more significant values for percent exceedance. The resulting regression has an r-squared value of 0.9534. Solving for X when Y is equal to 10% yields a geometric mean threshold of 68 CFU/100ml. This means that, using summer data, a geometric mean of 68 can be used to represent the 400 CFU/100ml criterion. Since the geometric mean is a more reliable statistic than percentile when limited data are available, 68 CFU/100ml was used to represent the 400 CFU/100ml criterion for all sites. The inclusion of all data from summer months (May through September) to compare with the 30-day criterion is justified because summer represents the critical period when primary and secondary contact with water bodies is most prevalent. A more detailed justification for using summer data can be found in Section 7.1,"Seasonal Variation and Critical Conditions."

Figure 6 **Percent of summer values over 400 CFU/100ml as a function of summer geometric mean values**



$$y = 0.2234\mathrm{Ln}(x) - 0.8414 \qquad \text{Equation 1}$$

$R^2 = 0.9534$

Geometric mean, and summer geometric mean, and percent reductions were determined at each location for both criteria using Equations 2 through 4. To satisfy the 200 CFU/100ml criteria, equations 2 and 3 were applied. Equations 2 and 4 were used in satisfying the 400 CFU/100ml criteria.

$$GeometricMean\ for\ 200CFU\ criteria = \sqrt[n]{y_1 y_2 y_3 y_4 \ldots y_n} \qquad \text{Equation 2}$$

where:
y = sample measurement
n = total number of samples

$$200CFU\ criteriaPercentReduction = \frac{(Geometricmean - (200 - e))}{Geometricmean} \times 100\% \qquad \text{Equation 3}$$

$$400CFU\ criteriaPercentReduction = \frac{(SummerGeometricmean - (68 - e))}{SummerGeometricmean} \times 100\% \qquad \text{Equation 4}$$

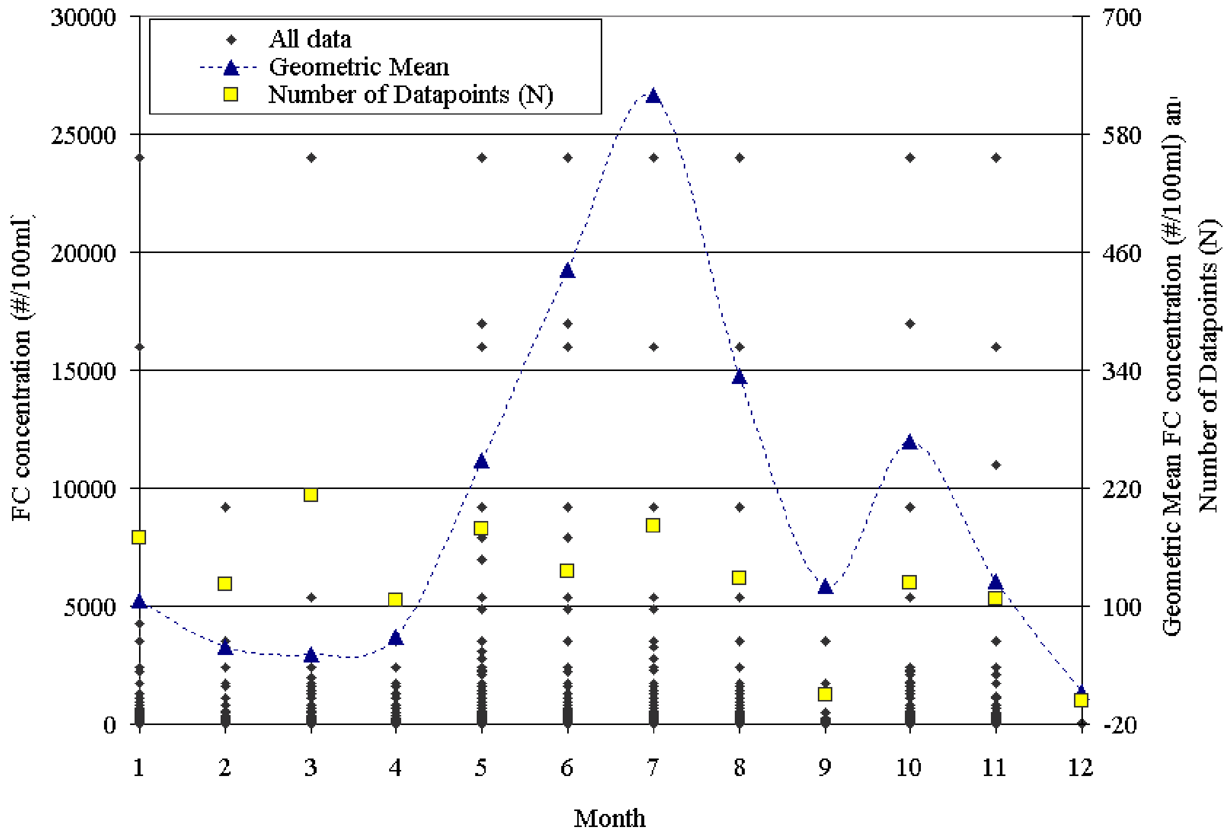
where:
e = (margin of safety)

This percent reduction can be applied to nonpoint and stormwater sources as a whole or be apportioned to categories of nonpoint and stormwater sources within the study area. The extent to which nonpoint and stormwater sources have been identified and the process by which they will become identified will vary by study area based on data availability, watershed size and complexity, and pollutant sources.

7.1. Seasonal Variation/Critical Conditions

These TMDLs will attain applicable surface water quality standards year round. The approach outlined in this paper is conservative given that in most cases fecal coliform data were collected during the summer months, a time when in-stream concentrations are typically the highest. This relationship is evidenced when calculating, on a monthly basis, the geometric mean of fecal coliform data collected statewide. Statewide fecal coliform geometric means during water years 1994-1997 were compared on a monthly basis and are shown in Figure 7. The 1994-1997 period was chosen for this analysis so that the significance of the number of individual datapoints for any given month was minimized. During the 1994-1997 period year-round sampling for fecal coliform was conducted by sampling four times throughout the year. Following 1997, the fecal coliform sampling protocol was changed to five samples during a 30-day period in the summer months. As evident in Figure 7, higher monthly geometric means are observed between May and September with the highest values occurring during mid-summer. This relationship is also evident when using the entire 1994-2002 dataset or datasets from individual water years. Given this relationship, summer is considered the critical period for violating fecal coliform SWQS and, as such, sampling during this period is considered adequate for meeting year round protections and designated uses.

Figure 7 **Statewide monthly fecal coliform geometric means during water years 1994-1997 using USGS/NJDEP data.**



7.2. Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). For these TMDLs calculations, both an implicit and explicit Margin of Safety (MOS) are incorporated. Implicitly, a MOS is inherent in the estimates of current pollutant loadings, the targeted water quality goals (New Jersey's SWQS) and the allocations of loading. This was accomplished by taking conservative assumptions throughout the TMDL evaluation and development. Examples of some of the conservative assumptions include treating fecal coliform as a conservative substance, applying the fecal coliform criteria to stormwater sources, and applying the fecal coliform criteria to the stream during all weather conditions. Fecal coliforms decay in the environment (i.e. outside the fecal tract) relatively rapidly, yet this analysis assumes a linear relationship between fecal load and instream concentration. Furthermore, it is generally recognized that fecal contamination from stormwater poses much less risk of illness than fecal contamination from sewage or septic system effluent (Cabelli, 1989). Finally, much of the fecal coliform is flushed into the system during rainfall events and passes through the system in a short time. Primary and secondary recreation generally occur during dry periods.

An explicit MOS is provided by incorporating a confidence level multiplier associated with log-normal distributions in the calculation of the load reduction for both the 200 and 400 standards. Using this method, the 200 and 400 targets are reduced based on the number of data points and the variability within each data set. For these TMDLs, a confidence level of 90% was used in calculating the MOS. As a result, and as identified in Appendix C, the target value will be different for each stream segment or grouped segments. The explicit margin of safety is calculated using the following steps:

1- FC data (x) will transformed to Log form data (y),
2- the mean of the Log- transformed data (y) is determined, $\bar{y}$
3- Determine the standard deviation of the Log-transformed data, S_y using the following equation:

$$S_y = \sqrt{\frac{\sum_i (y_i - \bar{y})^2}{N-1}}$$

4- Determine the Geometric mean of the FC data (GM)
5- Determine the standard deviation of the mean (standard error of the mean), $s_{\bar{y}}$, using the following equation:

$$s_{\bar{y}} = \frac{s_y}{\sqrt{N}}$$

6- For the 200 standard ($x_{standard}$), $y_{standard}$ = Log(200)= 2.301, thus for a confidence level of 90%, the target value will be the lower confidence limit (n= -1.64), $y_{target} = y_{std} - n \cdot s_{\bar{y}}$, for example, the 200 criteria: y_{target} = 2.301- n* $s_{\bar{y}}$
7- The target value for x, $x_{target} = 10^{y_{target}}$
8- The margin of safety (e) therefore will be e = $x_{standard}$ - x_{target}
9- Finally, the load reduction = $\frac{GM - x_{target}}{GM} \cdot 100\%$, for example the 200 criteria will be defined as: $\frac{(GM - (200 - e))}{GM} \cdot 100\%$

   The 400 criteria would be defined as: $\frac{(GM - (68 - e))}{GM} \cdot 100\%$

8.0 TMDL Calculations

Because these TMDLs are calculated based on ambient water quality data, the allocations are provided in terms of percent reductions. In the same way, the loading capacity of each stream is expressed as a function of the current load:

$LC = (1 - PR) \cdot L_o$, where

LC = loading capacity for a particular stream;
PR = percent reduction as specified in Tables 7-10;

L_o = current load.

8.1. Wasteload Allocations and Load Allocations

For the reasons discussed previously, these TMDLs do not include WLAs for traditional point sources (POTWs, industrial, etc.). WLAs are hereby established for all NJPDES-regulated point sources (including NJPDES-regulated stormwater), while LAs are established for all stormwater sources that are not subject to NJPDES regulation, and for all nonpoint sources. Both WLAs and LAs are expressed as percentage reductions for particular stream segments.

Table 7 identifies the required percent reduction necessary for each stream segment or group of segments to meet the fecal coliform SWQS. The reductions reported in these tables include a margin of safety factor and represent the higher percent reduction (more stringent) required of the two criteria. Reductions that are required under each criteria are located in Appendix C. In all cases, the 400 CFU/100ml criteria was the more stringent of the two criteria, thus values reported in Table 7 were equal to the percent required to meet the 400 CFU/100ml criteria.

Table 7 TMDLs for fecal coliform-impaired stream segments in the Northeast Water Region as identified in Sublist 5 of the 2002 Integrated List of Waterbodies. The reductions reported in this table represent the higher, or more stringent, percent reduction required of the two fecal colifom criteria.

TMDL No.	WMA	Station Name/Waterbody	Sublist 5 Segment	Summer Geometric Mean CFU/100ml	MOS as a percent of the target conc.[1]	Percent Reduction (LA) without MOS	Percent Reduction (LA) with MOS	Wasteload Allocation (WLA) as a Percent Reduction, with MOS
1	3	Macopin River at Macopin Reservoir	01382450	59	46%	-16%	**37%**	**37%**
2	3	Wanaque River at Highland Avenue	01387010	208	53%	67%	**85%**	**85%**
3	3	Ramapo River near Mahwah	01387500	431	44%	84%	**91%**	**91%**

TMDL No.	WMA	Station Name/Waterbody	Sublist 5 Segment	Summer Geometric Mean CFU/100ml	MOS as a percent of the target conc.[1]	Percent Reduction (LA) without MOS	Percent Reduction (LA) with MOS	Wasteload Allocation (WLA) as a Percent Reduction, with MOS
4	4	West Branch Saddle River at Upper Saddle R.	01390445	1,144	30%	94%	**96%**	**96%**
5	4	Saddle River at Saddle River	01390500					
6	4	Saddle River at Ridgewood Ave at Ridgewood	01390900					
7	4	Hohokus Brook at Mouth at Paramus	01391100					
8	4	Saddle River at Rochelle Park	01391200					
9	4	Saddle River at Lodi	01391500					
10	4	Passaic R. below Pompton R. at Two Bridges	01389005	652	30%	90%	**93%**	**93%**
11	4	Passaic River at Little Falls	01389500					
12	4	Preakness Brook near Little Falls	01389080					
13	4	Peckman River at West Paterson	01389600					
14	4	Deepavaal Brook at Fairfield	01389138					
15	4	Diamond Brook at Fair Lawn	01389860	1,544	47%	96%	**98%**	**98%**
16	4	Goffle Brook at Hawthorne	01389850					
17	5	Hackensack River at River Vale	01377000	294	34%	77%	**85%**	**85%**
18	5	Musquapsink Brook at River Vale	01377499	709	54%	90%	**96%**	**96%**
19	5	Pascack Brook at Westwood	01377500					
20	5	Tenakill Brook at Cedar Lane at Closter	01378387	159	91%	57%	**96%**	**96%**
21	5	Coles Brook at Hackensack	01378560	1,093	68%	94%	**98%**	**98%**
22	6	Black Brook at Madison	01378855	1,370	29%	95%	**96%**	**96%**
23	6	Passaic River near Millington	01379000					
24	6	Dead River Near Millington	01379200					
25	6	Passaic River near Chatham	01379500					
26	6	Canoe Brook near Summit	01379530					
27	6	Rockaway River at Longwood Valley	01379680	373	54%	82%	**92%**	**92%**
28	6	Rockaway River at Blackwell Street	01379853					
29	6	Beaver Brook at Rockaway	01380100	362	43%	81%	**89%**	**89%**
30	6	Stony Brook at Boonton	01380320	214	32%	68%	**78%**	**78%**
31	6	Rockaway River at Pine Brook	01381200	571	28%	88%	**91%**	**91%**
32	6	Passaic River at Two Bridges	01382000	276	33%	75%	**83%**	**83%**

[1] MOS as a percent of target is equal to: $\frac{e}{200 CFU/100ml}$ or $\frac{e}{68 CFU/100ml}$ where "e" is defined as the MOS in Section 7.2

8.2. Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included at this time. The loading capacity of each stream is expressed as a function of the current load (Section 8.0), and both WLAs and LAs are expressed as percentage reductions for particular stream segments (Section 8.1). Therefore, the percent reductions from current levels must be attained in consideration of any new sources that may accompany future development.

9.0 Follow - up Monitoring

The NJDEP's primary surface water quality monitoring unit is the Office of Water Monitoring Management. In association with the Water Resources Division of the U.S. Geological Survey, the NJDEP have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. Bacteria monitoring, as part of the ASMN network, are conducted five times during a consecutive 30-day summer period each year. The data from this network has been used to assess the quality of freshwater streams and percent load reductions. Although other units also perform monitoring functions, the ASMN will remain a principal source of FC monitoring.

10.0 Implementation

When bacterial sources are easily identifiable, measures outlined in section 10.2, Source Categories and Best Management Practices (BMPs), will be applied to reduce bacterial loading to meet SWQ standards. When bacterial sources are not easily identifiable, load duration curves will be used in conjunction with bacterial source tracking, if necessary, to identify pathogen sources.

Much of the stormwater discharged to the surface waters in question is discharged through "small municipal separate storm sewer systems" (small MS4s) that are proposed to be regulated under the Department's proposed Phase II NJPDES stormwater rules for the Municipal Stormwater Regulation Program. Under those proposed rules and associated draft general permits, nearly all municipalities (and various county, State, and other agencies) in the Northeast Region will be required to implement various control measures that should substantially reduce bacteria loadings, including measures to eliminate "illicit connections" of domestic sewage and other waste to the small MS4, adopt and enforce a pet waste ordinance, prohibit feeding of unconfined wildlife on public property, clean catch basins, perform good housekeeping at maintenance yards, and provide related public education and employee training. The WLAs and LAs in Table 7 are not themselves "Additional Measures" under proposed N.J.A.C. 7:14A-25.6 or 25.8.

Sections 10.2 and 10.4 identify BMPs and monitoring measures that in some respects are in addition to the control measures required in these general permits. These BMPs and monitoring measures are also not "Additional Measures" under proposed N.J.A.C. 7:14A-25.6 or 25.8. However, the Department will seek to have these BMPs and monitoring measures implemented through means other than requirements in these general permits. Also, in the future, the Department may propose and adopt WQM plan amendments that identify one or more of these BMPs (or other BMPs) and monitoring measures as "Additional Measures" for some or all of the permittees under these general permits.

10.1. Load Duration Curve (LDC)

As explained in Section 6.2, a LDC can be a beneficial tool as a first step in identifying potential pathogen sources. LDCs for listed segments in the Northeast region are located in Appendix D. In each case, thirty (30) years of USGS gage flow data (water years 1970-2000), from the listed station, were used in generating the curve. When a recent 30-year period was not available at the listed station, an adjacent station was selected based on station correlation information in US Geological Survey Open File Report 81-1110 (USGS, 1982). When an adjacent station was used in the manner, flows were adjusted to the station of interest based on a ratio of watershed size. LDCs were not developed for stations in which a satisfactory correlation could not be found.

10.2. Source Categories and Best Management Practices

The TMDLs developed in this report were developed with the assistance of stakeholders in WMAs 3, 4, 5 and 6 as part of the Department's ongoing watershed management efforts. Through the creation of the watershed management planning process over the past several years, Public Advisory Committees (PACs) and Technical Advisory Committees (TACs) were created in all 20 WMAs. Whereas the PACs serve in an advisory capacity to the New Jersey Department of Environmental Protection, and examined and commented on a myriad of issues in the watersheds, the TACs were focused on the scientific, ecological, and engineering issues relevant to the mission of the PAC. The Department in collaboration with the Northeast TACs narrowed the scope of the primary sources of fecal contamination to the following:

Non-Human Sources of Fecal Coliform

- Canada geese
- Pet Waste
- Stormwater basins
- Direct stormwater discharges to waterbodies
- Farms, zoos and livestock

Human Sources of Fecal Coliform

- Malfunctioning or older improperly sized septic systems

- Failing sewage conveyance systems
- Improper garbage storage and disposal

10.3. Management Strategies

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993). A combination of best management practices and direct remedies of illicit sources that are found through track-down monitoring will be used to implement these TMDLs.

10.3.1. Short-Term Management Strategies

Short-term management strategies include existing projects dubbed "Action Now" that are on the ground projects funded by the Department to address fecal and other NPS impairments to an impaired waterbody. These projects include stream bank restoration projects, ordinance development and catchbasin cleanouts. Funding sources include Clean Water Act 319(h) funds and State sources. Since 1998, 319(h) funds have provided approximately $3 million annually.Priority is given to funding projects that address TMDL implementation, development of stormwater management plans and projects that address impairment based on Sublist 5 listed waterbodies.

An example of such a project is a two-year project evaluating stormwater quality in a low-density residential area located in Hanover Township, Morris County. As part of the study, catch basin cleaning and public education and outreach were conducted. The outreach program targeted homeowners, landscapers and pet owners and was based on enhancing awareness and effecting behaviors that would reduce specific potential sources of NPS contaminants.

10.3.2. Long–Term Management Strategies

While short-term management measures will begin to reduce sources of fecal coliform in the Northeast Water Region, additional measures will be needed to verify and further reduce or eliminate these sources. Some of these measures may be implemented now, where resources are available and sources have already been identified as causing the fecal impairment. Both short-term and long-term management strategies that address fecal reduction related to these identified sources may be eligible for future Departmental funding.

Source Categories for Long-Term Management Strategies

1) Canada Geese

Geese are migratory birds that are protected by the Migratory Bird Treaty Act of 1918 and other Federal and State Laws. Resident Canada geese are those birds that do not migrate, but are protected by this and other legislation. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS)-Wildlife Services program reports that the 1999 estimated population of non-migratory geese in New Jersey was 83,000. Geese and other pest waterfowl have been identified as one of several primary sources of pathogen loading to impaired water bodies in the Northeast Region. Geese may produce up to 1½ pounds of fecal matter a day.

Canada Goose Damage Management Plan

Because geese are free to move about and commonly graze and rest on large grassy areas associated with schools, parks, golf courses, corporate lawns and cemeteries, solutions are best developed and conducted at the community level through a community-based goose damage management program. USDA's Wildlife Services program recommends that a community prepare a written Canada Goose Damage Management Plan that may include the following actions:

- Initiate a fact-finding and Communication Plan
- Enact and Enforce a No Feeding Ordinance
- Conduct Goose Damage Control Activities such as Habitat Modification
- Review and Update Land Use Policies
- Reduce or Eliminate Goose Reproduction (permit required)
- Hunt Geese to Reinforce Nonlethal Actions (permit required)

Procedures such as handling nests and eggs, capturing and relocating birds, and the hunting of birds require a depredation permit from either the USDA APHIS Wildlife Services or U.S. Fish and Wildlife Services. Procedures requiring permits should be a last resort after a community has exhaustedthe other listed measures. The Department's draft guide *Management of Canada Geese in Suburban Areas, March 2001,* which may be found at www.state.nj.us/dep/watershedmgt under publications, provides extensive guidance on how to modify habitat to serve as a deterrent to geese as well as other prevention techniques such as education through signage and ordinances.

2) Stormwater Detention Basins and Impoundments

Stormwater detention basins may act as sources of fecal coliform due to the accumulation of geese and pet waste in basins. Under certain conditions, coliform will increase in numbers in basins. As a result, significant quantities of fecal coliform can be discharged during storm events.

Impoundments created by small dams across streams have been a measure commonly used for flood control by municipalities in New Jersey. In addition to flood control, the impoundments were often incorporated into public parks in order to provide recreational opportunities for residents. Many of the impoundments are surrounded by mowed turf areas, which in combination with open water serve as an ideal habitat for geese and an attraction for pet walking. Specific management measures to reduce fecal coliform inputs to these waterbodies include:

- Development of Stormwater Management Plan
- Establishment of Riparian Buffers and "no mow" zones
- No feed ordinances for all waterfowl and wildlife and signage
- Retrofit of detention/retention basins to achieve water quality control
- Conduct regularly scheduled stormwater basin cleanout and maintenance, storm sewer inlet cleanouts and street sweeping programs

3) Pet Waste

Specific management measures to reduce pet waste include:

- Adoption of pet waste disposal i.e. pooper scooper ordinances
- Signage in parks and other public recreation areas
- Provide plastic bags dispensers in public recreation areas

4) Agricultural

Agricultural activities are potential sources of fecal coliform. Possible contributors are direct contributions from livestock permitted to traverse streams and stream corridors, manure management from feeding operations, use of manure as a soil fertilizer/amendment. Implementation of conservation management plans and best management practices are the best means of controlling agricultural sources of fecal coliform. Several programs are available to assist farmers in the development and implementation of conservation management plans and best management practices.

Agricultural Conservation Programs

The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. There are a number of USDA farm programs currently addressing NPS pollution. A few of these include:

- **The Environmental Quality Incentive Program (EQIP)** is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

- **The Conservation Reserve Program (CRP)** is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

- **The Wetland Reserve Program (WRP)** is designed to address the restoration of previously farmed wetlands. Easements are purchased for a 10-year, 30-year, or permanent duration.

- **Integrated Crop Management** is a best management practice designed to reduce the application of fertilizers and herbicides using soil samples and education to control nutrient and pesticide application to cropland.

- **The Farmland Preservation Program (FPP)** is designed to strengthen the agricultural industry and preserve important farmlands to enhance the economy and quality of life in the Garden State. Four different programs are available: The eight-year Program, where landowners voluntarily restrict non-agricultural development on their land for 8 years. In exchange, participants are eligible for cost-sharing grants for soil and water conservation projects, as well as other statutory benefits and protections. The Easement Purchase Program, where landowners sell the development rights on their land to the County Agriculture Development Board (CADB), non-profit organizations or directly to the State. Compensation for this sale is based upon the appraised value of the development rights on the land. The landowner retains ownership of the land and is eligible for cost-sharing grants for soil and water conservation projects and other benefits. The Fee Simple Program, where farms are acquired by the State Agriculture Development Committee (SADC, which is in but not of, the NJDA) based upon their fair market value and auction them off to private owners, after agricultural deed restrictions have been placed on the land. Lastly, there is the Easement Donation Program, where landowners donate their development easements to the SADC or the CADB. All of these programs have been in place since 1983.

- **The Soil & Water Conservation Cost-Sharing Program** is available to participants in a Farmland Preservation Program pursuant to the Agriculture Retention and Development Act. A Farmland Preservation Program (FPP) means any voluntary FPP or municipally approved FPP, the duration of which is at least 8 years, which has as its principal purpose as long term preservation of significant masses of reasonably contiguous agricultural land within agricultural development areas. The maintenance and support of increased agricultural production must be the first priority use of the land. Eligible practices include erosion control, animal waste control facilities, and water management practices. Cost sharing is provided for up to 50% of the cost to establish eligible practices.

- **The State Conservation Cost Share Program (CCSP)** is administered by the State Soil Conservation Committee and is integrated with the federal Environmental Quality Incentives Program (EQIP). It provides technical and financial assistance to producers for prevention and control of nonpoint sources of pollution. Cost sharing is provided for up to 75%, and in some cases 90% of the cost of installing approved conservation practices. Applications are approved based upon their environmental benefits and water quality enhancements.

- **Conservation Reserve Enhancement Program (CREP).** The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, has recently submitted a proposal to the USDA to offer financial incentives for agricultural landowners to voluntarily implement conservation practices on agricultural lands. The NJ Conservation Reserve Enhancement Program (NJ CREP) will be part of the USDA's Conservation Reserve Program (CRP). The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland. Following are some highlights of the New Jersey CREP proposal:

    - 30,000 acres of agricultural land are targeted for conservation, with 4,000 acres of agricultural land targeted for permanent conservation easement. Farmland enrolled but not permanently preserved will be under rental contract for 10-15 years
    - Conservation practices under the program are riparian buffers, filter strips, contour buffer strips, and grass waterways.
    - Water quality benefits of the program are expected to assist in achieving biologically healthy streams.
    - Permanent preservation of 4,000 acres of CREP lands will aid in reaching open space preservation goals.
    - The proposal is for a $100 million program representing a 3:1 Federal/State match, with New Jersey providing $23 million and USDA – Commodity Credit Corporation committing $77 million.

5) Stormwater Management

The Department has recently proposed Stormwater Management Rules and NJPDES Phase II Municipal Stormwater Regulation Rules that will establish standards and a regulatory program for stormwater management. Stormwater general permits issued by the Municipal Stormwater Regulation Program will address stormwater pollution

6) Malfunctioning and Older Improperly Sized Septic Systems; Illicit Connections of Domestic Sewage

Malfunctioning and older improperly sized septic systems contribute to fecal coliform loading in two ways: the system may fail hydraulically, where there is surface break out; or hydrogeologically, under conditions when soils are inadequate to filter pathogens. Specific management measures include the implementation of the NJPDES Municipal Stormwater Regulation Program, Sanitary Surveys, Septic System Management Programs and future sewer service area designations for service to domestic treatment works.

Sanitary surveys are conducted in an effort to evaluate the water quality of natural surface waters and identify those components that affect water quality, including geographic factors and pollution sources. The focus of the sanitary survey is to identify nonpoint and stormwater source contribution of fecal coliform within the watershed. It is accomplished by sampling for various types of fecal indicators (fecal coliform, enterococcus, fecal streptococcus, *E. coli* and coliphage) during wet and dry weather conditions. Where potential problems with septic systems are identified, as described below, a trackdown study may be warranted. This could lead to an analysis of alternatives to address any identified inadequacies, such as rehabilitation of septic systems or connection to a sewage treatment system, as appropriate.

10.4. Potential Sources of Fecal Impairment to Impaired Water Bodies

In an effort to locate pathogen sources to streams listed in this report, each stream segment was walked and potential sources noted based on the source categories listed in Section 10.2. The information gathered during those site visits is listed below by their respective WMA. The below are not considered to be a list of comprehensive sources, rather they will be used in conjunction with additional site visits, LDCs, and as appropriate, bacterial source tracking to identify actual pathogen sources.

10.4.1. Watershed Management Area 3

Macopin River at Macopin Reservoir (Site ID #01382450)

Potential sources noted within this watershed include detention basins at the upper end of Echo Lake, stables (Echo Lake Stables) located on east Echo Lake Road near Echo Lake above Macopin Gorge, and potential septic source located on Route 23 (City of Newark).

Wanaque River at Highland Avenue (Site ID #01387010)

Canada Geese were observed at a number of locations within this watershed. These areas include: the Wanaque Athletic Fields, Lake Inez, Lower Twin Lake (large geese population), and Skyland Lake. Possible problem stormwater detention basins were noted specifically at Pompton Lakes, Lake Inez and Skyland Lake. Potential failing septics noted at Dupont Village and Wanaque; these areas in the process of being sewered. . Possible pet sources observed at Lower Twin Lake and Skyland Lake.

Ramapo River near Mahwah (Site ID #01387500)

Potential sources in failing septic systems located in Oakland. Almost all Oakland is on septic systems, many failing and solid rock below ~3-feet. Stormwater outfalls present where Masonicus Brook and Mahwah Rivers converge. Canada geese observed at Ramapo College atlethic fields, and other recreational fields. Horse farms located across from Ramapo College. Crystal Lake (bathing beach) has been closed several times due to high fecal concentrations.

10.4.2. Watershed Management Area 4

Passaic River below Pompton River at Two Bridges (Site ID #01389005)

This entire segment is highly developed with many stormwater outfalls, however, much of this area was developed prior to the practice of constructing detention basins. This area may benefit from stormwater management retrofits. Sources upstream on the Pompton River at Packanack Lake (Site ID #01388600) include potential failing septic systems in the Hoffman Grove section of Wayne (110 homes potential); open manure storage observed on Black Oak Ridge Road and Cross Road. Canada Geese observed at Wayne Municipal Park (Sheffield Fields), Packanack Lake Country Club, Pompton Lakes crossroads at golf driving range, Old MacDonald Park, Pequannock Park (directly above testing site), and Kehum Park.

Preakness Brook near Little Falls (Site ID #01389080)

Potential sources include: animal agriculture from Van Pien Dairy Farm, pet sources from Tintle Park, wildlife and geese sources from Preakness Golf Course, High School on Valley Road, High Mountain Golf Course, Wetland area,

Deepavaal Brook at Fairfield (Site ID #01389138)

Geese were observed at Mountain Ridge Golf Course and Green Brook Country Club.

Passaic River at Little Falls (Site ID #01389500)

Geese observed at the Passaic County Golf Course on River Road and island middle of Passaic River. Potential human source from a significant homeless population. Several stormwater pipes observed to discharge directly to the river.

Peckman River at West Paterson (Site ID #01389600)

Geese and wildlife were observed in several areas including: town parks, reservoir lands, golf course, and Essex County park. Other potential sources included pet waste from residential areas located adjacent to the river and stormwater pipes discharging directly to river north of the golf course.

Goffle Brook at Hawthorne (Site ID #01389850)

Site visit confirmed over 200 geese, 150 ring-billed and laughing gulls, 75 ducks and 100 pigeons, and pets at Goffle Brook Park. Potential source includes failing septic systems in upper reach.

Diamond Brook at Fair Lawn (Site ID #01389860)

Geese, wildlife, pet wildlife observed at the Passaic County Park System. Geese observed at the Vander Plat Park fields. Garbage, including disposable diapers, observed behind Pathmark on Hemlock Ave. Geese observed at Fair Lawn Memorial Cemetery.

WB Saddle River at Upper Saddle River (Site ID #01390445)

Stormwater, Geese, and wildlife noted as potential sources.

Saddle River at Ridgewood (Site ID #01390500)

Potential septic system impact from homes located directly beside the river on Old Stone Church Road. Gulls, cormorants (16) and over 80 geese observed at Otto C. Pehle Section of Saddle River Park. Pets, wildlife observed throughout the watershed and potential impact from Wild Duck Pond Park.

Ramsey Brook at Allendale (Site ID #01390900)

Wildlife (geese, deer, foxes, and dogs) observed at Crestwood Park. Geese and other wildlife observed at Apple Ridge golf course, Ramsey Country Club golf course, Lake Street at Ramsey, and Napolekao Pond. Potentially failing septics in Mahwah.

HoHoKus Brook at the mouth of the Saddle River, Paramus (Site ID #01391100)

Potential failing septic systems in HoHoKus and Wyckoff. Geese observed or apparent at Whites' Pond, Saddle River Park, Glen Rock Section (50 geese observed), Dunkerhook Park, and Wild Duck Pond. Dog walking observed at Saddle River Park, Glen Rock Section and Dunkerhook Park. Poultry farm observed and appears to be an enclosed operation

Saddle River at Fairlawn (Site ID #01391200)

Wildlife (150 geese, 75 seagulls, 25 doves) observed at Saddle River park, Wild Duck Pond area. No-feed signs posted (dog and waterfowl both), however, people observed still feeding waterfowl. At the Saddle River Park at Rochelle Park, no geese were observed but physical signs apparent and ducks appear to be fed. Geese observed at Bergen County Golf Courses and Ridgewood Country Club.

Saddle River at Lodi (Site ID #01391500)

Geese and pet walking observed at the Main St. Cemetery.

10.4.3. Watershed Management Area 5

Hackensack River at River Vale (Site ID #01377000)

Geese observed at Golf Course, Open Spaces, and County Park. Septic Systems in Old Tappan recently converted to sewers.

Musquapsink Brook at River Vale (Site ID #01377499)

Canada Geese observed at elementary school ballfields and nearby cemeteries. No septics are located in this area. Pumping from the Saddle River and discharging to the Musquapsink Brook represents a potential source of FC.

Pascack Brook at Westwood (Site ID #01377500)

No septics are located in this area. Potential sources included: Woodcliff Lake Reservoir, Corporate Parks in Montvale (source of geese droppings to Bear Brook which feeds into Pascack Brook), waste management transfer station, geese around the Woodcliff Lake, stormdrains discharge into Woodcliff Lake, and street sweeping materials from DPWs for Park Ridge, Hillsdale, and Westwood.

Tenakill Brook at Cedar Lane at Closter (Site ID #01378387)

Potential sources include: failing septics in Alpine, geese and waterfowl at Tenakill Middle School ballfields, Alpine Country Club, Tenafly Park, Demarest Nature Center, and Demarest Park/Duck Pond. The municipal park is located adjacent to Demarest Duck pond along Tenakill Brook and is subjected to geese and other waterfowl depositing droppings on turf areas within the park. Demarest Duck Pond is also the receiving body for stormwater outfalls that capture runoff from nearby roads, residential areas and commercial areas. Dredging of Demarest Duck Pond is slated for completion during 2003. Demarest Borough is committed to the shoreline restoration and nonpoint source improvement to the pond and park area and has sought additional funding to stabilize 1,600 linear feet of degraded shoreline around Demarest Duck Pond along Tenakill Brook with a 20 foot wide native vegetative buffer. The Environmental Commission has already implemented several small restoration projects along Tenakill Brook and is an active participant in the Department's Watershed process.

Coles Brook at Hackensack (Site ID #01378560)

No septics or agriculture are located in this watershed. Geese/Waterfowl, disposable diapers, and dog waste observed at Van Saun Park. Potential sources of pet waste include Oradell, River Edge, Paramus, and Emerson residential areas. Geese observed at the Emerson Golf Course, Paramus Middle School alongside Bkanky Brook (feeds into Coles Brook). Zoo observed, however, recently tied to sanitary sewer.

10.4.4. Watershed Management Area 6

Black Brook at Madison (Site ID #01378855)

The headwaters of this segment include the Fairmount Country Club where geese are a contributing factor. At Green Village Packing Company on Britten Road in Green Village, residents have reported that the company has, in recent years, dumped its animal wastes and scraps into local woods. Following complaints, the company has been shipping them out via truck. Recent complaints are that the trucks leak. Other potential sources include: Miele Kennel, Rolling Knolls Landfill, Britten Road, Chatham, and wildlife (deer and geese)

Passaic River Near Millington (Site ID #01379000)

This segment is directly adjacent to the Great Swamp Wildlife Refuge, thus wildlife are a potential source. Geese populations were observed at the following locations: AT&T Corporation grounds off Madisonville Road, Somerset County Environmental Education Center ponds, Southard Park, Basking Ridge Golf Course, northeast of the intersection of White Bridge Road and Carlton Road, at the Southwest corner of the intersection of White Bridge Road and Pleasant Plains Road, east of Pleasant Plains Road, north of White Bridge Road; east of the Passaic River, north of Stone House Road; and south of White Bridge Road, east of Pleasant Plains Road in Long Hill Township. The majority of this watershed contains urbanized landuse that has many detention basins, pets, and deer. Other potential sources include: Somerset County horse stables and horse trails through Lord Stirling Park and livestock populations at the southwest corner of the intersection of White Bridge Road and Carlton Road; east of the Passaic River, north of Stone House Road; and east of Pleasant Plains Road between White Bridge Road and Sherwood Lane.

Dead River Near Millington (Site ID #01379200)

Potential sources in this watershed include: Geese (New Jersey National Golf Course, Pleasant Valley road near King George Road where a large geese population of approximately 1000 was observed), pets, livestock and pastures present.

Passaic River Near Chatham (Site ID #01379500)

The following potential sources in this watershed include: geese (at Canoe Brook Country Club, Brook Lake Country Club and Cedar Ridge Country Club), wildlife, failing septics, pets, detention basins, and landfills (Bradley Loren Landfill, Florham Park Borough Waste Landfill, Vitto Marchetto Sanitary Landfill, Passaic Township Sanitary Landfill)

Canoe Brook Near Summit (Site ID #01379530)

Geese are suspected at Essex Fells Country Club, Crestmont Country Club, East Orange Golf Club and Summit Municipal Golf Course. Wildlife, especially deer, and pets are also thought to contribute a bacteria load.

Rockaway River at Longwood Valley (Site ID #01379680)

Wildlife and failing septics noted as potential sources.

Rockaway River at Blackwell Street (Site ID #01379853)

Potential sources include Hurd Park (goose population, no riparian buffer), and landfills.

Beaver Brook near Rockaway (Site ID #01380100)

This watershed contains several lake communites; many of which are on septic systems. Thus the potential for failing septics exist throughout the watershed. A portion of this watershed is designated as wildlife management area or reservoir protection area, thus, wildlife contribution is a potential. Geese observed at Rockaway Township recreational field located off of Old Beach Glen.

Stony Brook at Boonton (Site ID #01380320)

Canada geese observed at the picnic area of Pyramid Mountain Natural Historic Area, and at Rockaway Valley athletic fields off of Rockaway Valley Road, in Caterbury, and on Hill Road. Livestock operations are located off of Hill Road abutting a tributary to the impaired segment, near intersection of Kingsland and Rockaway Valley, and at intersection of Birchwood and Valley.

Rockaway River at Pine Brook (Site ID #01381200)

Potential sources include: Sharkey Landfill, Ecology Lake Club Sanitary Land Fill, Knoll East County Club Golf Course, wildlife, and geese.

Passaic River at Two Bridges (Site ID #01382000)

Wildlife and leaking septics noted as potential sources.

10.5. Pathogen Indicators and Bacterial Source Tracking

Advances in microbiology and molecular biology have produced several methodologies that discriminate among sources of fecal coliform and thus more accurately identify pathogen sources. The numbers of pathogenic microbes present in polluted waters are few and not readily isolated nor enumerated. Therefore, analyses related to the control of these pathogens must rely upon indicator microorganisms. The commonly used pathogen indicator organisms are the coliform groups of bacteria, which are characterized as gram-negative, rod-shaped bacteria. Coliform bacteria are suitable indicator organism because they are generally not found in unpolluted water, are easily identified and quantified, and are generally more numerous and more resistant than pathogenic bacteria (Thomann and Mueller, 1987).

Tests for fecal organisms are conducted at an elevated temperature (44.5°C), where the growth of bacteria of non-fecal origin is suppressed. While correlation between indicator organisms and diseases can vary greatly, as seen in several studies performed by the EPA and others, two indicator organisms *Esherichia coli* (*E. coli*) and enterococci species showed stronger correlation with incidence of disease than fecal coliform (USEPA, 2001). Recent advances have allowed for more accurate identification of pathogen sources. A few of these methods, including, molecular, biochemical, and chemical are briefly described in the following paragraph.

Molecular (genotype) methods are based on the unique genetic makeup of different strains, or subspecies, of fecal bacteria (Bowman et al, 2000). An example of this method includes "DNA fingerprinting" (i.e., a ribotype analysis which involves analyzing genomic DNA from fecal *E. coli* to distinguish human and non-human specific strains of *E. coli*.). Biochemical (phenotype) methods include those based on the effect of an organism's genes actively producing a biochemical substance (Graves et al., 2002; Goya et al 1987). An example of this method is multiple antibiotic resistance (MAR) testing of fecal *E. coli*. In MAR testing, *E. coli* are isolated from fecal samples and exposed to 10-15 different antibiotics. In theory, *E. coli* originating from wild animals should show resistance to a smaller number of antibiotics than *E. coli* originating from humans or pets. Given this general trend, MAR patterns or '"signatures" can be defined for each class of *E. coli* species. Chemical methods are based on finding chemical compounds associated with human wastewater, and useful in determining if the sources are human or non-human. Such methods measure the presence of optical brighteners, which are contained in all laundry detergents, and soap surfactants in the water column. Unlike the optical brightener method, the measurement of surfactants may allow for some quantification of the source.

BST methods have already been successfully employed at the NJDEP in the past decade. Since 1988, the Department's Bureau of Marine Water Monitoring has worked cooperatively with the University of North Carolina in developing and determining the application of RNA coliphage as a pathogen indicator. This research was funded through USEPA and Hudson River Foundation grants. These studies showed that the RNA coliphages are useful as an indicator of fecal contamination, particularly in chlorinated effluents and that they can be serotyped to distinguish human and animal fecal contamination. Through these studies, the Department has developed an extensive database of the presence of coliphages in defined contaminated areas (point human, non-point human, point animal, and non-point animal). More recently, MAR and DNA fingerprinting analyses of *E. coli* are underway in the Manasquan estuary to identify potential pathogen sources (Palladino and Tiedemann, 2002). These studies along with additional sampling within the watershed will be used to implement the necessary percent load reduction.

10.6. Reasonable Assurance

With the implementation of follow-up monitoring, source identification and source reduction, the Department is reasonably assured that New Jersey's Surface Water Quality Standards will be attained for fecal coliform. Activities directed in the watersheds to reduce fecal coliform loading shall include options, included but not limited to education projects that teach best management practices, approval of projects funded by CWA Section 319 Nonpoint Source (NPS) Grants, recommendations for municipal ordinances regarding feeding of wildlife and pooper-scooper laws, and stormwater control measures.

The fecal coliform reductions proposed in these TMDLs assume that existing NJPDES permitted municipal facilities will continue to meet New Jersey's Surface Water Quality Standard requirements for disinfection. Any future facility will be required to meet water quality standards for disinfection.

11.0 Public Participation

The Water Quality Management Planning Rules NJAC 7:15-7.2 require the Department to initiate a public process prior to the development of each TMDL and to allow public input to the Department on policy issues affecting the development of the TMDL. Accordingly the Department shall propose each TMDL as an amendment to the appropriate areawide water quality management plan. As part of the public participation process for the development and implementation of the TMDLs for fecal coliform in the Northeast Water Region, the NJDEPs, Division of Watershed Management, Northeast Bureau worked collaboratively with a series of stakeholder groups throughout New Jersey as part of the Department's ongoing watershed management efforts.

The Department's watershed management process was designed to be a comprehensive stakeholder driven process that is representative of members from each major stakeholder group (agricultural, business and industry, academia, county and municipal officials, commerce and industry, purveyors and dischargers, and environmental groups). As stated previously, through the creation of this watershed management planning process over the past several years Public Advisory Committees (PACs) and Technical Advisory Committees (TACs) were created in all 20 WMAs. Whereas the PACs serve in an advisory capacity to the Department, and examined and commented on a myriad of issues in the watersheds, the TACs were focused on scientific, ecological, and engineering issues relevant to the mission of the PAC.

The Northeast Bureau discussed with the WMA 3, WMA 4, WMA 5 and WMA 6 TAC members the Department's TMDL process through a series of presentations and discussions that culminated in the development of the 32 TMDLs for Streams Impaired by Fecal Coliform in the Northeast Water Region. The below paragraphs outline public involvement.

- Integrated Listing Methodology presentations were made by the Northeast Bureau within the DWM to the Northeast TACs throughout the month June; requesting that they review the Integrated List and submit comments to the Department by the September deadline. Presentations were made to WMA 5 TAC on June 18, 2002; WMA 6 TAC on June 20, 2002; WMA 3 TAC on June 21, 2002; and WMA 4 TAC on June 27, 2002.
- Expedited Fecal Coliform and Lake TMDL presentations were given at the September TAC meetings. The finalized Sublist 5 list was also disseminated. The TACs were briefed about the executed Memorandum of Agreement between the Department and EPA Region 2 with the imminent timeline. The TACs were asked to review sites and think about sources for discussion at the October TAC meetings at which time the Northeast Bureau would bring maps with municipalities and impaired stream segments and other features to facilitate the conversation.
- At the October TAC meetings (WMA 5: October 15, 2002; WMA 3 October 19, 2002; WMA 4 October 24, 2002 and WMA 6 October 28, 2002) TAC members were asked to identify based on their local knowledge potential sources of impairment. Draft copies of the Northeast Fecal TMDL report were distributed for informational purposes only. TAC members were advised that the formal comment period would be during the New Jersey Register Notice, but that the Department was interested in their input on policy issues affecting the development of the TMDL.
- At the November and December TAC meetings, the draft Fecal TMDL Report was distributed for informal comments prior to the NJR Notice.

Additional public participation and input was received through the NJ EcoComplex. The Department contracted with Rutgers NJ EcoComplex (NJEC) in July 2001. The role of NJEC is to provide comments on the Department's management strategies, including those related to the development of TMDL values. NJEC consists of a review panel of New Jersey University professors who provide a review of the technical approaches developed by the Department. The New Jersey Statewide Protocol for Developing Fecal TMDLs was presented to NJEC on August 7, 2002 and was subsequently reviewed and approved. The statewide approach was also presented the Passaic TMDL Workgroup in May 2002 for their input and approval. The New Jersey's Statewide Protocol for Developing Lake and Fecal TMDLs was presented by the Northeast Bureau at the SETAC Fall Workshop on September 13, 2002 and met with their approval.

11.1. AmeriCorps Participation

AmeriCorps is a national service initiative that was started in 1993 and is the domestic Peace Corps. The New Jersey Watershed Ambassadors Program is a community-oriented AmeriCorps environmental program designed to raise awareness about watershed issues in New Jersey. Through this program, AmeriCorps members are placed in watershed management areas across the state to serve their local communities. Watershed Ambassadors monitor the rivers of New Jersey through River Assessment Teams (RATs) and Biological Assessment Teams (BATs) volunteer monitoring programs.

Representatives from the Department in conjunction with the Watershed Ambassadors conducted RATs surveys on each of the impaired segments. These visual assessments were conducted from October to December 2002.

11.2. Public Participation Process

In accordance with N.J.A.C. 7:15–7.2(g), these TMDLs are hereby proposed by the Department as an amendment to the Northeast Water Quality Management Plan. N.J.A.C. 7:15-3.4(g)5 states that when the Department proposes to amend the areawide plan on its own initiative, the Department shall give public notice by publication in a newspaper of general circulation in the planning area, shall send copies of the public notice to the applicable designated planning agency, if any, and may hold a public hearing or request written statements of consent as if the Department were an applicant. The public notice shall also be published in the New Jersey Register.

Notice of these TMDLs was published January 21, 2003 pursuant to the above noted Administrative Code, in order to provide the public an opportunity to review the TMDLs and submit comments. The Department has determined that due to the level of interest in these TMDLs, a public hearing will be held. Public notice of the hearing, provided at least 30 days before the hearing, was published in the New Jersey Register and in two newspapers of general circulation and will be mailed to the applicable designated planning agency, if any, and to each party, if any, who was requested to issue written statement of consents for the amendment.

All comments received during the public notice period and at any public hearings will become part of the record for these TMDLs. All comments will be considered in the establishment of these TMDLs and the ultimate adoption of these TMDLs. When the Department takes final agency action to establish these TMDLs, the final decision and supporting documentation will be sent to U.S.E.P.A. Region 2 for review and approval pursuant to 303(d) of the Clean Water Act (33 U.S.C. 1313(d)) and 40 CFR 130.7.

References

Bowman, A.M., C. Hagedorn, and K. Hix. 2000. Determining sources of fecal pollution in the Blackwater River watershed. p. 44-54. *In* T. Younos and J. Poff (ed.), Abstracts, Virginia Water Research Symposium 2000, VWRRC Special Report SR-19-2000, Blacksburg.

Cabelli, V. 1989. Swimming-associated illness and recreational water quality criteria. Wat. Sci. Tech. 21:17.

Alexandria K. Graves, Charles Hagedorn, Alison Teetor, Michelle Mahal, Amy M. Booth, and Raymond B. Reneau, Jr. Antibiotic Resistance Profiles to Determine Sources of Fecal Contamination in a Rural Virginia Watershed. Journal of Environmental Quality. 2002 31: 1300-1308.

National Research Council. 2001. Assessing the TMDL Approach to water quality management. National Academy Press, Washington, D.C.

New Jersey Department of Environmental Protection. 1998. Identification and Setting of Priorities for Section 303(d) Water Quality Limited Waters in New Jersey, Office of Environmental Planning

New Mexico Environmental Department. 2002. TMDL for Fecal Coliform on three Cimarron River Tributaries in New Mexico.
Online at: http://www.nmenv.state.nm.us/swqb/CimarronTMDL.html

Palladino, M. A., and Tiedemann, J. (2001) Differential Identification of *E. coli* in the Manasquan River Estuary by Multiple Antibiotic Resistance Testing and DNA Fingerprinting Analysis. Monmouth University, NJ

Goyal, S.M. 1987. Methods in Phage Ecology. pp. 267-287. In: Phage Ecology, S.M. Goyal, C.P. Gerba and G. Bitton (Eds.) John Wiley and Sons, New York.

Saunders, William and Maidment, David. 1996. A GIS Assessment of Nonpoint Source Pollution in the San Antonio- Nueces Coastal Basin. Center for Research in Water Resources. Online Report 96-1:

Stiles, Thomas C. (2001). A Simple Method to Define Bacteria TMDLs in Kansas. Presented at the WEF/ASIWPCA TMDL Science Issues Conference, March 7, 2001.

Thomann, R.V. and J.A. Mueller. 1987. Principles of Surface Water Quality Modeling and Control, Harper & Row, Publishers, New York.

USEPA. 1986. Implementation Guidance for Ambient Water Quality Criteria for Bacteria. EPA-823-D-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-92-002. Washington, DC.

USEPA. 1997. Compendium of tools for watershed assessment and TMDL development. EPA841-B-97-006. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2001. Protocol for Developing Pathogen TMDLs. EPA841-R-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

U.S. Geological Survey. 1982. Low - Flow Characteristics and Flow Duration of New Jersey Streams. Open-File Report 81-1110.

Appendix A: Explanation of stream segments in Sublist 5 of the *2002 Integrated List of Waterbodies* for which TMDLs will not be developed in this report.

Data to support removing River Segments from List 5 to List 1 for Fecal Coliform.

- Pequannock River at Macopin Intake Dam, Station #01382500

Re-assessments of data from station #01382500, the Pequannock River at Macopin Intake Dam, indicate that the water quality standards are met at this location. Measurements taken between 2/22/1994 and 7/17/00 at Station #01382500, show a geometric mean of 34 CFU/100 ml, and that 7.8% of values are over 400 CFU/100ml.

River segments to be moved from Sublist 5 to Sublist 3 for fecal coliform.

- Wanaque River at Wanaque, #01387000;
- Hackensack River at New Milford, #01378500

Two segments listed on Sublist 5, station #01387000, the Wanaque River at Wanaque (WMA 3), and station #01378500 the Hackensack River at New Milford (WMA 5), were included on Sublist 5 based on their listings on previous 303(d) lists with no recent data to assess their current attainment status. Therefore, TMDLs will not be developed for these locations until and unless recent data indicated violations of the surface water quality standards.

River segments to be moved from Sublist 5 to Sublist 4 for fecal coliform.

- Whippany River at Morristown, #01381500;
- Whippany River near Pine Brook, #01381800

Two segments, #01381500, the Whippany River at Morristown, and #01381800, the Whippany River near Pine Brook, were included as part of the Whippany River Watershed Fecal Coliform TMDL adopted on 4/16/2000 and published in the New Jersey Register on 6/5/2000. Upon adoption of this TMDL Report, the Department will remove these two waterbodies for fecal coliform from Sublist 5 to move them to Sublist 4 as identified in the below table.

Sublist 5 river segments listed for fecal coliform for which TMDLs will not be developed in this report.

- Passaic River at Elmwood Park, #01389880

The Passaic River at Elmwood Park, segment #01389880, is located in an area affected by combined sewer overflows (CSOs). CSOs are sewage systems that use a single pipe to transport both stormwater runoff from rainstorms and sewage from households, businesses and industries to sewage treatment plants. During dry weather, combined sewers send all wastewater to the STPs. During wet weather, stormwater quickly fills the combined sewers, which carry both sanitary sewage and runoff from streets, parking lots, and rooftops. The overflows carry bacteria from the untreated sewage as well as other pollutants in the stormwater. Additional potential FC sources were identified during a site visit on October 24, 2002 and include geese (at park on River Road across from High School), homeless populations, and dog pounds/shelters.

The methodology employed in this report is not appropriate for use in areas affected CSOs, thus, this stream segment will be addressed with a separate management approach.

List of Sublist 5 segments to be moved to Categories 1, 3 or 4 based upon reassessment of data, the need for current data, or the prior completion of a TMDL report.

WMA	Station Name/Waterbody	Site ID	New Sublist Listing	Explanation
03	Pequannock River at Macopin Intake Dam	01382500	Sublist 1	Re-assessment shows non-impairment
03	Wanaque River at Wanaque	01387000	Sublist 3	Updated monitoring needed
04	Passaic River at Elmwood Park	01389880	No change	CSO influence
05	Hackensack River at New Milford	01378500	Sublist 3	Updated monitoring needed
06	Whippany River at Morristown	01381500	Sublist 4	TMDL completed in 1999
06	Whippany River near Pine Brook	01381800	Sublist 4	TMDL completed in 1999

Appendix B: Municipal POTWs Located in the TMDLs' Project Areas

WMA	Station #	NJPDES	Facility Name	Discharge Type	Receiving waterbody
3	1387500	NJ0027774.001A	Oakland Boro - Oakwood Knolls	MMI	Ramapo River via storm sewer
3	1387500	NJ0080811.001A	Oakland Twp - Riverbend	MMI	Ramapo River
3	1387500	NJ0021253.001A	Ramapo BOE - Indian High	MMI	Pond Creek (Ramapo River)
3	1387500	NJ0053112.001A	Oakland Boro - Chapel Hill Estates	MMI	Ramapo River via pond and storm sewer
3	1387500	NJ0021342.001A	Oakland Boro Skyview-Highbrook STP	MMI	Caille Lk via unnamed tributary & storm sewer
3	1387500	NJ0021946.001A	US Army - Nike Base	MMI	Darlington Brook via unnamed tributary
3	1387500	NJ0030384.001A	Oakland BOE - Manito Ave	MMI	Caille Lake via unnamed tributary and storm sewer
3	1387500	NJ0030384.001V	Oakland BOE - Manito Ave	MMI	Caille Lake via unnamed tributary and storm sewer
4	1389600	NJ0025330.001A	Cedar Grove Twp STP	MMJ	Peckman River
4	1389600	NJ0024490.004A	Verona Twp	MMJ	Peckman River
4	1389600	NJ0021687.001A	Essex County Hospital	MMJ	Peckman River
4	1389080	NJ0028002.001A	Wayne Twp - Mountain View	MMJ	Singac Brook (Preakness)
4	1389080	NJ0021261.001A	NJDHS-NJ Development Center	MMI	Passaic River
6	1379200	NJ0022845.001A	Harrison Brook STP	MMJ	Dead River
6	1379500	NJ0020427.001A	Caldwell Boro STP	MMJ	Passaic River via unnamed tributary
6	1379500	NJ0024511.001A	Livingston Twp	MMJ	Passaic River
6	1379500	NJ0025518.001A	Florham Park SA	MMJ	Passaic River
6	1379500	NJ0024937.001A	Molitor Water Pollution	MMJ	Passaic River
6	1379500	NJ0021636.001A	New Providence Boro	MMJ	Passaic River
6	1379500	NJ0024937.002A	Molitor Water Pollution	MMJ	Passaic River
6	1379500	NJ0027961.001A	Berkeley Heights	MMJ	Passaic River
6	1379500	NJ0020427.SL3A	Caldwell Boro STP	MMJ	Sludge Application
6	1379500	NJ0020427.SL3B	Caldwell Boro STP	MMJ	Sludge Application
6	1379500	NJ0020427.SL3M	Caldwell Boro STP	MMJ	Sludge Application
6	1381200	NJ0022349.001A	Rockaway Valley SA	MMJ	Rockaway River
6	1381200	NJ0024970.001A	Parsippany-Troy Hills SA	MMJ	Whippany River
6	1378855	NJ0020290.001A	Chatham Township - Main	MMI	Black Brook
6	1379200	NJ0021083.001A	Veterans Adm Medical Center	MMI	Harrisons Brook via unnamed tributary
6	1379200	NJ0022497.001A	Warren Twp SA - Stage 4	MMI	Dead River
6	1379200	NJ0050369.001A	Warren Twp SA - Stage 5	MMI	Dead River
6	1379500	NJ0020281.001A	Chatham Hill STP	MMI	Passaic River
6	1379500	NJ0052256.001A	Chatham Township - Chatham Glen	MMI	Passaic River

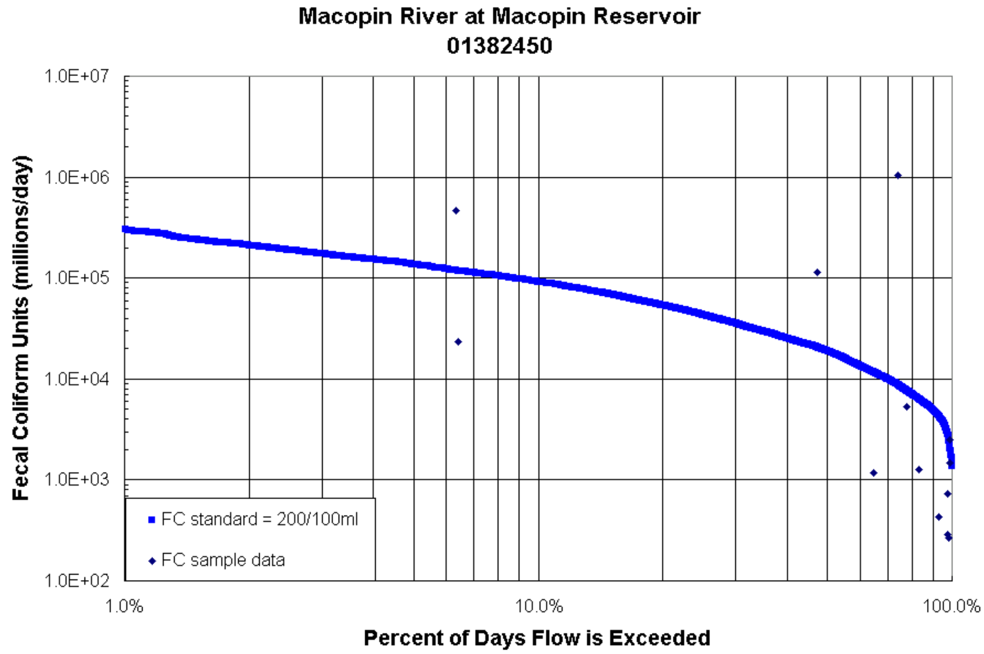
6	1379500	NJ0022489.001A	Warren Twp SA - Stage 1 & 2	MMI	Passaic River
6	1379500	NJ0024465.001A	Long Hill Twp STP - Stirling Hills	MMI	Passaic River
6	1379500	NJ0021938.001A	US Army - Nike Base	MMI	Passaic River
6	1380320	NJ0022276.001A	Stonybrook School	MMI	Untermeyer Lake via storm sewer
6	1379680	NJ0021091.001A	Jefferson Twp High - Middle School	MMI	Edison Brook
6	1379680	NJ0026867.001A	Jefferson Twp - White Rock	MMI	Mitt Pond (Russia Brook)
6	1379853	NJ0026603.001A	Randolph Twp BOE - High School	MMI	Mill Brook via unnamed tributary
6	1379853	NJ0032808.001A	Rockaway Townsquare Mall	MMI	Green Pond Brook

Appendix C: TMDL Calculations

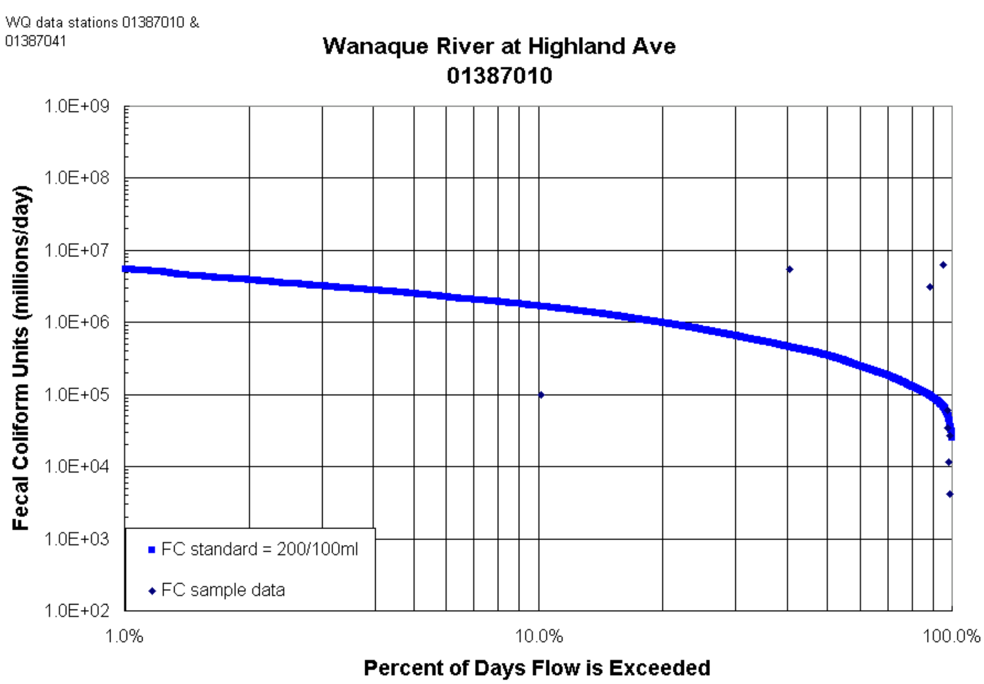
WMA	Station Names	303(d) Category 5 Segments	Water Quality Stations	Load Allocation (LA) and Margin of Safety (MOS): 200 FC/100ml Standard: Geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	400 FC/100ml Standard: Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Wasteload Allocation (WLA)
3	Macopin R at Echo Lake, Macopin R at Macopin Reservoir	01382450	01382410, 01382450	59	46%	-240%	-85%	59	46%	-16%	37%	37%
3	Wanaque R at Highland Avenue, Wanaque R at Pompton Lakes	01387010	01387010, 01387041	160	53%	-25%	42%	208	53%	67%	85%	85%
3	Ramapo R near Mahwah	01387500	01387500	291	44%	31%	61%	431	44%	84%	91%	91%
4	West Branch Saddle R at Upper Saddle River, Saddle R at Saddle River, Saddle R at Ridgewood Ave, Saddle R at Grove St., Ramsey Bk at Allendale, Hohokus Bk at Paramus, Saddle R at Rochelle Park, and Saddle R at Lodi	01390445, 01390500, 01390900, 01391100, 01391200, 01391500	01390445, 01390470, 01390510, 01390518, 01390900, 01391100, 01391490, 01391500	1,157	30%	83%	88%	1,144	30%	94%	96%	96%
4	Passaic R below Pompton R at Two Bridges, Passaic R at Little Falls, Preakness Bk, near Little Falls, Peckman R at W. Patterson, and Deepavaal Bk at Fairfield	01389005, 01389500, 01389080, 01389600, 01389138	01389500, 01389080, 01389600, 01389138	583	30%	66%	76%	652	30%	90%	93%	93%
4	Goffle Bk at Hawthorne, Diamond Bk at Fair Lawn	01389850, 01389860	01389850, 01389860	1,515	47%	87%	93%	1,544	47%	96%	98%	98%

WMA	Station Names	303(d) Category 5 Segments	Water Quality Stations	Load Allocation (LA) and Margin of Safety (MOS)								Wasteload Allocation (WLA)
				200 FC/100ml Standard				400 FC/100ml Standard				
				Geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	
5	Hackensack R. at Rivervale	01377000	01377000, 01376970	248	34%	19%	46%	294	34%	77%	85%	85%
5	Pascack Br at Westwood and Musquapsink Br at Rivervale	01377499, 01377500	01377499, 01377500	709	54%	72%	87%	709	54%	90%	96%	96%
5	Tenakill Br at Cedar Lane at Closter	01378387	01378387	159	91%	-26%	88%	159	91%	57%	96%	96%
5	Coles Br at Hackensack	01378560	01378560	1,093	68%	82%	94%	1,093	68%	94%	98%	98%
6	Black Brook at Madison, Passaic R nr Millington, Dead R nr Millington, Canoe Brook nr Summit, Passaic R nr Catham	01378855, 01379000, 01379200, 01379530, 01379500	01378855, 01379000, 01379200, 01379530, 01379500	675	29%	70%	79%	1,370	29%	95%	96%	96%
6	Rockaway R at Longwood Valley, Rockaway R at Berkshire Valley, Rockaway R at Blackwell St.	01379680, 01379853	01379680, 01379700, 01379853	253	54%	21%	64%	373	54%	82%	92%	92%
6	Beaver Brook at Rockaway	01380100	01380100	362	43%	45%	68%	362	43%	81%	89%	89%
6	Stony Brook at Boonton	01380320	01380320	214	32%	7%	37%	214	32%	68%	78%	78%
6	Rockaway R at Pine Brook	01381200	01381200	281	28%	29%	49%	571	28%	88%	91%	91%
6	Passaic R at Two Bridges	01382000	01382000	227	33%	12%	41%	276	33%	75%	83%	83%

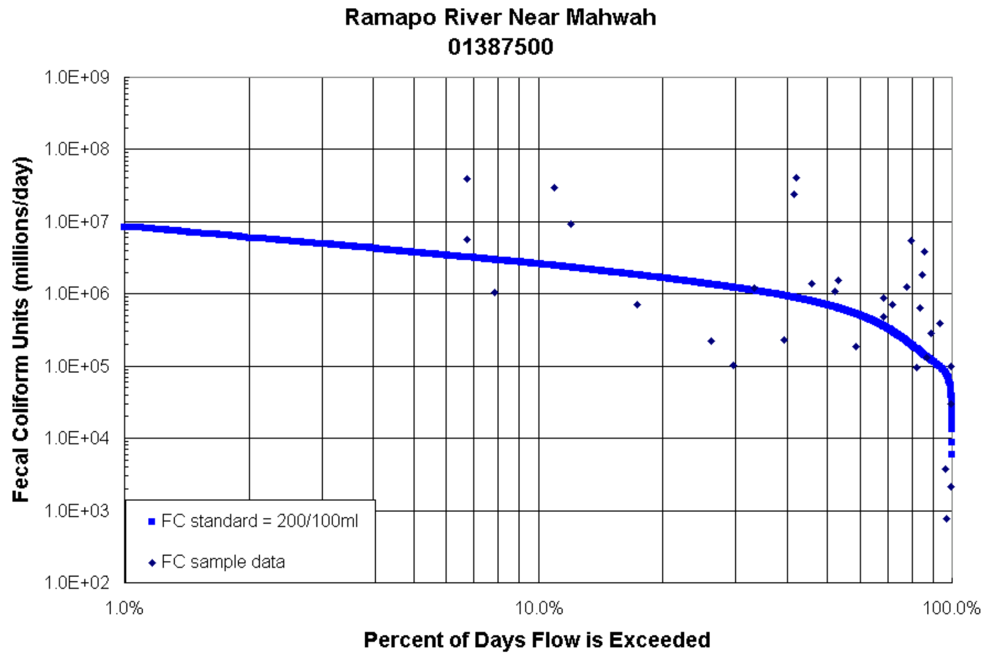
Appendix D: Load Duration Curves for each listed waterbody



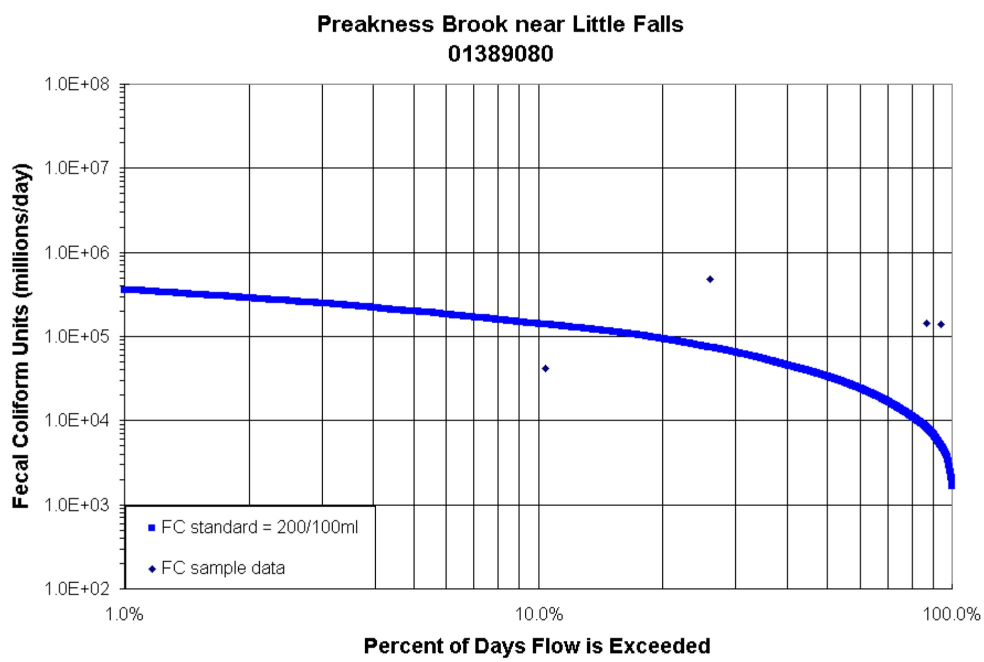
Load Duration Curve for Macopin River at Macopin Reservoir. Fecal coliform data from USGS station # 01382450 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



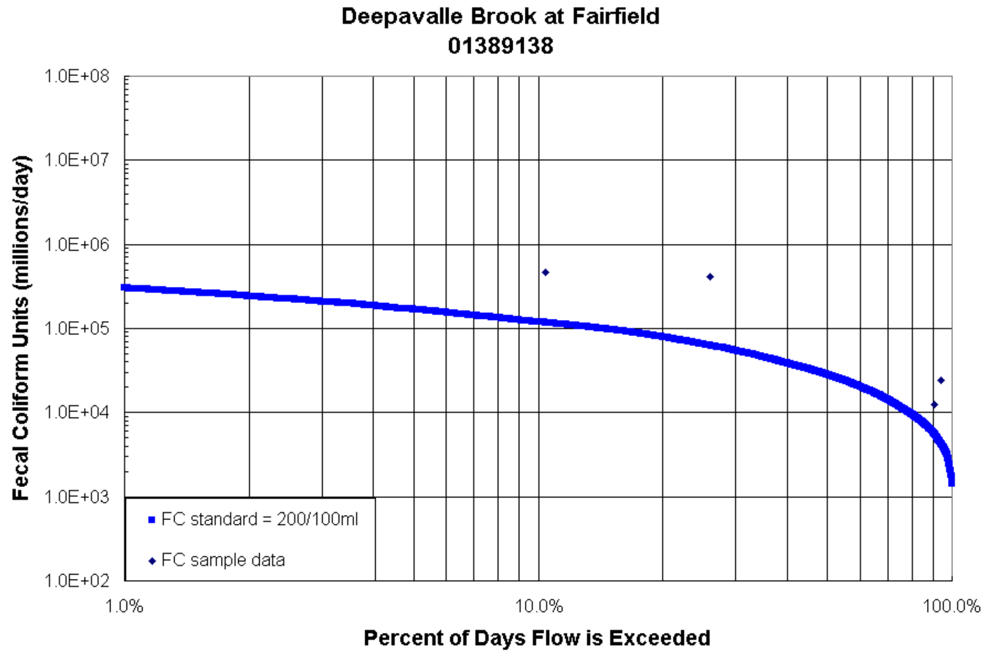
Load Duration Curve for Wanaque River at Highland Ave. Fecal coliform data from USGS station # 01387010 & 01387041 during the period 1/27/97 through 8/9/99. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



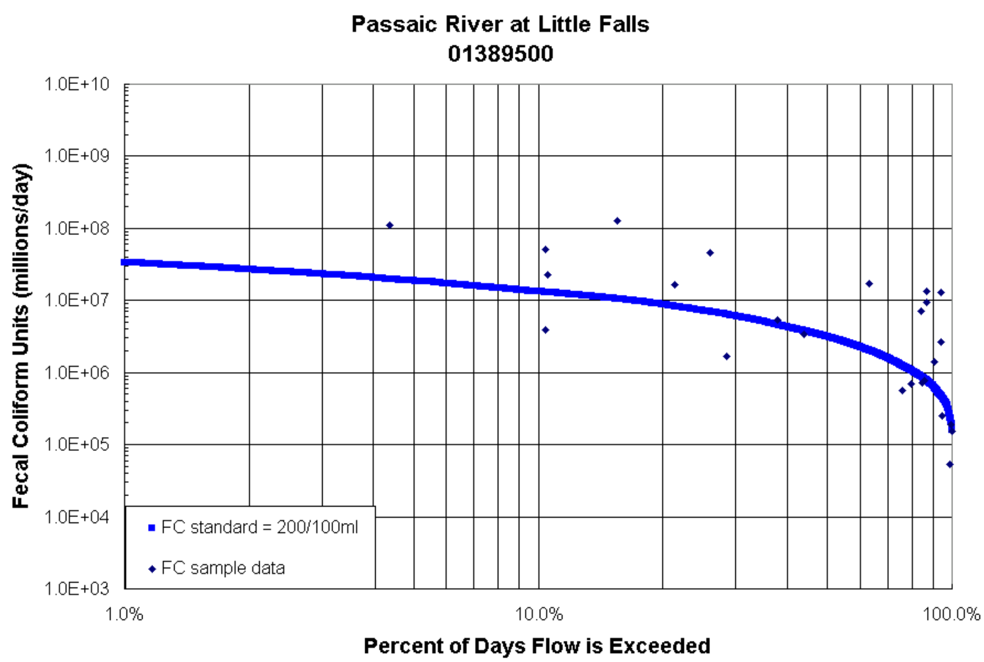
Load Duration Curve for Ramapo River Near Mahwah. Fecal coliform data from USGS station # 01387500 during the period 2/24/94 8/3/00. Water years 1970-2000 from USGS station # 01387500 (Ramapo River Near Mahwah) were used in generating the FC standard curve.



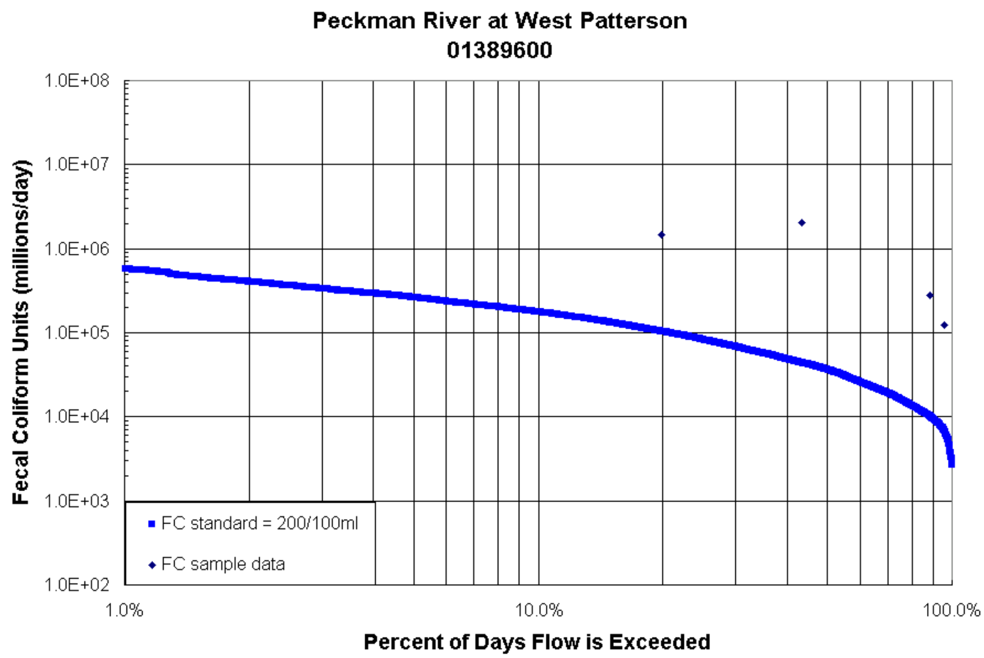
Load Duration Curve for Preakness Brook Near Little Falls. Fecal coliform data from USGS station # 01389080 during the period 4/16/98 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



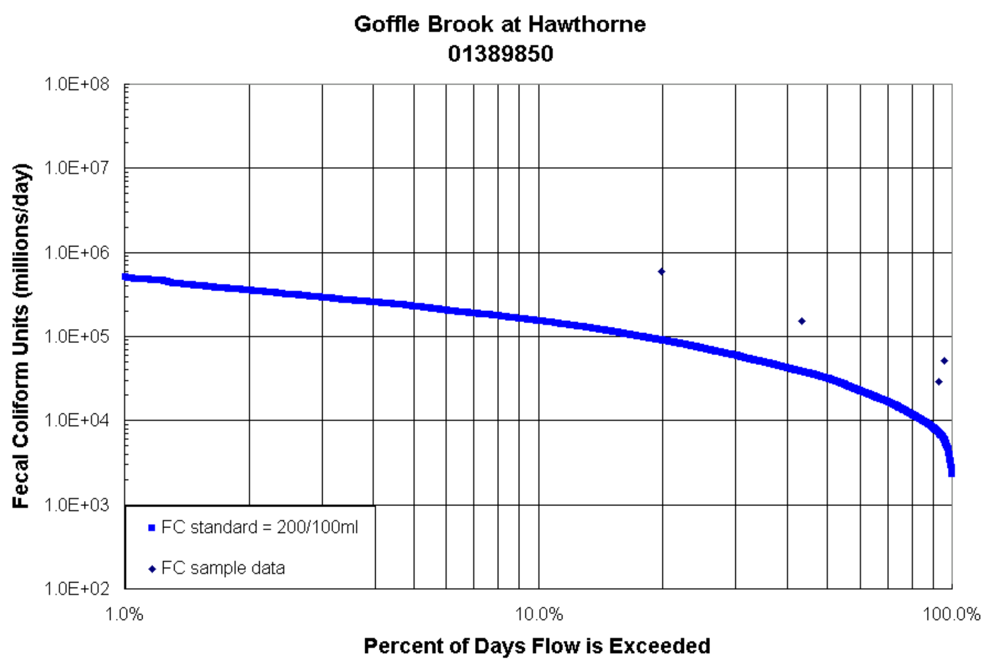
Load Duration Curve for Deepavalle Brook at Fairfield. Fecal coliform data from USGS station # 01389138 during the period 4/16/98 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



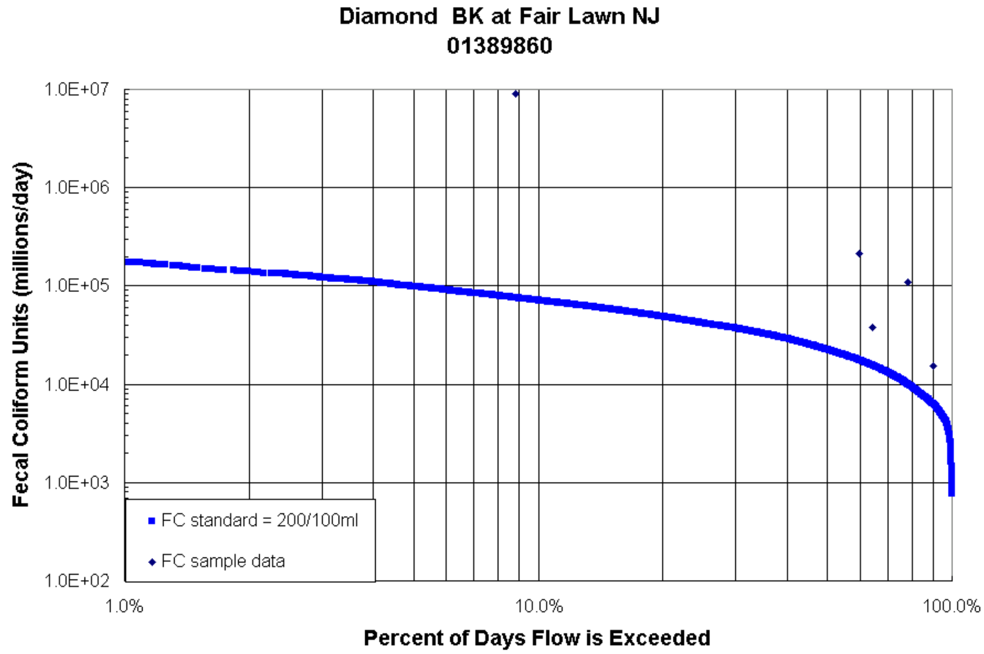
Load Duration Curve for the Passaic River at Little Falls. Fecal coliform data from USGS station # 01389500 during the period 2/18/94 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



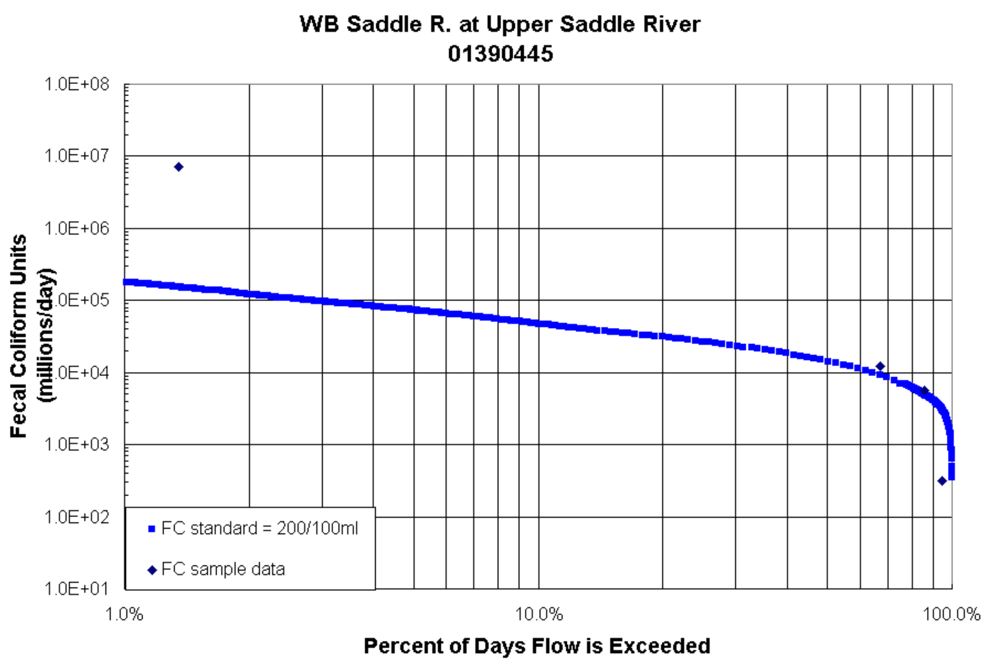
Load Duration Curve for Peckman River at West Patterson. Fecal coliform data from USGS station #01389600 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



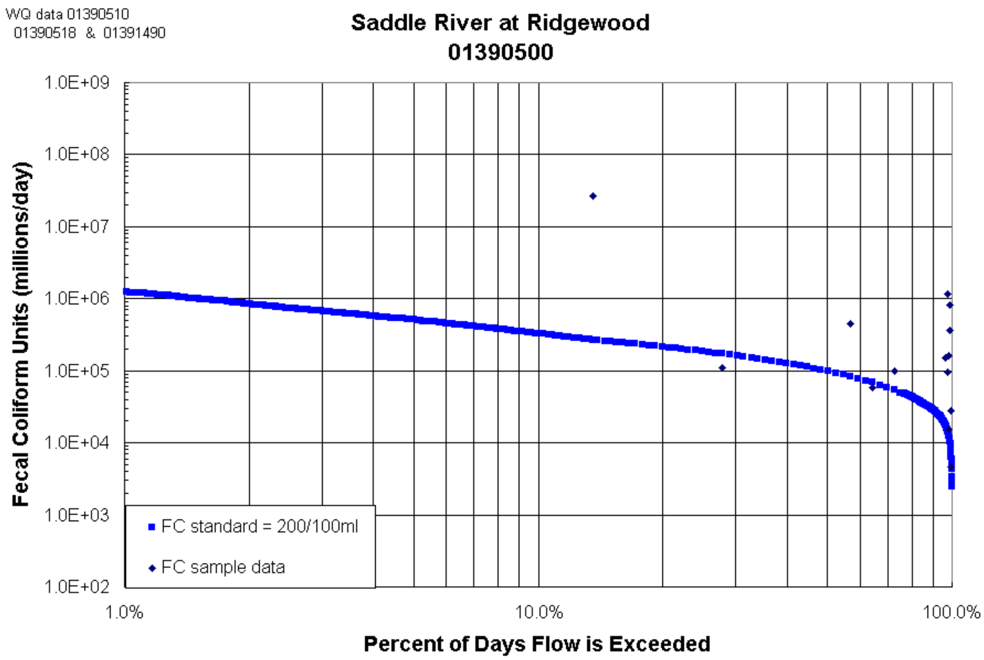
Load Duration Curve for Goffle Brook at Hawthorne. Fecal coliform data from USGS station # 01389850 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



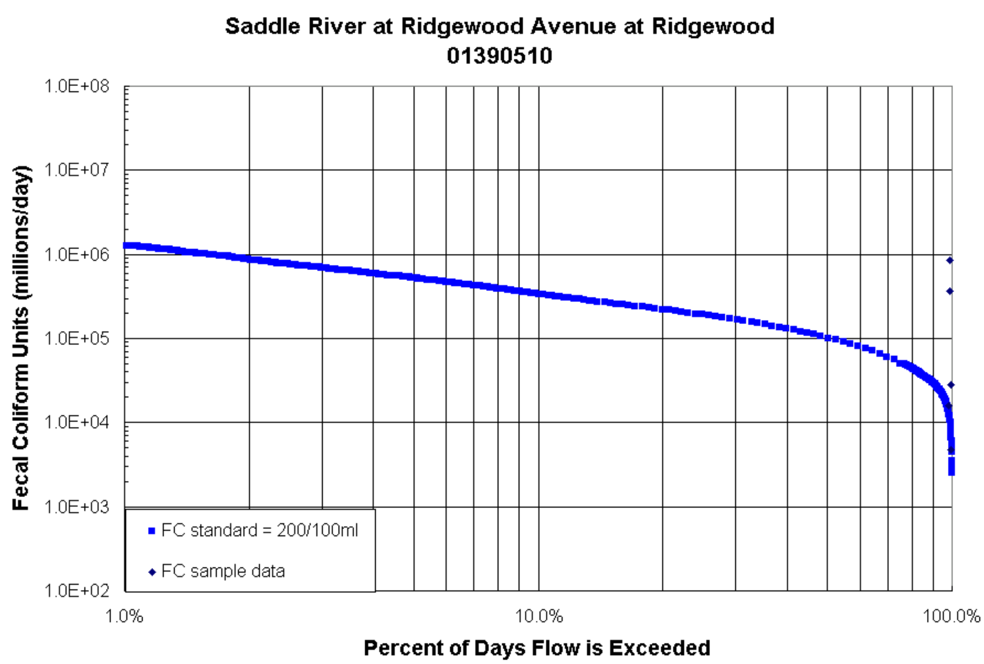
Load Duration Curve for Diamond Bk at Fair Lawn. Fecal coliform data from USGS station # 01389860 during the period 6/29/00-7/27/00. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve



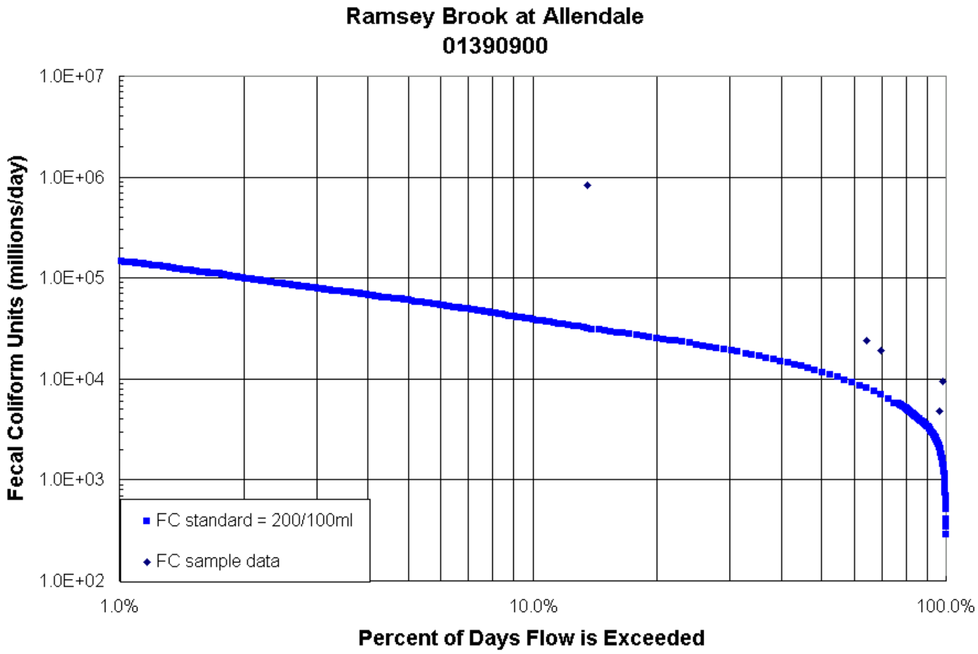
Load Duration Curve for WB Saddle R at Upper Saddle River. Fecal coliform data from USGS station # 01390445 during the period 11/4/99 through 8/7/00. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



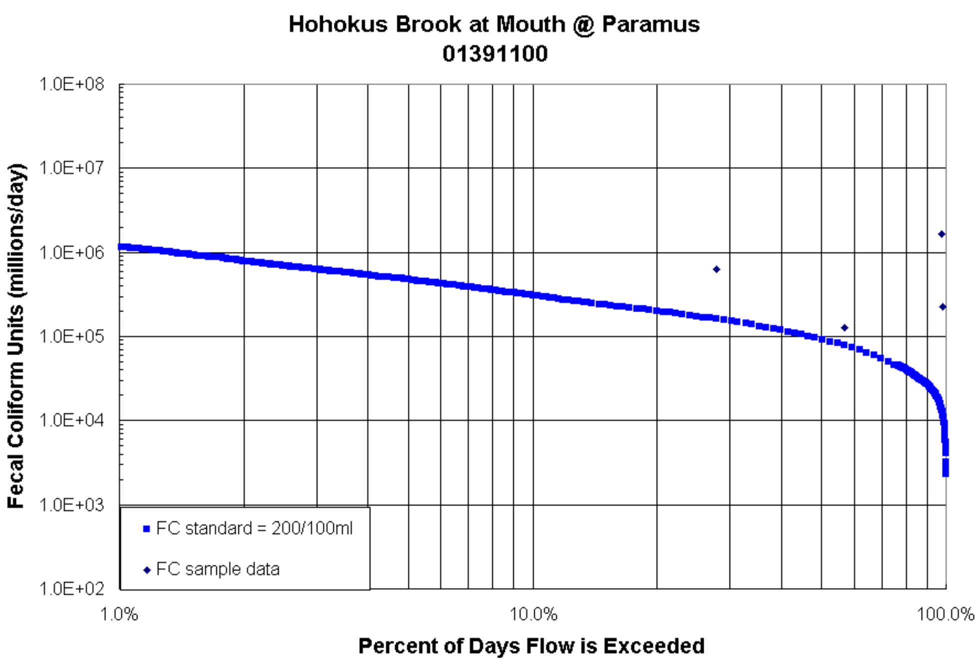
Load Duration Curve for Saddle R at Ridgwood. Fecal coliform data from USGS station # 01390510,01390518, & 01391490.during the period 11/6/97-8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



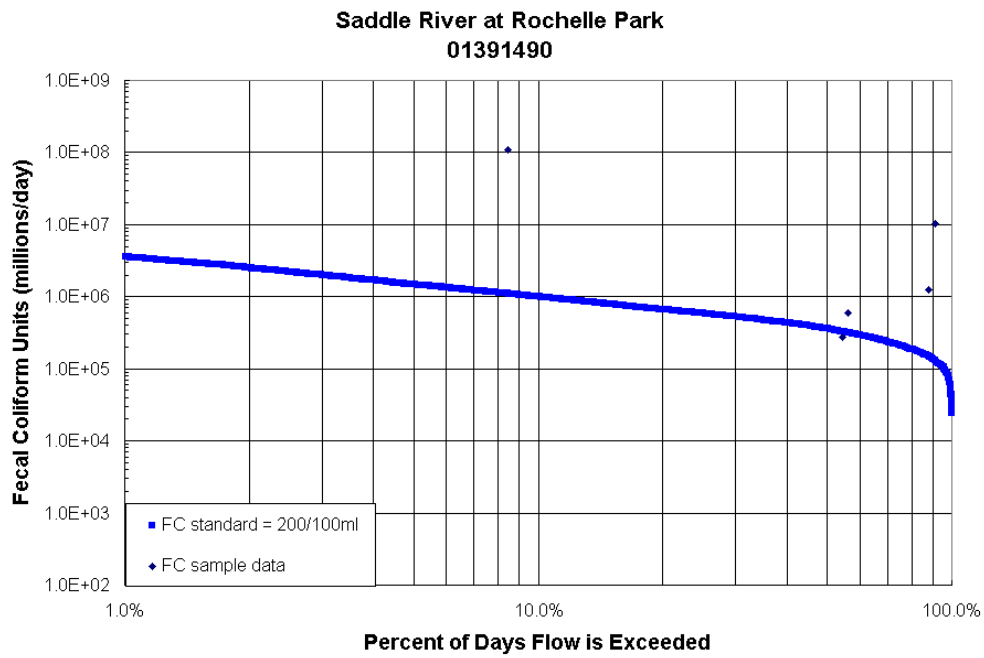
Load Duration Curve for Saddle River at Ridgewood Avenue at Ridgewood. Fecal coliform data from USGS station # 01390510 during the period 7/13/99 through 8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



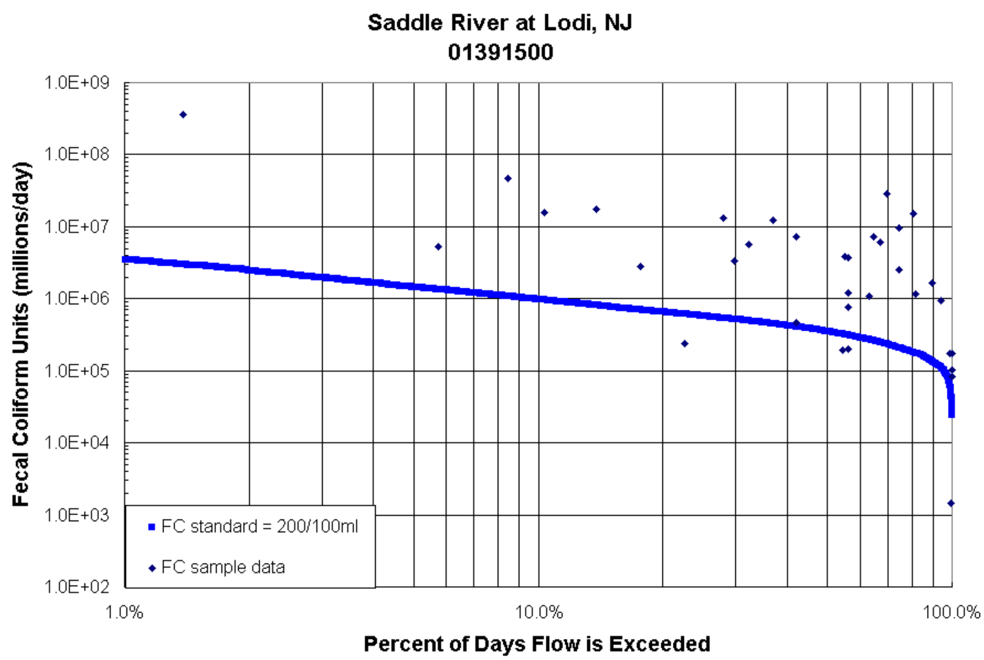
Load Duration Curve for Ramsey Brook at Allendale. Fecal coliform data from USGS station # 01390900 during the period 11/6/97 through 9/1/98. Water years 1970-2000 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



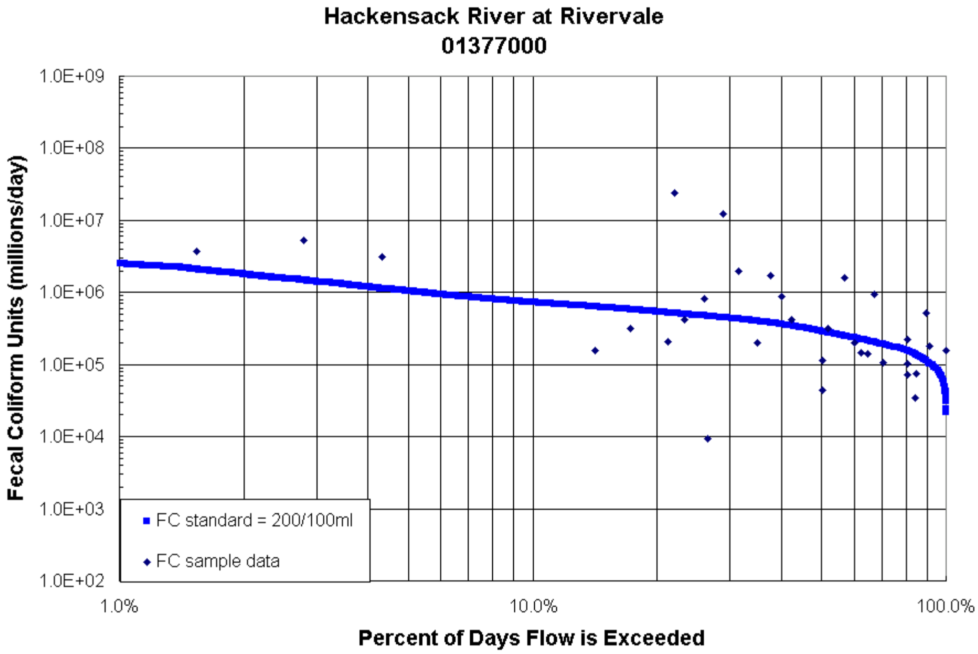
Load Duration Curve for Hohokus Brook at Mouth@ Paramus. Fecal coliform data from USGS station # 01391100 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



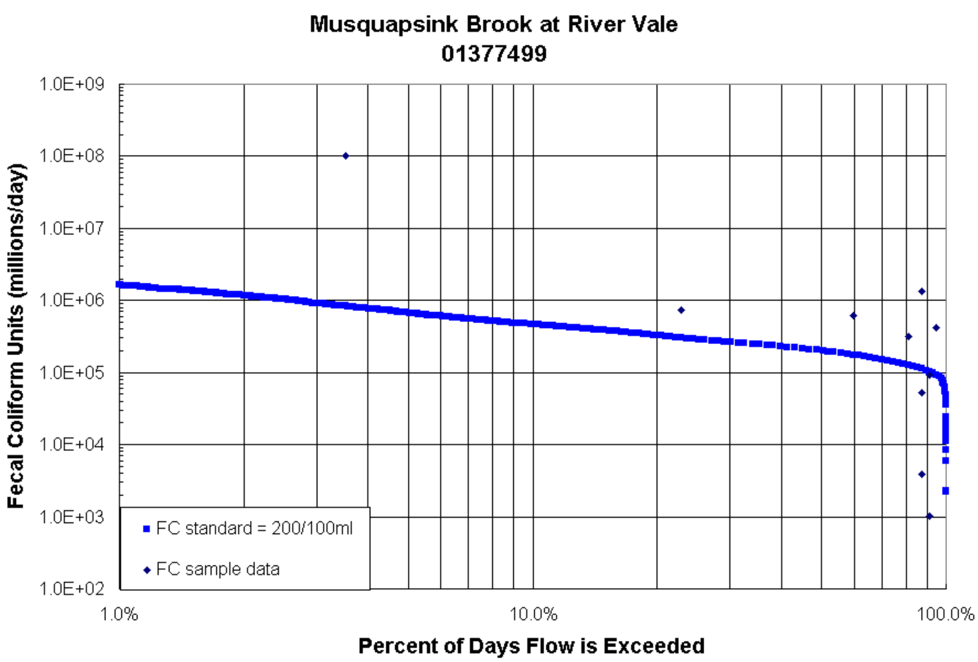
Load Duration Curve for Saddle River at Rochelle Park. Fecal coliform data from USGS station # 01391490 during the period 11/6/97 through 9/16/98. Water years 1970-2001 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard curve.



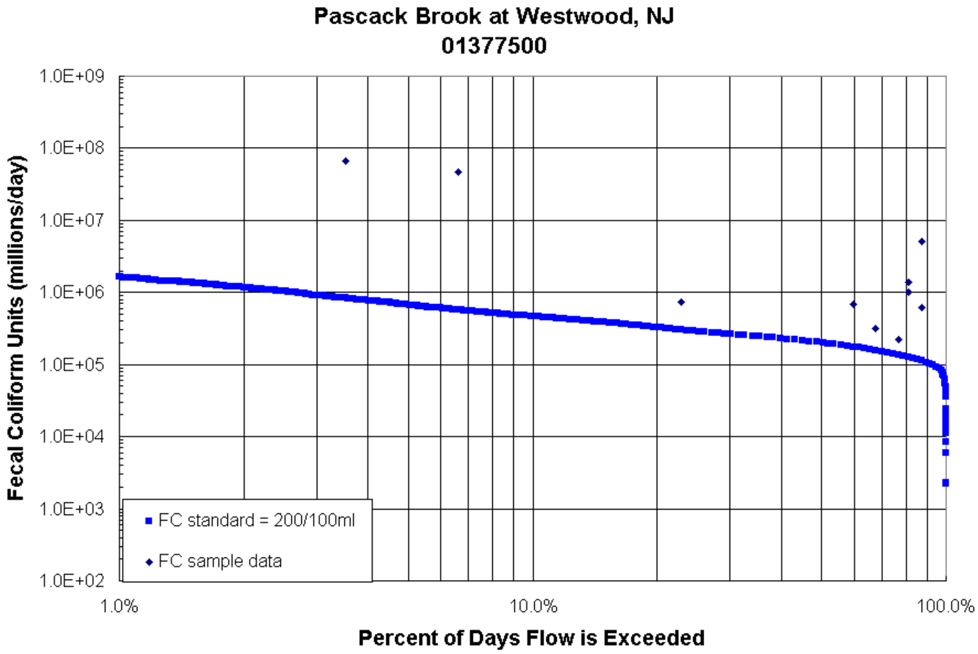
Load Duration Curve for Saddle River at Lodi. Fecal coliform data from USGS station # 01391500 during the period 2/22/94 through 9/13/00. Water years 1970-2000 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard curve.



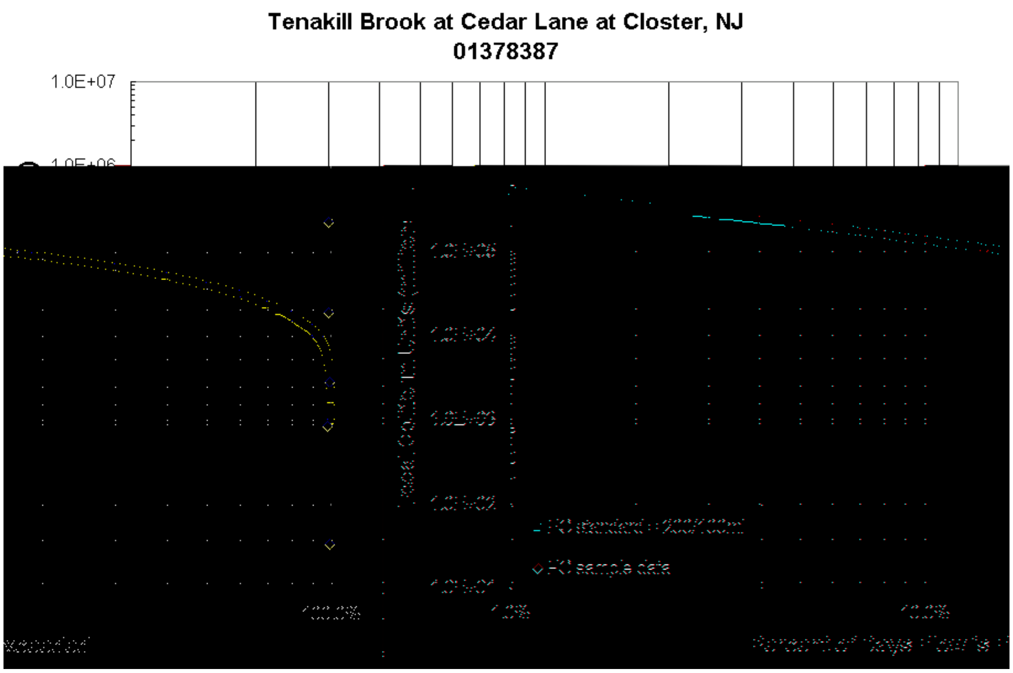
Load Duration Curve for the Hackensack River at Rivervale. Fecal coliform data from USGS station # 01377000 during the period 2/17/94 through 8/3/00. Water years 1970-2000 from USGS station # 01377000 (Hackensack River at Rivervale) were used in generating the FC standard curve.



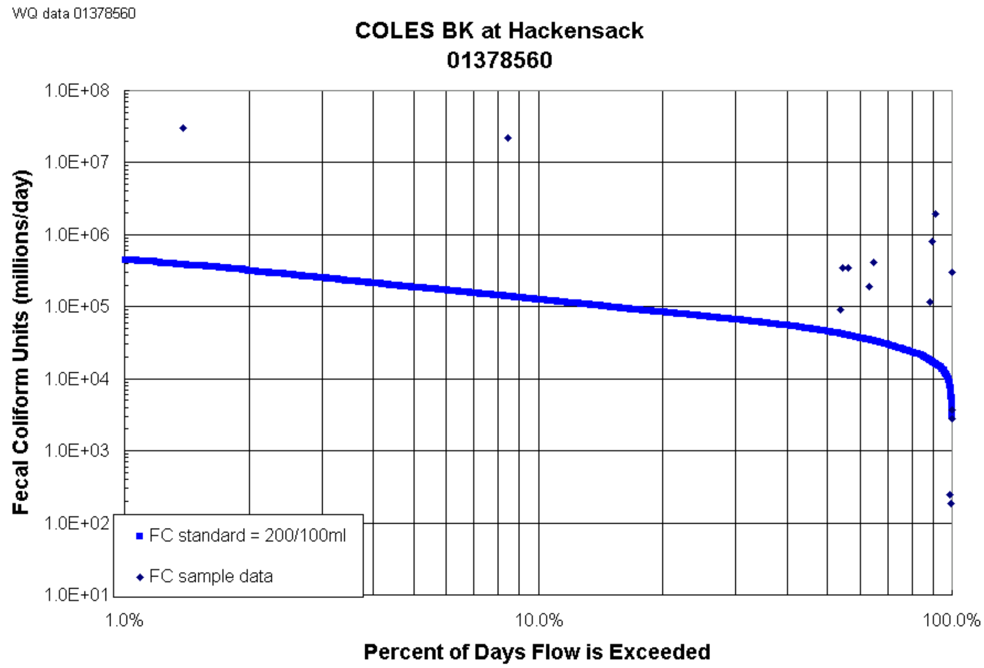
Load Duration Curve for Musquapsink Brook at River Vale. Fecal coliform data from USGS station # 01377499 during the period 7/13/99 through 9/7/00. Water years 1970-2000 from USGS station # 01377499 (Musquapsink Brook at River Vale) were used in generating the FC standard curve.



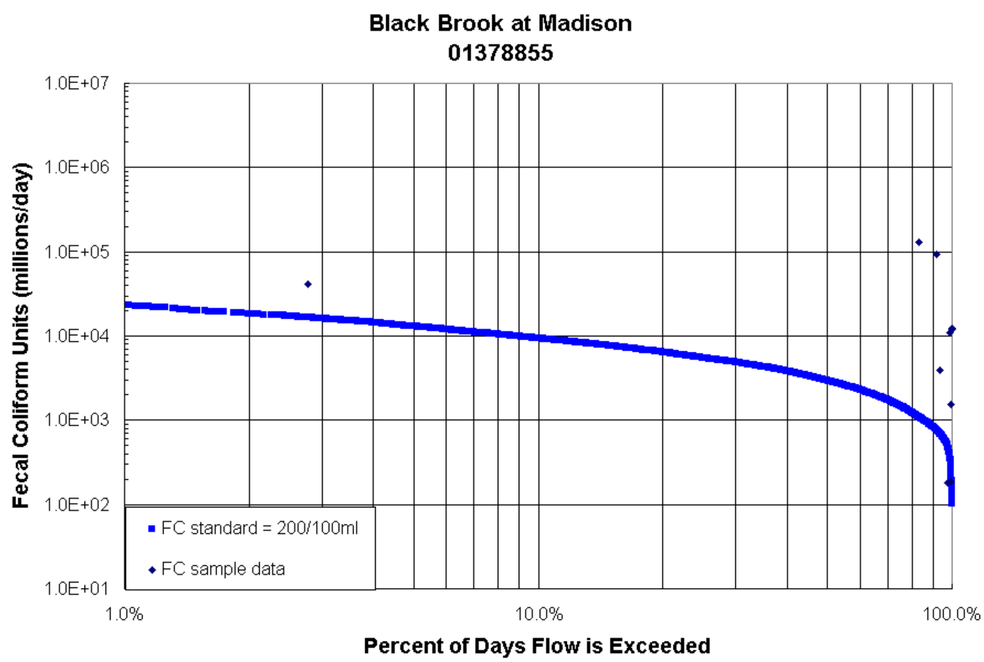
Load Duration Curve for Pascack Brook at Westwood. Fecal coliform data from USGS station # 01377500 during the period 6/1/98 through 9/6/98. Water years 1970-2000 from USGS station # 01377500 (Pascack Brook at Westwood) were used in generating the FC standard curve.



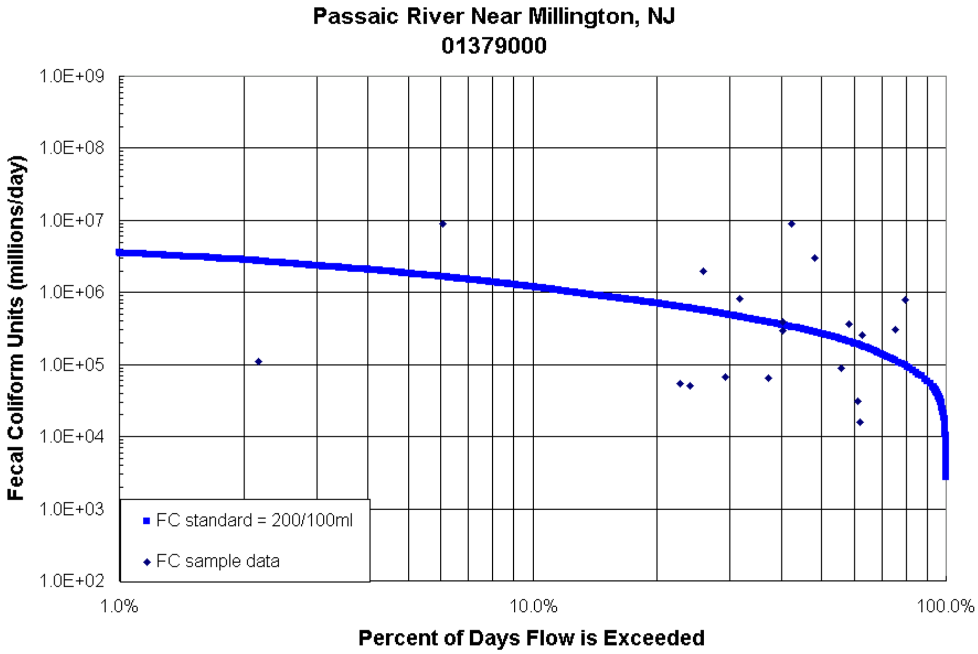
Load Duration Curve for Tenakill Brook at Cedar Lane at Closter. Fecal coliform data from USGS station # 01378387 during the period 7/13/99 through 8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



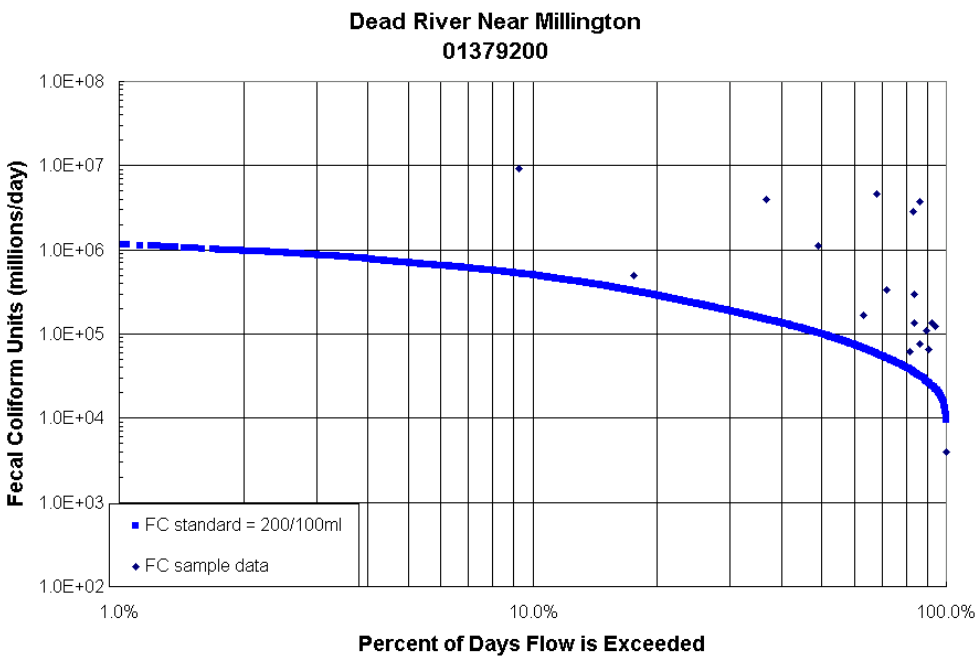
Load Duration Curve for the COLES BK at Hackensack. Fecal coliform data from USGS station # 01378560 during the period 11/5/97 through 8/23/00. Water years 1970-2001 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard



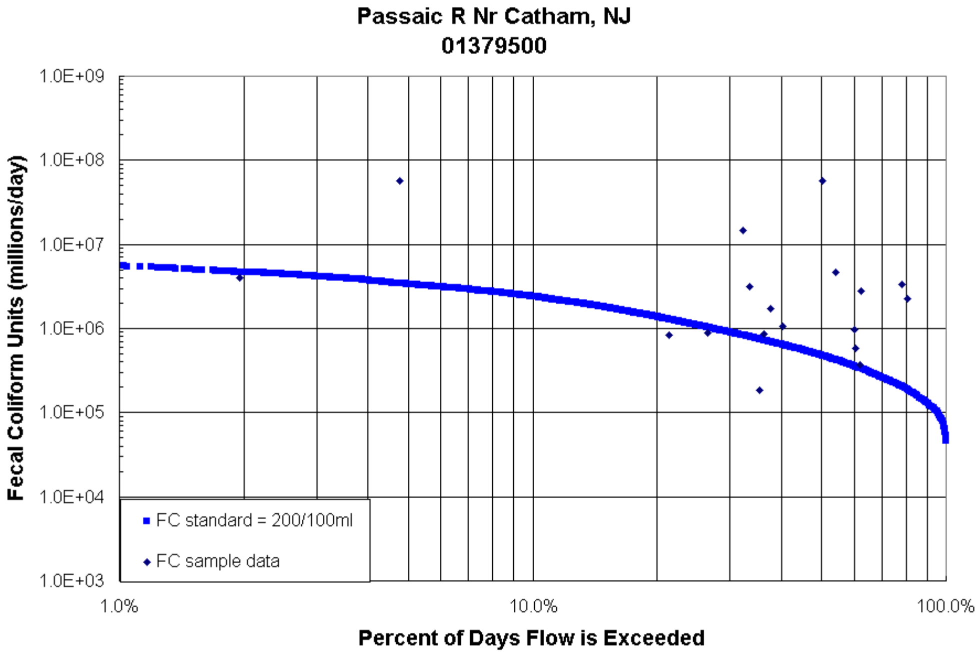
Load Duration Curve for Black Brook at Madison. Fecal coliform data from USGS station # 01378855 during the period 11/18/97 through 9/1/99. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



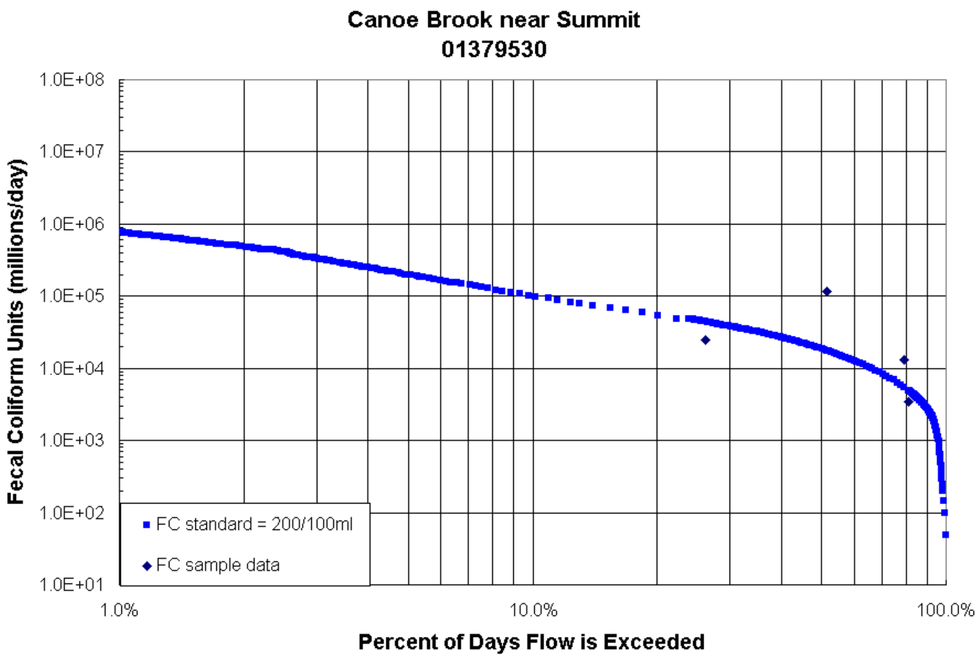
Load Duration Curve for the Passaic R Nr Millington. Fecal coliform data from USGS station # 01379000 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379000 (Passaic R Nr Millington) were used in generating the FC standard curve.



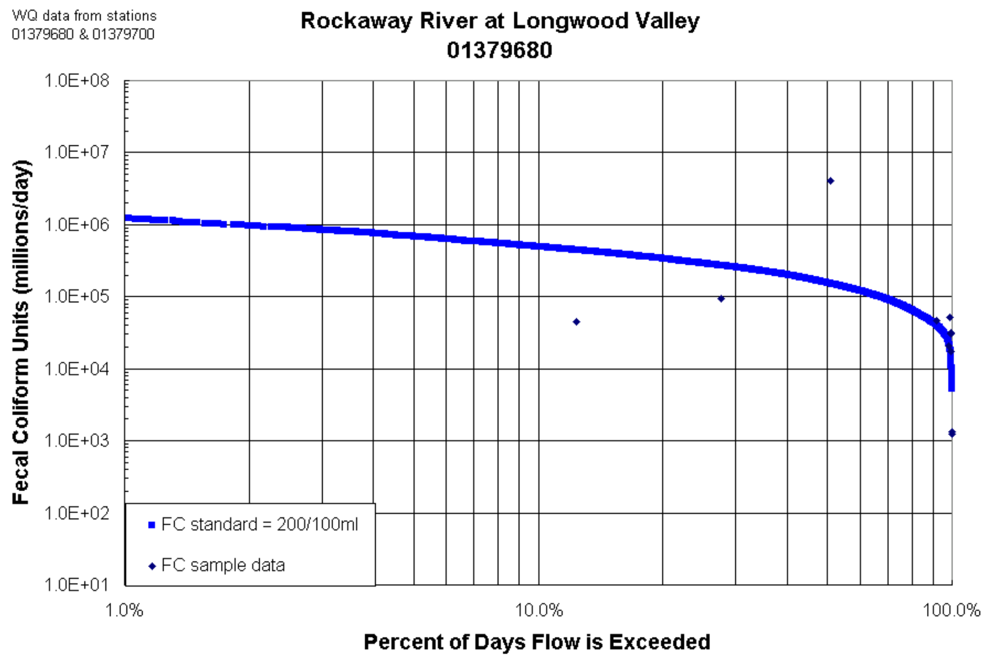
Load Duration Curve for the Dead River Near Millington. Fecal coliform data from USGS station # 01379200 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379500 (Passaic R Nr Catham) were used in generating the FC standard curve.



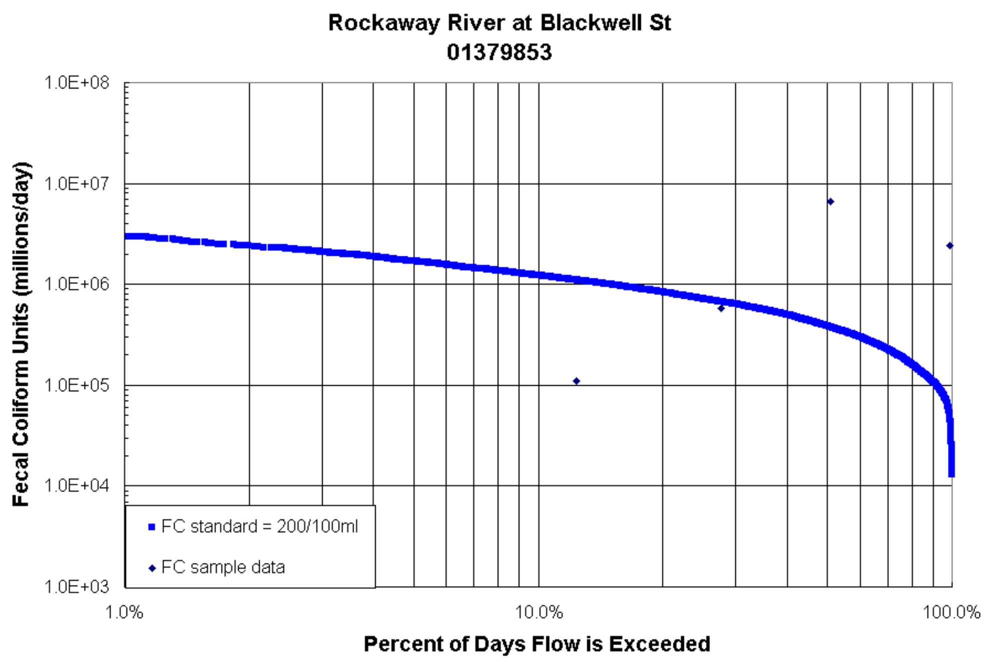
Load Duration Curve for the Passaic R Nr Catham. Fecal coliform data from USGS station # 01379500 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379500 (Passaic R Nr Catham) were used in generating the FC standard curve.



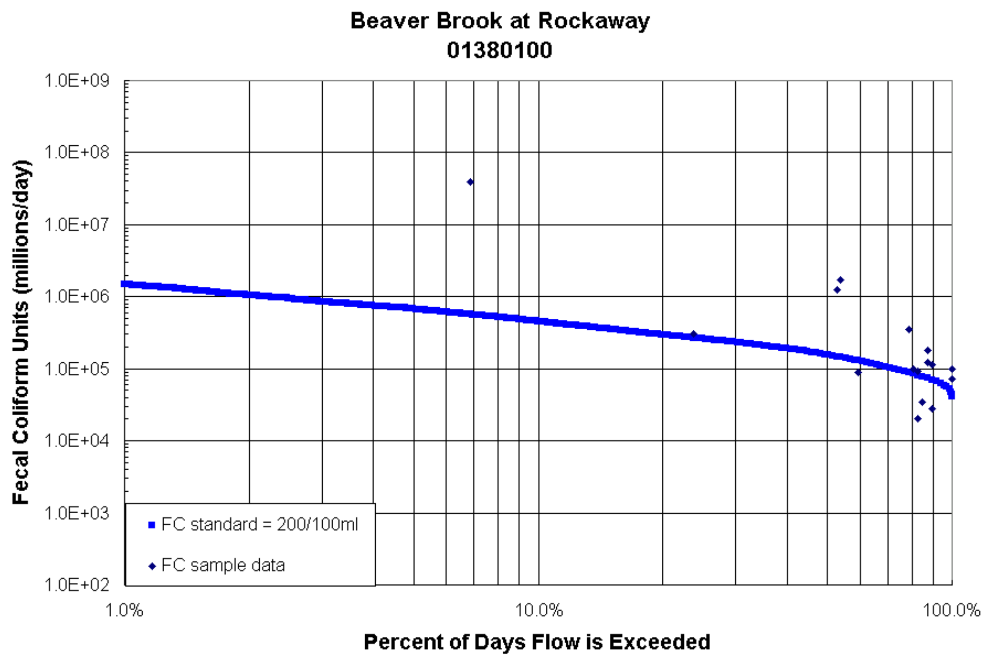
Load Duration Curve for Canoe Brook near Summit. Fecal coliform data from USGS station # 01379530 during the period 4/23/98 through 9/16/98. Water years 1970-2000 from USGS station # 01379530 (Canoe Brook near Summit) were used in generating the FC standard curve.



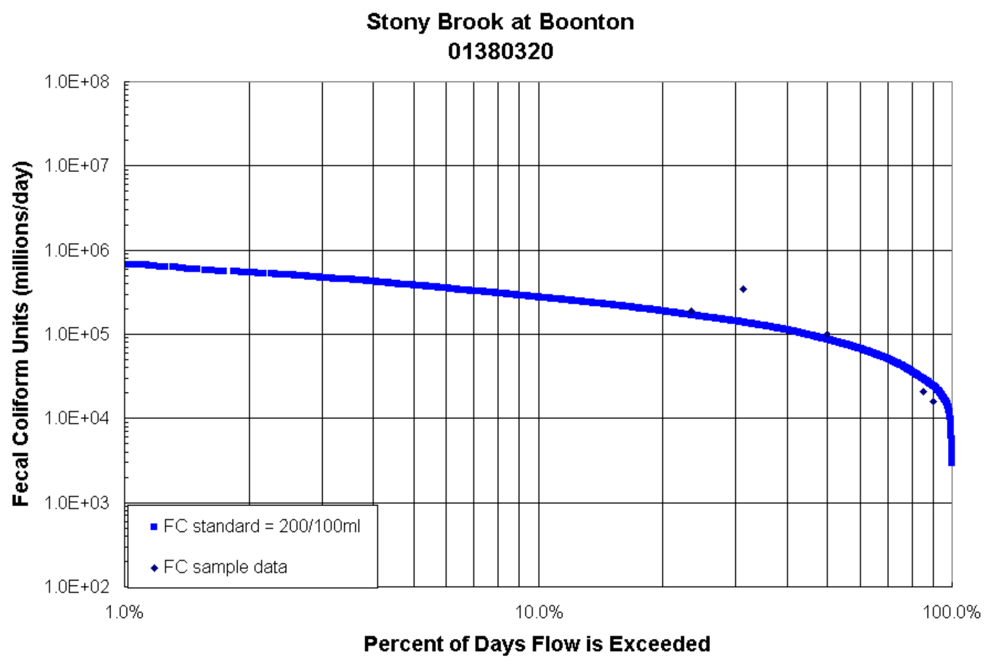
Load Duration Curve for Rockaway River at Longwood Valley. Fecal coliform data from USGS station # 01379680 & 01379700 during the period 1/27/97 through 9/2/99. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



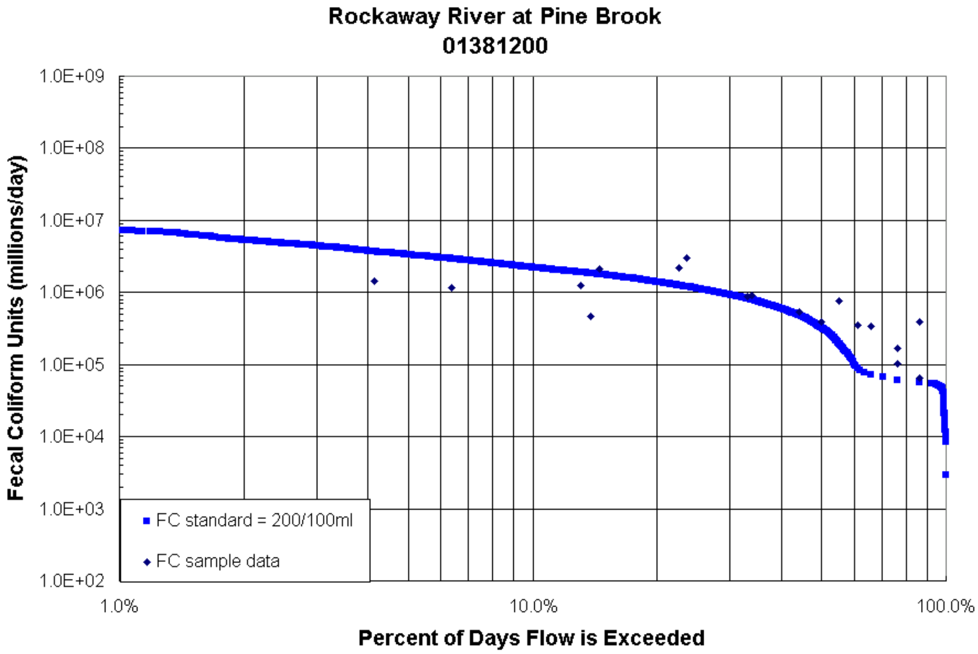
Load Duration Curve for Rockaway River at Berkshire Valley. Fecal coliform data from USGS station # 01379853 during the period 4/15/98 through 9/22/98. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



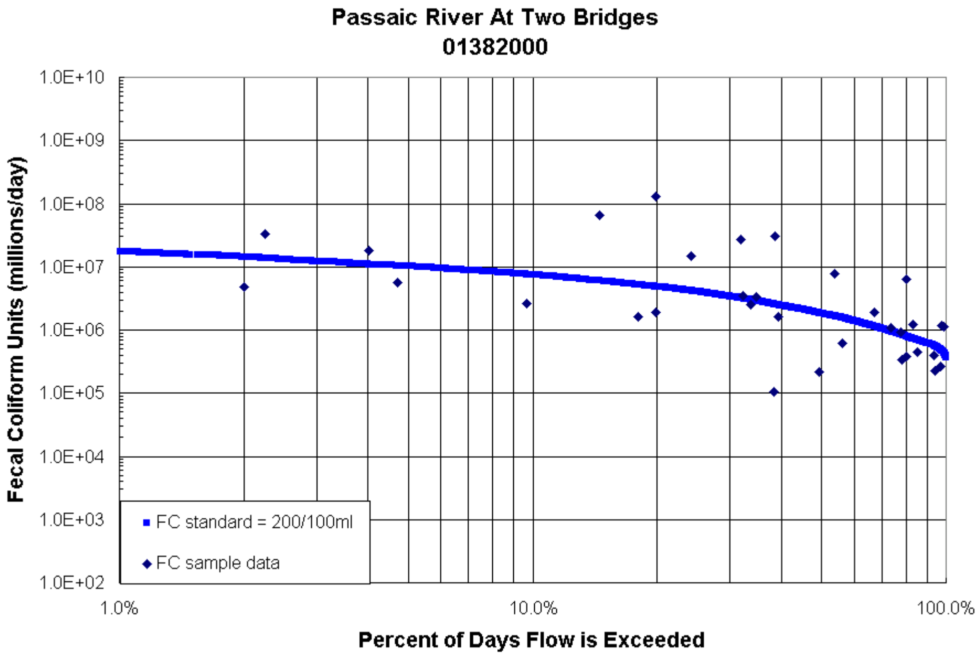
Load Duration Curve for the Beaver Brook At Rockaway. Fecal coliform data from USGS station # 01380100 during the period 11/13/97 through 8/7/2000. Water years 1970-2000 from USGS station # 01381500 (Whippany River at Morristown, NJ) were used in generating the FC standard curve.



Load Duration Curve for Stony Brook At Boonton. Fecal coliform data from USGS station # 01380320 during the period 12/13/99 through 9/7/00. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



Load Duration Curve for the Rockaway R at Pine Brook. Fecal coliform data from USGS station # 01381200 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01381000 (Rockaway River below Reservoir at Boonton, NJ) were used in generating the FC standard curve.



Load Duration Curve for the Passaic River at Two Bridges. Fecal coliform data from USGS station # 01382000 during the period 1/27/94 through 810/2000. Water years 1970-2000 from USGS station # 01381900 (Passaic R at Pine Brook, NJ) were used in generating the FC standard curve.

Appendix C

Amendment to the

Northeast, Upper Raritan, Sussex County and

Upper Delaware Water Quality Management Plans

Total Maximum Daily Load Report

For the

Non-Tidal Passaic River Basin

Addressing Phosphorus Impairments

Amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans

Total Maximum Daily Load Report For the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments

Watershed Management Areas 3, 4 and 6

Proposed: May 7, 2007
Adopted: April 24, 2008

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

Table of Contents

Tables

Figures

1.0 Executive Summary

This Total Maximum Daily Load (TMDL) document addresses phosphorus impairments in the non-tidal Passaic River basin, i.e., the river and its tributaries upstream of Dundee Dam, including the Wanaque Reservoir. On July 5, 2005 the Department proposed two TMDL amendments to address phosphorus in the Passaic River basin. One document addressed the Wanaque Reservoir and the Passaic River and tributaries upstream of the confluence of the Pompton and Passaic Rivers. Because of the diversion of water from the Passaic and Pompton Rivers to the Wanaque Reservoir, the Wanaque Reservoir TMDL proposed phosphorus load and wasteload allocations in the Passaic River basin upstream of the confluence of Passaic and Pompton Rivers. The other July 5, 2005 proposal addressed Pompton Lake and its drainage area and provided inputs to the Wanaque Reservoir TMDL. At that time, the Department believed that proceeding with these TMDLs would expedite attainment of water quality improvement in the Passaic River basin, in which phosphorus reductions had been stayed as a result of a settlement agreement between the Department and various wastewater treatment facilities in the basin. The Department received comments on these proposals, primarily with regard to the water quality endpoint in the Wanaque Reservoir, the mass balance model used to estimate phosphorus loadings to the reservoir, the cost to achieve the wasteload allocations assigned to wastewater treatment facilities, and the feasibility of achieving the nonpoint source load reductions specified in the TMDLs. As noted in the July 5, 2005 proposal of the Wanaque Reservoir TMDL, the Department was concurrently engaged in a basin-wide study that included extensive water quality monitoring and development of dynamic flow and water quality models. The intent of the basin-wide study was to identify in-stream critical locations, in addition to the Wanaque Reservoir, that would need phosphorus load reductions in order to attain Surface Water Quality Standards. It was recognized that an outcome of the basin-wide study could be a refinement of the load and wasteload allocations identified in the July 5, 2005 proposals. In light of delays in establishing the July 5, 2005 proposals, completion of the basin-wide study and in consideration of the comments received, the Department has determined that integration of the basin-wide study with relevant findings of the July 5, 2005 proposals is the most efficient means to achieve water quality objectives in the Passaic River basin. Therefore, the July 5, 2005 proposals will not be established. This comprehensive TMDL document, in combination with the companion TMDL document addressing Pompton Lake and its drainage area, addresses the non-tidal Passaic River basin impairments identified in Tables 1 and 2.

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (Department) is required to assess the overall water quality of the State's waters and identify those waterbodies with a water quality impairment for which TMDLs may be necessary. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. The Department fulfills its assessment obligation under the CWA through the Integrated Water Quality Monitoring and Assessment Report, which includes the Integrated List of Waterbodies (303(d) list) and is issued biennially. The *2004 Integrated List of Waterbodies* was adopted by the Department on October 4, 2004 (36 NJR 4543(a)) as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a).

The *2004 Integrated List of Waterbodies* was initially relied upon to determine the scope of the study. This list identified 17 impaired segments in the non-tidal Passaic River basin as impaired for phosphorus based on in-stream concentrations of total phosphorus in excess of 0.1 mg/l. In addition, 9 stream segments were placed on Sublist 3 because additional information was needed in order to fully assess the status of the waterbodies. The Wanaque Reservoir, although not listed as impaired on the *2004 Integrated List*, had been identified as a critical location that needed to be considered in the development of TMDLs for the impaired stream segments that are a source of phosphorus load to the reservoir. In addition, water quality data evaluated for the TMDL indicate exceedances of the numeric water quality criterion for phosphorus. Subsequently, the Department proposed the *2006 Integrated List of Waterbodies*, which identifies impairments based on HUC 14 Assessment Units rather than stream segments associated with discrete monitoring locations. This change in assessment methodology allows establishment of a stable base of assessment units for which the attainment or non-attainment status of all designated uses within each subwatershed or assessment unit will be identified. The *2006 Integrated List of Waterbodies* is now approved. Tables 1 and 2 and Figure 1 below show the relevant listings and their priority ranking as they appear on the 2004 and the 2006 *Integrated Lists*. Table 2 also includes the intended action for each assessment unit as a result of the TMDL studies.

Table 1. Stream segments identified on Sublists 3 and 5 of the *2004 Integrated List* assessed for phosphorus impairment.

WMA	Site Id #	Station Name/Waterbody	2004 list TP status	Priority Ranking*
03	01388910	Pompton River at Rt 202 in Wayne	Sublist 5	Medium
03	01388100	Ramapo River at Dawes Highway	Sublist 5	Medium
03	01387500	Ramapo River near Mahwah	Sublist 5	Medium
03	01387014	Wanaque River at Pompton Lakes	Sublist 5	Medium
03	01387000	Wanaque River at Wanaque	Sublist 5	Medium
03	01382800	Pequannock River at Riverdale	Sublist 3	NA
03	01388720	Pompton River Trib at Ryerson Rd	Sublist 3	NA
04	01389880	Passaic River at Elmwood Park (combined with Passaic River at Merlot Ave in Fairlawn – 01389870)	Sublist 5	High
04	01389500	Passaic River at Little Falls (combined with Passaic River at Singac - 01389130)	Sublist 5	High
04	01389005	Passaic River Below Pompton River at Two Bridges	Sublist 5	High
04	01389138	Deepavaal Brook at Fairfield	Sublist 3	NA
04	01389860	Diamond Brook at Fair Lawn	Sublist 3	NA
04	01389600	Peckman River at West Paterson	Sublist 3	NA
04	01389080	Preakness Brook near Little Falls	Sublist 3	NA
06	01378855	Black Brook at Madison	Sublist 5	High
06	01379200	Dead River near Millington	Sublist 5	High
06	EWQ0231	Passaic River at Eagle Rock Ave in East Hanover	Sublist 5	High
06	01382000	Passaic River at Two Bridges	Sublist 5	High
06	01379500	Passaic River near Chatham	Sublist 5	High
06	01379000	Passaic River near Millington	Sublist 5	High
06	01381200	Rockaway River at Pine Brook	Sublist 5	High
06	01381500	Whippany River at Morristown	Sublist 5	High
06	01381800	Whippany River near Pine Brook	Sublist 5	Medium
06	01379530	Canoe Brook near Summit	Sublist 3	NA
06	01379800	Green Pond Brook at Dover	Sublist 3	NA
06	01379853	Rockaway River at Blackwell St	Sublist 3	NA

* Priority Ranking is only assigned to waterbodies that are on Sublist 5

Table 2. Assessment Units Analyzed from the *2006 Integrated List*

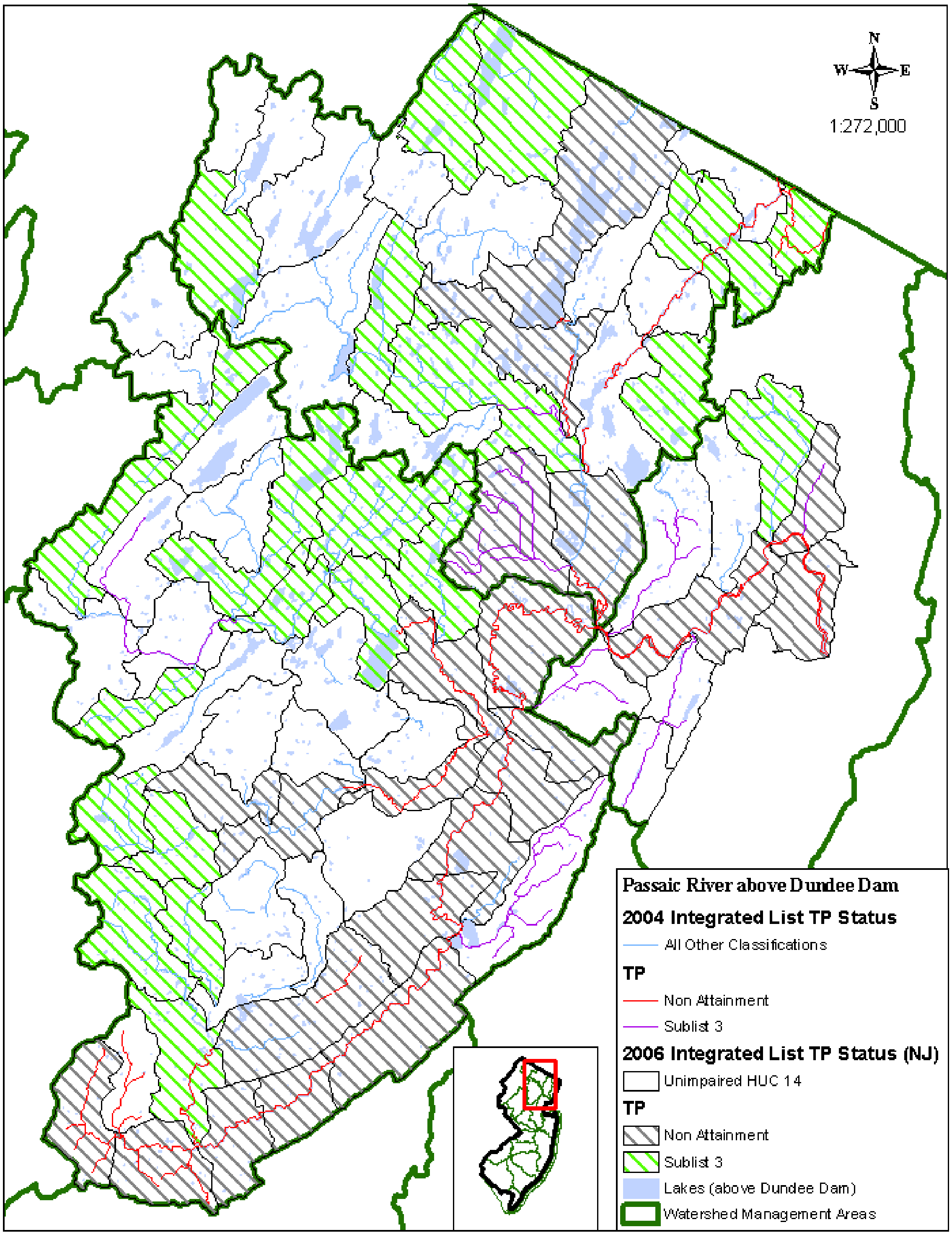
WMA	Assessment Unit ID	Assessment Unit Name	Status of TP Assessment	Priority Ranking	Proposed Action*
03	Wanaque Reservoir-03	Wanaque Reservoir-03	Sublist 3	NA	Propose TMDL
03	02030103070020	Belcher Creek (Pinecliff Lake & below)	Sublist 3	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070010	Belcher Creek (above Pinecliff Lake)	None	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070030	Wanaque R/Greenwood Lk (abv Monks gage)	Sublist 3	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070070	Wanaque R/Posts Bk (below reservoir)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103110010	Lincoln Park tribs (Pompton River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103110020	Pompton River	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103050080	Pequannock R (below Macopin gage)	Sublist 3		WLAs and LAs assigned per Passaic TMDL
03	02030103070060	Meadow Brook/High Mountain Brook	None		WLAs and LAs assigned per Passaic TMDL
03	02030103070050	Wanaque Reservoir (below Monks gage)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103100010	Ramapo R (above 74d 11m 00s)	Sublist 5	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100040	Ramapo R (Bear Swamp Bk thru Fyke Bk)	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100030	Ramapo R (above Fyke Bk to 74d 11m 00s)	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100020	Masonicus Brook	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100050	Ramapo R (Crystal Lk br to Bear Swamp Bk)	Sublist 4A*	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100070	Ramapo R (below Crystal Lake bridge)	Sublist 5	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100060	Crystal Lake/Pond Brook	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103070040	West Brook/Burnt Meadow Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050030	Pequannock R (above Oak Ridge Reservoir outlet)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050060	Pequannock R (Macopin gage to Charlotteburg)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050010	Pequannock R (above Stockholm/Vernon Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050020	Pacock Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050040	Clinton Reservoir/Mossmans Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050050	Pequannock R (Charlotteburg to Oak Ridge)	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050070	Stone House Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	Dundee Lake-04	Dundee Lake-04	Sublist 3	NA	Propose TMDL
04	02030103120070	Passaic R Lwr (Fair Lawn Ave to Goffle)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120100	Passaic R Lwr (Goffle Bk to Pompton River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120080	Passaic R Lwr (Dundee Dam to F.L. Ave)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120050	Goffle Brook	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL

04	02030103120040	Molly Ann Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120030	Preakness Brook / Naachtpunkt Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120060	Deepavaal Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120020	Peckman River (below CG Res trib)	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120010	Peckman River (above CG Res trib)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103040010	Passaic R Upr (Pompton R to Pine Bk)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020100	Whippany R (Rockaway R to Malapardis Bk)	Impaired	High	WLAs and LAs assigned per Passaic TMDL; DO eliminated as basis of impairment
06	02030103010180	Passaic R Upr (Pine Bk br to Rockaway)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020050	Whippany R (Malapardis to Lk Pocahontas)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010160	Passaic R Upr (Hanover RR to Columbia Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010150	Passaic R Upr (Columbia Rd to 40d 45m)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010060	Black Brook (Great Swamp NWR)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010130	Passaic R Upr (40d 45m to Snyder Ave)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010080	Dead River (above Harrisons Brook)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010120	Passaic R Upr (Snyder to Plainfield Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010110	Passaic R Upr (Plainfield Rd to Dead River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010100	Dead River (below Harrisons Brook)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103030160	Montville tribs.	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010010	Passaic R Upr (above Osborn Mills)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010020	Primrose Brook	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010070	Passaic R Upr (Dead R to Osborn Mills)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020080	Troy Brook (above Reynolds Ave)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020030	Greystone / Watnong Mtn tribs	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020090	Troy Brook (below Reynolds Ave)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020060	Malapardis Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010140	Canoe Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020070	Black Brook (Hanover)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010030	Great Brook (above Green Village Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010040	Loantaka Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010050	Great Brook (below Green Village Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010090	Harrisons Brook	None	NA	WLAs and LAs assigned per Passaic TMDL

06	02030103030030	Rockaway R (above Longwood Lake outlet)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030110	Beaver Brook (Morris County)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030120	Den Brook	None		WLAs and LAs assigned per Passaic TMDL
06	02030103030130	Stony Brook (Boonton)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030080	Mill Brook (Morris Co)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020010	Whippany R (above road at 74d 33m)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020020	Whippany R (Wash. Valley Rd to 74d 33m)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030010	Russia Brook (above Milton)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030020	Russia Brook (below Milton)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030050	Green Pond Brook (above Burnt Meadow Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030100	Hibernia Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030060	Green Pond Brook (below Burnt Meadow Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	None	NA	WLAs and LAs assigned per Passaic TMDL

*The Non-Tidal Passaic River Basin TMDL report is based on a watershed approach to address phosphorus impairments in 2 critical locations and 22 segments listed for phosphorus on the 303(d) list. This watershed TMDL includes reductions in phosphorus throughout the watershed including sources within the 22 303(d)-listed segments. The 2 critical locations were not listed on the 303(d) list but were found to be impaired through this TMDL study. The numeric in-stream criteria for total phosphorus is 0.1 mg/l unless it can be demonstrated that phosphorus is not a limiting nutrient and will not otherwise render a water unsuitable for its designated use. The 22 segments on the 303(d) list were listed due to an exceedance of the 0.1 mg/l total phosphorus criteria. Through this TMDL study and based on careful evaluation of monitoring and modeling data, it was determined that phosphorus is not a limiting nutrient in most locations and does not render these 22 303(d)-listed waters unsuitable for their designated uses. The reductions required in these waters to achieve the watershed criteria at the critical locations will further ensure that the phosphorus standards in these listed waters will continue to be met.

Figure 1. Passaic River above Dundee Dam with the *2004 and 2006 Integrated Lists* Phosphorus Assessments



The non-tidal Passaic River Basin TMDLs are based on an integration of water quality and hydrodynamic models. A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River and its major tributaries: Dead River, Whippany River, Rockaway River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, a small stream segment of the Pequannock River, Singac Brook, and Peckman River. The WASP 7 model is a dynamic compartment model that can be used to predict a variety of water quality responses due to natural phenomena and man-made pollution for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters (Omni Environmental, 2007). DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this TMDL study (Spitz, 2007). A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW (Omni Environmental, 2007). Outside of the domain of the WASP 7/DAFLOW model, a mass balance model (Najarian, 2005) was used to simulate daily loads of total phosphorus and orthophosphorus. A reservoir model, Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS), was used to model the water quality of the Wanaque Reservoir based on loading inputs from the other models and in consideration of diversions into the Wanaque Reservoir. The LA-WATERS model and subsequent analyses link phosphorus loading with chlorophyll-a response in the Wanaque Reservoir and includes a hydrothermal component and water quality modules, which were successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and subsequently re-validated (Najarian Associates, 2000).

For assessment purposes, a waterbody is deemed impaired with respect to phosphorus when phosphorus levels exceed the numeric criteria in the Surface Water Quality Standards (SWQS). Under this approach, the narrative exception to applicability of the numeric criterion in streams and other narrative criteria are not assessed prior to listing. The SWQS allow for development of watershed or site specific criteria, where appropriate, that protect designated uses. Through this TMDL study, it was determined that the in-stream numeric criterion does not apply within the WASP 7/DAFLOW modeled domain because monitoring and simulation demonstrate that phosphorus is not rendering the waters unsuitable for the designated uses. For these assessment units, phosphorus will be removed as a basis of impairment in the next Integrated List. Critical locations where phosphorus is causing excessive primary productivity were identified to be the Wanaque Reservoir and Dundee Lake. As part of this TMDL proposal, the Department proposed, and has now adopted, watershed criteria in accordance with N.J.A.C. 7:9B-1.5(g)3 in these locations, as the best means to ensure protection of the designated uses. The watershed criteria are expressed in terms of a seasonal average concentration (June 15-September 1) of the response indicator, chlorophyll-*a*. The criteria are tailored to the unique characteristics of each critical location and are expressed as a seasonal average of 10 μg/L chlorophyll-*a* in the Wanaque Reservoir and a seasonal average of 20 μg/L chlorophyll-*a* in Dundee Lake. As the result of this TMDL study, phosphorus will not be considered as a basis for non-attainment in these waterbodies in the next Integrated List. One location, Whippany River (Rockaway River to Malapardis Brook), is listed as impaired for dissolved oxygen. Through this TMDL study it has been determined that the low dissolved oxygen levels observed are due to natural conditions. Therefore, in this location dissolved oxygen will be removed as a basis of impairment in the next Integrated List.

The wasteload allocations for wastewater treatment facilities needed to meet the watershed criteria at Wanaque Reservoir and Dundee Lake are based on a long term average year-round effluent concentration of 0.4 mg/l of total phosphorus for most wastewater discharges (see Table 14 and discussion for exceptions). The Department intends to establish monthly average, concentration-only effluent limits that will apply year round for the identified wastewater dischargers located above the confluence of the Pompton and Passaic Rivers using the methodology in the USEPA's *Technical Support Document for Water Quality-Based Toxics Control* (USEPA, 1991), assuming a 4 times per month sampling frequency and a coefficient of variation of 0.6. With these inputs, this methodology produces a monthly average effluent limit of 0.76 mg/l. Dischargers below the confluence of the Pompton and Passaic Rivers will also receive this numeric limit, which needs to be applied only from May through October to meet the watershed criteria. Dischargers in the Greenwood Lake drainage area will retain the WLAs and associated effluent limits established in the Greenwood Lake TMDL (NJDEP 2004). Five dischargers that contribute loads outside the boundaries of the model domain are assigned a wasteload allocation consistent with the allowable load in the current permits in order to maintain boundary conditions. Nonpoint and stormwater point source load reductions are also required in order to achieve the water quality targets in the study area. The percent reduction for these sources ranges from 0 to 85 percent and will be achieved through measures identified in the implementation section. Subject to the constraints of achieving the specified load reductions, attaining the watershed criteria in the Wanaque Reservoir and Dundee Lake, and accomplishing needed upgrades within the compliance schedule established in the discharge permits, modification of wasteload allocations and load allocations may be accomplished through water quality trading. EPA awarded a Targeted Watershed Grant to Rutgers University to facilitate water quality trading in the Passaic River basin. This study is expected to identify appropriate trading ratios and other trading rules that will ensure the TMDL objectives are attained within the Passaic River basin.

This TMDL Report is consistent with US EPA's May 20, 2002 guidance document entitled, *Guidelines for Reviewing TMDLs under Existing Regulations Issued in 1992* (Sutfin, 2002), which describes the statutory and regulatory requirements for approvable TMDLs. This TMDL Report was proposed as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans (WQMP). Following the proposal, public comments were summarized and responses prepared, including minor revisions to the document as noted in the Response to Comment, included as Appendix F. This TMDL Report is adopted as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans (WQMP) in accordance with N.J.A.C.

7:15-3.4 (g). This action effectuates the establishment of the watershed criteria, which were proposed along with the TMDL, as the applicable Surface Water Quality Standards for Wanaque Reservoir and Dundee Lake, as provided for at N.J.A.C. 7:9B-1.5(g)3.

2.0 Introduction

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is 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. The Integrated Water Quality Monitoring and Assessment Report combines these two assessments and assigns waterbodies to one of five sublists on the Integrated List of Waterbodies. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), or are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required. For the non-tidal portion of the Passaic River basin, the *2004 Integrated List of Waterbodies* identified 17 impaired segments and 9 segments that had limited assessment or data availability.

The *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report*, which was approved during the pendency of this TMDL proposal, identifies impairments based on designated use attainment and then lists the parameters responsible for the non-attainment of the designated use. The assessments are conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. The *2006 Integrated Water Quality Monitoring and Assessment Report* assessment units addressed in this TMDL report are identified in Table 2, along with the assessment status with respect to the parameter total phosphorus. The complete assessment status of the assessment units in Table 2 is identified in Appendix C.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background, and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point and nonpoint sources in the form of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, a margin of safety (MOS) and, as an option, a reserve capacity (RC).

EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that the TMDLs in this report address the following items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.
4. Load allocations.
5. Wasteload allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.

3.0 Pollutants of Concern and Area of Interest

Pollutants of Concern

The primary pollutant of concern for this TMDL study is phosphorus. When present in excessive amounts, phosphorus can lead to excessive primary productivity, in the form of algal and/or macrophyte growth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. There are also implications from excessive algae with respect to drinking water use. Algal blooms in raw drinking water sources can cause taste and odor problems and treatment inefficiencies, having a negative impact on conventional treatment at a drinking water system. When algae are present in large amounts purveyors must increase the use of disinfectants and oxidants to treat the algae resulting in an increase in disinfection byproducts such as trihalomethanes, some of which are listed by EPA as likely carcinogens. In addition, the respiration cycle of excessive plant material can cause significant swings in pH and dissolved oxygen, which can result in violation of criteria for these parameters, which can adversely affect the aquatic community. Low dissolved oxygen can result from factors besides the respiration side of the diurnal swing associated with excessive primary productivity, which must be considered when assessing the role of phosphorus in causing observed water quality. For example, biochemical oxygen demand and nitrification of ammonia from wastewater treatment discharges consume dissolved oxygen. Besides anthropogenic sources, the natural process of breaking down normal amounts of plant and animal materials that have settled to the stream bed also consumes oxygen and is known as sediment oxygen demand (SOD). In addition, dissolved oxygen can be naturally low in some areas, such as headwaters, where surface water is derived close to ground water sources, which are low in dissolved oxygen, and have not had time to oxygenate from exposure to the atmosphere. In some parts of the study area, monitoring data and/or model simulations indicate that the dissolved oxygen criteria may not be met during critical conditions. Most of these segments are not identified as non-attaining with respect to dissolved oxygen in the 2004 and 2006 *Integrated Lists* because the non-attainment conditions, including flow and time of day, were extreme and not captured during routine monitoring. However, the non-attainment of dissolved oxygen criteria was determined to be a result of natural conditions, as discussed further below. Therefore, these areas should not be assessed as impaired in the next listing cycle.

The Department has surface water quality standards for phosphorus. As stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters:

> <u>Phosphorus, Total (mg/l):</u>
>
> i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.
>
> ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Regarding watershed and site specific criteria, N.J.A.C. 7:9B-1.5(g)3 states:

> The Department may establish watershed or site-specific water quality criteria for nutrients in lakes, ponds, reservoirs or streams, in addition to or in place of the criteria in N.J.A.C. 7:9B-1.14, when necessary to protect existing or designated uses. Such criteria shall become part of these Water Quality Standards.

Elaborating on "…render waters unsuitable…" N.J.A.C. 7:9B-1.5(g)2 states:

> Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

The waterbodies listed in Tables 1 and 2 have a FW2 classification. Some also carry a C1 classification, as depicted in Figure 5. The designated uses, both existing and potential, that have been established by the Department for waters of the State classified as such are as stated below:

In all FW2 waters, the designated uses are (N.J.A.C. 7:9B-1.12):

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;

3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

Numerous waterbodies within the Passaic River basin were placed on Sublist 5 in both the 2004 and 2006 *Integrated Lists* (see Tables 1 and 2), based on data showing phosphorus in excess of the numeric in-stream criterion of 0.1 mg/l. However, data are not generally available to assess waterbodies relative to the narrative nutrient criteria and support of the designated uses. Therefore, the numeric criterion is often the sole basis for listing of a waterbody with respect to phosphorus. One of the objectives of the monitoring program conducted for this TMDL report was to determine if phosphorus was causing excessive productivity and the associated water quality effects.

Appendix E of the *TMDL for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River Watershed* (NJDEP 1999) set forth the salient points supporting the conclusion that the numeric in-stream criterion of 0.1 mg/l did not apply in the Whippany River Watershed because phosphorus was not causing excessive primary productivity and its associated effects. Within the domain of Approach Areas 1 and 3, which are described below, the Department monitored relevant parameters under a range of flow conditions at representative locations. The details of the monitoring program and data generated are provided in the support materials for this TMDL document (TRC Omni, 2004). Diurnal dissolved oxygen and chlorophyll-*a* are the two parameters that are most illustrative of the effects of phosphorus in the waterbodies. As noted above, excessive productivity will be indicated by high concentrations of chlorophyll-*a* and diurnal dissolved oxygen patterns that exhibit a large swing and may also entail dissolved oxygen concentration at the bottom of the swing that is below the SWQS. Based on careful evaluation of the data, the Department determined that phosphorus is not responsible for causing excessive primary productivity within streams in the specified domain, except in a small portion at the terminis of the Peckman River. Therefore, except in that location, the 0.1 mg/l numeric criterion is not applicable for in-stream locations within the model domain, Approach Areas 1 and 3. Phosphorus is causing excessive primary productivity in two locations that are actually or nominally lakes: the Wanaque Reservoir and the impounded portion of the lower Passaic above Dundee Dam, also referred to as Dundee Lake. Refer to Appendix J of Omni 2007 for supporting information.

More specifically, the data show that the Upper Passaic River basin is significantly influenced by the conditions of the source waters emanating from the Great Swamp, which do not allow much light penetration due to dark color, which in turn inhibits algal growth. In addition, dissolved oxygen starts out low and remains so, with little diurnal swing. Low dissolved oxygen concentrations in the Upper and Middle Passaic River are due to two factors, the conditions of the source waters coming from Great Swamp and the natural levels of SOD. Observed SOD values in these reaches are among the highest values in the basin, as measured in 2004. The high rate of SOD materials in these reaches results from the Great Swamp and other wetlands complexes contributing abundant detritus, as well as the overall low stream velocity, which promotes settling. For example, the Whippany River (Rockaway River to Malapardis Brook; 02030103020100-01) is currently listed as non-attaining for dissolved oxygen. This location fails to meet current water quality criteria for dissolved oxygen. However, this has been determined to be because of natural conditions—dissolved oxygen starts out low, and there is significant natural SOD. Simulation of extreme reduction of phosphorus showed no improvement relative to not violating the minimum daily dissolved oxygen criterion. Therefore, at this location oxygen will be removed as a basis for impairment in the next listing cycle. The middle portion of the Passaic River is transitional with respect to productivity. Here, productivity is increasing, but not yet excessive. In a small portion of this reach, the diurnal dissolved oxygen swings in the critical 2002 summer were approaching 6 mg/l. Simulation of extreme reductions in phosphorus resulted in a slight decrease in the amplitude of the diurnal swing but did not improve the degree of violation of the minimum daily dissolved oxygen criterion (see station Passaic River at Stanley Ave, Chatham, near PA4 Chatham, (Omni Environmental, 2007). It was concluded that the observed and simulated low levels of oxygen were due to natural conditions and these areas should not be assessed as impaired with respect to oxygen in the next Integrated List. As water quality improvements may result in improved clarity and light penetration, the water quality at Chatham will be revisited following implementation of the TMDL.

At the confluence of the Pompton and Passaic Rivers, the Wanaque South intake diverts water into the Wanaque Reservoir. Water diverted at this location can, depending on pumping relative to stream flows, include both the Pompton and Passaic Rivers. As a result, phosphorus loads from both waterbodies can be directed to the reservoir, where they accumulate and cycle within the impoundment creating the opportunity for excessive primary productivity over the growing season. High levels of chlorophyll-*a* have been observed in the Wanaque Reservoir, although measured levels are lower than they would be naturally due to physical and chemical control measures exercised by NJDWSC. The Lower Passaic is notably influenced by phosphorus, with indicators of primary productivity pronounced above Dundee Dam. The waters impounded behind Dundee Dam are also known as Dundee Lake. Here, diurnal dissolved oxygen swings are extreme, with minimum daily averages for dissolved oxygen violated during the critical period, and chlorophyll-*a* levels are excessive.

Having identified that the Wanaque Reservoir and Dundee Lake were the locations where phosphorus is responsible for excessive productivity as indicated by excessive levels of chlorophyll-*a* and/or excessive diurnal dissolved oxygen swings, the Department exercised the models to determine the phosphorus reductions needed to achieve water quality conditions that would support the designated uses.

Modeling of the non-tidal Passaic River basin illustrates that achieving the numeric phosphorus criteria as "not to exceed" values in the critical locations, Wanaque Reservoir and Dundee Lake, is not necessary to achieve acceptable levels of the response indicators dissolved oxygen and chlorophyll-*a*. Selected illustrative graphs are found in Appendix E with more detailed information provided in the TMDL support documents, Omni, 2007, Najarian, 2005 and Najarian, 2007.

In its "*Protocols for Developing Nutrient TMDLs*" First Edition November 1999, and in *"Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs"*, First Edition April 2000, EPA lists chlorophyll-*a* as a suitable indicator for nutrient TMDLs. In the Guidance document EPA developed nutrient water quality criteria guidance for lakes and reservoirs for fourteen major Ecoregions of the United States. The guidance recommends several candidate nutrient criteria for the protection of designated uses; chlorophyll-*a*, total phosphorus, total nitrogen, and Secchi depth. In addition to the referenced EPA guidance for nutrient criteria, several states (Missouri, North Carolina, Pennsylvania, Oregon, Alabama, and Kansas) have selected chlorophyll-*a* as the common translator to address narrative criteria. Values selected in these states for various designated use range from 10 μg/L to 40 μg/L and reflect the best professional judgment of levels needed to support the designated uses in the particular setting.

The Department concurs with the finding that response indicators are a suitable target for protecting waterbodies from the effects of excessive nutrients. The Department has also concluded that the numeric criteria for phosphorus in these impounded areas are not the best indicators for determining when these waters are rendered unsuitable for the designated uses. In these locations, the response indicators chlorophyll-*a* (both locations) and dissolved oxygen, particular the degree of diurnal swing (Dundee Lake), provide a better measure of meeting water quality objectives and supporting designated uses than the default numeric criteria. In consideration of EPA guidance, the experience of other states and the model results, chlorophyll-*a* was selected as the basis for measuring attainment of water quality objectives in the critical locations.

The Department considered the physical characteristics of each critical location, existing and designated uses of the waterbodies, EPA guidance, literature values and the experiences of other states in selecting the target value for each waterbody. Through the comprehensive water quality modeling developed in this TMDL study, a direct and quantitative linkage has been established between chlorophyll-*a* and total phosphorus concentrations. This allows identification of the phosphorus reductions needed to achieve the target chlorophyll-*a* concentrations.

The Wanaque Reservoir is large and deep and is used primarily as an important water supply reservoir, providing drinking water to over 3 million people. During critical periods, such as in 2002, more than the equivalent volume of the Reservoir is pumped in and then drawn for water supply. The reservoir also serves recreational purposes, supporting trout throughout the fishing season. The Department determined that the Wanaque Reservoir warrants a conservative chlorophyll-*a* target of 10 μg/L, in consideration of its great capacity to store and cycle phosphorus, its importance as a drinking water supply reservoir as well as its value as a cold-water fishery, all of which warrant a lower allowable level of productivity.

The Dundee Dam serves to slightly widen the river for a distance of approximately one mile upstream of the dam. While nominally a lake, the average residence time in the impounded reach is simulated to be only about 1.4 days. Because of its riverine characteristics, absent a watershed criterion, the default in-stream numeric criterion for phosphorus would be more applicable here than the lake criterion. Dundee Lake is characterized as a warm water, riverine environment, which warrants a higher level of productivity. The water impounded behind Dundee Dam is relatively shallow and has a very short retention time. It is not currently used as a drinking water supply, but is permitted for use as a source of industrial water. Because of these characteristics, the Department has determined that a chlorophyll-*a* target of 20 μg/L is appropriate.

Various seasonal periods were assessed. For both locations, a seasonal average period defined as from June 15 to September 1 was found to provide a conservative outcome in terms of required phosphorus load reductions. This period was selected in order to provide an extra measure of protection for the designated uses.

Because the Department does not have surface water standards for chlorophyll-*a*, pursuant to N.J.A.C. 7:9B-1.5(g)3, the Department has established watershed criteria in terms of chlorophyll-*a* for these two critical locations in the Passaic River basin as part of this TMDL. The criteria are 10 μg/L as a seasonal average (June 15-September 1) in the Wanaque Reservoir and 20 μg/L as a seasonal average in Dundee Lake. With adoption of this TMDL report, these watershed criteria are the SWQS for these waterbodies, subject to approval by EPA. The full technical basis for the selection of these criteria is provided in Appendix E.

Area of Interest

The spatial focus of this TMDL study is the non-tidal Passaic River basin. This spatial extent includes the stream segments and HUC 14 subwatersheds identified in Tables 1 and 2 and depicted in Figure 1. Some of the HUC 14 subwatersheds have been specifically assessed as impaired with respect to phosphorus. In addition, through this TMDL study, the impounded area behind Dundee Dam, also known as Dundee Lake, and the Wanaque Reservoir have been identified as impaired with respect to phosphorus and will be addressed as well. Unimpaired subwatersheds are included in the study because loadings are taken as inputs to the model domain and WLAs and LAs are established as a result of this study. Multiple approaches to calculating loads are used in this study and the spatial extent of each approach is depicted in Figure 2. Pompton Lake and its drainage area are depicted as within the spatial extent because loadings from this area are inputs to the non-tidal Passaic River basin analysis. However, the Pompton Lake and the associated drainage area are addressed in a companion TMDL report. Greenwood Lake and its associated drainage area are also depicted because loadings are taken as a boundary condition input to this study. However, Greenwood Lake and associated drainage were addressed in a previously established TMDL (NJDEP 2004) that was approved by EPA on September 29, 2004. The Greenwood Lake drainage area, the Pompton Lake drainage area, as well as the remaining direct drainage to the Wanaque Reservoir, are covered under the spatial extents identified as Greenwood Lake TMDL spatial extent and Approach 2. Except for the direct drainage to the Wanaque

Reservoir (Greenwood Lake and Approach 2) and the headwaters taken as boundary conditions (Approach 4), the portion of the study area upstream of the confluence of the Pompton and Passaic Rivers is addressed through Approach 1, which is the integration of the WASP 7/DAFLOW model and the LA-WATERS to establish the load reductions to meet the water quality objective in the Wanaque Reservoir. The portion of the spatial extent below the confluence is addressed through Approach 3, which uses the WASP 7/DAFLOW model to establish the load reductions needed to meet the water quality objective in Dundee Lake. The headwater areas outside the explicit model domain of the WASP 7/DAFLOW model are depicted as Approach 4 and are affected by the TMDL study because loads are contributed at the model boundaries and must be maintained at current or lower levels to ensure the TMDL is achieved.

Table 3. Sublist 5 and Sublist 3 stream segments in spatial extent of non-tidal Passaic River basin TMDL study

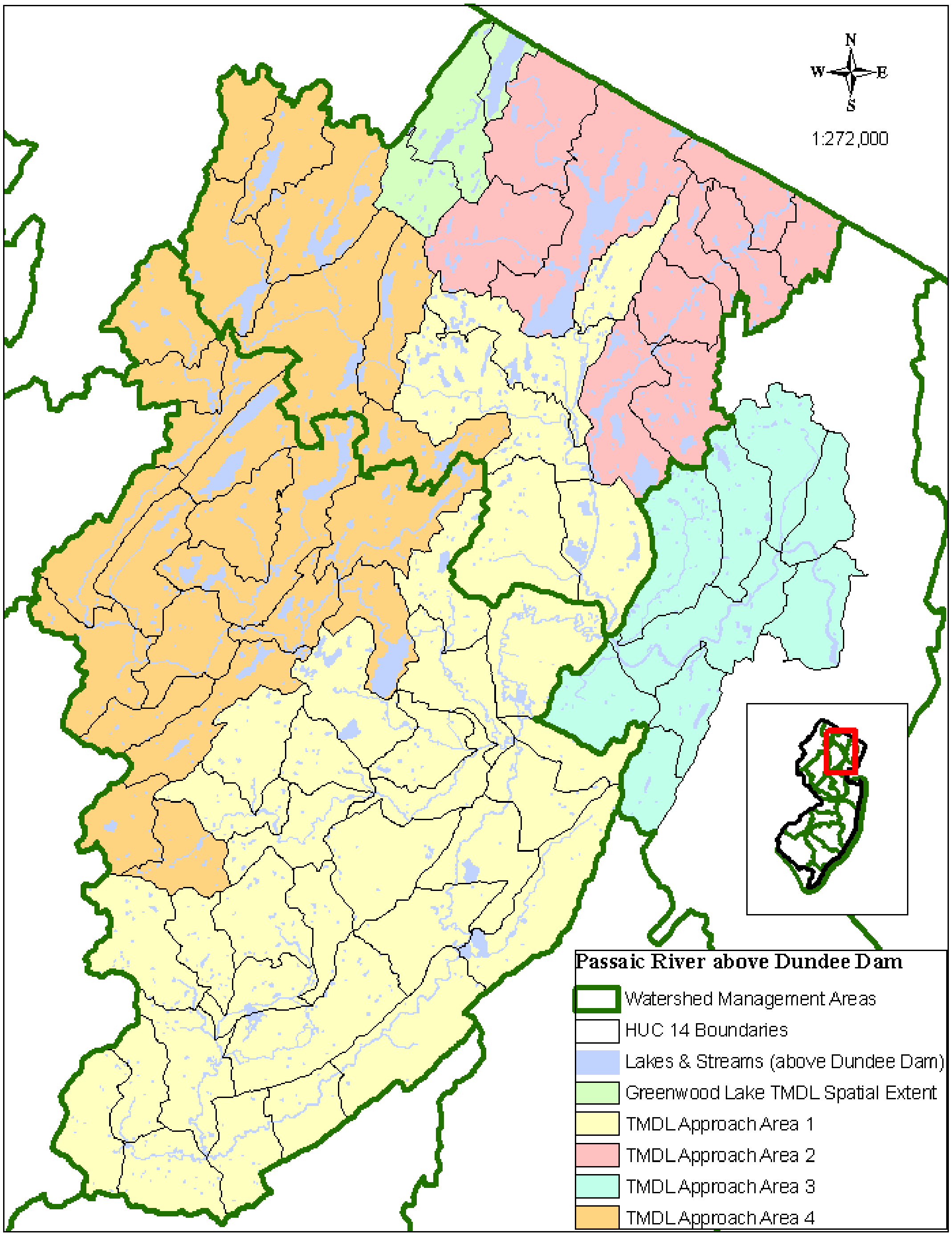
Site ID	Site Location and Waterbody/ General Description	Approx. River Miles
01388910	Pompton River at Rt 202 in Wayne	4.67
01388100	Ramapo River at Dawes Highway	1.88
01387500	Ramapo River near Mahwah	17.73
01387014	Wanaque River at Pompton Lakes	3.32
01387000	Wanaque River at Wanaque	0.55
01389880	Passaic River at Elmwood Park (combined with Passaic River at Merlot Ave in Fairlawn - 01389870)	13.73
01389500	Passaic River at Little Falls (combined with Passaic River at Singac - 01389130)	15.0
01389005	Passaic River Below Pompton River at Two Bridges	1.83
01378855	Black Brook at Madison	2.35
01379200	Dead River near Millington	21.86
EWQ0231	Passaic River at Eagle Rock Ave in East Hanover	10.33
01382000	Passaic River at Two Bridges	14.14
01379500	Passaic River near Chatham	14.90
01379000	Passaic River near Millington	5.17
01381200	Rockaway River at Pine Brook	6.77
01381500	Whippany River at Morristown	0.74
01381800	Whippany River near Pine Brook	6.61
01382800	Pequannock River at Riverdale	3.39
01388720	Pompton River Trib at Ryerson Rd	17.93
01389138	Deepavaal Brook at Fairfield	6.25
01389860	Diamond Brook at Fair Lawn	2.60
01389600	Peckman River at West Paterson	7.66
01389080	Preakness Brook near Little Falls	8.87
01379530	Canoe Brook near Summit	17.60
01379800	Green Pond Brook at Dover	4.48
01379853	Rockaway River at Blackwell St	6.08

Table 4. HUC 14 Assessment Units from *2006 Integrated List* addressed in this and related TMDL studies

WMA	HUC14	Subwatershed Name	Acres	TMDL Approach
03	Wanaque Reservoir-03	Wanaque Reservoir-03	NA	Area 2
03	02030103070020	Belcher Creek (Pinecliff Lake & below)	5782.4	Greenwood Lake
03	02030103070010	Belcher Creek (above Pinecliff Lake)	3480.1	Greenwood Lake
03	02030103070030	Wanaque R/Greenwood Lk (above Monks gage)	9360.3	Greenwood Lake, Area 2
03	02030103070070	Wanaque R/Posts Bk (below reservoir)	6915.9	Area 1
03	02030103110010	Lincoln Park tribs (Pompton River)	8394.4	Area 1
03	02030103110020	Pompton River	6963.2	Area 1
03	02030103050080	Pequannock R (below Macopin gage)	10835.8	Area 1
03	02030103070060	Meadow Brook/High Mountain Brook	3837.5	Area 1
03	02030103070050	Wanaque Reservoir (below Monks gage)	13749.4	Area 2
03	02030103100010	Ramapo R (above 74d 11m 00s)	3721.0	Area 2
03	02030103100040	Ramapo R (Bear Swamp Bk thru Fyke Bk)	3018.1	Area 2
03	02030103100030	Ramapo R (above Fyke Bk to 74d 11m 00s)	4305.5	Area 2
03	02030103100020	Masonicus Brook	2783.2	Area 2
03	02030103100050	Ramapo R (Crystal Lk br to Bear Swamp Bk)	4041.2	Area 2
03	02030103100070	Ramapo R (below Crystal Lake bridge)	7224.0	Area 2
03	02030103100060	Crystal Lake/Pond Brook	5509.0	Area 2
03	02030103070040	West Brook/Burnt Meadow Brook	7570.0	Area 2
03	02030103050030	Pequannock R (above Oak Ridge Res outlet)	6710.2	Area 4
03	02030103050060	Pequannock R (Macopin gage to Charl'brg)	5047.7	Area 4
03	02030103050010	Pequannock R (above Stockholm/Vernon Rd)	3464.2	Area 4
03	02030103050020	Pacock Brook	4590.8	Area 4
03	02030103050040	Clinton Reservoir/Mossmans Brook	8486.6	Area 4
03	02030103050050	Pequannock R (Charlotteburg to Oak Ridge)	11761.1	Area 4
03	02030103050070	Stone House Brook	4677.0	Area 4
04	Dundee Lake-04	Dundee Lake-04	NA	Area 3
04	02030103120070	Passaic R Lwr (Fair Lawn Ave to Goffle)	3590.6	Area 3
04	02030103120100	Passaic R Lwr (Goffle Bk to Pompton R)	7606.2	Area 3
04	02030103120080	Passaic R Lwr (Dundee Dam to F.L. Ave)	4784.0	Area 3
04	02030103120050	Goffle Brook	5657.9	Area 3
04	02030103120040	Molly Ann Brook	4994.2	Area 3
04	02030103120030	Preakness Brook / Naachtpunkt Brook	7121.1	Area 3
04	02030103120060	Deepavaal Brook	4867.7	Area 3
04	02030103120020	Peckman River (below CG Res trib)	3253.3	Area 3
04	02030103120010	Peckman River (above CG Res trib)	3217.2	Area 3
06	02030103040010	Passaic R Upr (Pompton R to Pine Bk)	7602.0	Area 1
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	5138.4	Area 1
06	02030103020100	Whippany R (Rockaway R to Malapardis Bk)	3594.7	Area 1
06	02030103010180	Passaic R Upr (Pine Bk br to Rockaway)	3417.4	Area 1
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	4412.7	Area 1
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	3594.5	Area 1

06	02030103020050	Whippany R (Malapardis to Lk Pocahontas)	4305.7	Area 1
06	02030103010160	Passaic R Upr (Hanover RR to Columbia Rd)	5479.7	Area 1
06	02030103010150	Passaic R Upr (Columbia Rd to 40d 45m)	5383.1	Area 1
06	02030103010060	Black Brook (Great Swamp NWR)	9089.8	Area 1
06	02030103010130	Passaic R Upr (40d 45m to Snyder Ave)	7958.8	Area 1
06	02030103010080	Dead River (above Harrisons Brook)	4864.6	Area 1
06	02030103010120	Passaic R Upr (Snyder to Plainfield Rd)	3471.7	Area 1
06	02030103010110	Passaic R Upr (Plainfield Rd to Dead R)	4278.7	Area 1
06	02030103010100	Dead River (below Harrisons Brook)	4949.9	Area 1
06	02030103030160	Montville tribs.	5065.5	Area 1
06	02030103010010	Passaic R Upr (above Osborn Mills)	6486.3	Area 1
06	02030103010020	Primrose Brook	3354.2	Area 1
06	02030103010070	Passaic R Upr (Dead R to Osborn Mills)	5694.0	Area 1
06	02030103020080	Troy Brook (above Reynolds Ave)	6439.2	Area 1
06	02030103020030	Greystone / Watnong Mtn tribs	4972.4	Area 1
06	02030103020090	Troy Brook (below Reynolds Ave)	3870.6	Area 1
06	02030103020060	Malapardis Brook	3256.4	Area 1
06	02030103010140	Canoe Brook	7691.3	Area 1
06	02030103020070	Black Brook (Hanover)	6644.3	Area 1
06	02030103010030	Great Brook (above Green Village Rd)	5071.5	Area 1
06	02030103010040	Loantaka Brook	3238.2	Area 1
06	02030103010050	Great Brook (below Green Village Rd)	3296.1	Area 1
06	02030103010090	Harrisons Brook	3485.2	Area 1
06	02030103030030	Rockaway R (above Longwood Lake outlet)	4288.8	Area 4
06	02030103030110	Beaver Brook (Morris County)	9453.2	Area 4
06	02030103030120	Den Brook	5769.4	Area 4
06	02030103030130	Stony Brook (Boonton)	7864.4	Area 4
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	5100.6	Area 4
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	3382.2	Area 4
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	4417.5	Area 4
06	02030103030080	Mill Brook (Morris Co)	3130.3	Area 4
06	02030103020010	Whippany R (above road at 74d 33m)	3875.7	Area 4
06	02030103020020	Whippany R (Wash. Valley Rd to 74d 33m)	4015.3	Area 4
06	02030103030010	Russia Brook (above Milton)	5478.7	Area 4
06	02030103030020	Russia Brook (below Milton)	3099.4	Area 4
06	02030103030050	Green Pond Brook (above Burnt Meadow Bk)	4721.3	Area 4
06	02030103030100	Hibernia Brook	5074.7	Area 4
06	02030103030060	Green Pond Brook (below Burnt Meadow Bk)	5055.7	Area 4
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	5825.2	Area 4
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	4692.5	Area 4

Figure 2. Spatial extent of non-tidal Passaic River basin study and related studies with modeling approach applied.



General description

The non-tidal Passaic River basin includes all of Watershed Management Areas 3 and 6, and a portion of Watershed Management Area 4, as described below:

Watershed Management Area 3

Watershed Management Area 3 (WMA 3) includes watersheds that drain the Highlands portion of New Jersey. WMA 3 lies mostly in Passaic County but also includes parts of Bergen, Morris, and Sussex Counties and is comprised of 21 municipalities that lie entirely or partially within the watershed boundary. There are four sub-watersheds in WMA 3: Pompton, Ramapo, Pequannock and Wanaque River watersheds. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton River. The Pompton River is, in turn, a major tributary to the Upper Passaic River. WMA 3 contains some of the State's major water supply reservoir systems including the Wanaque Reservoir, the largest surface water reservoir in New Jersey.

The Pequannock River watershed is 30 miles long and has a drainage area of 90 square miles. The headwaters are in Sussex County and the Pequannock River flows east, delineating the Morris/Passaic County boundary line. The Pequannock River joins the Wanaque River and flows to the Pompton River in Wayne Township. Some of the major impoundments within this watershed are Kikeout Reservoir, Lake Kinnelon Reservoir, Clinton Reservoir, Canistear Reservoir, Oak Ridge Reservoir, and Echo Lake Reservoir. The great majority of the land within this watershed is forested and protected for water supply purposes or is parkland.

The Ramapo River and Pompton River watersheds comprise a drainage area of about 160 square miles; 110 square miles of which are in New York State. The Ramapo River flows from New York into Bergen County and enters the Pequannock River to form the Pompton River in Wayne Township. The Ramapo River is 15 miles long on the New Jersey side. The Pompton River, a tributary to the Passaic River, is 7 miles long. Some of the major impoundments within this watershed include Point View Reservoir #1, Pompton Lakes, and Pines Lake. Over one-half of this watershed is undeveloped; however, new development is extensive in many areas.

The Wanaque River watershed has a total drainage area of 108 square miles. The headwaters of the river lie within New York State as a minor tributary to Greenwood Lake (located half in New Jersey and half in New York). The New Jersey portion lies in West Milford, Passaic County. The Wanaque River joins up with the Pequannock River in Riverdale Township. The Wanaque River is 27 miles in length. Some of the major impoundments and lakes with this watershed are the Wanaque Reservoir, Monksville Reservoir, Greenwood Lake, and Arcadia Lake. Most of the land in this watershed is undeveloped, consisting of vacant lands, reservoirs, parks and farms.

The Wanaque Reservoir located in WMA 3 was completed in 1930 to serve as a water supply source to northern New Jersey municipalities. The reservoir is about 6 miles long and one mile wide with an area of 2300 acres of water surface and consists of 8 dams. The supporting documentation for this TMDL, prepared by Najarian Associates, describes the Wanaque Reservoir system as follows:

> The Wanaque and Monksville Reservoirs are owned and operated by the North Jersey District Water Supply Commission (NJDWSC). These two reservoirs comprise one of the largest water supply/storage systems in New Jersey. This system is the primary source of drinking water for much of Passaic, Essex, Bergen and Hudson Counties. Following the completion of the Wanaque South Project in the late 1980s, the long-term safe yield of this combined reservoir system was upgraded to 173 mgd. The system currently provides approximately 160 mgd of potable water supply to its customers (including other water companies).

Table 5. Description of Reservoirs

	Wanaque Reservoir	**Monksville Reservoir**
Water surface elevation	302.4 ft.	400.0 ft
Capacity of reservoir	29,630 mg	7,000 mg
Area of water surface	2,310 acres	505 acres
Width at widest point	1.2 mi	0.6
Length	6.6 mi	3.3 mi
Average width	0.5 mi	0.2 mi
Greatest depth	90 ft	100 ft
Average depth	37 ft	42 ft
Watershed area	90.1 mi^2	42.2 mi^2

> To maintain this yield, the Wanaque Reservoir utilizes inflows from three separate sources: (1) its natural tributary system, which includes the Monksville Reservoir; (2) the Pompton Lakes intake, which is located on the Ramapo River; and (3) the Two Bridges intake, which is located on the Pompton River about 750 feet upstream from the confluence with the Passaic River. The NJDWSC has the capability of pumping up to 150 mgd from the Pompton Lakes intake, and up to 250 mgd from the Two Bridges intake. By design, when the diversion from the Two Bridges intake exceeds the available flow in the Pompton River, this intake has the ability to reverse flows in the lowermost reach of the Pompton River and tap the locally impounded waters of the Passaic River. Thus, the entire upper Passaic watershed (with a drainage area of 361 square miles) becomes a contributing source to the Reservoir. To maintain water quality and protect users in the downstream portions of the Passaic, Pompton and Ramapo Rivers, the Department has implemented several restrictions on intake usage, including:

(a) no diversions during July and August unless there is a declared drought emergency; (b) no diversions from the Pompton Lakes intake when flows in the Ramapo River are below 40 mgd; and (c) no diversions when flows in the Passaic River at Little Falls are below 17.6 mgd (modified from Najarian (2005)).

Watershed Management Area 4

Watershed Management Area 4 (WMA 4) includes the Lower Passaic River (from the Pompton River confluence downstream to the Newark Bay) and its tributaries, including the Saddle River. The Saddle River is located in the tidal portion of the Passaic River Watershed, and is outside of the scope of the non-tidal Passaic studies. The WMA 4 drainage area is approximately 180 square miles and lies within portions of Passaic, Essex, Hudson, Morris and Bergen Counties.

The Lower Passaic River watershed originates from the confluence of the Pompton River downstream to the Newark Bay. This 33-mile section, of which approximately 16 miles is non-tidal, meanders through Bergen, Hudson, Passaic, and Essex Counties and includes a number of falls, including the Great Falls at Paterson.

Dundee Lake located in WMA 4 was created as a result of dam erected in 1859 by the Dundee Manufacturing Company replacing a smaller earlier dam, to harness the Passaic's water power and to make the river navigable from Newark to Paterson. The Dundee Dam curves 450 feet across the Passaic River and marks the boundary between the 17-mile tidal stretch of the Lower Passaic River to the river mouth at Newark Bay. Today, Dundee Dam and Lake are co-owned by the North Jersey District Water Supply Commission and the United Water Company. Dundee Lake is currently permitted for industrial water supply withdrawal.

Watershed Management Area 6

Watershed Management Area 6 (WMA 6) represents the area drained by waters from the upper reaches of the Passaic River Basin including the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. Extensive suburban development and reliance upon ground water sources for water supply characterize WMA 6. WMA 6 lies in portions of Morris, Somerset, Sussex and Essex counties and includes the Upper and Middle Passaic River, Whippany River and Rockaway River watersheds.

The Upper Passaic River watershed is approximately 50 miles long and consists of a drainage area approximately 200 square miles in portions of Somerset, Morris, and Essex Counties. This section of the Passaic River is a significant source of drinking water for much of northeastern New Jersey. Major tributaries to the Upper Passaic River include the Dead River, Rockaway River, Whippany River, and Black Brook. The Great Swamp National Wildlife Refuge is located within the Upper Passaic River watershed. Approximately one-half of this watershed is undeveloped, including preserved open space, with the remainder primarily residential and commercial. This watershed is facing significant development pressure.

The approximately 11 square mile Middle Passaic River watershed includes Great Piece Meadows and Deepavaal Brook. The Great Piece Meadows is a freshwater wetland with a drainage area of approximately 12 square miles and is prone to flooding. Various owners privately own the Great Piece Meadows.

The Rockaway River watershed has a drainage area of approximately 133 square miles and is approximately 37 miles long. The Rockaway River flows east to its confluence with the Whippany River at Pine Brook. Major tributaries include Stone Brook, Mill Brook, Beaver Brook, and Den Brook. The land use patterns in this area are complex and include undeveloped areas, parklands, residential development and industrial/commercial uses.

The Whippany River watershed drains approximately 69 square miles and is located entirely within Morris County. The river is approximately 18 miles long and flows to the Passaic River. Two major tributaries are Black Brook and Troy Brook. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

Land use in the non-tidal Passaic River basin is depicted in Figure 3 and summarized in Table 6.

Figure 3. 2002 Land Use in the Passaic River above Dundee Dam

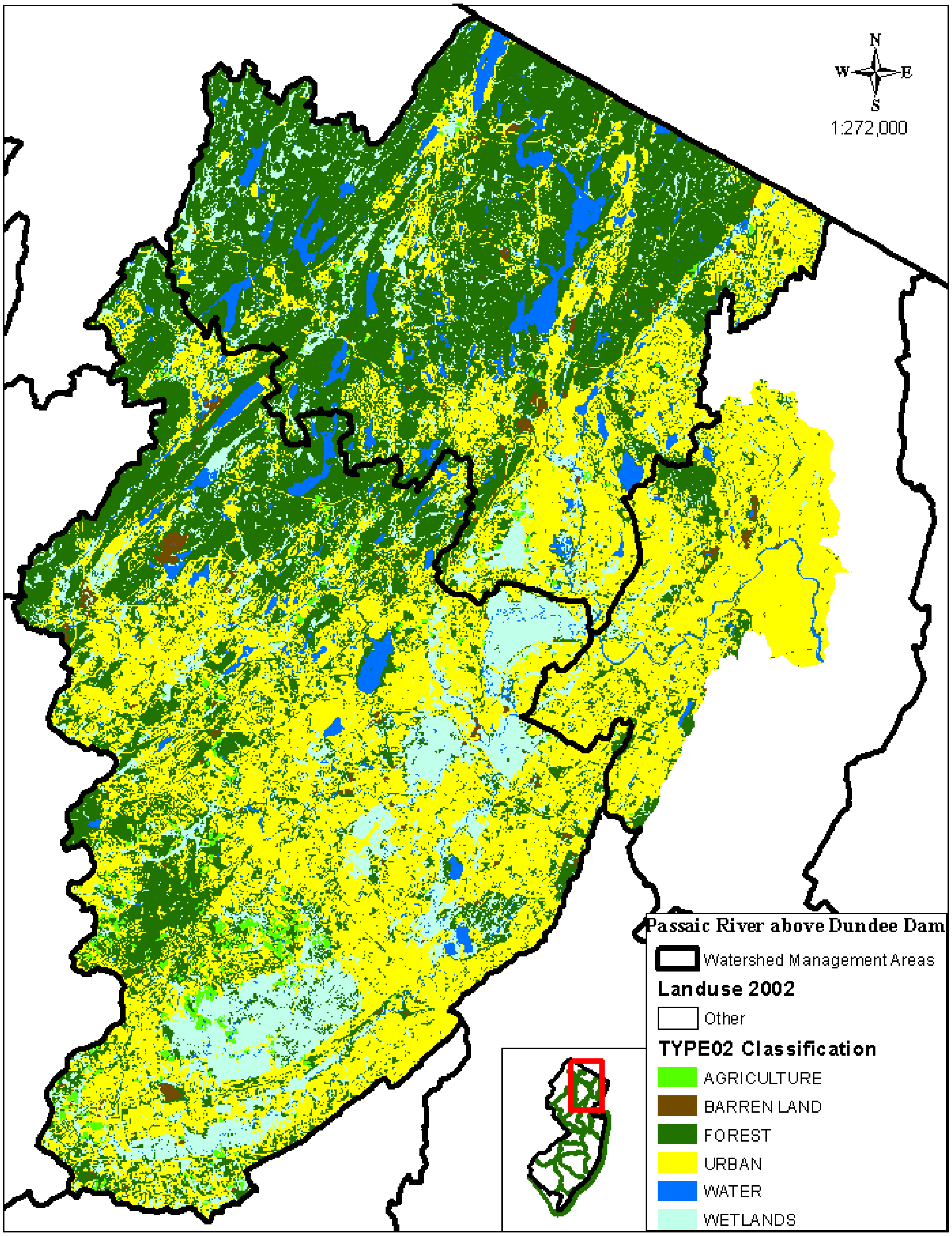


Table 6 . 2002 Land Use in the Passaic River above Dundee Dam

Land Use Classification (TYPE02)	Acres	Percent
Agriculture	281,138	1.8%
Barren Land	377,724	2.4%
Forest	4,221,843	26.8%
Urban	6,308,355	40.1%
Water	545,036	3.5%
Wetlands	4,002,509	25.4%
TOTAL	15,736,605	100%

4.0 Source Assessment

Point Sources

For the purposes of TMDL development, point sources include domestic and industrial wastewater treatment plants that discharge to surface water, combined sewer overflows, as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Point sources contributing phosphorus loads within the affected drainage area include the wastewater treatment facilities listed in Table 7 as well as combined sewer overflows and stormwater point sources, including the Tier A municipalities listed in Appendix B. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through BMPs. The distinction is that stormwater point sources are regulated under the Clean Water Act. Combined sewer overflows are found in the City of Paterson within the spatial extent of this TMDL study. The loading from combined sewer overflows was determined and was an input to the water quality model for the study. The contribution from combined sewer overflows was found to be small and reduction of this load would result in no significant difference in the outcome. Therefore, the WLA for this source reflects the existing loading. This is a conservative assumption in that the measures required under the municipal stormwater permits will reduce the overland runoff component of CSOs.

The point sources identified in Table 7 will receive individual WLAs. Refer to Figure 4 for location of major point sources. The remaining point sources, which are stormwater point sources, are quantified with the nonpoint sources, as described below, but will be assigned a WLA that will be expressed as a percent reduction of loads associated with land uses that are more amenable achieving load reductions.

Table 7. Permitted Point Sources within the Non-Tidal Passaic River Basin that contribute TP

NJPDES Permit #	Facility Name	DSN	Effluent Permit Conditions (1), (2)			Flow (mgd) (3)	Loading (kg/day) (3)	Permitted Flow (mgd)
			Timeframe	TP (mg/l)	TP (kg/day)			
NJ0002577	NABISCO FAIR LAWN BAKERY	001A & 002A	Monthly Avg. Daily Max.	MR MR	---- ----	--	--	0.385
NJ0003476	EXXONMOBIL RESEARCH & ENGINEERING	005A	Monthly Avg. Daily Max.	1 MR	MR MR	0.0499	0.716	0.29
NJ0020281	CHATHAM HILL SEWAGE TREATMENT	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0071	0.044	0.03
NJ0020290	CHATHAM TWP MAIN STP	001A	Monthly Avg.	1	----	0.6596	1.495	1
NJ0020427	CALDWELL BORO STP	001A	Monthly Avg. Weekly Avg.	4.2 / 4 MR	MR MR	3.3667	42.887	4.5
NJ0021083	VETERANS ADMIN MEDICAL CENTER-LYONS	001A	Monthly Avg. Weekly Avg.	1 MR	1.51 MR	0.0999	1.528	0.4
NJ0021091	JEFFERSON TWP HIGH-MIDDLE SCHOOL	001A	Monthly Avg. Weekly Avg.	1 1.5	0.1 0.16	0.0101	0.028	0.0275
NJ0021253	RAMAPO-INDIAN HILLS H.S. WTP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0068	0.009	0.0336
NJ0021342	OAKLAND-SKYVIEW-HIGH BROOK STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.013	0.003	0.023
NJ0021636	NEW PROVIDENCE WWTP	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0275	0.208	1.5
NJ0022276	STONYBROOK SCHOOL	001A	Monthly Avg. Weekly Avg.	MR [1] MR	MR MR	0.0011	0.004	0.01
NJ0022284	KINNELON TWP HIGH SCHOOL - (4)	001A	Monthly Avg. Weekly Avg.	1 MR	0.113 MR	0.0051	0.037	0.03
NJ0022349	ROCKAWAY VALLEY REG SA	001A	Monthly Avg. Weekly Avg.	3.4 / 3.2 MR	MR MR	9.3	62.724	12
NJ0022489	WARREN TWP STAGE I-II STP	001A	Monthly Avg. Weekly Avg.	4.2 / 3.6 MR	MR MR	0.3344	3.74	0.47
NJ0022497	WARREN TWP STAGE IV STP	001A	Monthly Avg. Weekly Avg.	7.1 / 5.2 MR	MR MR	0.3129	5.857	0.8
NJ0022845	BERNARDS SA - HARRISON BROOK STP	001A	Monthly Avg. Weekly Avg.	5.2 / 5 MR	MR MR	1.7288	26.003	2.5
NJ0023698	POMPTON LAKES BOROUGH MUA	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.7377	0.814	1.2
NJ0024414	W MILFORD SHOPPING CENTER	001A	Monthly Avg. Weekly Avg.	1 MR	0.075 MR	0.0047	--	0.02
NJ0024457	OUR LADY OF THE MAGNIFICENT	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0009	0.001	0.0012

NJ0024465	LONG HILL TWP-STIRLING HILLS STP	001A	Monthly Avg. Weekly Avg.	4.4 / 3.7 MR	MR MR	0.9091	10.627	0.9
NJ0024490	VERONA TWP STP	004A	Monthly Avg. Weekly Avg.	5.4 / 3.7 MR	MR MR	2.15	3.17	3
NJ0024511	LIVINGSTON TWP STP	001A	Monthly Avg. Weekly Avg.	4.3 / 3.9 MR	68.4/62 MR	2.8492	36.741	4.6
NJ0024902	HANOVER SEWERAGE AUTHORITY	001A	Monthly Avg. Weekly Avg.	5 / 4.5 MR	MR MR	1.9508	28.049	4.61
NJ0024911	MORRIS TWP - BUTTERWORTH STP	001A	Monthly Avg. Weekly Avg.	3.04 / 2.24 MR	MR MR	1.6506	10.773	3.3
NJ0024929	MORRIS TWP - WOODLAND STP	001A	Monthly Avg. Weekly Avg.	1 MR	7.6 MR	1.2567	2.979	2
NJ0024937	MADISON-CHATHAM JT MTG - MOLITOR	001A	Monthly Avg. Weekly Avg.	4.4 / 4 MR	MR MR	2.2971	34.579	3.5
NJ0024970	PARSIPPANY TROY HILLS	001A	Monthly Avg. Weekly Avg.	4.9 / 5 MR	MR MR	12.5092	152.045	16
NJ0025330	CEDAR GROVE TWP STP	001A	Monthly Avg.	4 / 3.5	----	1.21	1.9	2
NJ0025496	MORRISTOWN TOWN STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	2.9079	6.917	6.3
NJ0025518	FLORHAM PARK S.A.	001A	Monthly Avg. Weekly Avg.	3.3 / 2.9 MR	MR MR	0.8793	7.566	1.4
NJ0026174	W MILFORD TWP MUA - CRESCENT PARK STP	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.0284	--	0.064
NJ0026514	PLAINS PLAZA SHOPPING CENTER	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0093	0.206	0.02
NJ0026689	NJDHS-GREYSTONE PARK PSYCH HOSP	001A	Monthly Avg. Weekly Avg.	1 MR	1.51 MR	0.2153	0.195	0.4
NJ0026867	JEFFERSON TWP-WHITE ROCK STP	001A	Monthly Avg. Weekly Avg.	1 MR	0.5 MR	0.0978	0.049	0.1295
NJ0027006	RINGWOOD ACRES STP	001A	Monthly Avg.	1	MR	0.0231	0.037	0.036
NJ0027201	REFLECTION LAKE GARDEN APTS	001A	Monthly Avg. Weekly Avg.	1 MR	0.02 MR	0.0013	--	0.005
NJ0027669	WEST MILFORD TWP MUA - AWOSTING	001A & 002A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0623	--	0.045
NJ0027677	WEST MILFORD TWP MUA- OLDE MILFORD	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.097	--	0.172
NJ0027685	WEST MILFORD MUA-HIGHVIEW ACRES STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0534	0.105	0.2
NJ0027774	OAKLAND-OAKWOOD KNOLLS WWTP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0177	0.003	0.035
NJ0027961	BERKELEY HTS WPCP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	1.5494	23.018	3.1

NJ0028002	WAYNE TWP - MOUNTAIN VIEW	001A	Monthly Avg. Weekly Avg.	3.4 / 3.1 MR	---- ----	6.79	2.29	13.5
NJ0028291	ISP MANAGEMENT CO INC	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	--	--	0.05
NJ0028541	WEST MILFORD TWP MUA – BIRCHILL	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.0123	--	0.02
NJ0029386	TWO BRIDGES SEWERAGE AUTHORITY	001A	Monthly Avg. Weekly Avg.	5 / 5.3[1*] MR	MR MR	4.7503	64.459	10
NJ0029432	RINGWOOD BOE - ERSKINE SCHOOL	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.001	--	0.008
NJ0029858	OAKLAND CARE CENTER	001A	Monthly Avg.	1	0.11	0.0239	0.012	0.03
NJ0029912	NJDOT-HARDING REST AREA (Oct-April) - (5)	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0014	0.007	0.025
NJ0032395	RINGWOOD PLAZA STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0066	0.009	0.0117
NJ0050369	WARREN TWP STAGE V STP	001A	Monthly Avg. Weekly Avg.	7.1 / 5.1 MR	MR MR	0.1377	1.917	0.38
NJ0052256	CHATHAM TWP-CHATHAM GLEN STP	001A	Monthly Avg. Weekly Avg.	4.3 / 3.7 MR	MR MR	0.1214	1.591	0.155
NJ0053112	OAKLAND-CHAPEL HILL ESTATES STP	001A	Monthly Avg. Weekly Avg.	0.05 0.075	0.002 0.003	0.0069	0.001	0.01
NJ0053759	WANAQUE VALLEY REG S.A.	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.9181	1.152	1.25
NJ0080811	RAMAPO RIVER CLUB STP - Oakland Twp Riverbend	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0696	0.018	0.1137
NJ0104451	BAYER CORPORATION	001A	Monthly Avg. Daily Max.	1 MR	---- ----	--	--	0.216
NJG0108880	PATERSON CITY - 31 CSOS	--	----	----	----	--	--	--

Footnotes:

(1) Current permit requirements as of April 19, 2007.

(2) Limitations or monitoring requirements with a "/" indicates the following limitations: Summer / Winter. Summer is applicable in the months of May through October. Winter limitations are applicable in the months of November through April. Limitations and monitoring requirements without a "/" apply year-round.

(3) Data summarized October 1, 1999 to November 30, 2003 (Omni Environmental, 2007)

(4) Permit revoked on October 25, 2005, due to connection to the Two Bridges Sewerage Authority W.W.T.P

(5) Permit revoked on September 30, 2003 due to connection to the Morris Township Woodland W.P.C.U.

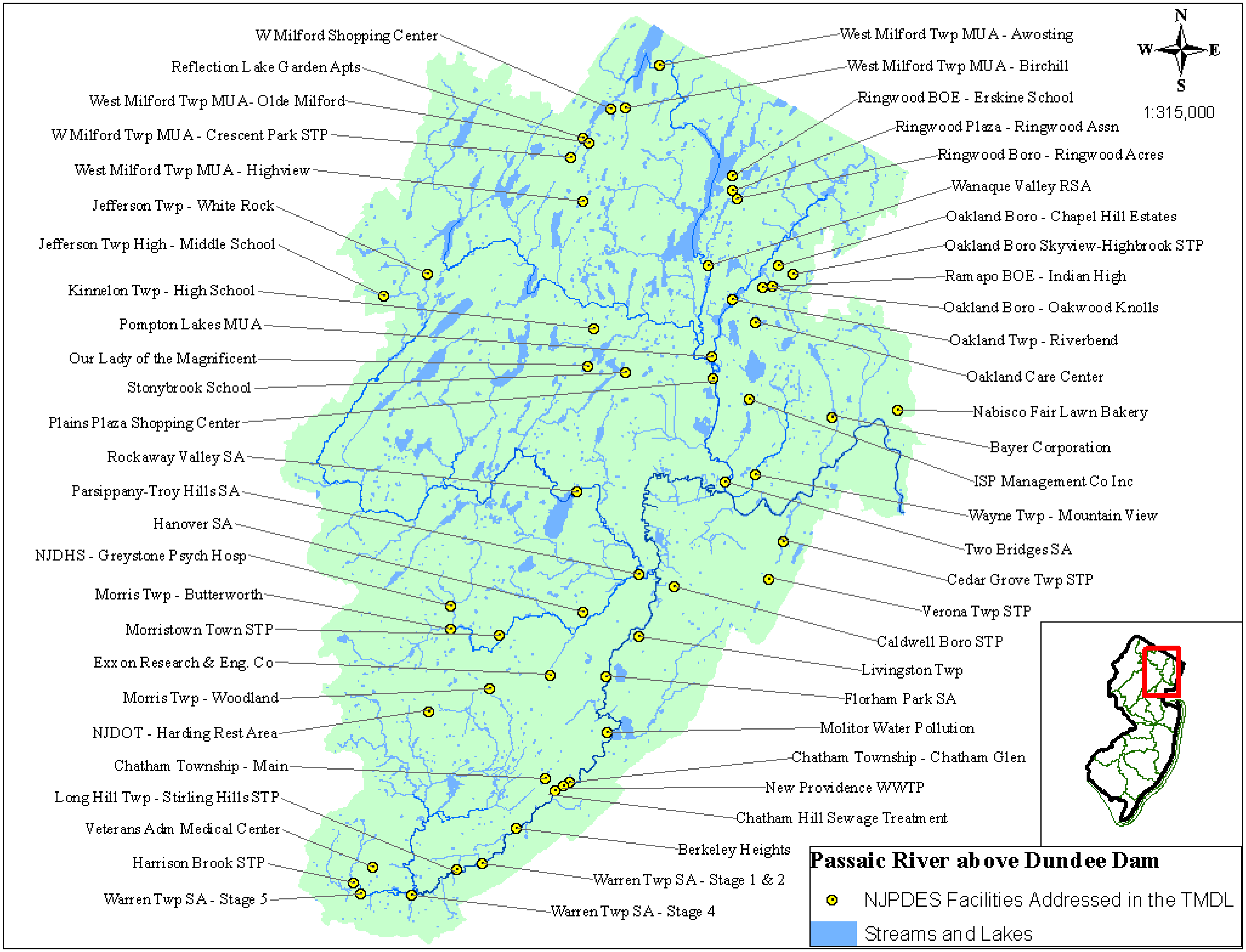
[1] Permit Condition of 1 mg/l for the monthly average TP concentration from January through December will become effective on June 1, 2011.

[1*] Permit Condition of 1 mg/l for the monthly average TP concentration from January through December will become effective at a flow of 9.639.mgd.

MR Monitor and report only.

---- Not required by permit condition.

Figure 4. NJPDES Point Source Discharges of Phosphorus in the Passaic River above Dundee Dam



Nonpoint Sources

For the purposes of TMDL development, potential nonpoint sources include stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces. Nonpoint sources can also include categories such as failing or inappropriately located septic systems and direct contributions from wildlife, livestock and pets. These sources are not assigned separate loads. They are adequately captured by the nonpoint source loading method described below. Tier B municipalities in the spatial extent are identified in Appendix B.

Within the WASP7 /DAFLOW modeled domain (Approach areas 1 and 3), nonpoint source contributions as well as storm driven point sources were quantified by separating stream flow into runoff and tributary baseflow. The nonpoint source loads were calculated based on the flow-weighted Event Mean Concentration (fEMCs) for each parameter and sub-basin, tributary baseflow concentrations for tributary baseflows, and an estimate of the individual contribution of surface flow and tributary baseflow from each sub-basin as determined through the hydrograph separation algorithm in WAMIT. The EMCs for NH3-N, NO3-N, OrgN, OrthoP, OrgP, DO and CBODu were calculated by averaging the data collected for this study from each storm event for each station, among storm events for each station, and lastly from different stations for each land use type (Table 8). The land use types are subdivided into residential, commercial, agricultural, forest, wetlands and barren.

Table 8. Runoff EMCs for Each Land Use Category

Constituent	Residential	Commercial	Agriculture	Wetlands	Forest*
NH3-N	0.16	0.21	0.10	0.12	0.04
NO3-N	0.94	0.65	1.42	0.76	0.26
Org-N	1.27	0.90	1.09	1.58	0.54
OrthoP	0.103	0.076	0.261	0.170	0.023
Org-P	0.217	0.149	0.183	0.186	0.064
CBOD5	2.7	4.2	3.8	5.9	1.3

* EMCs for barren land were not available for the storm water sampling events, and were assumed to be the same as forest EMCs.

Using both land use and State Soil Geographic (STASGO) layers, polygons were created consisting of different soil types and land uses. The areas of the polygons were calculated and an area-weighted curve number (CN) value was assigned to each individual polygon. By grouping areas with the same land use type, the area-weighted CN value was calculated based on the area of each polygon. These CN values estimate the amount of runoff flow that is generated by each land type in order to properly weight the EMCs for each sub-basin. Curve numbers were not used to calculate any flows for the model. Flows were provided by DAFLOW and separated into tributary baseflow and runoff. Curve numbers were used only to estimate the proportion of runoff flow that is generated by each land type in order to properly weight the EMCs for each sub-basin.

The tributary baseflow concentrations were not assumed to vary by land use type. Tributary baseflow as defined in this study is not primarily the direct discharge of groundwater to modeled streams. Tributary baseflow also reflects dry-weather discharge of tributaries within each contributing sub-basin. Tributary baseflow concentrations for constituents other than phosphorus are assumed to be constant throughout the basin, while tributary baseflow phosphorus concentrations are assumed to vary by the major stream branches (Tables 9 and 10).

Table 9. Tributary Baseflow Concentrations for Nutrients Other than Phosphorus

NH3-N (mg/l)	NO3-N (mg/l)	Org-N (mg/l)	CBOD5 (mg/l)	DO (mg/l)
0.09	0.56	0.09	2.0	3.0

Table 10. Watershed Specific Phosphorus Concentrations for Tributary Baseflow

Model Branch Groupings	**TP (mg/l)**	**Ortho P (mg/l)**
Forest Dominated (Wanaque River)	0.045	0.021
Major Tributaries (Pequannock, Ramapo, Pompton, Whippany, and Rockaway Rivers)	0.054	0.023
Upper Passaic / Minor Tributaries (Upper and Mid-Passaic River, Dead River, and Singac Brook)	0.063	0.022
Lower Passaic (Lower Passaic and Peckman Rivers)	0.060	0.031

The total volume of water from tributary baseflow and surface flow reaching the streams during a flow model time step (3 hours) is multiplied by the tributary baseflow concentrations and fEMCs to yield the nonpoint source load for each water quality parameter. For more detail on the estimation of nonpoint sources, refer to supporting documentation for this TMDL (Omni Environmental, 2007).

Within the Wanaque Reservoir direct drainage area and Pompton Lake watershed (Approach 2) a similar approach was used to evaluate nonpoint source contributions. Again the basis for this approach was a GIS analysis of the watershed's land uses and gauged USGS flow data, which was separated into baseflow and stormwater runoff components. However, EMCs were developed as part of a multi-year analysis using the unit area load (UAL) methodology rather than by the analysis of storm event water quality data. This approach provided EMCs on a composite basis for each subwatershed. EMCs for total phosphorus ranged from 0.13 mg/l in the more pristine subwatersheds (such as Ringwood Creek) to 0.30 mg/l in a more developed area (such as the Pompton Lakes subwatershed. Baseflow was assigned a constant concentration of 0.01 mg/l TP, which was found to be representative of base flow from a relatively pristine location in the watershed. For more information on this method of estimating nonpoint sources, refer to Najarian, 2005.

Table 11. UALs used to Estimate EMCs for Land Use Loads

Land Use Categories	UAL Coeff. (kg/hc/yr)	UAL Coeff. (lb/ac/yr)
Low Intensity Residential	0.7	0.623
High Intensity Residential	1.6	1.424
Comm./Ind./Trans	2/1.7/1	1.8/1.5/.9
Mixed Urban/Recreational	1.0	0.890
Crops/Pasture/Hay	1.5	1.335
Deciduous Forest	0.1	0.089
Evergreen Forest	0.1	0.089
Mixed Forest	0.1	0.089
Shrubland	0.1	0.089
Woody Wetlands	0.1	0.089
Herbaceous Wetlands	0.1	0.089
Open Water	0.1	0.089
Disturbed Areas	0.1	0.089

(modified from Najarian 2005)

5.0 Analytical Approach and TMDL Calculation

The non-tidal Passaic River Basin TMDLs are based on an integration of water quality and hydrodynamic models. A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River and its major tributaries: Dead River, Whippany River, Rockaway River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, a small stream segment of the Pequannock River, Singac Brook, and Peckman River. The WASP 7 model is a dynamic compartment model that can be used to predict a variety of water quality responses due to natural phenomena and man-made pollution for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters. The model includes time varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange. WASP 7 uses as inputs time series of flow, pollutant loads and several water quality parameters (Omni Environmental, 2007). DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this study (Spitz, 2007). The flow model routes water downstream using time series inputs from streamflow gauges, discharges and diversions and incremental flows from tributaries and subbasins along the mainstem. A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW (Omni Environmental 2007). WAMIT includes algorithms to calculate nonpoint source loads as a function of tributary baseflow and surface waters given by a hydrograph separation scheme, sub-basin characteristics and flow-weighted runoff concentrations for different land use types, as described above under nonpoint source loads.

The LA-WATERS (Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation) model was used to link loading with concentration response in the Wanaque Reservoir. LA-WATERS is a two-dimensional (longitudinal and vertical) hydrothermal/water quality model. It was successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and then re-validated (Najarian Associates, 2000). A detailed description of LA-WATERS is provided in Najarian (1988). A simulation of baseline (existing) conditions was conducted over the selected 10-year period (1993-2002) using water quality data obtained from North Jersey District Water Supply Commission (NJDWSC), USGS and Passaic Valley Water Commission (PVWC), flow data from USGS gauging stations, pumping data from NJDWSC and meteorological data from National Climatic Data Center's Newark International Airport weather station. In response to model inputs, LA-WATERS simulates laterally averaged velocities, water temperature and constituent concentrations at all grid locations for a selected period. Simulated constituents include organic phosphorus, dissolved inorganic phosphorus, particulate inorganic phosphorus, dissolved oxygen, carbonaceous biological oxygen demand, nitrogenous biological oxygen demand and temperature. As indicated, the reservoir endpoint is based on chlorophyll-*a* concentration. A discussion of the phosphorus – chlorophyll-*a* relationship in the Wanaque Reservoir is provided in a report addendum (Najarian Associates, 2007).

To conduct future simulations of water quality in the Wanaque Reservoir, loadings were estimated in two ways. A time series of daily in-stream total phosphorus and dissolved phosphorus concentrations developed for Approach Area 1 (Omni 2007), described above, was used with the daily schedule of Wanaque South diversions to develop one portion of the reservoir's loading input. The diversion load from the

Pompton Lakes intake and the reservoir's direct tributary load were developed using a simple mass-balance model. The mass-balance model was based on an input of observed USGS flow data, reported discharger monitoring data and GIS-based non-point source assessment using hydrograph separation, a UAL-based EMC for storm flows and a separate concentration for groundwater contributions. This approach was verified using an 11-year time series (from 1992 through 2002) of observed in-stream concentrations (Najarian 2005, Litwack et al. 2006).

More detailed discussion on the above models is available in the supporting documents for this TMDL prepared under contract to the Department by Najarian Associates (Najarian 2005 and 2007), Omni Environmental (Omni, 2007), and (Spitz, 2007).

Certain boundary premises were factored into this TMDL study, as follows. TMDLs have been established for Verona Park Lake (NJDEP 2003) and Greenwood Lake (NJDEP 2004), which are within the drainage area for this TMDL study. The loading from the Greenwood Lake drainage area reflects the loading reductions needed to attain the SWQS, as specified in that TMDL. Further, water quality modeling of the Peckman River assumes attainment of the SWQS in Verona Park Lake. The companion TMDL document for Pompton Lake and associated drainage area provides inputs to this TMDL study. The Pompton Lake TMDL study includes the Ramapo River, which originates in New York and enters New Jersey with a significant phosphorus load and concentrations in excess of the SWQS. As a boundary condition for the Pompton Lake TMDL study, it was assumed that the water quality will attain New Jersey's SWQS at the border, represented by the quality measured at the Ramapo at Mahwah monitoring station. As the Ramapo River currently enters New Jersey with phosphorus concentrations in excess of the standards, it will be necessary for New York to implement measures to reduce phosphorus loads in order to realize this boundary condition. Recently, New York issued a permit for the Western Ramapo treatment facility, which is currently under construction. This facility will replace some smaller facilities and, with an effluent limit of 0.2 mg/l, will result in an overall reduction in point source phosphorus load in the Ramapo River. However, it is expected that reductions in NPS will be needed for full attainment of the boundary condition. This assumption is important for demonstrating compliance at the Mahwah station, which is in the spatial extent of the Pompton Lake/Ramapo River TMDL study. However, inputs to the non-tidal Passaic River basin TMDL study are taken from the anticipated quality of water leaving Pompton Lake, assuming the TMDL condition is achieved. This latter water quality is dependent primarily on load reductions called for in the New Jersey portion of the drainage area, as quality improves downstream of Mahwah.

Seasonal Variation, Critical Conditions, MOS and Reserve Capacity

A TMDL must account for critical conditions and seasonal variations. The summer season is the critical period for biological activity, algal blooms and associated oxygen effects (excessive swings and/or dips below criterion). Yet winter and early spring are the times when, due to diversions from the Pompton and Passaic Rivers, phosphorus loadings to the Wanaque Reservoir are usually highest. As a result, load reductions must be required year-round for sources that contribute loads to the Wanaque Reservoir. Critical conditions and seasonal variation were addressed through inclusion of a simulation period that included extreme hydrologic conditions, such as the hot, dry summer of WY2001 and the water supply drought of WY2002, during which diversions from the Pompton and Passaic were much greater than normal in winter and spring. In addition, the simulation of future conditions assumes wastewater treatment facilities are at full permitted capacity and that pumping into the Wanaque Reservoir is consistent with the full permitted water supply allocation of 173 mgd. At the Dundee Lake critical location, the critical period is during the growing season. Simulations indicate that phosphorus reductions from wastewater treatment facilities outside the months of May through October have no effect on the observed seasonal average chlorophyll-*a* levels, due to the riverine nature of Dundee Lake. Therefore, below the confluence of the Pompton and Passaic Rivers, seasonal effluent limits (May through October) are consistent with achieving the watershed criterion for Dundee Lake.

In the development of a TMDL, Section 303(d) of Clean Water Act requires specification of a Margin of Safety (MOS) – an unallocated portion of the assimilative capacity. A MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). In particular, a MOS accounts for uncertainties in the loading estimates, physical parameters and the linked models themselves. The MOS, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. An implicit MOS and reserve capacity are included by setting the chlorophyll-*a* targets below the proposed watershed criteria for the Wanaque Reservoir and Dundee Lake. Specifically, the targets are reduced to 9.6 μg/L and 19 μg/L in the Wanaque Reservoir and Dundee Lake, respectively, for the MOS. The targets are reduced to 9.2 μg/L and 18 μg/L in the Wanaque Reservoir and Dundee Lake, respectively, for a reserve capacity. The reserve capacity is established even though there is considerable unutilized capacity in existing wastewater treatment facilities to account for as yet unknown future new or expanded treatment facilities. The allocation of loading capacity, including the WLAs and LAs identified in this report, will achieve a chlorophyll-*a* level of 9.2 μg/L in the Wanaque Reservoir and 18 μg/L chlorophyll-*a* in Dundee Lake, on a seasonal average basis. This is compared to the proposed watershed criteria of 10 μg/L and 20 μg/L, respectively in these locations. There are additional conservative assumptions that provide an additional implicit MOS. Reductions in sources are not assumed in Approach Area 4 or from CSOs, yet reductions are expected as a result of implementing the minimum measures required in municipal stormwater permits.

Allocation of Loading Capacity

WLAs are established for all point sources, while LAs are established for nonpoint sources, as these terms are defined in "Source Assessment."

Stormwater discharges can be a point source or a nonpoint source, depending on NPDES regulatory jurisdiction, yet the suite of measures to achieve reduction of loads from stormwater discharges is the same, regardless of this distinction. Stormwater point sources receiving a WLA are distinguished from stormwater generating areas receiving a LA on the basis of land use. This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously. Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore allocations are established according to source categories, with stormwater from urban land use types given wasteload allocations and stormwater from other land use types given load allocations. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the urban land use categories that are not NJPDES-regulated. Nothing in these TMDLs shall be construed to require the Department to regulate a stormwater source under NJPDES that would not already be regulated as such, nor shall anything in these TMDLs be construed to prevent the Department from regulating a stormwater source under NJPDES.

Loads from some land uses, specifically forest, wetland, water and barren land are not readily adjustable. As a result, existing loads from these sources have been set equal to the future loads. Therefore, the overall load reduction required from land uses is obtained from land uses for which reduction measures are more practicable. Nonpoint source load reductions range from 0 to 85 percent, depending on the Approach Area. Nonpoint source loads were assumed to remain constant from the land areas in Approach Area 4, because this area is a boundary condition for Approach Area 1. Approach Area 1 requires a nonpoint source load reduction of 60 percent, except for the Greenwood Lake drainage area where a nonpoint source load reduction of 43 percent is required, with an overall reduction of 54 percent for that combined area. The Pompton Lake drainage area requires an 80 percent nonpoint source reduction, as described in the companion TMDL report for that area. The TMDL for Verona Park Lake required an 85 percent TP load reduction, and this drainage area is a boundary input to Approach Area 3.

Allocation of the loading capacity for the two critical locations is presented in Tables 12 and 13. Individual WLAs are set forth in Table 14.

Table 12. Distribution of WLAs and LAs among source categories for the Non-Tidal Passaic River Downstream of Wanaque Reservoir

Long Term Average Daily (kg/d TP)	Pompton River Basin			Upper/Mid Passaic River Basin			Lower Passaic River Basin			Total		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Wasteload Allocations (WLAs)												
Wastewater from STP Dischargers	61	19	69%	435[1]	104[1]	76%	92	29	69%	588	152	74%
Stormwater from Residential Land Use Areas	9.5	4.5	53%	24.1	9.6	60%	8.1	3.2	60%	42	17	60%
Stormwater from Other Urban Land Use Areas	9.5	4.4	54%	24.9	10.0	60%	9.5	3.8	60%	44	18	60%
CSO Discharges	0	0	N/A	0	0	N/A	4.9	4.9	0%	4.9	4.9	0%
Load Allocations (LAs)												
Headwater Boundaries	72	26	64%[3]	26[2]	26[2]	0%	5.7	4.9	13%[4]	104	57	45%
Tributary Baseflow	7.5	7.5	0%	21.6	21.6	0%	6.3	6.3	0%	35	35	0%
Stormwater from Agricultural Land Use Areas	0.5	0.2	60%	1.2	0.5	60%	0.0	0.0	0%	1.8	0.7	60%
Stormwater from Forest and Barren Land Use Areas	1.1	1.1	0%	0.8	0.8	0%	0.2	0.2	0%	2.1	2.1	0%
Stormwater from Wetlands Land Use Areas	8.5	8.5	0%	14.2	14.2	0%	0.7	0.7	0%	23	23	0%
Loading Capacity (LC′)	**170**	**71**	**58%**	**549**	**187**	**66%**	**127**	**53**	**58%**	**845**	**310**	**63%**

1 WLAs for Chatham Township – Main (1.51kg/d) and Morris Twp – Woodland (3.03kg/d) were added to the total WLAs of the Upper/Mid Passaic River Basin
2 WLAs for Chatham Township – Main (1.51kg/d) and Morris Twp – Woodland (3.03kg/d) were subtracted from the total LAs of the Upper/Mid Passaic River Basin
3 Implementation of percent reduction through Pompton Lake and the Wanaque Reservoir TMDLs
4 Implementation of percent reduction through Verona Park Lake TMDL

Table 13. Distribution of WLAs and LAs among source categories for the Wanaque Reservoir critical location

	TMDL Allocation Type	Existing Conditions[1]		**Post-TMDL allocations	TMDL Specification* Wanaque Reservoir only		
		**Total watershed	Wanaque Reservoir only				
		kg TP/day	kg TP/day	kg TP/day	kg TP/day	% of LC	Percent Reduction[2]
Loading Capacity (LC)		59.00		25.22		-	57%
Point Sources other than Stormwater							
NJPDES Dischargers[3]	WLA	0.32	0.13	0.19[4]	0.08[4]	0.3%	38%
Loading from Intake Diversions							
Diversions from Ramapo River[5]	LA	3.23	3.23	0.68	0.68	2.7%	79%
Diversions from Two Bridges[6]	LA	37.48	37.48	11.20	11.20	44.4%	70%
Internal Loading							
Sediment/Base Flow	LA	3.14	1.79	3.14	1.79	7.1%	0%
Greenwood Lake input	LA	-	7.82	-	4.67	23.9%	Greenwood Lake TMDL
Land Use Surface Runoff[7]							
Low Intensity Residential	WLA	1.90	1.08	0.88	0.43	1.7%	60%
High Intensity Residential	WLA	4.14	2.36	1.91	0.95	3.7%	60%
Commercial/Industrial/Transportation	WLA	1.82	1.04	0.84	0.42	1.6%	60%
Mixed Urban/Recreational	WLA	0.67	0.38	0.31	0.15	0.6%	60%
Crops/Pasture/Hay	LA	0.56	0.32	0.25	0.13	0.5%	60%
Deciduous Forest	LA	3.37	1.93	3.37	1.93	7.6%	0%
Evergreen Forest	LA	0.34	0.19	0.34	0.19	0.8%	0%
Mixed Forest	LA	0.83	0.47	0.83	0.47	1.9%	0%
Shrubland	LA	0.05	0.05	0.05	0.05	0.2%	0%
Woody Wetlands	LA	0.29	0.17	0.29	0.17	0.7%	0%
Herbaceous Wetlands	LA	0.03	0.02	0.03	0.02	0.1%	0%
Open Water	LA	0.67	0.38	0.67	0.38	1.5%	0%
Disturbed Areas	LA	0.16	0.16	0.16	0.16	0.6%	0%

* an implicit MOS and Reserve Capacity has been specified in terms of chlorophyll-*a* level achieved compared to target.
** The total watershed for the Wanaque Reservoir includes the Greenwood Lake drainage area. Greenwood Lake and its drainage area were addressed in a previously established TMDL by NJDEP that was approved by EPA on September 29, 2004. The loads from the Greenwood drainage area are taken as boundary conditions and input into the Wanaque Reservoir TMDL.
1 average annual loads for existing conditions based on 1993-2002 model simulation
2 = 1 - (TMDL load /Existing load)*100
3 WLA for 2 facilities within Reservoir tributary watershed downstream from the Greenwood Lake TMDL (2004)
4 The mathematic error 0.20 kg TP/day has been corrected to 0.27 kg TP/day.
5 diversion load typically equals 3%-5% of the annual river load - for river load see Table 6.2 (Najarian 2005)
6 phosphorus concentrations at diversion intake were computed per Omni Environmental, 2007
7 see Table 6.9 for associated land use areas (Najarian 2005)

Table 14. Point Sources assigned individual WLAs for Phosphorus based on TMDL Study

NJPDES Permit Number	Facility Name	**TMDL Approach**	Permitted Flow (MGD)	TMDL Wasteload Allocation	
				Long Term Average Conc. (mg/l TP)	WLA (Kg/d TP)
NJ0003476	Exxon Research & Eng Co	Approach 1	0.29	0.4	0.4
NJ0020281	Chatham Hill STP	Approach 1	0.03	0.4	0.05
NJ0020290	Chatham Township – Main (2)	Approach 1	1	0.4	1.5
NJ0020427	Caldwell Boro STP	Approach 1	4.5	0.4	6.8
NJ0021083	Veterans Adm Medical Center	Approach 1	0.4	0.4	0.61
NJ0021636	New Providence Boro	Approach 1	1.5	EEQ	de minimus
NJ0022349	Rockaway Valley SA	Approach 1	12	0.4	18.2
NJ0022489	Warren Twp SA - Stage 1 & 2	Approach 1	0.47	0.4	0.7
NJ0022497	Warren Twp SA - Stage 4	Approach 1	0.8	0.4	1.2
NJ0022845	Harrison Brook STP	Approach 1	2.5	0.4	3.8
NJ0023698	Pompton Lakes MUA	Approach 1	1.2	0.4	1.8
NJ0024465	Long Hill Twp STP - Stirling Hills	Approach 1	0.9	0.4	1.4
NJ0024511	Livingston Twp	Approach 1	4.6	0.4	7.0
NJ0024902	Hanover SA	Approach 1	4.61	0.4	7.0
NJ0024911	Morris Twp – Butterworth	Approach 1	3.3	0.4	5.0
NJ0024929	Morris Twp – Woodland (2)	Approach 1	2	0.4	3.03
NJ0024937	Molitor Water Pollution	Approach 1	3.5	0.4	5.3
NJ0024970	Parsippany-Troy Hills SA	Approach 1	16	0.4	24.2
NJ0025496	Morristown Town STP	Approach 1	6.3	0.4	9.5
NJ0025518	Florham Park SA	Approach 1	1.4	0.4	2.1
NJ0026514	Plains Plaza Shopping Center	Approach 1	0.02	0.4	0.03
NJ0026689	NJDHS – Greystone Psych Hosp	Approach 1	0.4	0.4	0.6
NJ0027006	Ringwood Boro – Ringwood Acres	Approach 1	0.036	0.4	0.05
NJ0027961	Berkeley Heights	Approach 1	3.1	0.4	4.7
NJ0028291	ISP Management Co Inc	Approach 1	0.05	Treated at Wayne (NJ0028002)	
NJ0029386	Two Bridges SA	Approach 1	10	0.4	15.1
NJ0032395	Ringwood Plaza - Ringwood Assn	Approach 1	0.01168	0.4	0.02
NJ0050369	Warren Twp SA - Stage 5	Approach 1	0.38	0.4	0.6
NJ0052256	Chatham Township - Chatham Glen	Approach 1	0.155	0.4	0.23
NJ0053759	Wanaque Valley RSA	Approach 1	1.25	0.4	1.9
	Total for Approach 1		**82.7**		**122.8**
NJ0021253	Ramapo BOE - Indian High(7)	Approach 2	0.0336	0.4	0.05
NJ0021342	Oakland Boro Skyview-Highbrook STP(7)	Approach 2	0.023	0.4	0.03
NJ0027669	West Milford Twp MUA – Awosting (6)	Approach 2	0.045	0.4	0.07
NJ0027774	Oakland Boro - Oakwood Knolls(6)	Approach 2	0.035	0.4	0.05
NJ0029432	Ringwood BOE – Erskine School(7)	Approach 2	0.008	0.4	0.01

NJ0029858	Oakland Care Center[7]	Approach 2	0.03	0.4	0.05
NJ0053112	Oakland Boro - Chapel Hill Estates[7]	Approach 2	0.01	0.4	0.02
NJ0080811	Ramapo River Club STP - Oakland Twp Riverbend[7]	Approach 2	0.1137	0.4	0.17
	Total for Approach 2		**0.3**		**0.45**
NJ0002577	Nabisco Fair Lawn Bakery [1]	Approach 3	0.385	0.4	0.6
NJ0024490	Verona Twp STP [1]	Approach 3	3	0.4	4.5
NJ0025330	Cedar Grove Twp STP [1]	Approach 3	2	0.4	3.0
NJ0028002	Wayne Twp - Mountain View [1]	Approach 3	13.5	0.4	20.4
NJ0104451	Bayer Corporation [1]	Approach 3	0.216	0.4	0.33
NJG0108880	Paterson City - 31 CSOs	Approach 3	N/A	N/A	4.9
	Total for Approach 3				**33.7**
NJ0021091	Jefferson Twp High - Middle School [3]	Approach 4	0.0275	see Table 7 for permit limits	0.10
NJ0022276	Stonybrook School [3]	Approach 4	0.01	see Table 7 for permit limits	0.04
NJ0024457	Our Lady of Magnificent School [3]	Approach 4	0.0012	see Table 7 for permit limits	0.005
NJ0026867	Jefferson Twp – White Rock [3]	Approach 4	0.1295	see Table 7 for permit limits	0.49
NJ0027685	West Milford Twp MUA – Highview [3]	Approach 4	0.2	see Table 7 for permit limits	0.76
	Total for Approach 4		**0.37**		**1.4**
NJ0024414	W Milford Shopping Center [4]	Greenwood Lake		Greenwood Lake TMDL	0.013
NJ0026174	W Milford Twp MUA - Crescent Park STP [4]	Greenwood Lake		Greenwood Lake TMDL	0.082
NJ0027201	Reflection Lake Garden Apts [4]	Greenwood Lake		Greenwood Lake TMDL	0.003
NJ0027677	West Milford Twp MUA- Olde Milford [4]	Greenwood Lake		Greenwood Lake TMDL	0.248
NJ0028541	West Milford Twp MUA – Birchill [4]	Greenwood Lake		Greenwood Lake TMDL	0.033
	Total from Greenwood Lake TMDL				**0.378**

(1) These dischargers are located in the Lower Passaic River Basin, downstream of the Passaic and Pompton Rivers. Based on the TMDL Analysis, a seasonal effluent limit (May through October) is applicable.
(2) These two facilities are located in the Great Swamp watershed and are included in the Passaic River headwater load allocation. Based on the analysis provided in Appendix D (Omni Environmental, 2007), WLAs are established for these facilities based on a LTA of 0.4 mg/l total phosphorus.
(3) These five discharge facilities are located outside model boundaries. Because of the fact that the TP loads generated by these dischargers are insignificant when compared to the boundary loads, the impact of these dischargers is de minimus. For example, assuming no natural TP load attenuation, the average total permitted load from these facilities is less than 0.71% of the total boundary load. Therefore, the WLAs established for these facilities are based on permitted flow and monthly average concentration in accordance with current permit conditions. The effluent limits set forth in the applicable NJPDES permits will remain in effect.
(4) These discharges are located within the spatial extent of the EPA approved Greenwood Lake TMDL; thus the waste load allocations set in the Greenwood Lake TMDL, which shall be expressed as load limits, apply. These loads are accounted for in the Greenwood Lake boundary condition.

(5) TP Load is based on average existing flow and concentration. Note, to estimate the loads entering Greenwood Lake, the estimated loads from the three discharges located upstream of Pinecliff Lake (i.e., W Milford Twp MUA - Crescent Park STP, Reflection Lake Garden Apartments and West Milford Twp MUA- Olde Milford) were multiplied by 0.44 to account for the retention effect of Pinecliff Lake on phosphorus, therefore the net TP load from these dischargers entering the Greenwood Lake would be0 .19kg/d as shown in table 13.
(6) These dischargers are located in the Wanaque Reservoir Watershed
(7) These dischargers are located in the Pompton Lake Watershed; see Pompton Lake/Ramapo River TMDL for complete description

In a Department review of the active NJPDES surface water point source discharges that contain phosphorus within the Passaic River basin above Dundee Dam, two facilities were found that required further description. The first is New Providence Borough STP (NJ0021636). The New Providence STP is a sanitary wastewater treatment plant that transfers all of the wastewater up to 3.0 MGD to the Joint Meeting of Essex and Union County STP (NJ0024741). The wastewater is discharged to the Passaic River only during heavy wet weather events when wastewater flows are above 3.0 MGD. Because of the intermittent nature of this discharge, the load is de minimus and did not figure into the modeled loads. Therefore, New Providence STP will be assigned a WLA of "0" and will be required to maintain existing effluent quality. Additionally, the facility will not qualify for water quality trading described in the second paragraph below. The second is ISP Management Co. Inc. (NJ0028291), which is an industrial surface water discharge with a sanitary component. Under a Department issued Treatment Works Approval (TWA), the ISP Management Co. Inc. surface water discharge will cease in the near future when the facility ties into the Wayne Twp. Mountain View STP (NJ0028002). Therefore, ISP Management Co. Inc. is addressed within the Wayne Twp. Mountain View STP calculation in the TMDL. Should the ISP Management Co. facility not tie into Wayne Twp. Mountain View STP, the discharge would be subject to the 0.4 mg/l total phosphorus LTA concentration limit.

The assignment of WLAs to point sources, other than stormwater point sources, is based on each source discharging at the permitted capacity at the same long term average effluent concentration. WLAs must be expressed as a daily load in accordance and with EPA requirements. However, effluent concentrations can and do vary on a daily basis. This variation can occur and still achieve the water quality objective provided that, on balance, reductions in point and nonpoint source loads on a long term basis conform to those needed to attain the watershed criteria that have been established through this TMDL. Except as noted below, for wastewater treatment facilities within the WASP 7/DAFLOW (Omni Environmental, 2007) and mass balance (Najarian 2005, as amended) model domains, the Department will establish year-round concentration-only effluent limits determined by applying EPA's *Technical Support Document for Water Quality-Based Toxics Control* (USEPA, 1991) methodology to the LTA of 0.4 mg/l, with a minimum of a 4 times per month sampling frequency and a coefficient of variation equal to the default value of 0.6. For these facilities, the resulting monthly average effluent limit will be 0.76 mg/l. Treatment facilities below the confluence of the Pompton and Passaic Rivers, as identified in Table 14, qualify for seasonal limits, applicable from May through October, as discussed above. Treatment facilities addressed in the Greenwood Lake TMDL will retain the WLAs and effluent limits set forth in that TMDL report. There are five treatment facilities identified in Table 14 that are outside the model domains. In order to maintain the boundary conditions, these facilities will be assigned a WLA consistent with the current permit limits. While this represents a small increase compared to the existing load contributed by these facilities, both the existing loads and the increased loads are de minimus relative to the overall boundary load (less than 0.71%). In addition, four of the facilities discharge to an impoundment, which would significantly mask any contribution from these facilities.

Dischargers will be allowed to engage in water quality trading negotiations to effect a change in effluent limits, with Department approval. It should be noted that, in June 2005 EPA awarded a Targeted Watershed grant in the amount of $900,000 to Rutgers University for the purpose of developing a water quality trading pilot with respect to the phosphorus impairment in the Passaic River basin. This project has been investigating the options for and overall viability of a trading approach in the Passaic River basin. This project will produce a set of tools and rules that will govern allowable trades within the study area. These will include trading ratios and management zones within which trades can occur and still achieve the TMDL outcomes at the critical locations. Once the proposed tools and rules are developed, they will be subject to public comment. Following this process, as well as Department and EPA approval of the protocols, interested permittees can proceed to negotiate trades that achieve the desired result in a more cost effective way. For example, it may be more cost effective for a few larger facilities to upgrade to a higher level than for all treatment facilities to upgrade to the same level. Because diversion of Pompton and Passaic River water into the Wanaque Reservoir is a loading source, another option in the portion of the watershed above the confluence of the Pompton and Passaic Rivers is to trade wastewater treatment plant upgrades for treatment of river water by NJDWSC prior to diversion to the reservoir. The Department anticipates allowing 1 year from the date of permit issuance, provided the terms of acceptable trades have been subject to public comment and approved by EPA and the Department, to negotiate trades so that treatment plant upgrades consistent with permit limits are implemented within the compliance schedules that will be set forth in the permits.

6.0 Follow-up Monitoring

The Water Resources Division of the U.S. Geological Survey and the Department have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. A second ambient monitoring network, NJDEP's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from this these networks have been used to assess the quality of freshwater streams and percent load reductions. Through this TMDL, watershed criteria are proposed for the Wanaque Reservoir and Dundee Lake expressed in terms of a seasonal average of chlorophyll-*a*. Therefore, in order to assess effectiveness of this TMDL, these locations will need to be monitored specifically for chlorophyll-*a* following implementation of the reductions called for.

7.0 Implementation Plan

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

The Department recognizes that TMDLs alone are not sufficient to restore impaired stream segments. The TMDL establishes the required pollutant reduction targets while the implementation plan identifies some of the regulatory and non-regulatory tools to achieve the reductions, matches management measures with sources, and suggests responsible entities for non-regulatory tools. This provides a basis for aligning available resources to assist with implementation activities. Wastewater treatment plants represent the most significant source of phosphorus and needed reductions will be obtained through effluent limitations in their NJPDES permits. For nonpoint source reductions, projects proposed by the State, local government units and other stakeholders that would implement the measures identified within the impaired watershed are a priority for available State (for example, CBT) and federal (for example, 319(h)) funds. In addition, the Department's ongoing watershed management initiative will develop detailed watershed restoration plans for impaired stream segments in a priority order that will identify more specific measures to achieve the identified load reductions.

In these impaired watersheds wetlands and forest represent a significant portion of the land use. As discussed under source assessment, loads from these land uses are not readily adjustable. Agricultural land use is a small portion of the current land use. Therefore, urban land use sources must be the focus for implementation. Urban land use will be addressed primarily by stormwater regulation, including requiring adoption of fertilizer management ordinances, as described below. The limited amount of agricultural land uses will be addressed by implementation of conservation management practices tailored to each farm. Other measures are discussed further below.

Stormwater measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction for nonpoint sources and are applied to the land use categories that correspond to the areas regulated under industrial and municipal stormwater programs. The BMPs required through stormwater permits, supplemented by the additional measure for fertilizer discussed below, are generally expected to achieve the required load reductions. The success of these and the other strategies described below for nonpoint source load reduction will be assessed through follow up monitoring. As needed, consistent with the concept of adaptive management, other additional measures may need to be identified and included in stormwater permits. Additional measures that may be considered in the future include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to provide or enhance nutrient removal. A more detailed discussion of stormwater source control measures follows.

The NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" to develop stormwater management programs consistent with the NJPDES permit requirements. The stormwater discharged through "municipal separate storm sewer systems" (MS4s) also regulated under the Department's stormwater rules. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, street sweeping, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development. For example, the US Department of Transportation Federal Highway Administration cites a state of California study on vacuum sweeper efficiency in which a total phosphorus removal rate of 74% was achieved, compared to mechanical sweeper efficiency rate of 40% (www.fhwa.dot.gov/environment).

Because most of the land use based phosphorus load reductions must be obtained from urban land uses, an additional measure to reduce the phosphorus load from landscape maintenance is needed in order to effectively reduce the phosphorus load originating from the extensive urban land uses. The literature supports that a significant overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. In fact, after 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because they found that most soils had enough phosphorus to keep a lawn healthy. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

Therefore, as identified in Appendix B, the municipalities within the spatial extent of this TMDL study will be required to adopt an ordinance, consistent with a model ordinance provided by the Department, as an additional measure of the Municipal Stormwater Permit. The model ordinance can be viewed at www.state.nj.us/dep/watershedmgt/rules.htm under the section heading Water Quality Management Rules. The additional measure is as follows:

Fertilizer Management Ordinance

Minimum Standard – Municipalities identified in Appendix B shall adopt and enforce a fertilizer management ordinance, consistent with the model ordinance provided by the Department.

Measurable Goal - Municipalities identified in Appendix B shall certify annually that they have met the Fertilizer Management Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities identified in Appendix B shall have fully implemented the Fertilizer Management Ordinance minimum standard.

Agricultural and other measures

Generic management strategies for nonpoint source categories, beyond those that will be implemented under the municipal stormwater regulation program, and responses are summarized below.

Table 15. Nonpoint Source Management Measures

Source Category	Responses	Potential Responsible Entity	Possible Funding options
Human Sources	Septic system management programs	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Non-Human Sources	Goose management programs, riparian buffer restoration	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Agricultural practices	Develop and implement conservation plans or resource management plans	Property owner	EQIP, CRP, CREP

Human and Non-Human measures

Where septic system service areas are located in close proximity to impaired waterbodies, septic surveys should be undertaken to determine if there are improper effluent disposal practices that need to be corrected. Septic system management programs should be implemented in municipalities with septic system service areas to ensure proper design, installation and maintenance of septic systems. Where resident goose populations are excessive, community based goose management programs should be supported. Through stewardship programs, areas such as commercial/corporate lawns should be converted to alternative landscaping that minimizes goose habitat and areas requiring intensive landscape maintenance. Where existing developed areas have encroached on riparian buffers, riparian buffer restoration projects should be undertaken where feasible. In the Pompton Lake drainage area an ambitious reduction of nonpoint source loads is called for. In this drainage area restoration of riparian buffers is a focus for implementation of the Pequannock River Temperature TMDLs (NJDEP, 2004). This measure is expected to provide additional load reductions needed to achieve this objective.

Agricultural measures

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

The Environmental Quality Incentive Program (EQIP*)* is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

The Conservation Reserve Program (CRP) is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

Conservation Reserve Enhancement Program (CREP) The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, signed a $100 million CREP agreement earlier this year. This program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP is part of the USDA's Conservation Reserve Program (CRP). There is a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

Current Implementation Projects

The following projects are either ongoing or are anticipated to be implemented in the TMDL study area. These projects were either funded by the 319(h) grants and/or funding was provided by the Corporate Business Tax and are expected to have an immediate and positive effect on water quality. They include riparian buffer planting, goose management, septic management, stormwater retrofits, ordinances and public education.

1. Rockaway River: Restore 3,000 continuous feet of degraded buffer on Jackson Brook (tributary to Rockaway River) and develop and implement a goose management strategy in Hurd Park, Dover (project ongoing)
2. Rockaway River: Stormwater Wetland Restoration project at the Morris County Department of Public Works (DPW) site in Roxbury to reduce fecal

coliform and Total Suspended Solids (TSS) input to the Rockaway River. (work ongoing)

3. Whippany River: Development of ordinances and zoning policies to reduce NPS pollution in municipalities of the Whippany River watershed. (Work completed)
4. Posts Brook: Stormwater implementation project in the Township of West Milford. (Work ongoing)
5. Visual Assessment of Streams in WMA 3 and ranking for stream restoration; Restoration of Camp Glen Gray, Bergen County Park to address stormwater runoff from erosion sources. (Work completed)
6. Ramapo Reservation Lake: Installation of 1000 feet of riparian buffer restoration. (Completed)
7. Greenwood Lake: Identify stormwater problem areas and based on the identification of "hot spots" implement two retrofits to reduce NPS load, as funds permit. (Work ongoing)
8. Greenwood Lake: Based on Stormwater Plan identified in #7 above additional funding for stormwater implementation is anticipated for the 2007 cycle of 319(h) funding.
9. Belchers Creek: Installation of cross-sectional catch basins to reduce NPS pollutants to Pinecliff Lake. (Work completed)
10. Development of an Onsite Wastewater Treatment Systems Management Plan Greenwood Lake: The New Jersey section of the Greenwood lake watershed is located in West Milford Township. Using 604(b) funds this planning effort will include: the development of a digital database and establishment of a process for the tracking of OWTS; an update of the estimate of the lake's annual phosphorus load originating from the OWTS; Collection of sub-surface soil leachate samples to quantify the phosphorus and fecal coliform entering the lake or its tributaries; identification of potential management measures for the OWTS; an effective, aggressive, pro-active public educational initiative; an implementation schedule including budgetary and technical needs; and the development of an objective and rational prioritization scheme for the OWTS focusing on maintenance, inspection and to varying degrees rehabilitation. The grant provides for identification of potential management measures to address the prioritized OWTS within the planning area to be developed into an OWTS BMP manual. The final task will be the submission of the OWTS Management Plan by the Township to the NJDEP as a proposed amendment to the Northeast Areawide Water Quality Management Plan.
11. Watershed Based Restoration Plan for Molly Ann Brook (ongoing).
12. Verona Park Lake: Installation of 10-foot wide vegetated buffer on the lake shoreline to address large resident goose population. (Work completed)

13. Bee Meadow Pond: Development of goose management plan with 1100 feet of linear shoreline restoration with pre-implementation and post-implementation monitoring. (Post-implementation monitoring is ongoing).
14. East Lake and Bryant's Stream: Riparian restoration on Whippany tributaries. Goose management implementation included (Work completed).
15. Troy Brook: Development of regional stormwater management plan including drainage area specific objectives. (Work ongoing).
16. Speedwell Lake: Riparian restoration to address erosion, stormwater and geese. (Work completed).
17. Whippany River: Retrofit an existing stormwater detention basin to reduce NPS load, plant approximately 20,000 square feet of detention basin with native vegetation. (Work completed).
18. Development of a septic management plan in the Greenwood Lake Watershed (work ongoing).
19. Preakness Watershed Plan; offshoot of the Passaic River Priority Stream Segment (Two Bridges to Elmwood Park) Plan. (Work ongoing).
20. Pequannock River Thermal Mitigation, Monitoring and Assessment: This project addressed two nonpoint source areas that are contributing to the increased temperature due to loss or riparian canopy. Riparian restoration was undertaken at Bailey Brook in Bloomingdale and the Pequannock River in Riverdale. Another component of this project was the documentation of areas in the Pequannock River headwaters that are impacted by current or past beaver activity and the collection of flow and temperature data for all significant tributaries in the Lower Pequannock drainage. Identification and mapping of stormwater outfalls in the lower and central Pequannock drainages were also undertaken. The majority of this project is complete, the monitoring is still underway as part of this contract, to ensure a longer term database for temperature in this watershed.
21. A *WMA 3 Restoration Master Plan* was conducted over two years using a visual assessment protocol modified from the USDA methodology. This project was also funded with 319(h) funding. The project included four sub-watersheds, one of which was the Pequannock. Forty-five sites in the Pequannock Basin were identified for restoration projects. The average score based on the visual assessment for the overall basin was 7.8 SVAP (STREAM VISUAL ASSESSMENT PROTOCOL). Of the 45 sites, 24 scored below the basin average scores. Several of the Pequannock sites were rated as high priority and these sites would be priority sites for future restoration projects. Streambank restoration with replacement canopy would have a mitigating effect on temperature exceedances and limit exposure of waterbody to sunlight; thus minimizing the potential for algal growth. An addendum of the final report included a Management Strategy Table with a Habitat Enhancement category. For this category several sites on the Pequannock River and Kanouse Brook have been identified as candidates for habitat

restoration and enhancement. As part of the WMA 3 Restoration Master Plan the following sites were identified as containing deficient riparian buffers and these sites can provide a starting point for addressing riparian corridor restoration on both the mainstem Pequannock and significant tributaries feeding the river:

- Site 142- Pequannock River northwest of Route 23 between old Route 23 and Route 23 Railroad
- Site 143- Pequannock River southwest tributary of Pequannock headwaters at Rt. 23 bridge crossing
- Site 153- Clinton Brook 0.25 miles above Clinton Reservoir
- Site 155- Kanouse Brook, 0.65 miles north of confluence with Pequannock River
- Site 156- Kanouse Brook, 2.2 miles north of confluence with Pequannock River
- Site 158- Clinton Brook, 1.1 miles south of Clinton Reservoir adjacent to LaRue Road
- Site 168- Stone House Brook at confluence with Pequannock River
- Site 172- Pequannock River, 0.8 miles north of confluence with Wanaque
- Site 174- Matthew Brook
- Site 176- Van Dam Brook, Riverdale Town Park
- Site 177- Pequannock River, 0.15 miles north of confluence of Beaver Brook

This list should not be considered inclusive as it was part of a larger project for WMA 3 of which thermal mitigation was not the primary focus; therefore the list should be considered a starting point. The study also looked at ownership of land, and had public lands as a criterion for evaluation. As redevelopment occurs, inclusion of a riparian corridor to provide canopy should be implemented where feasible.

22. Other completed 319(h) projects in the watershed that support the restoration of Green Infrastructure throughout the Passaic River Basin:

- Center Street Restoration Project
- Mendham Detention Basin Retrofit
- Rockaway River stream corridor improvement at Knoll Golf Club
- Bryant Stream/Phase I and Construction for East Lake in Burnham Park
- Lakeside Restoration/East Lake in Burnham—Phase II

<u>Priority Stream Segment Initiative</u>

In addition to the generic and specific, current and future implementation measures identified above, the Department, through its watershed management program, has undertaken the development of watershed restoration plans for priority stream segments. Each area identifies specific measures and the means to accomplish them for specific impaired pollutant. Priority was based on the following criteria:

- Headwater area;
- Proximity to drinking water supply;

- Proximity to recreation area;
- Possibility of adverse human health conditions;
- Proximity to a lake intake;
- Existence of eutrophication;
- Phosphorus is identified as the limiting nutrient;
- Existence of use impairments;
- Ability to create a measurable change;
- Probability of human source;
- Stream Classifications;
- High success level.

Listed below are priority stream segments projects located within the TMDL Study Area, in which activities are occurring to support the development of watershed restoration plans that will, in turn, lead to implementation projects that will help address phosphorus and other pollutants of concern.

NPS Grant: Demonstration Project to Support TMDL Implementation for the Pequannock River

As identified in the Pequannock River TMDL and the Pequannock River Temperature Impairment Characterization, Assessment and Management Plan discharges into river tributaries from smaller lakes and ponds can contribute to thermal elevation in the Pequannock River and its tributaries. This occurs because impoundments slow flows, expose waters to increased sunlight and release heated surface water from impoundments over spillway outlets. Preliminary sampling by the Pequannock River Coalition has shown that small impoundments do offer a level of temperature stratification within these impoundments that may be utilized to achieve downstream temperature reductions of 3-4 degrees Fahrenheit. This project is a demonstration project and will actually occur on the West Brook in the Township of West Milford. The West Brook is impaired for temperature. The demonstration project will provide siphon piping from bottom water to provide a temperature reduction in the West Brook. This system will be monitored and documented for replication on other waterways.

Passaic River from Two Bridges to Elmwood Park Border

This project involved the development of an in-depth characterization of the current conditions relating to the pollutant of concern, fecal coliform, within the identified stream segment based on available data, and an evaluation and assessment of the findings of that characterization to evaluate and assess the short-term and long-term management measures that will be required to allow the stream to achieve full attainment of its designated uses. A Stream Characterization Report, including cost-benefit analyses, monitoring and modeling as applicable with available funds, identification of data gaps, and recommendations for further work and actions were the principal deliverables.

Future Project Recommendations

1. The development of BMPs and Model ordinances to address the reduction of fecal coliform, and other pollutants, including phosphorus, associated with nonpoint sources.
2. The development of a Watershed Management Plan of an associated waterway, Molly Ann Brook, was a direct result of the Characterization and Assessment Report findings.

Rockaway River between Route 80 and Blackwell Street in Dover

The Rockaway River Watershed Cabinet (RRWC) completed a detailed water quality sampling and analysis for a portion of the Rockaway River with a focus on fecal coliform. The RRWC is evaluating a segment of the Rockaway River in Dover Town, Wharton Borough, and Roxbury Township to develop an implementation plan consistent with the NJDEP TMDL and nonpoint source program. The stream segment begins at the Blackwell Street crossing in Dover and continues upstream to the Interstate Highway Route 80 crossing. This four-mile segment flows through developed areas of the towns as well as significant areas of undeveloped forest and wetlands. In this reach, three tributary streams, Jackson Brook, Green Pond Brook and Stephens Brook, join the Rockaway River. The goal of this evaluation was to assist with the identification of impacts to the stream and specifically evaluate nonpoint source pollution sources, storm water runoff concerns, and potential sources of bacteria (fecal coliform). Measures to reduce fecal coliform will also reduce phosphorus.

Future Project Recommendations

1. Construction of wetlands and floodplain restoration along Green Pond Brook. Currently, this area receives surface water runoff from an adjacent roller rink parking lot and surrounding roads. It is assumed that the site historically was a forested floodplain associated with Green Pond Brook. The proposed restoration action will include removal of the root mat, installation of slope stabilization, biodegradable filter fabric and excavation of a series of wetland treatment ponds connected by a meandering channel to treat storm water from a 6-acre drainage area prior to discharge into the Rockaway River. (Work ongoing)

2. Implementation of stormwater BMPs and restoration projects to include Bowlby Pond and Mckeel Brook drainage areas. Restoration activities could include reconnecting the natural drainages, and /or day lighting or improving the outfall channel connection resulting in the reduction of sediments and stream velocities thus by restoring the natural hydrology to the brooks and enhancing the fish and wildlife populations.

3. Development of a Regional Stormwater Management Plan. The plan will be designed to comply with NJDEP Storm water Regulations and permitting

requirements to be met by each municipality. The municipalities involved include Dover Town, Wharton Borough, Rockaway, Randolph, Mine Hill, Roxbury and Jefferson Townships.

8.0 Reasonable Assurance

Reasonable assurance that the TMDL will result in attainment of the proposed chlorophyll-*a* watershed criteria requires both a reduction of the current phosphorus loading and protection against increased phosphorus loading from future development. The above implementation plan describes various regulatory and non-regulatory management measures that will result in reduced phosphorus loads.

Additionally, NJDEP adopted the Stormwater Management Rules N.J.A.C 7:8, will minimize the impact of stormwater run-off from new development. The Stormwater Management Rules, N.J.A.C. 7:8, establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department's Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, and Waterfront Development.

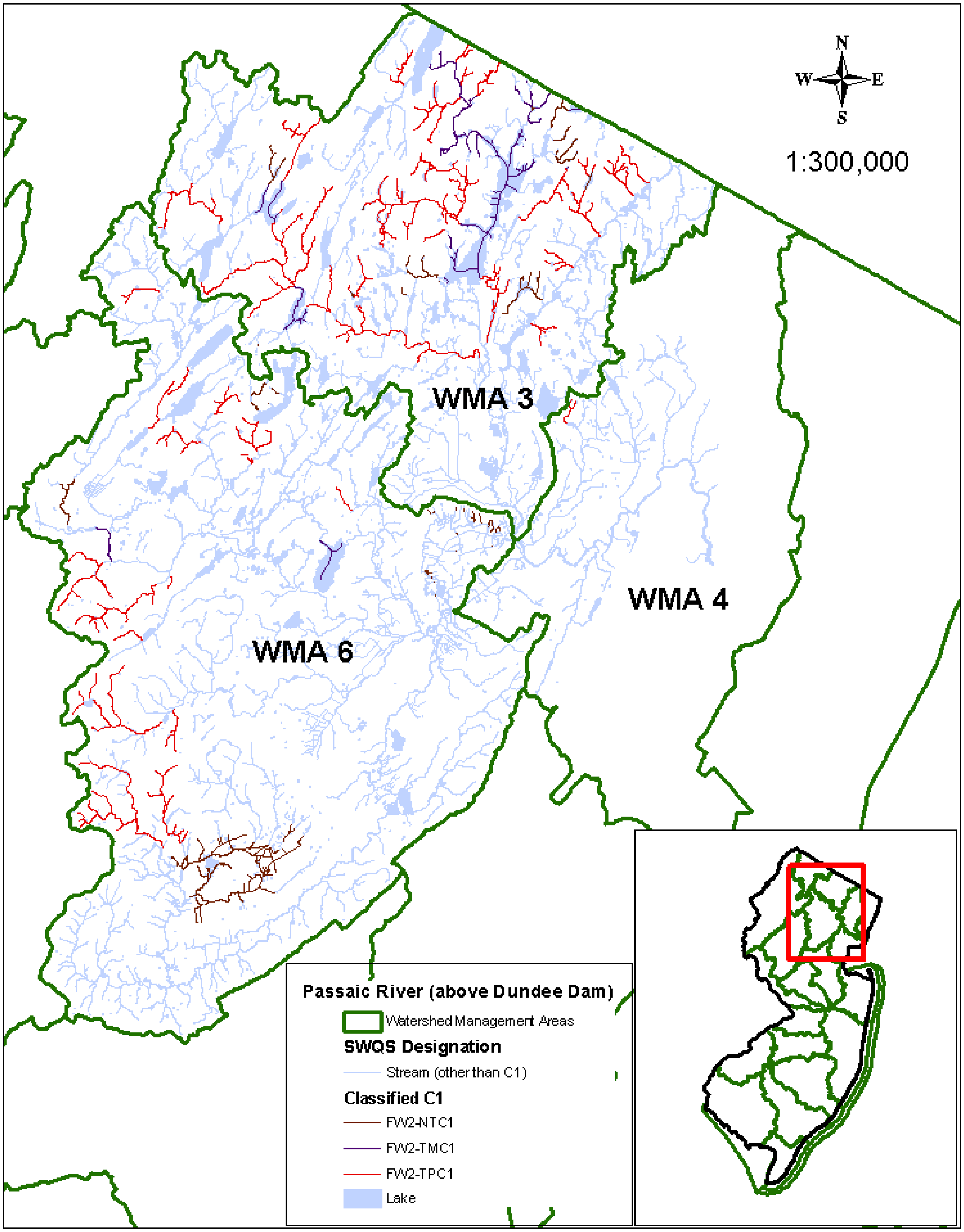
The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients.

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities will also be updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules.

Furthermore, the New Jersey Stormwater Management Rules establish a 300-foot special water resource protection area (SWRPA) around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. Category One waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at http://www.state.nj.us/dep/wmm/sgwqt/sgwqt.html C1 designations within the pertinent portion of the Passaic River watershed are depicted on Figure 5.

Commitment to carry out the activities described in the implementation plan to reduce phosphorus loads, including establishing NJPDES effluent limits for wastewater treatment facilities, the requirements of the Stormwater Management Rules and the Municipal Stormwater Regulation Program, present and future priority stream segment and other projects, provide reasonable assurance that the chlorophyll-*a* site watershed criteria will be attained for phosphorus in the spatial extent of the TMDL study. Follow up monitoring will identify if the strategies implemented are completely, or only partially successful. It will then be determined if other management measures can be implemented to fully attain the chlorophyll-*a* watershed criteria or if it is necessary to consider other approaches, such as use attainability. Although not currently listed as impaired, as part of this TMDL study, it was determined that a small stretch of the Peckman River at its mouth experiences excessive primary productivity. Nevertheless, this location was not identified as a critical location for which phosphorus reductions would be targeted at this time. This area is under consideration for channel modification as described in a report entitled *Peckman River Basin New Jersey Feasibility Studies for Flood Control and Ecosystem Restoration*, (ACOE, 2002). If the channel modifications were to be implemented, the mouth of the Peckman River may no longer be a site subject to excessive primary productivity. Therefore, WLAs were assigned to Peckman River dischargers as needed to attain the Dundee Lake water quality objectives. The Department will continue to monitor this situation and may determine that more stringent WLAs are needed to attain water quality objectives in the Peckman River.

Figure 5. Category One waterways in WMAs 3, 4, and 6 (as of January 1, 2007)



9.0 Public Participation

In accordance with the Water Quality Management Planning Rules each TMDL shall be proposed by the Department as an amendment to the appropriate areawide water quality management plan(s) in accordance with N.J.A.C. 7:15-3.4(g). N.J.A.C. 7:15-3.4(g)5 states that when the Department proposes to amend an areawide water quality plan on its own initiative, the Department shall give public notice by publication in a newspaper of general circulation in the planning area, shall send copies of the public notice to the applicable designated planning agency, if any, and may hold a public hearing or request written statements of consent as if the Department were an applicant. In addition, the Department is proposing watershed criteria for the Wanaque Reservoir and Dundee Lake. With adoption of this TMDL, these watershed criteria become the SWQS in accordance with N.J.A.C. 7:9B-1.5(g)3, subject to approval by EPA.

The Department has maintained a long term commitment to the stakeholder process and public participation in the development of this TMDL for the Passaic River Basin. The TMDL was developed with assistance and direct input from stakeholders in Watershed Management Areas 3, 4 and 6.

The stakeholder process in the Passaic River Basin has been continuous for over 13 years. The resulting collaborative restoration process arose out of a 1993 pilot watershed initiative in the Whippany River Watershed (1993 – 2000) and litigation over permit requirements. The Department's early meetings with dischargers in 1996 in response to a settlement agreement over proposed phosphorus permit limits coupled with the Whippany River Watershed Pilot project evolved into a comprehensive watershed management process. This model for watershed management was later refined and replicated throughout the state in twenty watershed management areas (WMAs).

The Department initiated a pilot watershed project in 1993 in the Whippany River Watershed to aid the Department in developing a comprehensive watershed process that could be replicated throughout the state. The 70 square mile Whippany River Watershed lies in the heart of the larger Passaic River Basin and was instrumental in pulling stakeholders with varied interests and backgrounds together to discuss and address issues germane to the Watershed. Stakeholders included: active watershed groups, academics, business, industry, consultants, interested public, purveyors as well as dischargers. The watershed management process has afforded New Jersey a unique opportunity to openly discuss and vet projects that need to be undertaken to ensure New Jersey achieves its statewide "clean and plentiful" water goal.

The Public Advisory Group (PAG), Technical Advisory Committee (TAC) and several subcommittees met for 6 years in an effort to achieve the goal to restore and preserve the value of the Whippany River as a vital natural resource. A main reason that the

Whippany River Watershed was selected as the state's pilot watershed project was because of the number of dischargers located in the watershed. The Department recognized a unique opportunity in having dischargers, purveyors, environmental interest groups, local and state governments come together to vet and resolve issues unique to a specific geographic location. In addition to a replicable format for watershed management, one of several significant outcomes of the pilot watershed process included: the *TMDL for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River Watershed* adopted in December 1999 and its companion document Appendix G, *A Cleaner Whippany River Watershed NPS Pollution Control Guidance Manual for Municipal Officials, Engineers and Department of Public Works, May 2000*. A workshop was held to acquaint municipalities with the best management practices recommended by the Technical Advisory Committee's NPS Workgroup.

During this time, the Department had also been meeting with the dischargers and purveyors in the Passaic River Basin on a regular basis through The Passaic River Task Group (1996 – 1998). The first priority of the Group was common concerns on phosphorus and eutrophication. Originally, the Whippany TMDL was proposed in 1999 to address both fecal coliform and phosphorus. Subsequently, only the fecal TMDL was established, since it was determined that, in the Whippany River, phosphorus was not rendering the waters unsuitable for the designated uses and so no phosphorus impairment was present. The Department did not pursue delisting because the Whippany River is a tributary to the Passaic River Basin wherein total phosphorus had not been assessed with respect to phosphorus rendering waters unsuitable for designated uses and, at a minimum, the Wanaque Reservoir was known to be a critical location of concern with respect to phosphorus loading. Thus, study of the larger area could result in the finding that phosphorus reductions on the Whippany would be needed to achieve water quality objectives in downstream locations.

The Group met through 1998, at which time the Department began a statewide watershed process within each of 20 watershed management areas that had been delineated for this purpose. Consequently, a Public Advisory Committee (PAC) and TAC were initiated for WMA 6. After the completion of the Whippany Fecal TMDL the Department-led Whippany River Watershed PAG and its TAC evolved into the WMA 6 PAC and TAC respectively which, met regularly from 1998-2003. The WMA 6 TAC assumed the mandate to discuss water quality related issues such as TMDL requirements.

In the Fall of 2000, the Department awarded two years worth of grant funding to 16 lead entities to serve as an extension of the Department to facilitate the watershed process for all 20 watershed management areas throughout the state. Deliverables from this statewide process varied; but resulted in the creation of PACs and TACs for WMAs 3 and 4; development of an extensive watershed characterization and assessment for WMAs 3, 4, and 6; creation of water resource based open space plans; and the implementation of numerous streambank restoration projects. At the same time, in order to successfully develop a comprehensive Passaic River Basin TMDL study, a separate committee was charged to focus on nutrient impairments in the Basin. With the Department, the Workgroup prepared the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin,* October 2001. The primary purpose of the report was to memorialize the outcome of the discussions to develop TMDLs and other management responses. The Workgroup continued to meet monthly through 2003.

In 2004, monitoring and initial modeling results from the TMDL work conducted by Quantitative Environmental Analysis, LLC (QEA), Najarian Associates and Omni Environmental, acting under contract to the Department, were shared and made available to the Passaic River Basin stakeholders through several informational sessions. On March 23, 2004, QEA presented their findings from the Ramapo River and Pompton Lakes Study to the WMA 3 PAC. Data exchange meetings based on the information collected by Omni Environmental were held on April 15, 2004, April 27, 2004, and September 28, 2004 and all stakeholders were invited to attend. On November 18, 2004, Najarian Associates presented preliminary findings on the Wanaque TMDL to the Passaic River Basin stakeholders. The Department conducted informal meetings with stakeholders on April 27 and September 28, 2004 to present model calibration and verification. The Department then conducted a meeting on June 23, 2005 with the affected dischargers in the Basin to present the findings from the work completed by Najarian Associates for the Wanaque Reservoir and that portion of the Basin above the confluence of the Pompton and Passaic Rivers.

On July 5, 2005 the Department proposed a Phase 1 Passaic River Study TMDL for phosphorus in the Wanaque Reservoir and a TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River. A public hearing on these TMDLs was held on August 4, 2005 at the Cultural Center at the Lewis Morris County Park in Morristown. After the public meeting, at the request of the commenters, the Department extended the public comment period until November 21, 2005. Nearly 100 people attended the hearing and some of the specific issues/comments raised are discussed below.

- Applicability of the phosphorus standard as a not to exceed value in the Wanaque Reservoir is inappropriate.

  Based on the thorough monitoring of the Passaic River basin and identification of critical locations and the behavior of response indicators to phosphorus loads through dynamic modeling, watershed criteria for Wanaque Reservoir and Dundee Lake were proposed through this TMDL report and, with adoption of the TMDL, are now the applicable SWQS, subject to approval by EPA. These criteria are expressed in terms of a seasonal average chlorophyll–*a* concentration specific to each location.

- Costs associated with treatment for phosphorus removal and longer term implementation consequences such as increase in sludge production and associated cost for removal, chemical usage, and total dissolved solids increases in effluent being discharged to the receiving waters;

  The goal of a TMDL is to identify the load reductions necessary to achieve the SWQS and the designated use of the waterbody. This TMDL has evaluated the Passaic River basin thoroughly and determined where reductions in phosphorus load will result in environmental improvement. Further, watershed criteria proposed through this TMDL provide a fine tuning of the load reductions to achieve results in terms of response indicators. Reductions required are reasonable and achievable. Further, trading is offered as an option to achieve the needed load reductions in the most cost effective manner.

- The LA-WATERS model and water quality data inputs should be made available to the public for use to fully evaluate the TMDL results.

  The LA-WATERS model is a proprietary model and has not been released by the owners, NJDWSC and Najarian Associates. The proprietary nature of the model was known when the TMDL study for the Passaic River basin was initiated. This fact notwithstanding, the Passaic TMDL workgroup endorsed the use of this model, as documented in the public participation process. The LA-WATERS model has been peer reviewed and accepted as a valid predictive tool for the Wanaque Reservoir. The simulation outputs compared to actual data have been presented graphically in support documentation for this TMDL, which is sufficient for evaluating the scientific validity of the tool.

- Applicability of Phase I study to headwater dischargers given the in-progress comprehensive Phase II study.

  The Department proposed the Phase I TMDL with initial hopes to jumpstart water quality improvement. However, given delays experienced in finalizing Phase I, the Phase II study has since been completed. The Department has determined that the most efficient means to achieve water quality improvement is to incorporate the relevant portions of the Phase I study into this TMDL document.

- Water supply diversions should be treated as point sources, and the North Jersey District Water Supply Authority should receive a NJPDES permit for adding phosphorus load to the Wanaque Reservoir.

It has been determined that diversions are not point sources subject to permitting under the National Pollutant Discharge Elimination System permit, as discussed in the August 5, 2005 EPA memorandum, *Agency Interpretation on Applicability of Section 402 of the Clean Water Act to Water Transfers*. Nevertheless, the Department agrees conceptually that a water supply diversion responsible for delivering pollutant loads to a water body should be considered in assigning responsibility for pollutant load reductions necessitated by the act of diverting water. In this case, the load reductions required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. Water quality trading is an option through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir, which is affected by the diversion of Pompton and Passaic River water into the reservoir.

- Achieving the 80 percent reduction in NPS called for is unrealistic.

As discussed in Section 5.0 of this document, this TMDL utilizes EMCs in conjunction with land use distribution and area weighted contributions of stormwater to provide a more precise estimate of the contribution of nonpoint source loadings from the land use. As a result, the final percent reduction is 60 percent in most of the drainage area requiring a reduction, ranging from 0 to 85 percent. The Department believes the identified measures will attain these load reductions. Follow up monitoring will identify if the strategies implemented through this TMDL are completely, or only partially successful. It will then be determined if other nonpoint source management measures must be implemented to fully attain water quality objectives or if it is necessary to consider other approaches, such as use attainability.

- What are the assurances that New York will attain New Jersey's SWQS at the border, a boundary assumption for the TMDL.

NJDEP has been in communication with both New York State and US EPA regarding this TMDL and the need for New York to achieve New Jersey's SWQS at the border. Progress has been made with the application of a 0.2 mg/l effluent limit on the Western Ramapo Wastewater treatment facility. It is expected, however, that NPS load reductions also will be needed in order to fully achieve the boundary objective.

- Basin dischargers are receiving special treatment since other dischargers are already receiving permits with 0.1 mg/l phosphorus requirement.

In March 2003 the Department issued a *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* (phosphorus protocol) that provides the necessary guidance to determine if the numeric criterion for phosphorus applies. The phosphorus protocol is available to all dischargers who receive a water quality based effluent limit for phosphorus based on the numeric criterion. However, in the Passaic River basin, in response to permit appeals when phosphorus limits were initially imposed there, the Department entered into settlement agreements with Passaic River basin dischargers establishing that the Department will not impose a phosphorus effluent limit until the appropriate limit has been determined through a TMDL. The settlement agreements predate and obviate the application of WQBELs pending the outcome of this TMDL.

For the Phase II study, the Department conducted additional outreach on May 19, 2006 and a presentation was made on behalf of the Department at the October 13, 2006 2nd Passaic River Symposium held at Montclair State University. The Department met with the dischargers and purveyors on September 11, 2006 to seek input on chlorophyll-*a* target endpoints for the Wanaque Reservoir and Dundee Lake Dam and to share preliminary findings on load reductions and how these should be translated into effluent limits.

Throughout the development of the TMDLs for the Passaic River Basin input was received through Rutgers New Jersey EcoComplex (NJEC). The Department contracted with the NJEC in August 2001. The NJEC consists of a review panel of New Jersey university professors whose role is to provide comments on the Department's technical approaches for the development of TMDLs and other management strategies. Their comments on the TMDL study have resulted in refinements to the modeling work upon which this TMDL document is based.

Notice proposing the Passaic River basin phosphorus TMDL was published on May 7, 2007 in the New Jersey Register and in a newspaper of general circulation in the affected area in order to provide the public an opportunity to review the TMDL and submit comments. In addition, a public hearing was held on June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ 07962-1295. Notice of the proposal and hearing was provided to affected Designated Planning Agencies, municipalities, dischargers, and purveyors in the watershed. On October 20, 2007 the Department extended the comment period by an additional 30 days in order to afford more time for public review of the watershed model itself.

All comments received during the public notice period and at the public hearing for this TMDL study and the proposed watershed criteria upon which it is based are part of the record for this TMDL study and have been considered in finalizing this TMDL study. This final TMDL report, as well as the watershed criteria for Wanaque Reservoir and Dundee Lake have been adopted as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware WQMPs. As a result, the watershed criteria are now the SWQS with respect to phosphorus for the identified critical locations, subject to approval by EPA. The full summary of comments and responses can be found in Appendix F of this document.

Appendix A: Cited References

Total Maximum Daily Loads. Kansas Department of Health and Environment, Bureau of Water. May 2007
http://www.kdheks.gov/tmdl/eutro.htm

Kansas Department of Health and Environment (KDHE). *Neosho River Basin: Federal Council Grove Lake TMDL.* Kansas: KDHE, 2002

Litwack, H.S., DiLorenzo, J.L., Huang, P., and Najarian, T.O.. "Development of a Simple Phosphorus Model for a Large Urban Watershed: A Case Study". Journal of Environmental Engineering, 132 (2006): 538-546.

Missouri Department of Natural Resources (MDNR). *Total Maximum Daily Load for McDaniel Lake, Green County, Missouri.* Missouri: MDNR, February 3, 2004.

Najarian Associates, Inc., Poshu Huang, Tavit O. Najarian and Vajira Gunawardana, submitted under contract to the North Jersey District Water Supply Commission and Hackensack Water Company. "Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program". (1988).

Najarian Associates, Inc., submitted under contract to the New Jersey Department of Environmental Protection, Division of Watershed Management, Northeast Bureau. "Water Quality Assessment of the Upper Passaic River Watershed and the Wanaque Reservoir". (2000).

Najarian Associates, Inc., submitted under contract to the Department of Environmental Protection. "Development of a TMDL for the Wanaque Reservoir and Cumulative WLAs/LAs for the Passaic River Watershed". (2005).

Najarian Associates, Inc., submitted under contract to the New Jersey Department of Environmental Protection. "Phosphorus Chlorophyll a Relationship Wanaque Reservoir Addendum to the Najarian 2005 report". (2007).

New Jersey Department of Environmental Protection (NJDEP). Water Monitoring and Standards Element. *Integrated Water Quality Monitoring and Assessments Methods*. New Jersey: NJDEP, November 2003.

New Jersey Department of Environmental Protection. Water Monitoring and Standards Element. *Integrated Water Quality Monitoring and Assessments Methods*. New Jersey: NJDEP, December 2006.

New Jersey Department of Environmental Protection. Water Monitoring and Standards Element. *New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d).* New Jersey: NJDEP, 2004.

New Jersey Department of Environmental Protection. Water Monitoring and Standards Element. *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d).* New Jersey: NJDEP, 2006.

New Jersey Department of Environmental Protection. *Passaic River – Water Quality Management Study, Special Report by Jenq, T., Litwack, H. S., Hundal, H., and Hsueh, S.F..* New Jersey: NJDEP, 1987.

New Jersey Department of Environmental Protection. Division of Watershed Management and Whippany Nonpoint Source Workgroup. *A Cleaner Whippany River Watershed NPS Pollution Control Guidance Manual for Municipal Officials, Engineers and Department of Public Works.* New Jersey: NJDEP, May 2000.

New Jersey Department of Environmental Protection. Division of Water Quality. *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits.* New Jersey: NJDEP, March 2003.

New Jersey Department Environmental Protection. Division of Watershed Management. *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*. New Jersey: NJDEP, October 2001.

New Jersey Department of Environmental Protection. Division of Watershed Management. *Amendment to the Northeast Water Quality Management Plan - TMDL for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River Watershed.* New Jersey: NJDEP, 1999.

New Jersey Department of Environmental Protection. Division of Watershed Management. *Amendment to the Northeast Water Quality Management Plan - TMDL for Phosphorus to Address 3 Eutrophic Lakes in the Northeast Water Region*. New Jersey: NJDEP, 2003.

New Jersey Department of Environmental Protection. *Amendment to the Northeast Water Quality Management Plan - Total Maximum Daily Loads for Phosphorus to Address Greenwood Lake in the Northeast Water Region*. New Jersey: NJDEP, 2004.

New Jersey Department of Environmental Protection. *Amendment to the Northeast Water Quality Management Plan - Total Maximum Daily Loads to Address Temperature in the Pequannock River in the Northeast Water Region*. New Jersey: NJDEP, 2004.
North Jersey District Water Supply Commission (NJDWSC). *Watershed Characterization and Assessment – Passaic River Basin, WMA 3.* New Jersey : NJDWSC, 2002.

North Jersey District Water Supply Commission (NJDWSC). *Watershed Characterization and Assessment – Passaic River Basin, WMA 4.* New Jersey: NJDWSC, 2002.

North Jersey District Water Supply Commission (NJDWSC). *Watershed Characterization and Assessment – Passaic River Basin, WMA 6.* New Jersey: NJDWSC, 2002.

Oklahoma Water Resource Board. *Justification for Clorophyll-a Criteria to Protect Public and Private Water Supply Beneficial Use of Sensitive Waters.* June 2005

Pennsylvania Department of Environmental Protection. *Total Maximum Daily Load Dutch Fork Lake, Washington County, Pennsylvania State Water Plan 20 E.*
February 25, 2003.

Pennsylvania Department of Environmental Protection. *Total Maximum Daily for Lake Galena* (Peace valley PA617). Pennsylvania: PADEP, December 9, 2003.

Tetra Tech Inc., submitted under contract to the U.S. EPA, Region 3. *Total Maximum Daily of Nutrients for Green Lane Reservoir, Montgomery County,* PA. Pennsylvania: Tetra Tech Inc., March 10, 2003.

Texas Water Conservation Association (TWCA). *Development of Use-Based Chlorophyll Criteria for Recreational Reservoirs*. Texas: TWCA, June 2005.

TRC Omni Environmental Corporation, submitted under contract to Rutgers University New Jersey EcoComplex and New Jersey Department of Environmental Protection, Division of Watershed Management. *The Non-Tidal Passaic River Basin Nutrient TMDL: Phase I Data Summary and Analysis Report.* New Jersey: TRC Omni, March 2004.

TRC Omni Environmental Corporation, submitted under contract to Rutgers University New Jersey EcoComplex and New Jersey Department of Environmental Protection, Division of Watershed Management. *The Non-Tidal Passaic River Basin Nutrient TMDL Study Phase II Watershed Model and TMDL Calculations Appendices, Final Report*. New Jersey: TRC Omni, 2007.

U.S. Army Corp of Engineers (U.S.ACOE). *Peckman River Basin New Jersey Feasibility Studies for Flood Control and Ecosystem Restoration, Section 905(b).* New York District: U.S. ACOE, January 2002. (WRDA Preliminary Analysis)

U.S. EPA. *Quality Criteria for Water (Red Book)*. Washington, D.C.: U.S. EPA, 1976.
U.S. EPA. *Technical Support Document for Water Quality-Based Toxics Control*. Washington, D.C.: U.S. EPA, 1991. (*EPA-505-2-90-001).*

U.S. EPA. *Protocols for Developing Nutrient TMDLs* (First Edition*).*
Washington D.C.: U.S. EPA, 1993.

U.S. EPA. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Washington, DC.: U.S. EPA, January 1993. (EPA-840-B-92-002).

U.S. EPA. *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs,* (First Edition). Washington, D.C.: U.S. EPA, April 2000. (EPA-822-B00-001).

U.S. EPA. *Nutrient Criteria Technical Guidance Manual Rivers and Stre*ams. Washington D.C.: U.S. EPA, June 2000. (EPA-822-B-00-002).

U.S. EPA., *Ambient Water Quality Criteria Recommendations* (Lakes and Reservoirs in Nutrient Ecoregion IX). Washington D.C.: U.S. EPA, December 2000. (EPA-822-B-00-011).

U.S. EPA. *Total Maximum Daily Load Development for Nutrient Enrichment in Lake Weiss (HUC 03150105) Cherokee County, Coosa River Basin, Alabama.* Washington D.C.: U.S. EPA, November 1, 2004.

U.S. EPA. Memo*: Agency Interpretation on Applicability of Section 402 of the Clean Water Act to Water Transfers*. Washington D.C.: U.S. EPA, August 5, 2005.

U.S. EPA, Office of Wetlands, Oceans and Watersheds, Sutfin, C.H. *Memo: EPA Review of 2002 Section 303(d) Lists and Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992.* Washington D.C.: U.S. EPA, May 2002.

U.S. EPA, Office of Wetlands, Oceans and Watersheds, Wayland, R.H. III. *Memo: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs*. Washington: U.S. EPA, November 22, 2002.

U.S. Geological Survey, "A Land Use and Land Cover, Classification System for Use with Remote Sensor data, U.S. Geological Survey Professional Paper 964"; edited by NJDEP, 1976 http://www.nj.gov/dep/gis/digidownload/metadata/lulc95/anderson.html

U.S. Geological Survey, Spitz, F.J. *Simulation of Surface-Water Conditions in the Non-Tidal Passaic River Basin*. New Jersey: U.S. Geological Survey, Scientific Investigations Report 2007-5052, 2007.

Virginia Department of Environmental Quality, Tamin Younos, Water Resources Research Center, Virginia Tech; Carl Zipper, Department of Crop and Soil Environmental Sciences, Virginia Tech; and Jane Walker, Virginia Polytechnical Institute and State University, Blacksburg PANEL: "Nutrient Criteria Development for Lakes and Reservoirs- The Virginia Experience".

Appendix B: Municipalities and MS4 Designation in the Passaic River Basin

Municipal Name	County	WMA	Tier A or B	NJPDES Permit No.	Fertilizer Ordinance
Elmwood Park Borough	BERGEN	4	A	NJG0152617	Applicable
Fair Lawn Borough	BERGEN	4	A	NJG0149951	Applicable
Franklin Lakes Borough	BERGEN	3, 4	A	NJG0154121	Applicable
Garfield City	BERGEN	4	A	NJG0150282	Applicable
Glen Rock Borough	BERGEN	4	A	NJG0148300	Applicable
Mahwah Township	BERGEN	3	A	NJG0151211	Applicable
Midland Park Borough	BERGEN	4	A	NJG0152293	Applicable
Oakland Borough	BERGEN	3	A	NJG0148521	Applicable
Ramsey Borough	BERGEN	3	A	NJG0151491	Applicable
Ridgewood Village	BERGEN	4	A	NJG0152170	Applicable
Waldwick Borough	BERGEN	4	A	NJG0150321	Applicable
Wyckoff Township	BERGEN	4	A	NJG0152048	Applicable
Caldwell Borough	ESSEX	4, 6	A	NJG0152901	Applicable
Cedar Grove Township	ESSEX	4	A	NJG0150533	Applicable
Essex Fells Borough	ESSEX	4, 6	A	NJG0148792	Applicable
Fairfield Township	ESSEX	4, 6	A	NJG0150835	Applicable
Livingston Township	ESSEX	6	A	NJG0148245	Applicable
Millburn Township	ESSEX	6	A	NJG0153877	Applicable
Montclair Township	ESSEX	4	A	NJG0150568	Applicable
North Caldwell Borough	ESSEX	4, 6	A	NJG0148687	Applicable
Roseland Borough	ESSEX	6	A	NJG0152072	Applicable
Verona Township	ESSEX	4, 6	A	NJG0152897	Applicable
West Caldwell Township	ESSEX	4, 6	A	NJG0151815	Applicable
West Orange Township	ESSEX	4, 6	A	NJG0151190	Applicable
Boonton Town	MORRIS	6	A	NJG0153672	Applicable
Boonton Township	MORRIS	6	A	NJG0148091	Applicable
Butler Borough	MORRIS	3	A	NJG0149837	Applicable
Chatham Borough	MORRIS	6	A	NJG0147842	Applicable
Chatham Township	MORRIS	6	A	NJG0153630	Applicable
Denville Township	MORRIS	6	A	NJG0148229	Applicable
Dover Town	MORRIS	6	A	NJG0150495	NA
East Hanover Township	MORRIS	6	A	NJG0152056	Applicable
Florham Park Borough	MORRIS	6	A	NJG0151335	Applicable

Hanover Township	MORRIS	6	A	NJG0148971	Applicable
Harding Township	MORRIS	6	B	NJG0151165	Applicable
Jefferson Township	MORRIS	3, 6	A	NJG0151793	NA
Kinnelon Borough	MORRIS	3, 6	A	NJG0149781	Applicable
Lincoln Park Borough	MORRIS	3, 6	A	NJG0155586	Applicable
Long Hill Township	MORRIS	6	A	NJG0151424	Applicable
Madison Borough	MORRIS	6	A	NJG0150304	Applicable
Mendham Borough	MORRIS	6	A	NJG0151483	Applicable
Mendham Township	MORRIS	6	A	NJG0150819	Applicable
Mine Hill Township	MORRIS	6	A	NJG0153133	NA
Montville Township	MORRIS	3, 6	A	NJG0149403	Applicable
Morris Plains Borough	MORRIS	6	A	NJG0150002	Applicable
Morris Township	MORRIS	6	A	NJG0152463	Applicable
Morristown Town	MORRIS	6	A	NJG0153079	Applicable
Mount Arlington Borough	MORRIS	6	A	NJG0153265	NA
Mountain Lakes Borough	MORRIS	6	A	NJG0151386	Applicable
Parsippany-Troy Hills Township	MORRIS	6	A	NJG0150266	Applicable
Pequannock Township	MORRIS	3	A	NJG0148342	Applicable
Randolph Township	MORRIS	6	A	NJG0152501	Applicable
Riverdale Borough	MORRIS	3	A	NJG0152587	Applicable
Rockaway Borough	MORRIS	6	A	NJG0150746	NA
Rockaway Township	MORRIS	3, 6	A	NJG0151246	NA
Roxbury Township	MORRIS	6	A	NJG0152641	NA
Victory Gardens Borough	MORRIS	6	A	NJG0149110	NA
Wharton Borough	MORRIS	6	A	NJG0151645	NA
Bloomingdale Borough	PASSAIC	3	A	NJG0153371	Applicable
Clifton City	PASSAIC	4	A	NJG0150452	Applicable
Haledon Borough	PASSAIC	4	A	NJG0155144	Applicable
Hawthorne Borough	PASSAIC	4	A	NJG0149616	Applicable
Little Falls Township	PASSAIC	4	A	NJG0148911	Applicable
North Haledon Borough	PASSAIC	4	A	NJG0154130	Applicable
Paterson City	PASSAIC	4	A	NJG0155608	Applicable
Pompton Lakes Borough	PASSAIC	3	A	NJG0152145	Applicable
Prospect Park Borough	PASSAIC	4	A	NJG0154792	Applicable
Ringwood Borough	PASSAIC	3	A	NJG0152749	Applicable
Totowa Borough	PASSAIC	4	A	NJG0148636	Applicable
Wanaque Borough	PASSAIC	3	A	NJG0149306	Applicable
Wayne Township	PASSAIC	3, 4	A	NJG0150436	Applicable
West Milford Township	PASSAIC	3	A	NJG0148806	Applied with Greenwood Lake TMDL
West Paterson Borough	PASSAIC	4	A	NJG0151637	Applicable
Bernards Township	SOMERSET	6	A	NJG0148661	Applicable
Bernardsville Borough	SOMERSET	6	A	NJG0151068	Applicable
Bridgewater Township	SOMERSET	6	A	NJG0147893	Applicable
Far Hills Borough	SOMERSET	6	B	NJG0151599	Applicable
Warren Township	SOMERSET	6	A	NJG0154202	Applicable
Hardyston Township	SUSSEX	3, 6	B	NJG0152269	NA

Sparta Township	SUSSEX	6	A	NJG0148059	NA
Vernon Township	SUSSEX	3	B	NJG0149691	NA
Berkeley Heights Township	UNION	6	A	NJG0147923	Applicable
New Providence Borough	UNION	6	A	NJG0153494	Applicable
Summit City	UNION	6	A	NJG0153613	Applicable

Appendix C: Additional Impairments within TMDL Area

The two tables below identify the assessment units within the TMDL area of interest that have additional impairments not being addressed in the scope of this TMDL.

HUC 14 Assessment Units based on the 2006 Integrated Water Quality Monitoring and Assessment Report

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	02030103050030-01	Pequannock R(above OakRidge Res outlet)	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103050050-01	Pequannock R(Charlotteburg to OakRidge)	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103050060-01	Pequannock R(Macopin gage to Charl'brg)	Dissolved Oxygen	Aquatic Life (Trout)
03	02030103050080-01	Pequannock R (below Macopin gage)	Chlordane, DDX, Mercury, PCBs	Fish Consumption
03	02030103050080-01	Pequannock R (below Macopin gage)	Dissolved Oxygen	Aquatic Life (General & Trout)
03	02030103070020-01	Belcher Creek (Pinecliff Lake & below)	Temperature	Aquatic Life (General & Trout)
03	02030103070040-01	West Brook/Burnt Meadow Brook	Temperature	Aquatic Life (Trout)
03	02030103070050-01	Wanaque Reservior (below Monks gage)	Dissolved Oxygen, Pathogens, Temperature	Aquatic Life (General & Trout) & Primary Contact Recreation
03	02030103070060-01	Meadow Brook/High Mountain Brook	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103070070-01	Wanaque R/Posts Bk (below reservior)	Unknown Toxic	Aquatic Life (General & Trout)
03	02030103100070-01	Ramapo R (below Crystal Lake bridge)	Dissolved Oxygen, pH	Aquatic Life (General & Trout)
03	02030103110020-01	Pompton River	Chlordane, DDX, Lead, Mercury, PCBs, Unknown Toxic	Aquatic Life (General) & Fish Consumption
04	02030103120020-01	Peckman River (below CG Res trib)	Dioxin, PCBs, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
04	02030103120030-01	Preakness Brook / Naachtpunkt Brook	Pollutant Unknown	Aquatic Life (General & Trout)
04	02030103120040-01	Molly Ann Brook	Pollutant Unknown	Aquatic Life (General)
04	02030103120050-01	Goffle Brook	Total dissolved solids	Aquatic Life (General)
04	02030103120060-01	Deepavaal Brook	Pollutant Unknown	Aquatic Life (General)
04	02030103120070-01	Passaic R Lwr (Fair Lawn Ave to Goffle)	Arsenic, Chlordane, Cyanide, DDX, Dioxin, Mercury, PCBs	Aquatic Life (General), Primary Contact Recreation, Drinking Water Supply, & Fish Consumption
04	02030103120080-01	Passaic R Lwr (Dundee Dam to F.L. Ave)	Arsenic, Chlordane, Cyanide, DDX, Dioxin, Mercury, Pathogens, PCBs	Aquatic Life (General), Primary & Secondary Contact Recreation, Drinking Water Supply, & Fish Consumption
04	02030103120100-01	Passaic R Lwr (Goffle Bk to Pompton R)	Arsenic, Cadmium, Chlordane, Chromium, Copper, Cyanide, DDX, Dioxin, Lead, Mercury,	Aquatic Life (General), Primary & Secondary Contact Recreation, Drinking Water Supply, & Fish Consumption

			Pathogens, PCBs, Silver, Thallium, Zinc	
06	02030103010050-01	Great Brook (below Green Village Rd)	Pollutant Unknown	Aquatic Life (General)
06	02030103010060-01	Black Brook (Great Swamp NWR)	Arsenic	Aquatic Life (General) & Drinking Water Supply
06	02030103010070-01	Passaic R Upr (Dead R to Osborn Mills)	Arsenic, Cyanide	Aquatic Life (General) & Drinking Water Supply
06	02030103010080-01	Dead River (above Harrisons Brook)	Total Suspended Solids	Aquatic Life (General)
06	02030103010100-01	Dead River (below Harrisons Brook)	Total Suspended Solids	Aquatic Life (General)
06	02030103010110-01	Passaic R Upr (Plainfield Rd to Dead R)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010120-01	Passaic R Upr (Snyder to Plainfield Rd)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010130-01	Passaic R Upr (40d 45m to Snyder Ave)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010150-01	Passaic R Upr (Columbia Rd to 40d 45m)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010160-01	Passaic R Upr (HanoverRR to ColumbiaRd)	Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General) & Drinking, Agric., & Industrial Water Supply
06	02030103010170-01	Passaic R Upr (Rockaway to Hanover RR)	Chlordane, DDX, Mercury, PCBs, Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General), Fish Consumption, & Drinking, Agric., & Industrial Water Supply
06	02030103010180-01	Passaic R Upr (Pine Bk br to Rockaway)	Arsenic, Chlordane, DDX, Mercury, PCBs	Aquatic Life (General), Fish Consumption, & Drinking Water Supply
06	02030103020010-01	Whippany R (above road at 74d 33m)	Temperature	Aquatic Life (Trout)
06	02030103020020-01	Whippany R (Wash. Valley Rd to 74d 33m)	Temperature	Aquatic Life (Trout)
06	02030103030030-01	Rockaway R (above Longwood Lake outlet)	Mercury	Fish Consumption
06	02030103030040-01	Rockaway R (Stephens Bk to Longwood Lk)	Mercury, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
06	02030103030060-01	Green Pond Brook (below Burnt Meadow Bk)	Pollutant Unknown	Aquatic Life (General)
06	02030103030070-01	Rockaway R (74d 33m 30s to Stephens Bk)	Mercury	Fish Consumption
06	02030103030090-01	Rockaway R (BM 534 brdg to 74d 33m 30s)	Mercury, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
06	02030103030110-01	Beaver Brook (Morris County)	Mercury, pH	Aquatic Life (General & Trout) & Fish Consumption
06	02030103030130-01	Stony Brook (Boonton)	Pollutant Unknown	Aquatic Life (General)
06	02030103030140-01	Rockaway R (Stony Brook to BM 534 brdg)	Arsenic, Mercury, PCE/TCE, Pollutant Unknown	Aquatic Life (General), Fish Consumption, & Drinking Water Supply
06	02030103030150-01	Rockaway R (Boonton dam to Stony Brook)	Arsenic, Mercury, PCE/TCE	Aquatic Life (General & Trout), Fish Consumption, & Drinking Water Supply
06	02030103030170-01	Rockaway R (Passaic R to Boonton dam)	Mercury, PCE/TCE	Aquatic Life (General) & Fish Consumption
06	02030103040010-01	Passaic R Upr (Pompton R to Pine Bk)	Arsenic, Chlordane, DDX, Mercury, PCBs	Aquatic Life (General), Fish Consumption, & Drinking Water Supply

Lake Impairments on the *2006 Integrated Water Quality Monitoring and Assessment Report*

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	Canistear Reservoir-03	Canistear Reservoir-03	Mercury	Fish Consumption
03	Clinton Reservoir-03	Clinton Reservoir-03	Mercury	Fish Consumption
03	Echo Lake-03	Echo Lake-03	Mercury	Fish Consumption
03	Green Turtle Lake-03	Green Turtle Lake-03	Mercury	Fish Consumption
03	Greenwood Lake-03	Greenwood Lake-03	Mercury	Fish Consumption
03	Greenwood Lake-03	Greenwood Lake-03	Dissolved Oxygen	Aquatic Life (General)
03	Greenwood Lake-03	Greenwood Lake-03	Total Suspended Solids	Aquatic Life (General)
03	Monksville Reservoir-03	Monksville Reservoir-03	Mercury	Fish Consumption
03	Oak Ridge Reservoir-03	Oak Ridge Reservoir-03	Mercury	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Mercury	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	PCBs	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Dioxin	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	DDX	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Chlordane	Fish Consumption
03	Ramapo Lake-03	Ramapo Lake-03	Mercury	Fish Consumption
03	Shepherds Lake-03	Shepherds Lake-03	Mercury	Fish Consumption
03	Wanaque Reservoir-03	Wanaque Reservoir-03	Mercury	Fish Consumption
04	Dundee Lake-04	Dundee Lake-04	Mercury	Fish Consumption
05	Lake Tappan-05	Lake Tappan-05	Mercury	Fish Consumption
05	Oradell Reservoir-05	Oradell Reservoir-05	Mercury	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Chlordane	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Mercury	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	PCBs	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Chlordane	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Dioxin	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	DDX	Fish Consumption
06	Mountain Lake-06	Mountain Lake-06	Mercury	Fish Consumption
06	Speedwell Lake-06	Speedwell Lake-06	Mercury	Fish Consumption

Appendix D: TMDLs Completed in the Passaic River Basin: Streams

WMA	Stream Segment	Site /Segment ID/ EPA Reach No.	Municipalities in streamshed	Parameter(s)
3	Apshawa Brook	PQ15	West Milford Township	Temperature
3	Clinton Brook below Clinton Reservoir	PQ16	West Milford Township	Temperature
3	Macopin River at Echo Lake	01382410	West Milford Township	Temperature
3	Macopin River at Macopin Reservoir	01382450/ PQ 6	West Milford Township	Temperature and Fecal Coliform
3	Outlet Trib of Maple Lake	PQ14	Kinnelon Boro	Temperature
3	Pequannock- Butler	PQ10	Butler Boro	Temperature
3	Pequannock River above Clinton	PQ4	Jefferson and West Milford Townships	Temperature
3	Pequannock River below Clinton	PQ5	West Milford Township	Temperature
3	Pequannock River above	PQ7	Jefferson, Rockaway and West Milford	Temperature

	Macopin		Townships	
3	Pequannock River above Pacock	PQ1	Hardyston and Vernon Townships	Temperature
	Pequannock River below Pacock	PQ3	Hardyston and West Milford Townships	Temperature
3	Pequannock River at Macopin Intake Dam	PQ8	Bloomingdale, Butler, Pompton, Riverdale and Kinnelon Boros, and Rockaway and West Milford Townships	Temperature
3	Pequannock River at Riverdale	01382800/PQ 11	Bloomdale, Riverdale, Pompton Lakes and Butler Boros	Temperature
3	Pompton River Trib at Ryerson Rd	01388720	Riverdale, Lincoln, and Kinnelon Boros, and Pequannock, Montville and Wayne Townships	Fecal Coliform
3	Ramapo River near Mahwah	01387500	Franklin, Oakland, Ramsey, and Wanaque Boros, and Wayne and Mahwah Townships	Fecal Coliform
3	Wanaque River at Highland Avenue	01387010	Pompton Lakes and Wanaque Boros	Fecal Coliform
4	Deepavaal Brook at Fairfield	01389138	Fairfield and West Caldwell Township, and North Caldwell Boro	Fecal Coliform
4	Diamond Brook at Fair Law	01389860	Fair Lawn, Glen Rock, and Hawthorne Boros, and Ridgewood Village	Fecal Coliform
4	Goffle Brook at Hawthorne	01389850	Hawthorne and Midland Park Boros, Ridgewood Village,and Wycoff Township	Fecal Coliform
4	HoHokus Brook at Mouth at Paramus	0139110	Allendale, HoHokus, Glen Rock, Midland Park, and Waldwick Boros, Ridgewood Village, and Passaic City	Fecal Coliform
4	Passaic R. below Pompton R. at Two Bridges	01389005	Lincoln Park Boro, and Fairfield and Montville Townships	Fecal Coliform
4	Passaic River at Little Falls	01389500	Fairfield and Wayne Townships	Fecal Coliform
4	Peckman River at West Paterson	01389600	West Paterson and Verona Boros, and Cedar grove, Little Falls and West Orange Townships	Fecal Coliform
4	Preakness Brook Near Little Falls	01389080	Totowa Boro and Wayne Township	Fecal Coliform
4	Ramsey Brook at Allendale	01390900	Allendale and Ramsey Boros, and Mahwah Township	Fecal Coliform
4	Saddle River at Fairlawn	01391200	Fair Lawn and Paramus Boros, and Rochelle Park and Saddle Brook Townships	Fecal Coliform
4	Saddle River at Lodi	01391500	Allendale, Carlstadt, Fair Lawn, Glen Rock, Ho-Ho-Kus, Lodi, Maywood, Paramus, Waldwick, Wallington, and Woodridge Boros, Ridgewood Village, and Rochelle Park, and Saddle Brook Townships	Fecal Coliform
4	Saddle River at Ridgewood	01390500	Ho-Ho-Kus, Montvale, Paramus, Waldwick and Woodcliffe Lake Boros, Ridgewood Village and Upper Saddle River and Mahwah Townships	Fecal Coliform
4	West Branch Saddle River at Upper Saddle River	01390445	Mahwah and Upper Saddle River Townships	Fecal Coliform

6	Beaver Brook at Rockaway	01380100	Rockaway Boror and Denville, Chatham and Rockaway Townships	Fecal Coliform
6	Black Brook at Madison	01378855	Madison Boro and Chatham Township	Fecal Coliform
6	Canoe Brook near Summit	01379530	Essex Falls and Roseland Boros, and Livingston, Millburn, and West Orange Townships	Fecal Coliform
6	Dead River near Millington	01379200	Far Hills Boro and Warren and Bernards Township	Fecal Coliform
6	Passaic River at Tempewick Rd near Mendham	01378660	Mendham and Bernardsville Boro, and Mendham, Harding and Bernardsville Townships	Fecal Coliform
6	Passaic River at Two Bridges	01382000	Lincoln Park Boro and Fairfield and Montville Townships	Fecal Coliform
6	Passaic River near Chatham	01379500	Chatham, Florham Park, Madison, New Providence and Roseland Boros, Berkeley Heights, Chatham, East Hanover, Harding, Livingston, Long Hill, Millburn, Warren and West Caldwell Townships, and Summit City	Fecal Coliform
6	Passaic River near Millington	01379000	Bernards and Long Hill Townships	Fecal Coliform
6	Rockaway River at Blackwell Street	01379853	Rockaway, Victory Gardens, and Wharton Boro, and Dover, Mine Hill, Randolph and Rockaway Townships	Fecal Coliform
6	Rockaway River at Longwood Valley	01379680	Wharton Boro and Dover, Jefferson, Mine Hill, Randolph, Rockaway and Roxbury Townships	Fecal Coliform
6	Rockaway River at Pine Brook	01381200	Boonton, Montville and Parsippany-Troy Hills Townships	Fecal Coliform
6	Stony Brook at Boonton	01380320	Kinnelon Boro and Bernards, Boonton, Long Hill, Montville and Rockaway Townships	Fecal Coliform
6	Whippany River Near Pinebrook	1381800	Morristown, Hanover and East Hanover townships	Fecal Coliform
6	Whippany River near Morristown	13881500	Morristown, Hanover and East Hanover Townships	Fecal Coliform

Lakes

WMA	Assessment Unit Name	Assessment Unit ID	Municipalities in Lakeshed	Parameter
3	Bubbling Springs	Bubbling Springs-03	West Milford	Pathogens
3	Crystal Lake	Crystal Lake-03	Franklin Lakes, Mahwah, N. Haledon, Oakland, Wayne	Pathogens
3	Erskine Lake	Erskine Lake-03	Ringwood	Pathogens
3	Forest Hill Lake	Forest Hill Lake-03	West Milford	Pathogens
3	Greenwood Lake	Greenwood Lake-03	West Milford	Phosphorus
3	Kitchell Lake	Kitchell Lake-03	West Milford	Pathogens
3	Lake Edenwold	Lake Edenwold-03	Butler Boro, Kinnelon	Pathogens
3	Lake Ioscoe	Lake Ioscoe-03	Wanaque, Bloomingdale	Pathogens
3	Lionhead Lake	Lionhead Lake-03	Franklin Lakes, Wayne	Pathogens

WMA	Assessment Unit Name	Assessment Unit ID	Municipalities in Lakeshed	Parameter
3	Skyline Lakes	Skyline Lakes-03	Mahwah Twp, Ringwood, Wanaque	Pathogens
4	Toms Lake	Toms Lake-04	Wayne	Pathogens
4	Verona Park Lake	Verona Park Lake-04	West Orange, Verona	Phosphorus
6	Camp Lewis Lake	Camp Lewis-06	Rockaway Twp	Pathogens
6	Cold Spring Pond*	Cold Spring Pond-06	West Milford, Bloomingdale	Pathogens
6	Cozy Lake	Cozy Lake-06	Rockaway Twp, Jefferson	Pathogens
6	Fox's Pond	Foxs Pond - 06	Rockaway Boro, Rockaway Twp	Pathogens
6	Indian Lake	Indian Lake-06	Denville, Morris Twp, Parsippany Troy Hills, Randolph	Pathogens
6	Intervale Lake	Intervale Lake-06	Boonton Town, Boonton Twp, Mt. Lakes Boro, Parsippany Troy Hills	Pathogens
6	Lake Swannanoa	Lake Swannanoa-06	Hardyston Twp, Jefferson, Sparta	Pathogens
6	Mountain Lake	Mountain Lake-06	Mt. Lakes Boro, Boonton, Denville	Pathogens
6	Parsippany Lake	Parsippany Lake-06	Parsippany Troy Hills	Pathogens
6	Powder Mill Pond	Powder Mill Pond-06	Denville, Parsippany Troy Hills	Pathogens
6	Rainbow Lakes	Rainbow Lakes-06	Denville, Mt. Lakes, Parsippany Troy Hills	Pathogens
6	Sunrise Lake	Sunrise Lake-06	Harding, Mendham Twp	Pathogens
6	Telemark Lake	Telemark Lake-06	Rockaway Twp	Pathogens
6	West Lake	West Lake-06	Kinnelon Boro	Pathogens
6	White Meadow Lake	White Meadow Lake-06	Rockaway Twp	Pathogens

* Also known as Pond at Conference Center (Left & Right)

Appendix E

Rationale for Establishing Chlorophyll-*a* as Watershed Criteria to Protect Designated Uses of the Wanaque Reservoir and Dundee Lake

Background

The non-tidal Passaic River Basin TMDL study includes a system-wide water quality model that is calibrated and validated for nutrients, dissolved oxygen, and water column chlorophyll-*a*. Continuous simulations from October 1999 to November 2003 were used to account for seasonal variations and a range of hydrologic conditions. Watershed modeling analyses were performed to assess the impact of point and nonpoint source reductions of total phosphorus on dissolved oxygen, phosphorus concentrations, and chlorophyll-*a* within the model domain and, by linking with the LA-WATERS model, within the Wanaque Reservoir.

A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, and a small stream segment of the Pequannock River. The WASP 7 model is an enhancement of the original WASP model (Omni Environmental, 2007). WASP 7 is a dynamic compartment model that can be used for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters. The model helps users to analyze, and predict a variety of water quality responses due to natural phenomena and man-made pollution. DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this TMDL (Spitz, 2007). A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW. A reservoir model known as Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS) was used to model the water quality of the Wanaque Reservoir. The LA-WATERS model links phosphorus loading with chlorophyll-*a* response in the Wanaque Reservoir. It includes a hydrothermal component and water quality modules, which were successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and then re-validated (Najarian Associates, 2000). A mass balance model (Najarian, 2005) was used to simulate daily loads of total phosphorus and orthophosphorus in portions of the study area outside the WASP 7/DAFLOW model domain.

Using these integrated models, several future scenarios were simulated in order to explore the impacts of increases and decreases in phosphorus loads on the key water quality parameters, namely phosphorus concentration, dissolved oxygen, and phytoplankton, measured as water column chlorophyll-*a*. Critical locations identified through this process were the Wanaque Reservoir and the lower portion of the Passaic River impounded by Dundee Dam, also known as Dundee Lake. Absent watershed or site specific criteria, the applicable Surface Water Quality Standards in these locations is a numeric criterion of 0.05 mg/l of total phosphorus. However, based on its riverine nature and the results of model simulations, the in-stream numeric criterion would be more appropriate for Dundee Lake. The comprehensive modeling of the study area both illustrates that these numeric criteria applied as "not to exceed" values is not necessary to protect designated uses. Further, an alternative criterion, established in terms of the response indicator, chlorophyll-*a*, is a better measure of what it takes to achieve water quality objectives and support designated uses in the identified critical locations and allows identification of the value that should apply in each location. Consequently, the target TMDL condition is defined as the phosphorus loading condition that satisfies water quality end points of 20 µg/l and 10 µg/l chlorophyll-*a* for Dundee Lake and the Wanaque Reservoir, respectively.

Establishing Surface Water Quality Standards

Under the Clean Water Act Section 304(a), EPA issues national criteria recommendations to states and tribes to assist them in developing their water quality standards. When EPA reviews a state or tribal water quality standard for approval under 303(c) of the Clean Water Act, the agency must determine whether the adopted designated uses are consistent with the Clean Water Act requirements and whether the adopted criteria protect the designated use. EPA's regulations encourage states and tribes, when adopting water quality criteria as part of their water quality standards, to employ EPA's Section 304(a) guidance, to modify EPA's 304(a) guidance to reflect site-specific conditions or to use other scientifically defensible methods to derive criteria to protect the designated uses.

To meet the objectives of the Clean Water Act, EPA's implementing regulations specify that states must adopt criteria that contain sufficient parameters to protect existing and designated uses. Designated uses are an element of a water quality standard, expressed as a narrative statement, describing an appropriate intended human and/or aquatic life objective for a water body.

To meet the objective of protecting the designated uses, and in accordance with the Clean Water Act requirement, nutrient criteria development includes:

-Assessment of use impairment, i.e. manifestations of eutrophication, these candidates can be grouped as effect-based variables, also called response indicators. Effect-based variables usually include chlorophyll-*a*, dissolved oxygen, variation in pH, and water clarity. It is expected that assessment will vary based on designated uses.

-Assembly of all relevant information pertaining to establishing a nutrient criteria, e.g. historical and current data water quality data, physical, chemical and biological characteristics, designated uses, and reference sites.

-The selected criteria should result in quantifiable measure.

-The selected criteria should be implementable, and when criteria are met, it is expected that the water quality will support the designated uses.

-Water quality modeling, when necessary, to establish a linkage between overenrichment of nutrient concentration (causal variables of impairment) and nutrient impairment (effect or response variables of nutrient overenrichment). For example, a linkage between chlorophyll-*a* concentrations (response indicator) and phosphorus concentrations. Such linkage will help to implement the nutrient reduction needed to achieve the effect-based criteria.

-Nutrient enrichment impacts on downstream waterbodies should always be taken into consideration when proposing a site specific criterion.

Based on the above, it is apparent that the nutrient criteria development process can be complex and involve an extensive amount of data, knowledge and resources. At the same time, water quality management requires immediate and adequate measures in protecting water quality until a more comprehensive assessment can be done. The Department's strategy has been to establish default numeric criteria based on the EPA publication, *Quality Criteria for Water*, known as the red book, which was published in 1976, and to include several caveats, including a narrative exception for the applicability of the numeric criterion for streams, narrative nutrient policies and the option to establish alternative standards in addition to or in place of the default criteria.

The Department's current Surface Water Quality Standards (SWQS) for phosphorus, as stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters, are as follows:

Phosphorus, Total (mg/l):
i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.

ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where watershed or site-specific criteria are developed pursuant to N.J.A.C.

7:9B-1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Regarding watershed and site specific criteria, N.J.A.C. 7:9B-1.5(g) 3 states:
The Department may establish watershed or site-specific water quality criteria for nutrients in lakes, ponds, reservoirs or streams, in addition to or in place of the criteria in N.J.A.C. 7:9B-1.14, when necessary to protect existing or designated uses. Such criteria shall become part of these Water Quality Standards.

Elaborating on "…render waters unsuitable…" N.J.A.C. 7:9B-1.5(g)2 states:
Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

The narrative part of the nutrient criteria above, as well as the nutrient policies, illustrate that the primary goal of the nutrient criteria is to protect designated uses from nutrient related impacts while providing flexibility as to what the measurable criteria might be. This is appropriate because the level of nutrient over enrichment that will produce an observable impact on waterbodies will exhibit a high degree of variability. Factors that impact the degree of nutrient enrichment that is problematic may include temperature, solar radiation, turbidity, residence time, water depth and physical, chemical and biological characteristics of a waterbody, and others. As a result, a single numeric criterion based on a causal parameter will not be the most appropriate measure for all waterbodies. Instead, the most suitable candidate criteria for the representation of water quality that support designated uses may be the response indicators, i.e. chlorophyll-*a*, diurnal dissolved oxygen, variation in pH, and water clarity. This is consistent with the Clean Water Act (CWA), and the Code of Federal Regulations (CFR) definition of "criteria," which are "elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that support a particular use." When criteria are met, it is expected that the water quality will support the designated use (40 CFR 131.3[b]).

The State has seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. The Surface Water Quality Standards at N.J.A.C. 7:9B-1.12 provide that, in all FW2 waters, the designated uses are:

- Maintenance, migration and propagation of the natural and established aquatic biota;
- Primary and secondary contact recreation;
- Industrial and agricultural water supply;
- Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and

- Any other reasonable uses.

In assessing attainment of designated uses, as reflected in the both the 2004 and 2006 *Integrated Water Quality Monitoring and Assessment Methods Documents,* the Department takes the conservative approach of identifying waterbodies as impaired with respect to phosphorus where there is violation of numeric nutrient criteria. However, the Department is aware that what constitutes an impairment is not phosphorus enrichment, by itself, but rather the manifestations of eutrophication that may result when phosphorus causes excessive primary productivity. Specifically, when present in excessive amounts, phosphorus can lead to excessive primary productivity, in the form of algal and/or macrophyte growth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. There are also implications from excessive algae with respect to drinking water use. Algal blooms in raw drinking water sources can cause taste and odor problems and treatment inefficiencies, having a negative impact on conventional treatment at a drinking water system. When algae are present in large amounts purveyors must increase the use of disinfectants and oxidants to treat the algae resulting in an increase in disinfection byproducts such as trihalomethanes, some of which are listed by EPA as likely carcinogens. In addition, the respiration cycle of excessive plant material can cause significant swings in pH and dissolved oxygen, which can result in violation of criteria for these parameters, which can adversely affect the remainder of the aquatic community. Finally, excessive algae can affect water column transparency, which would impact recreational, water supply and fishery designated uses.

Selection of response indicator

In 2002, U.S. EPA developed nutrient water quality criteria guidance for lakes and reservoirs for fourteen major Ecoregions of the United States (USEPA 2000). The guidance recommends several candidate nutrient criteria for the protection of designated uses, the recommended candidates include both nutrient concentrations based on reference conditions, and effect-based variables. Those candidates are chlorophyll-*a*, total phosphorus, total nitrogen, and Secchi depth.

Chlorophyll represents a family of chlorophyll molecules expressed as a, b, c, d. Chlorophyll-*a* is selected because of its primary role in photosynthesis. Chlorophyll-*a* is easy to measure and is a useful surrogate for measuring algal biomass, which is either the direct (nuisance algal blooms) or indirect (high/low dissolved oxygen, pH and high turbidity) cause of most problems related to excessive phosphorus enrichment.

Modeling of the non-tidal Passaic River basin illustrates that phosphorus concentration as a not to exceed value in the critical locations, Wanaque Reservoir and Dundee Lake, is not necessary to achieve acceptable levels of the response indicators dissolved oxygen and chlorophyll-*a*. Using chlorophyll-*a* as the measurable criterion to evaluate when nutrients are present in excessive amounts is desirable because chlorophyll-*a* relates directly to the impairment of uses, as noted above and is easy to measure. Secchi depth was not considered as a candidate because water column transparency could be affected by inorganic suspended solids, color, and there is a weak correlation with nutrient concentrations. Because of the comprehensive water quality modeling developed in this TMDL study, a direct and quantitative linkage has been established between chlorophyll-*a* and total phosphorus concentrations. This allows identification of the phosphorus reductions needed to achieve a given chlorophyll-*a* concentration.

Selection of criterion value

Determination of the chlorophyll-*a* threshold that is appropriate can vary depending on the physical characteristics and the designated uses of a particular waterbody. In order to select the chlorophyll-*a* threshold to apply to each critical area, five factors were taken into consideration:

1. Designated uses, grouped as recreational, aquatic life, and water supply uses
2. Characteristics of the waterbody, e.g. hydrological characteristics.
3. Assessment of relevant water quality variables associated with the selected criterion, using the non-tidal Passaic River Basin models.
4. Potential to affect downstream waters, using the Passaic River Basin wide models.
5. Relationship to the existing numeric phosphorus criteria.

Most references use a range of values to describe the trophic status of a waterbody. Based on the literature reviewed, there is some consistency on the range of chlorophyll-*a* levels representing different trophic status of a lake. Chlorophyll-*a* greater than 20 µg/l is usually used to represent a Mesotrophic to Eutrophic lake status. Moderate levels of primary productivity in a waterbody that is designated for supporting fisheries or aquatic life uses would be beneficial, and levels of chlorophyll-*a* can be higher for this use than for swimming or drinking water supply uses. The level of primary productivity in a waterbody that is designated for supporting a cold water fishery would be different than for a waterbody designated as warm water fishery. One reason is the sensitivity of a cold water fishery to oxygen levels.

In addition to the unique characteristics of the Wanaque Reservoir and Dundee Lake, the Department considered the literature and experience of other states in selecting criteria for these locations. *The Nutrient Criteria Technical Manual for Lakes and Reservoirs* discusses the relationship between chlorophyll-*a* and phosphorus and its linkage to biomass. It notes that North Carolina uses a standard of 15 µg/L chlorophyll-*a* for cold water habitats and 40 µg/L in warm water habitats. It also cites Rascke (1994) who proposed a mean growing season limit of 15 µg/L chlorophyll-*a* for water supply impoundments in the southeastern United States and a value of 25 µg/L chlorophyll-*a* for water bodies primarily used for other purposes. The Kansas Department of Health and the Environment has implemented 12 µg/L chlorophyll-*a* target for domestic water supply reservoirs, with a 10% margin of safety, and 20 µg/l chlorophyll-*a* for secondary contact recreation lakes, with a 10% margin of safety. TMDLs developed in other states have selected chlorophyll-*a* levels as the water quality endpoint for the TMDL calculation. For example, TMDLs for Lake Galena, PA, Lake Nockamixon, PA, McDaniel Lake, MO and Federal Council Grove Lake, KS used 10 µg/L as the water quality endpoint. The TMDL prepared for Dutch Fork Lake, PA used a water quality endpoint of 20 µg/L. Several other EPA approved TMDLs for lakes (Green Lane Reservoir, PA TMDL and Lake Weiss, AL TMDL) utilized 20 µg/l for chlorophyll-*a* as the TMDL water quality target. This survey indicates that chlorophyll-*a* levels across a range have been selected as protective, based on the water body characteristics and uses.

Most of the chlorophyll-*a* levels cited are based on the observations of what levels are considered to be "undesirable" primarily for recreational and aesthetic designated uses. This approach is highly dependent on the individual observer's perceptions and responses regarding suitability for use vs. chlorophyll-*a* concentrations. For example, Texas Water Conservation Association published a study in 2005 *"Development of Use-Based Chlorophyll Criteria for Recreational Uses of Reservoirs."* The study was based on analysis of approximately 1800 surveys, 16 monitoring sites in 8 reservoirs and 310 sampling events. One of the objectives of the study was to assess the relationship between chlorophyll-*a* concentrations and suitability for recreational uses. Results of the observer's responses show great variation with respect to what constitutes use impairment for a given chlorophyll-*a* concentration. For example a comparable number of those surveyed found a lake with 4 µg/l to be equally suitable to a lake with 35 µg/l chlorophyll-*a.*

North Carolina State University's watershed information database (http://www.water.ncsu.edu/watershedss/info/algae.html) suggests that a mean growing season limit of 15 µg/l chlorophyll-*a* is appropriate for drinking water reservoirs, and that a mean growing season limit of 25 µg/l is appropriate to protect all other uses, namely recreational, aesthetic, and aquatic life. However, more and less restrictive values can be found in the literature. The State of Vermont established a chlorophyll-*a* target of 3 µg/l for Lake Champlain, Vermont, a major recreational, aesthetic, and aquatic life resource. On the other hand, for all water supply impoundments in North Carolina, chlorophyll-*a* levels may not exceed 40 µg/l at any time; for waters not serving as a water supply; chlorophyll-*a* may periodically exceed 40 µg/l during the growing season. The State of Oklahoma proposed a chlorophyll-*a* concentration of 10 µg/L to protect public water supply use (Oklahoma Water Resources Board, June 2005).

Two critical locations were identified in the non-tidal Passaic River TMDL: the Wanaque Reservoir and Dundee Lake. The characteristics of these two waterbodies are significantly different.

The Passaic River upstream of Dundee Dam is referred to as Dundee Lake. The aerial photo in Figure 1 shows the portion of the Passaic River designated as Dundee Lake in the NJDEP lakes GIS coverage. A bridge forms the "lake" boundary; however, the Passaic River upstream of the bridge is just as wide as it is downstream, and the Passaic River is deeper for about a mile upstream of the Dundee Dam. The portion of the river that is designated as Dundee Lake includes slightly more than 0.8 miles of river above the dam. The detention time in that portion of the river averages about 1.7 days per mile of river length. Dundee Lake is classified as a warm water fishery and is currently permitted for use as an industrial water supply.

Similar to Dundee Lake, Dutch Fork Lake in Pennsylvania functions somewhere between a lake and a slowly moving stream. Pennsylvania uses a 14 day detention time to distinguish between lakes and flowing waters. Dutch Fork Lake has a detention time of approximately 9 days, while Dundee Lake has an average detention time of 1.4 days. According to the Dutch Fork Lake TMDL (PADEP, 2003, p.5): "Hence, a 10 µg/l chlorophyll-*a* target, in addition to being infeasible and unachievable, is unnecessarily stringent in what is technically a flowing water. A 20 µg/l seasonal average chlorophyll-*a* target was used for the purpose of defining a total phosphorus TMDL for Dutch Fork Lake. This will result in a mildly eutrophic classification for

Dutch Fork Lake. Given the natural progression of all lakes and the fact that Dutch Fork Lake is 45 years old, Pennsylvania believes this is consistent with water quality standards for the Lake."

The fact that the impoundment of the Passaic River upstream of Dundee Dam constitutes an urban feature with a low detention time argues for using values in the upper end of the literature range. The Passaic River upstream of Dundee Dam has characteristics that are more like a stream than a lake. Absent a watershed criterion, the Department's default stream criterion for phosphorus would be more appropriate than the lake criterion. In 2002 the Department developed a technical manual for NJPDES Discharge to Surface Water Permits, which guides the evaluation of the applicability of the Department's numeric criterion for streams. This manual sets a seasonal average chlorophyll-*a* of 24 µg/l (seasonal average) and 32 µg/l (max 2-week mean) as the conservative threshold to determine when phosphorus is rendering waters unsuitable for designated uses. Given its characteristics, use of a similar threshold would be suitable for Dundee Lake. To be conservative, the Department proposes a seasonal average of 20 µg/L of chlorophyll-*a* for Dundee Lake. The seasonal averaging period is from June 15 to September 1. Based on the modeling, this period provides an additional degree of conservatism.

FIGURE 1 : Aerial Photo of Dundee lake

The non-tidal Passaic TMDL water quality modeling study allows assessment of the water quality that would be associated with the proposed chlorophyll-*a* criterion. The effect of wide range chlorophyll-*a* concentrations on diurnal dissolved oxygen concentrations were examined under a continuous model simulation of four years, including several critical conditions. Figure 2 below, shows the strong relationship between maximum dissolved oxygen swing and summer average chlorophyll-*a* for the Passaic River at Dundee Dam (powerful logarithmic relationship with an r^2 near 0.99). Figure 3 shows that both the "24 hr average" and the "not less than" dissolved oxygen criteria are being met under the TMDL simulation period, except for only violation to the not less than 4 mg/l criterion occurred during the drought of 2002 when the criteria was not applicable.

FIGURE 2: Relationship between DO Swing and Chlorophyll-*a*

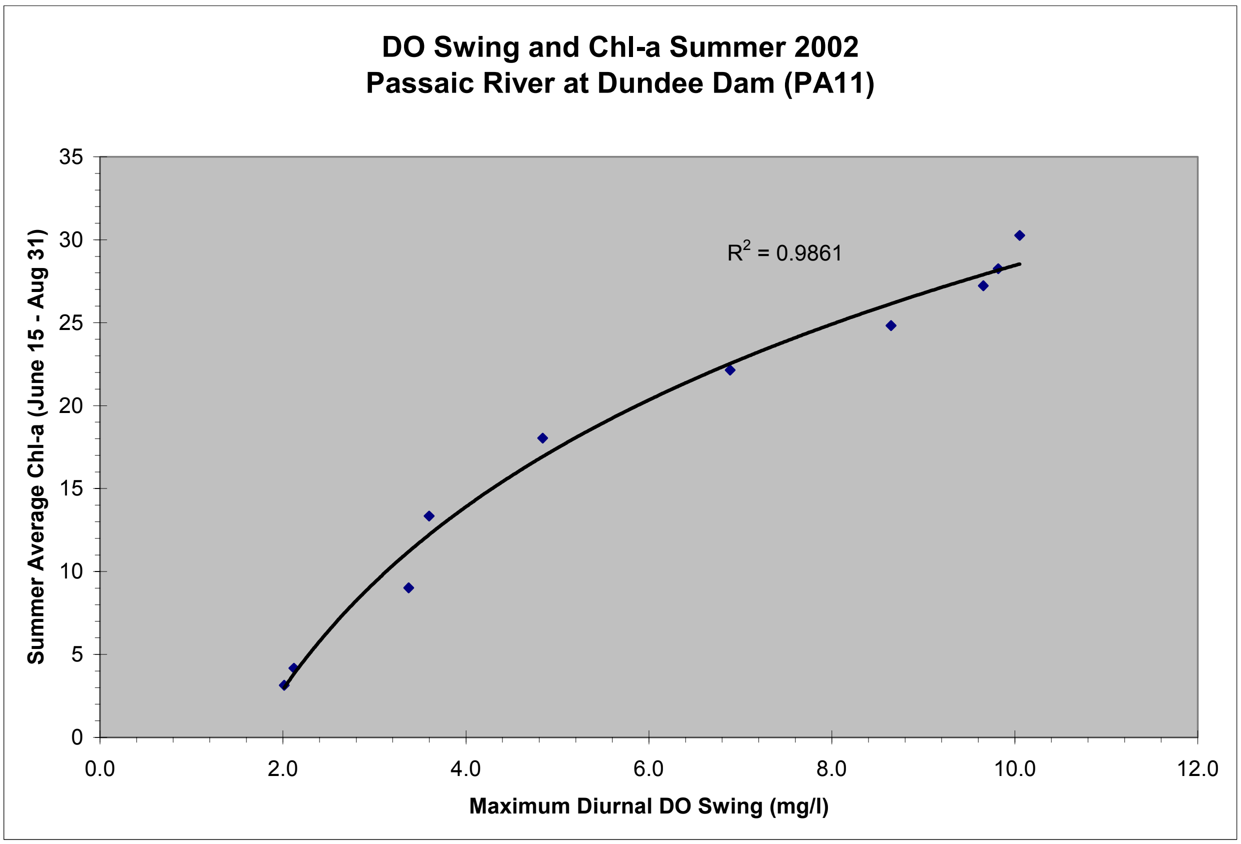
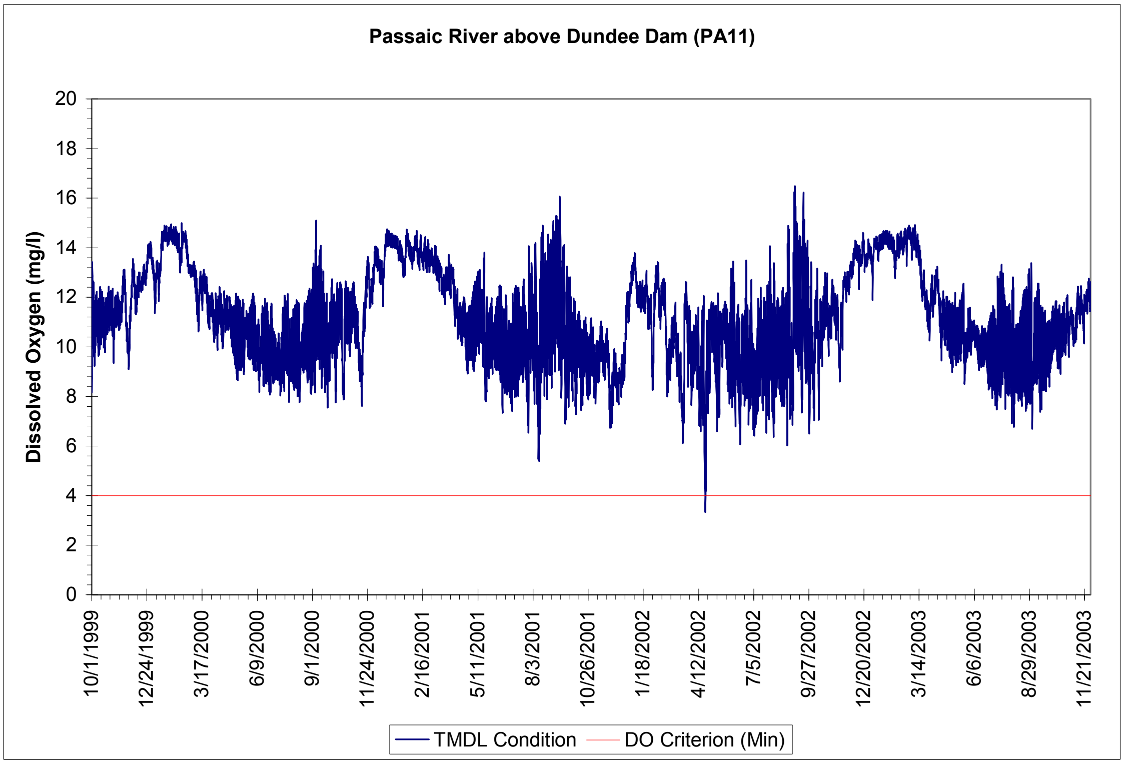
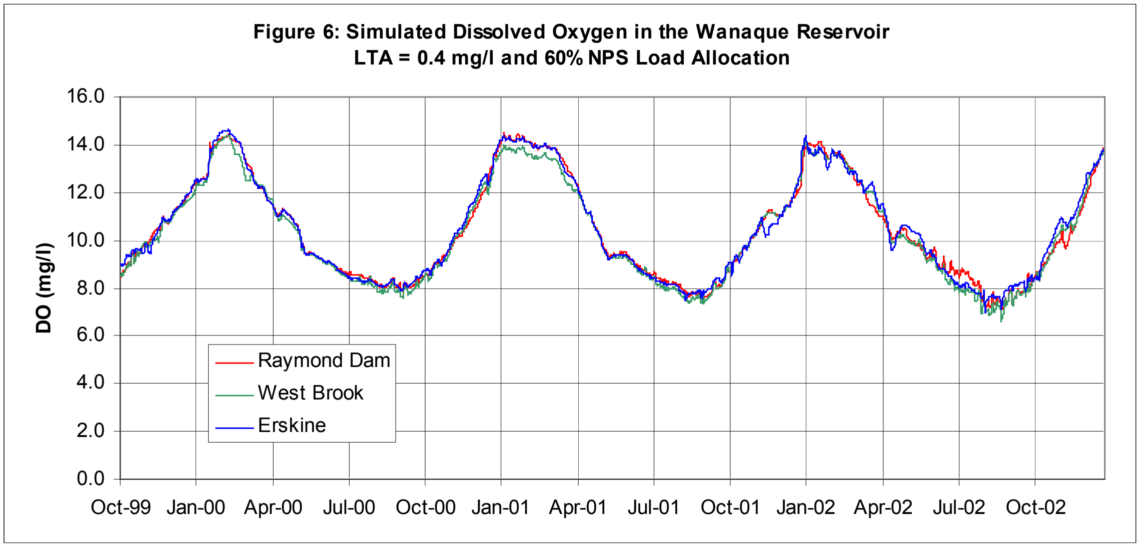


FIGURE 3 TMDL Condition in Passaic River at Dundee Dam – DO



The Wanaque Reservoir is distinctly different than Dundee Lake. The Wanaque Reservoir is large, the largest reservoir in area in New Jersey, and deep (average depth 37 feet, maximum depth 90 feet) and supports trout throughout the fishing season. It serves as a source of drinking water for 4 million people. In consideration of these characteristics, a more conservative chlorophyll-*a* target of 10 µg/L as a seasonal average is proposed. Evaluating the water quality implications of this target, Figure 4 below shows that both the "24 hr average" and the "not less than" dissolved oxygen criteria are met under the TMDL simulation period for the three locations modeled within the Reservoir.

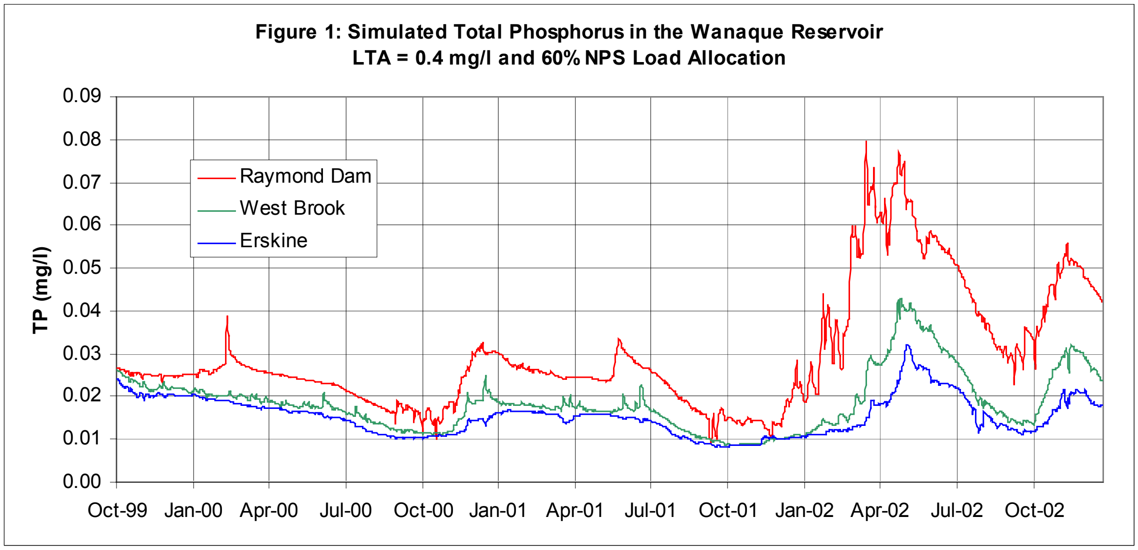
FIGURE 4 Simulated Dissolved Oxygen in the Wanaque Reservoir



Having a comprehensive water quality model allows assessment of downstream effects of a given condition. The modeling effort has identified the critical locations that require phosphorus reductions, as well as the level of phosphorus reduction needed to achieve a specified desired condition. As the study area reaches to the terminus of the non-tidal portion of the river, there is no concern about downstream effects beyond the study area.

Comparing the implications of the proposed chlorophyll-*a* criteria with the existing total phosphorus criteria shows that, on average, the appropriate default criteria are generally met. Figure 5 shows that the 0.05 µg/l total phosphorus criterion is being met for most of the model simulations. A mean total phosphorus concentration simulated from October 1999 through October 2002 shows phosphorus well below 0.03 mg/l at all three locations within the reservoir. Total phosphorus concentration exceeded the 0.05 mg/l criteria only during a few months during the drought year of 2002 and only at Raymond Dam.

FIGURE 5: Simulation of Total Phosphorus in the Wanaque Reservoir



Because of the fact that the Passaic River upstream of Dundee Dam is more like a stream than a lake, the total phosphorus concentrations at Dundee Lake were assessed against the stream total phosphorus criteria of 0.1 mg/l. Table 1 summarizes the results of the model simulation under the TMDL and existing conditions. The stream criterion is generally met, with the greatest deviation from the 0.1 mg/l TP criteria observed only during the drought year of 2002.

FIGURE 6 Total Phosphorus Concentrations in the Dundee Lake

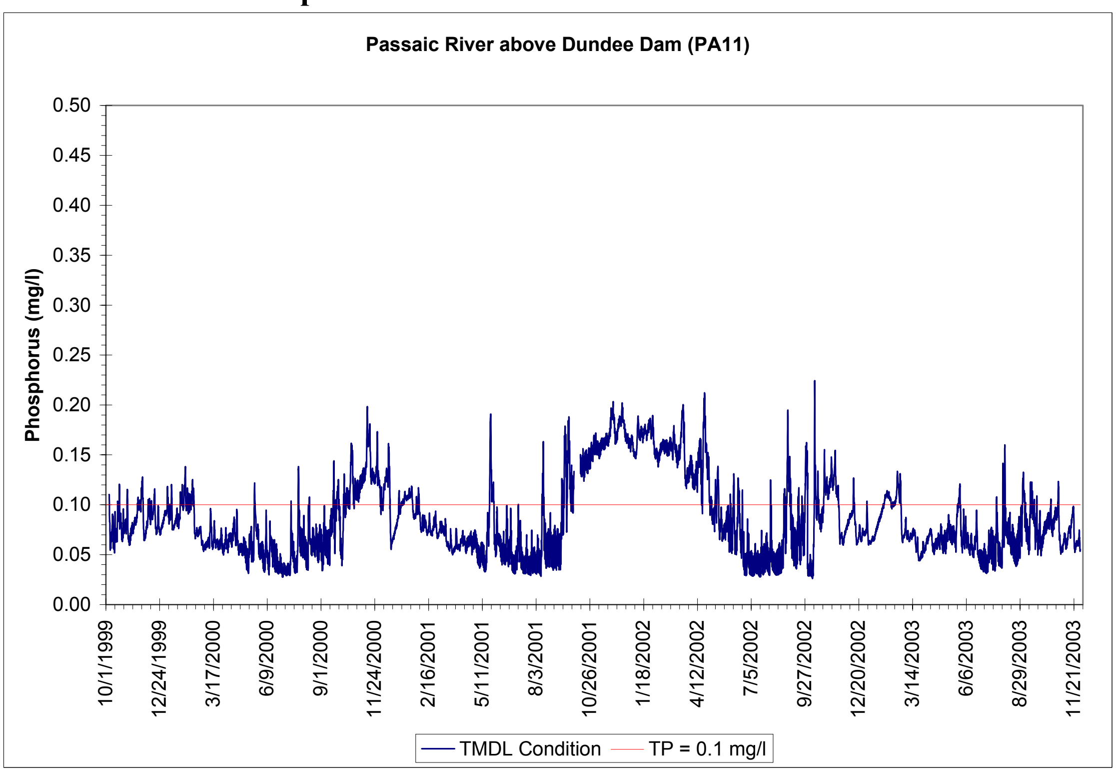


Table 1 Summary

	TP - Existing (mg/l)	TP - TMDL (mg/l)
Entire Time Period		
Count	14,971	14,971
Average	0.33	0.09
90th Percentile	0.56	0.15
Percent Rank 0.1	1%	70%
W/out WY2002		
Count	11,421	11,421
Average	0.28	0.08
90th Percentile	0.46	0.11
Percent Rank 0.1	1%	81%
W/out 2002 Water Supply Emergency		**1/24/2002 - 1/7/2003**
Count	11,531	11,531
Average	0.31	0.08
90th Percentile	0.56	0.14
Percent Rank 0.1	1%	74%

Conclusion

Chlorophyll-*a* is the common translator selected by states (Missouri, Pennsylvania, Oregon, Alabama and Kansas) to address narrative criteria and is supported by EPA in both "*Protocols for developing Nutrient TMDLs*, First Edition November 1999, which lists chlorophyll-*a* as suitable indicator for nutrient TMDLs, and in *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs"*, First Edition 2000. Chlorophyll-*a* is selected because of its primary role in photosynthesis. It is easy to measure and is a useful surrogate for measuring algal biomass, which is either the direct (nuisance algal blooms) or indirect (high/low dissolved oxygen, pH and high turbidity) cause of most problems related to excessive phosphorus enrichment. EPA's August 2002 approval of revisions to the New Jersey's phosphorus criteria specifically acknowledge that criteria may be developed through the watershed process (N.J.A.C. 7:9B-1.14 (c)5, and that it is consistent with the requirements under 40 CFR 131.11(b). Adoption of the non-tidal Passaic River basin TMDL establishes that the watershed criteria specified herein, upon approval by EPA, are the applicable surface water quality standards with respect to phosphorus within the identified domain.

Appendix F: Response to Comments: Non-tidal Passaic River Basin and Pompton Lake/Ramapo River Phosphorus TMDLs

Summary of Public Comments and Responses
The following people (listed alphabetically) submitted written and/or oral comments on one or both of the proposed TMDLs:

1. Alexander, Diane of Maraziti, Falcon, & Healey LLP for Rockaway Valley Regional Sewerage Authority, Letter and fax (same) dated July 6, 2007
2. Bongiovanni, Robert - Executive Director of Two Bridges Sewerage Authority. Letter dated July 3, 2007 (submitted with 16. below)
3. Covelli, Frank - Vice-Chairman of Wanaque Valley Regional Sewerage Authority, Letter dated November 8, 2006
4. Curran, Kelley of Great Swamp Watershed Association, Letter dated August 9, 2007
5. Decker, George - Chairman of Pompton Lakes Borough Municipal Utilities Authority, Letter dated November 7, 2006
6. Duch, Thomas - City of Garfield, Letter dated May 22, 2007
7. Filippone, Ella - Executive Director of Passaic River Coalition Watershed Association, Public Hearing, June 7, 2007
8. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 25, 2007
9. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 7, 2007
10. Goodsell, Robert of Post, Polak, Goodsell, MacNeill & Strauchler for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007
11. Kehrberger, Patricia of Hydroqual, Inc. for Township of Wayne, Letter and fax (same) dated July 6, 2007
12. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007
13. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated September 19, 2007
14. Matarazzo, Pat - Chairman of Passaic River Basin Alliance, Public Hearing June 7, 2007
15. Meyers, Mark of Quantitative Environmental Analysis, LLC for Two Bridges Sewerage Authority, Technical memorandum dated July 2, 2007
16. Plambeck, Richard - Mayor of Chatham Borough, Public Hearing June 7, 2007
17. Platt, Fletcher of Hatch Mott MacDonald and Technical Advisory Committee Member, Public Hearing, June 7, 2007
18. Singer, Steven - Counselor-at-Law for Township of Wayne, Letter and fax (same) dated July 6, 2007 (submitted with 11. below)
19. Thompson, B. - Email of July 6, 2007 with forwarded July 6, 2007 letter from N. Bardach of Virotech USA, Inc.
20. Tittel, Jeff - Director of Sierra Club, Public Hearing June 7, 2007
21. United States Environmental Protection Agency – Region 2, Letter dated July 9, 2007
22. Wolfe, Bill - Director of New Jersey Chapter of Public Employee for Environmental Responsibility (PEER), Public Hearing, June 7, 2007
23. Wynne, Michael - Executive Director of Hanover Sewerage Authority, Letter and fax (same) dated July 6, 2007

A summary of comments on the proposals and the Department's responses to those comments follows. The numbers(s) in brackets at the end of each comment corresponds to the commenters(s) listed above.

Extend Comment Period:

1. Comment: The Department should extend the comment period an additional 60 days to allow sufficient time to evaluate various aspects of the Phase 2 Watershed Model. (10)

Response: The entire TMDL development process included significant information sharing with the public and multiple opportunities for public comment. For the formal proposal, the Department advertised the public hearing 30 days prior to the date of the hearing and allowed a 30 day comment period following the hearing. In addition, due to unexpected difficulties in making the model available on the web, an additional 30 days was allowed to comment on the proposed TMDLs. The Department believes that a further extension of the comment period would not be likely to raise issues or provide new information, data or findings that were not previously raised or provided during the development of the amendment or during the comment period outlined above. The Department believes that adequate opportunity for comment was provided to all commenters on this amendment without the necessity of a further extension of the comment period.

End Point:

2. Comment: Use of site-specific criteria is supported. Based upon review of the proposed criteria and supporting documentation, commenter agrees that chlorophyll-*a* represents an optimum endpoint for the Wanaque Reservoir and Dundee Lake TMDLs. In addition, based upon the modeling results presented in the proposed report and supporting technical reports, it appears that the proposed chlorophyll-*a* values of 10 ug/L for the Wanaque Reservoir and 20 ug/L for Dundee Lake are adequately protective of the applicable designated uses. Specifically, the modeling results, as presented in the various figures, indicate that compliance with the chlorophyll-*a* proposed values will minimize the current nutrient-based impairments to these two waters: excessive diurnal dissolved oxygen swings, and elevated chlorophyll-*a* levels. The referenced literature and State examples serve to further justify the selection of these values. (21)

Response: The Department acknowledges the support of the watershed criteria developed for the two critical endpoints in the Passaic River Basin. With adoption of these TMDLs as amendments to the applicable Water Quality Management Plans, these criteria are adopted watershed criteria in accordance with the New Jersey Surface Water Quality Standards, *N.J.A.C.* 7:9B-1.5(g)3. The Department plans to post watershed criteria established as part of an adopted Water Quality Management Plan on its Water Quality Standards page.

3. Comment: Commenter believes that the discussion of the criteria could be reorganized to strengthen and clarify the justification as follows: a) the detailed information in Appendix E that

taken together leads to the conclusion that designated uses are protected should be summarized there and added to the main document on page 18; b) the experience of other states could be relegated to supporting information rather than included as part of the justification. (21)

Response: The Department believes that the body of the TMDL document should summarize information that is set forth in greater detail in Appendices and/or the supporting documents that accompany the TMDL. Repeating the detailed information contained in Appendix E in the body of the TMDL does not add to the strength of the argument. The detailed information on the experiences of other states has been moved to Appendix E. In addition, the Department has revised Section 3 and Appendix E to more clearly state that designated uses will be supported with attainment of the watershed criteria.

4. Comment: On page 17 there is a reference to a New York State guidance value of 20 ug/L of chlorophyll-*a* and a New York City value of 15 ug/L chlorophyll-*a* for the New York City water supply reservoirs. Please note that both the 20 ug/L and 15 ug/L values are for total phosphorus, not chlorophyll-*a*. In addition, it should be noted that the total phosphorus value 15 ug/L relates to a chlorophyll-*a* concentration of 7.0 ug/L, and is only applied to a subset of the New York City water supply reservoirs. (21)

Response: The error noted by the commenter was based on the commenter's review of a pre-release draft. The errors referenced by the commenter were corrected prior to release of the final May 7, 2007 proposal.

5. Comment: 40 C.F.R. 131.6(a)-(f) specify the minimum requirements for a water quality standards submission to EPA. With regard to the State's submission of the site specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, elements (b), (c) and (e) apply. Based upon the commenter's review of the applicable sections of the proposed TMDL Report, elements (b) and (c) are included in the proposal. The Department must also include the requisite Attorney General certification as part of the final submission in order to address the requirements of 40 C.F.R. 131.6(e). (21)

6. Comment: 40 C.F.R. 131.20(a)-(c) specify the Federal requirements for State review and revision of water quality standards. With regard to the State's submission of the site-specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, the applicable 40 C.F.R. 131.20 elements that apply are (b) and (c). The Department has fulfilled the requirements of 40 C.F.R. 131.20(b) through its public participation process. The Department's submission of the final chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, along with the final methodologies used for site-specific criteria development, as well as the above-referenced Attorney General certification will satisfy the requirements of 40 C.F.R. 131.20(c). (21)

Response to Comments 5 and 6: The TMDL documents, revised for adoption in accordance with the response to comments, include the final documentation of the watershed criteria (not site specific) relative to the phosphorus standard within the non-tidal Passaic River basin. The Department notes that the referenced DAG certification is required under Federal regulations to stipulate that the water quality standards have been duly adopted pursuant to State law. This certification was provided to EPA as part of the submission of the current Surface Water Quality Standards, which were approved by EPA's letter dated August 16, 2002. That letter specifically approved the revision to the "phosphorus criteria to acknowledge that criteria may be developed through the watershed process (N.J.A.C. 7:9B-1.14(c)5." The Department believes this obviates the need for the DAG certification specified at 40 C.F.R. 131.6(e). The Department will provide any documentation determined to be necessary to establish that the watershed criteria are the applicable surface water quality criteria relative to the phosphorus standard in the specified portion of the non-tidal Passaic River basin.

7. Comment: The Department needs to show that the existing standard is inappropriate or under-protective before an alternate watershed-specific criterion is developed. Further, establishing the criterion as part of the TMDL does not appear to be procedurally correct. The target for the Phase 1 TMDL was not to exceed 0.05 mg/L. The seasonal average approach appears to be a back door ruse to weaken the compliance condition. The most stringent policy should be in place to protect the public water supply. (22)

Response: Site-specific or watershed criteria can be either the same, more, or less stringent than the existing/default criteria, as stated in the adoption of amendments to the Surface Water Quality Standards proposed on December 18, 2000, see 34 N.J.R. 537(a), January 22, 2002; specifically responses to comments 247, 248 and 343-351. Establishing the criteria in terms of the response indicator, chlorophyll-*a*, is not a weakening of the criteria. Instead, development of a dynamic model that simulates the effect of nutrients, productivity and water quality effects of productivity based on the characteristics of the specific watershed has allowed the Department to set criteria that provide protection of designated uses without requiring nutrient reductions aimed at achieving a default criterion. The SWQS state that watershed criteria shall be established through the watershed process, which includes through adopting a TMDL, which establishes said criteria.

8. Comment: Selection of chlorophyll-*a* as the endpoint parameter and as a seasonal average to measure compliance for Dundee Lake and Wanaque Reservoir is appropriate. Chlorophyll-*a* as a measure of algae related to taste and odor problems in water supplies (drinking water use), algae interference in the normal operation of a water treatment plant (drinking water use), recreation use (aesthetics) and the resultant dissolved oxygen (aquatic life use) are a direct measure of meeting designated uses. (11), (12)

9. Comment: The use of chlorophyll-*a*, a response indicator of the effect of phosphorus on algal growth, as the endpoint for the TMDL is applauded. The use of chlorophyll-*a* is supported over the former approach, which applied the numerical phosphorus limit without any consideration of the effect. (23)

10. Comment: The use of summer average phytoplankton chlorophyll-*a* as a measure of whether or not nutrient concentrations are excessive is appropriate and the critical locations for this measure are the confluence of the Passaic and Pompton Rivers and in the Passaic upstream of Dundee Dam. The Department is commended for including Dundee Dam as an endpoint because it should be cleaned up so as to be suitable as a drinking water source. (7), (8), (9)

Response to Comments 8-10: The Department acknowledges these comments in support of use of chlorophyll-*a*. The Department selected chlorophyll-*a* as the appropriate response indicator for the Passaic River watershed criteria. Based on the development of a dynamic model for the Passaic River Basin that simulates the relationship between nutrients, productivity and water quality and allows identification of levels of chlorophyll-*a* that support designated uses in the critical locations.

11. Comment: While the use of chlorophyll-*a* as the response indicator for the TMDL is applauded, the selection of a summer average 10 ug/L target is very conservative and was made in the absence of any site specific data. A review of Florida lakes shows that 20 ug/L is exceeded only 2% of the time when the warm season average is 10 ug/L. This illustrates the conservative nature of the target. The selection of 10 ug/L is explained only in terms of reservoir characteristics: it is deep, and serves as a trout fishery and a drinking water supply. (15)

12. Comment: Moving from phosphorus to chlorophyll-*a* is a concern. We know phosphorus is a limiting factor. Chlorophyll-*a* is a biochemical byproduct. We all know what the standard is and that is what we should strive for. (20)

13. Comment: The seasonal average chlorophyll-*a* of 10 ug/L for the Wanaque Reservoir has not been documented as the appropriate end point and appears arbitrary. NJDEP lists the five factors taken into consideration in the selection of the chlorophyll-*a* value and cites a range of values adopted elsewhere, concluding that a conservative target is warranted for the Wanaque Reservoir. Was North Jersey District Waster Supply Commission (NJDWSC) input on the selection of the chlorophyll-*a* standard used or requested? An analysis and/or data from NJDWSC documenting the relationship of algae levels to treatment problems and/or taste and odor complaints from customers is necessary for the establishment of a protective chlorophyll-*a* standard for the reservoir. Although samples are collected monthly, values exceeding 10 ug/L are measured for most years. 15 ug/L appears to be normal for the Reservoir. NJDWSC should be an active participant in the establishment of the chlorophyll-*a* standard at their reservoir. (12)

14. Comment: The selection of 20 ug/l chlorophyll-*a* is arbitrary and not supported in the TMDL analyses. The Department's phosphorus technical guidance sets a threshold for chlorophyll-*a* of 24 ug/l as a seasonal average with a two-week mean of 32 ug/l. These values have been used for several years as a conservative threshold to determine when phosphorus is rendering waters unsuitable for designated uses. The endpoint should be the level at which Dundee Lake is not meeting designated uses. The 20 ug/L value was chosen to be conservative, an MOS was added, and the TMDL is based on an "extreme drought" year. The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions. Absent measured impairments, the Dundee Lake endpoint should be 30 ug/l seasonal average. (11)

Response to Comments 11-14: The selected watershed criteria are appropriate and protective and were established taking into account site-specific data. The Department's Surface Water Quality Standards (SWQS) for phosphorus include narrative statements regarding allowable levels of nutrients based on the effect they have on primary productivity and water quality. These provisions recognize that phosphorus is a potential causal factor that may result in excessive primary productivity and associated water quality impacts, particularly with respect to dissolved oxygen and pH, but that it does not necessarily do so in every location. The SWQS also include a provision at N.J.A.C. 7:9B-1.5(g)3 for establishing site specific or watershed criteria with regard to phosphorus recognizing the scientific reality that the nutrient dynamics in a given setting may warrant a different numeric value for phosphorus or a different basis to assess attainment of designated uses. It is generally held that measurement of acceptable levels of nutrients is ideally done in terms of response indicators of excessive productivity, such as chlorophyll-*a* (*Protocols for Developing Nutrient TMDLs,* First Edition, November 1999; *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs*, First Edition, April 2000, EPA). Based on the cited EPA guidance and experiences of other states as discussed in Appendix E of the TMDL, the selected chlorophyll-*a* value varied and reflected a best professional judgment guided by factors such as climate, physical lake characteristics and designated uses. As set forth in Appendix E of the TMDL, the Department evaluated model simulations of water quality response in the critical locations, the particular characteristics of the critical locations and their uses, as well as literature values and EPA guidance documents to guide selection of the watershed criteria. The Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 167-169) provides some discussion of the basis for the watershed criterion established for Dundee Lake based on a water quality target of 20 µg/l chlorophyll-*a* as a summer average. Appendix L of *The Passaic River Basin Nutrient TMDL Study report* (Omni 2007) also includes simulations of water quality response at Dundee Lake as well as throughout the river basin, given attainment of the 20 µg/l endpoint. Furthermore, the Wanaque Reservoir Supplemental report (Najarian, 2007) provides graphical outputs for total phosphorus, chlorophyll-*a*, organic phosphorus, dissolved inorganic phosphorus, water temperature and dissolved oxygen that illustrate the water quality associated with the endpoint of 10 ug/L chlorophyll-*a*. Based on this information, the selected watershed criteria are protective of designated uses.

The statement that "The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions" is inaccurate. Extreme dissolved oxygen saturations and high chlorophyll-*a* were predicted under the Baseline Future Conditions at the critical locations, see Figures 36 and 37 on page 142 (Omni, 2007). Furthermore, actual measurements of chlorophyll-*a* and diurnal dissolved oxygen in the lower reaches of the Passaic River confirm high chlorophyll-*a* levels (97 µg/l at Market Street on August 14, 2002) and extreme supersaturation of dissolved oxygen (over 16 mg/l in August 2003). The suggested endpoint of 30 ug/l at Dundee Lake represents the Baseline Future Conditions, see graph 57 page 173. As stated above, this would result in extreme supersaturation of dissolved oxygen at the critical locations and would not be an acceptable endpoint. The use of the phosphorus protocol criteria at Dundee Lake is also not appropriate because the phosphorus protocol criteria were developed for flowing streams and this location is an impoundment. The *Technical Manual for Phosphorus Evaluations for NPDES Discharge to Surface Water Permits*, NJDEP, March 2003, which defines the criteria for determining is phosphorus is rendering waters unsuitable for the designated uses, specifically states that the "phosphorus protocol study, including application of the thresholds, is not applicable where there is a downstream impoundment. At the selected watershed criteria, the levels of biomass and associated water quality response parameters, dissolved oxygen and pH, are compatible with the actual and designated uses.

The proposed watershed criteria were presented to the regulated community and NJDWSC at the September 11, 2006 meeting. At that time, the NJDWSC indicated that this level of chlorophyll-

a will provide suitable protection for use of the Wanaque Reservoir for public potable water supply after conventional filtration treatment, as provided in the SWQS designated uses for FW-2 waters.

15. Comment: It was understood that the Phase 1 TMDL would be superseded by the Phase 2 TMDL, but it was expected that the Phase 1 TMDL would jumpstart water quality improvement and the Phase 2 TMDL would ratchet down on limits to be fully protective. The Phase 1 TMDL had an endpoint of not to exceed 0.05 mg/L of total phosphorus while the Phase 2 TMDL establishes a watershed criteria in terms of chlorophyll-*a*. Which is more protective of the drinking water use? The Department should provide a side by side comparison of the two TMDL documents. (22)

Response: The commenter is correct in stating that the purpose of the Phase 1 TMDL, which addressed phosphorus impairment in the Wanaque Reservoir, was to accelerate water quality improvement by determining and directing the phosphorus reductions needed to attain SWQS in the reservoir. However, there was no preconceived notion of what the final outcome of the overall TMDL for the Passaic River basin would be. The outcome was to be and is driven by the science of the model results. The development and application of a dynamic, basin-wide model that is capable of simulating the effects of nutrients on productivity and the associated water quality effects has enabled the Department to provide a carefully balanced implementation approach using response indicators as the water quality endpoints. Tying phosphorus reduction to attainment of levels of chlorophyll-*a* that are protective of the designated uses achieves the water quality objective without incurring unnecessary treatment expense.

The commenter is directed to Figure 5.7 in (Najarian, 2005), and Figure 1 in the supplemental report entitled *Phosphorus Chlorophyll a Relationship Wanaque Reservoir Addendum to Najarian 2005* (Najarian, 2007) for a comparison of the in-lake phosphorus concentrations as the result of the two approaches. Beyond this, given the myriad differences in the two TMDL documents (spatial extent, modeling approach, critical locations, endpoints, etc.) a side by side comparison of the documents is not appropriate. Instead, the Department has explained in the current TMDL documents that the Phase 1 TMDL has been withdrawn, provided a response to the key comments on the Phase 1 proposal, and has reiterated any relevant information from Phase 1 in the current TMDL documents.

16. Comment: The Passaic TMDL was developed for an overly conservative drought condition. NJDEP establishes wastewater treatment plant discharge effluent limits for phosphorus based a 7Q10 receiving water flow, a flow condition with a return period of 10 years. Najarian 2005 states that this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. The year 2002 represents a severe condition when NJDEP declared drought warning status for northeast New Jersey. From the "Wanaque Reservoir TMDL Development New Model Scenario" prepared by Najarian & Assoc. in 2007, the volume of diversion to the reservoir exceeded the reservoir during the "sustained drought" period of WY2002 (October 1, 2001 through September 30 2002) . In addition, the TMDL calculation was performed with pumping at the ultimate safe yield as provided by NJDWSC. Any carryover of phosphorus to the next year is minimal. The 2002 drought year

upon which the Passaic TMDL is based is "conservative" and the developed chlorophyll-*a* standard should not apply. (12)

17. Comment: The Passaic TMDL for Dundee Lake was developed for an overly conservative drought condition, a point noted by the New Jersey EcoComplex (NJEC). Najarian 2005 states that the rainfall in this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. Effluent limits are based on a 7Q10 receiving water flow, a return period of 10 years. Flow is an important driver for productivity, illustrated by the reduction in chlorophyll-*a* in Baseline Future Conditions, when plants are at full permitted flow, compared to Existing Conditions. It is recommended that the NJDEP use Water Year 2001 instead of the extreme drought year as the basis for the TMDL. (11)

Response to Comments 16 and 17: The TMDL was not developed for an overly conservative drought condition. The Passaic River Basin has experienced several drought periods in the last 15 years, notably 1994-1995, 1998-1999, and 2001-2002. From a water supply perspective, 2002 was notable but not unique. Reservoir capacity has dipped below 10 billion gallons three times since the beginning of 1993 – extensive pumpage from river intakes was needed to refill the reservoir after each event. Thus, given that this is a managed system, conditions that could produce the adverse water quality effects in the reservoir can occur more frequently (and more severely) than do purely meteorological droughts. Further, in terms of the prevalence of low-flow warm-weather conditions conducive to algal growth, 2002 was not significantly different than other recent drought periods. For instance, the average flow at the Little Falls gage (01389500) from June through September was 230 cfs in 2002, compared with 168 cfs in 1995. Similarly, 81% of the daily summer flows in 2002 were below the published 70th percentile flow of 295 cfs at that same gage, compared to 84% during the summer of 1995. The commenter states that phosphorus does not accumulate in the reservoir, presumably because water pumped in does, on occasion, exceed that which is pumped out. This situation does not occur every year and even when pumping does exceed outflow, phosphorus can settle below the level of pumpage and be available for algal growth following turnover events. Finally, even if 2002 were not utilized for the TMDL calculations, simulated algal concentrations at Dundee Lake were similar in 2001 and 2002.

18. Comment: The measurement of success of the TMDL must be based on attainment of the chlorophyll-*a* targets that will be assessed through a sufficient monitoring program. (15)

19. Comment: Confirmation is requested that the objective of the TMDL is the achievement of the designated chlorophyll-*a* level, not whether an in-stream phosphorus level of 0.4 ppm LTA has been met. (2)

Response to Comments 18 and 19: The attainment of the established watershed criteria at the critical locations is the objective of the TMDL. While the watershed criteria are established in terms of chlorophyll-*a*, attainment will depend on reducing phosphorus loads in accordance with the TMDL, which includes wasteload allocations and load allocations to point and nonpoint sources, respectively. An in-stream phosphorus level has not been specified. The TMDL is based on long term average effluent concentrations that will be applied to wastewater treatment facilities through NJPDES permitting following adoption of the TMDL. The long term average concentrations will be reflected as monthly average effluent limits in the applicable NJPDES permits, subject to water quality trading. As indicated in Table 14, most facilities will be receiving an effluent limit based on a long term average concentration of 0.4 mg/L. The Department concurs that assessment of successful implementation of the TMDL will require an adequate follow-up monitoring program, as described in the TMDL under "Follow-up Monitoring".

Models:

20. Comment: It is stated that phosphorus concentrations in baseflow (page 58 of technical document) ranged from 0.02 to 0.09 mg/l in pristine locations, and from 0.02 to 0.13 mg/l in areas affected only by nonpoint sources; one would expect there to be a greater difference. There should be discussion of the reason(s) why these two concentrations are similar. (21)

Response: The referenced document does offer an explanation that the amount of forest and wetlands in a drainage area appeared to be the most significant influence on tributary concentration. To elaborate, the Passaic River headwaters are strongly influenced by major wetland complexes, namely the Great Swamp and Great Piece Meadows. An analysis of the export of phosphorus from the Great Swamp to the Passaic River is provided in Appendix D of the Passaic River Basin Nutrient TMDL Study report (Omni 2007). In addition, data at reference locations in the Passaic River basin demonstrate that tributaries in relatively pristine areas frequently have higher phosphorus concentrations than might otherwise be expected. The Passaic River TMDL study accounted for these background phosphorus sources using the best available data.

21. Comment: Using global parameters implies that the aquatic ecosystem has similar characteristics in all of the segments (pages 98-99 of technical document). What assumptions are used to make the determination as to which parameters should be calibrated globally or locally? (21)

Response: Most parameters are applied throughout the model domain (global). The EPA Water Quality Analysis Program 7.0 (WASP7) model allows that certain parameters can be assigned localized values. In this modeling approach, local parameter values are only assigned when necessary to obtain an acceptable calibration, unless localized information is available (such as location-specific light attenuation coefficients). It is possible to divide the study area into separate models that are then linked externally and this may be necessary to achieve an acceptable calibration in some waterbodies. In the Passaic River TMDL model, calibration was successful using a single model throughout the study area.

22. Comment: In the Light Extinction Coefficients (pages 68-69 of the technical document), "The surface light energy and the light energy at the deepest measurement were used to derive the value of K." Why was it estimated this way rather than taking the average over depth? (21)

Response: As described in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 68), the Beer-Lambert law was used to calculate light extinction coefficient as a function of light energy at the surface and light energy at a particular depth. The light energy at the deepest measurement was used in order to obtain an estimate over the largest depth of the photic zone. This procedure is commonly used to estimate light extinction coefficients when light energy measurements are available (Wool, T.A., R.B. Ambrose, J.L. Martin, E.A. Comer, WASP Version 6.0 Draft User's Manual, pp. 11-38).

23. Comment: Regarding Table 13: specify the dates of the July and August events; more than two events should be considered if K1 will be used throughout the year; estimates for light extinction coefficients should cover more than only the summer period and during storm events; and there is no description why the K1 values vary so much between the July and August event for some of the stations and the implications of this variability. (21)

Response: Light extinction measurements were generally taken during the July and August 2003 diurnal events, which occurred July 15, 16, and 18 of 2003 and August 24, 25 and 26 of 2003. The July and August light extinction coefficients are consistent for most locations, with only two of 23 showing variability. The extent and quality of light extinction data for the Passaic River TMDL study was appropriate given the state-of-the-art for these types of modeling studies. Light extinction data was sufficient and appropriate to inform a model concerned with productivity during critical periods. Light extinction is important during low-flow summer periods when periphyton and macrophyte productivity is highest. Light extinction can vary spatially in WASP, but not temporally. The Passaic River Basin TMDL study benefited from multiple localized light extinction measurements, providing a basis to assign spatially variable values.

24. Comment: The observed Hydroqual and the observed Omni SOD data are significantly different. Do they represent one value or an averaged value? The observed values are very different than the calibrated SOD values. (page 111, Table 24 of the technical document). (21)

Response: Field measurements of SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling, G. L. Bowie et. al., 1985). For the model, SOD values for large areas were needed. Taking into consideration the variability of individual site measurements, the issue of precision of SOD measurements in general, and the extensive amount of SOD data needed to characterize the SOD profile in the Passaic Basin based on data alone, SOD values were assigned by model calibration rather than assign one value or an average value. A limited number of SOD measurements at sampling stations in the Passaic River were conducted in order to perform a reality check on the calibration SOD values. It should be noted that average dissolved oxygen levels are largely influenced by hydraulics through reaeration, and by stream temperature due to solubility differences. SOD primarily influences the average DO and causes only a minor impact on the DO diurnal variation.

25. Comments: In many of the figures of the report, it is difficult to determine the importance of the difference between simulated and observed data. The differences are provided as total difference rather than percentage difference (i.e. Table 8). For other tables, the units are not provided. (i.e. Table 25). There is at times limited or no discussion of the implication of differences between simulated and observed data. Based on the figures provided how accurate is

the model? (i.e. Table 22). Whenever observed mean data is presented the number of data points used should be included (i.e. Table 26). (21)

Response: The perceived difficulty in determining the importance of differences between simulated and observed data is a result of the large-scale watershed modeling study that was conducted. The graphical presentation in Appendices E and F of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) was deemed the best way to convey the overall results.

As noted, even a well-calibrated model may at times show a poor comparison between simulated and observed data; for example, a poorly characterized boundary condition may cause a poor fit, even though the model is well-calibrated and perfectly suitable to evaluate future conditions based on an assumed boundary condition. On the other hand, a poorly calibrated model can show a very good fit between simulated and observed data, perhaps due to an over-reliance on localized parameters to force a good fit, or due to a limited set of observation data under a variety of conditions. It is appropriate to provide absolute differences rather than percent differences between simulated and observed data, because the absolute magnitude provides a better sense of the importance of the difference. For instance, the percent differences for ammonia might be high simply because the ammonia levels are low. Units for the calibration statistics are concentrations (e.g. mg/l), and are provided in the example calibration graphs. For Omni sampling stations, generally 12 or 20 observations were available for the 2003 calibration period. Statistics were only derived when enough observed data were available. The model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

26. Comment: When providing coefficients of correlation (page 93), the document should state whether the comparison between data sets is for a monthly, daily or hourly time period. The squared correlation coefficient, R^2, could be significantly different between monthly and daily datasets, and this could also give valuable insight on model performance. Are there other statistical measures that could provide insight on model accuracy and performance? (21)

Response: Descriptions of calibration statistics are provided in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 98). Statistics were calculated automatically within the WASP post-processor by comparing intra-day simulation values with observed values. This method is the only one available within the WASP post-processor, and is considered the preferred method when evaluating the goodness of fit for a dynamic water quality model. The use of intraday comparisons tends to exaggerate the differences between observed and predicted values.

The most relevant statistics available within the WASP post-processor were selected. "Mean Error" provides a key absolute measure of the average difference between predicted and observed concentrations. A Mean Error of zero indicates that overpredictions and underpredictions were exactly balanced. The average predicted value is provided along with the average among the observed values. These means are important because they provide a context to understand the importance of the Mean Error. The predicted and observed standard deviations provide an indication of how well the model captured the variability about the mean. Finally, the squared correlation coefficient, R^2, is provided as a measure of the degree to which model predictions and observations vary together linearly. Appendix G includes graphical representations of predicted versus measured total phosphorus concentrations for stations throughout the model domain, providing another measure of model performance. The calibration procedure consisted primarily of plotting the discrete observed data and the continuous simulated data together, and comparing them. Limited statistics were considered to provide some guidance during calibration. Based on the many representations of model performance, and thorough evaluation by the Department and the New Jersey EcoComplex, the model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

27. Comment: What is limiting biological productivity in the different stream segments? (Page 149 of the technical document) For example, if in certain locations DO is not very sensitive to phosphorus reductions, but these areas are very sensitive to changes in velocity and light, couldn't this be evaluated in the model analysis? (21)

Response: Biological productivity is influenced dynamically by a number of factors, including nutrient availability, flow, velocity, light penetration, temperature, and substrate. Some of these factors can be evaluated independently through model sensitivity. The purpose of this study was to determine the extent to which phosphorus was affecting biological productivity. Where phosphorus was found to be causing excessive productivity and related water quality impacts, the purpose was to determine the amount of phosphorus reduction that would achieve water quality objectives, expressed in terms of the watershed criteria as chlorophyll-*a* criteria at the critical locations. The study did conclude that other factors were responsible for water quality effects in the portions of the basin. For example, lack of light penetration due to naturally occurring dark water was the reason for low observed productivity in upper reaches of the basin, even when phosphorus was present in sufficient quantities to support high productivity; and low dissolved oxygen was found to be a naturally occurring condition in some locations either because source waters were naturally low in dissolved oxygen or because of high natural SOD from large wetlands complexes.

28. Comment: Why not incorporate shading in the TMDL analysis? (21)

Response: Generally, the modeled streams in this study are higher order streams for which shading would not be expected to be as significant a factor as in smaller streams. For this reason, data on percent canopy cover were not collected during the data collection phase. As expected, it was not necessary to incorporate shading to obtain a meaningful calibration. Few, if any, large watershed studies of this magnitude incorporate shading into the water quality analyses. In terms of using shading as a management response, this may be effective for a limited spatial extent in smaller tributaries, but productivity was not found to be an issue in these smaller order stream areas.

29. Comment: Does the reduction in phosphorus loads have an effect on biological productivity throughout at different stations in the watershed? Chlorophyll-*a* graphs could accompany phosphorus graphs for each location in Figures 26-48 of the technical document. (21)

Response: The overall conclusion of the study was that phosphorus was responsible for causing excessive primary productivity in the identified critical locations, but not elsewhere in the basin. Therefore, focus was on simulated outcomes of reductions at the critical locations. Chlorophyll-*a* graphs showing the impact of phosphorus reductions in the body of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) are provided for locations where phytoplankton is important. Appendix J provides a more complete set of graphs showing the impact of extreme phosphorus reductions on chlorophyll-*a* and dissolved oxygen throughout the basin.

30. Comment: A major assumption in the TMDL model is "that phosphorus is a conservative constituent and the dominant factor in determining in-stream concentrations of phosphorus in the Passaic system is the relative dilution, depending on available streamflow, of a significant and relatively constant wastewater discharge load." This seems to hold true at current phosphorus loadings in the Passaic and Pompton Rivers, which exceed surface water quality standards several-fold. However, there is inadequate narrative detail describing the range of in-stream phosphorus concentrations for which the conservative mass-balance assumption is valid. Please explain in greater detail why the assumptions made at current loadings will remain valid when TMDLs are implemented and dischargers reduce their loadings. (21)

Response: This assumption is only used in a limited way for estimating loadings to the Wanaque Reservoir from direct drainage to the reservoir outside the domain of the dynamic model and for loadings to Pompton Lake. Loading reductions from dischargers are not significant in these drainage areas and exceedances of existing numeric criteria are not significant. Therefore, the loading assumptions from the limited drainage areas where this approach was used are believed to remain valid in the future scenario.

31. Comment: In Table 3-1, the R^2 for the mass balance model for the Ramapo River at Pompton Lakes is 0.244. According to the analysis, the reason for low correlations seems to be partially due to greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l. Please identify background literature that supports this claim. What is the correlation between observed and simulated phosphorus concentrations for all data above 0.10 mg/l? (21)

Response: Background literature supporting the statement made regarding the greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l can be found in numerous references; the report provides two: USEPA, (1993) "Guidance on Evaluation, Resolution, and Documentation of Analytical Problems Associated with Compliance Monitoring: Washington, D.C., U.S. Government Printing Office, USEPA 821-B-93-001, June 1993; and, USEPA, (1985) "U.S. Code of Federal Regulations, Title 50," Washington, D.C., U.S. Government Printing Office, November 13, 1985, 46906. Statistical analysis, including correlation between observed and simulated phosphorus concentrations for data above 0.10 mg/l, would be of limited usefulness and not technically supported because of the small number of observations- only 10 data points exceeded the 0.10mg/L TP concentration.

32. Comment: On page 3-3 of the technical document for the Pompton Lake TMDL, please identify either the literature sources or the monitoring data on which the estimated baseflow concentration of 0.01 mg/l is founded. Please explain whether the baseflow concentration could vary based on the specific soils and bedrock present in the watershed? (21)

Response: It is important to note that the base flow component referred to in Pompton Lake TMDL document should not be confused with the tributary baseflow component used in the dynamic modeling for the overall Passaic River Basin TMDL document. Tributary baseflow in the latter document is the in-stream total phosphorus concentrations taken under 70th percentile low flow and includes both groundwater and residual from surface runoff/interflow. In the Pompton Lake document, the base flow concentration consists of ground water only. A base flow separation method was used with areal runoff loading coefficients to derive nonpoint source loadings in the Pompton Lake document. While ground water phosphorus concentration may vary based on local conditions, but in this region, based on the USGS ground water data for Passaic County, the 90th percentile dissolved phosphorus is 0.01 mg/L and the mode of the data is also 0.01 mg/L. This substantiates the use of this value for the base flow/ground water component in the Pompton Lake TMDL.

33. Comment: An explanation is needed as to how septic systems are incorporated into the TMDL analysis. The Wanaque Reservoir watershed seems to be impacted by septic system runoff since relatively high nitrate concentrations are found in West Brook, Cupsaw Brook and Erskine Brook, while the total phosphorus concentrations are similar for all tributaries. (See Table 2-6 on Page 2-4 of the technical document). Although one can surmise that these subwatersheds do not have sewer service, there could be an alternative explanation. The documents provide no information regarding the location of non-sewered areas or the failure rates of septic tanks in both the Wanaque Reservoir watershed and the greater Passaic-Pompton-Ramapo watershed. Furthermore, do areal phosphorus loadings for urban areas differ if they are served by separate storm water and sanitary sewer systems, combined sewer systems, or septic systems? This could be useful in determining the reduction in non-point source pollution that could be reasonably expected and also in providing more details on BMP implementation. (21)

Response: The majority of TMDL Approach Areas 1 and 3 are covered by centralized sewer systems. The majority of TMDL Approach Area 2 and 4 is serviced by individual septic systems and is taken as a headwater boundary condition to the TMDL model. Areas served by septic systems can be expected to contribute higher concentrations of nitrate either overland from failing systems or through groundwater entering the streams, because this compound is soluble and very mobile. However, the same is not true of phosphorus. The TMDLs and the technical documents address phosphorus loading from all nonpoint sources by hydrograph separation and assigning EMCs for each land use category. EMCs are derived through monitoring or Unit Areal Loads, and the non-storm load is estimated using the tributary baseflow monitoring results or groundwater data, depending on the approach applied (see discussion of Approach Areas in the TMDL document). Phosphorus is generally immobilized in the soil matrix, which is borne out by data on ground water concentrations of phosphorus in the basin (see response to Comment 32). Absent information about a particular septic system problem, the approaches used for nonpoint sources are believed to adequately account for septic system loading. Nevertheless, malfunctioning septic systems (e.g., those that result in a discharge directly to a water body) are identified as potential sources in Section 4.0 Source Assessment (page 34) and in Section 7.0 Implementation Plan (page 48), but the Department is not aware of any actual malfunctions. This potential would be as the result of a malfunction, not by design. The Department investigates reports of noncompliance with NJPDES permits, illegal point and nonpoint discharges, and accidental discharges. These discharges are not considered ongoing point sources that warrant a WLA; rather, they are ephemeral events that are addressed through compliance and enforcement measures as they occur. Regarding different loadings delivered by separate storm sewer areas compared to combined sewer areas, the loading coefficient method is not used in the very limited spatial extent of the study area in which combined sewers are used. In any case, phosphorus loadings from combined sewers were calculated separately from other stormwater loadings, as shown in Table 14 of the Passaic TMDL.

34. Comment: The Wanaque Reservoir model appears to over-estimate algal biomass during the 2002 drought period and the Wanaque Reservoir TMDL scenario results were incorrectly compared with the seasonal average target. (15)

Response: The observation that algal biomass is over-estimated during the 2002 drought is true in some locations and is believed to be the result of operational practices to prevent algal blooms during this period (e.g., application of alum, ultrasound treatment, aeration, etc.) Note that the model tracked the observed data during year 2002 at the Erskine station (Figure 4.15), where no alum was applied. Also, the available database indicates a relatively high nitrate concentration response to diversion loading at Raymond Dam during this period – concentrations that are largely unaffected by such practices. Since the model generally tracked the chlorophyll-*a* concentration data during other drought years (e.g., 1995, 1998), it is not overly conservative in predicting reservoir chlorophyll-*a* concentrations, absent taking extraordinary measures to suppress expression of algae.

35. Comment: The areas in the Wanaque Reservoir where characterizations are performed are not appropriate to determine the real background from undeveloped portions of the contributing drainage areas or to reveal how funky the reservoir gets when the pumps are turned on. (20)

Response: The TMDL modeling approach addressed the entire Wanaque Reservoir, and both graphic and/or tabular outputs for several stations within the reservoir representing both background (Erskine) and "hot spots" (Raymond Dam and West Brook) within the reservoir were presented in the supporting documentation (Najarian, 2005). The critical locations reflective of the most severe effects from diversion pumping were specifically modeled, ensuring that the critical location is accounted for when specifying load reductions.

36. Comment: The reservoir model does not accurately represent non-diversion and diversion loads to the reservoir; the dynamics of diversion events are not modeled accurately. (15)

37. Comment: The Department needs to explain the rationale for the parameters used in the reservoir water quality. (15)

38. Comment: Cycling of phosphorus in the Wanaque Reservoir is an important component of the model simulations that form the basis of the TMDL calculation. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. The Department has access to a numerical simulation model, in-reservoir monitoring data, and well-defined reservoir hydraulics to defensibly support its TMDL. Data on Reservoir-wide chlorophyll-*a* concentrations, as well as water treatments that NJDWSC implements, should be made available

so as to confirm the effectiveness of the TMDL in protecting the designated use of public water supply. (15)

Response to Comments 36-38: These comments were made on the Phase 1 TMDL and were repeated for the Phase 2 TMDL. The reservoir model is a hydrothermal/water quality model that was designed and is appropriate for evaluating the effect of diversion scenarios on water quality and trophic state in the reservoir. The reservoir model, Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS) simulates laterally averaged velocities, water temperature and constituent concentrations at all grid locations for a selected period. Simulated constituents include organic phosphorus, dissolved inorganic phosphorus, particulate inorganic phosphorus, dissolved oxygen, carbonaceous biological oxygen demand, nitrogenous biological oxygen demand and temperature. In addition, a relationship was derived between phosphorus and chlorophyll-*a.* The model simulates responses in these parameters, given specified loading inputs from diversion and natural drainage sources and the hydraulic dynamics of inflow/outflow volumes in this managed reservoir system. The Najarian 2005 TMDL study report provides sufficient data for the evaluation of model performance and results. Data is provided in the form of graphic outputs, summary loading budgets, and error analysis. For the Phase 2 TMDL, which targets a watershed criteria expressed as chlorophyll-*a*, additional information regarding the simulation of chlorophyll-*a* response, as well as tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam, were provided in a supplemental report (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788).

39. Comment: Key aspects of the Passaic TMDL are supported as technically defensible; however, it is also technically flawed in several key aspects that need to be addressed before adoption. The Wanaque Reservoir TMDL is flawed since only one alternative was evaluated. The seasonal average chlorophyll-*a* in Tables 1 and 2 of Najarian 2007 shows the summer average chlorophyll-*a* is 9.2 mg/L. It appears that the TMDL for Wanaque Reservoir including the MOS was the product of a guess that the TMDL LTA for Dundee Lake would "work" for the reservoir. More interchange between the river and reservoir modeling should be performed. The integrated model framework of DAFLOW plus the dynamic Passaic River Model plus the Wanaque Reservoir Model (the product of years of development and considerable public and discharger monies) has not been fully utilized to arrive at a TP load scenario for the reservoir. Model runs for existing conditions, Baseline Future Conditions, Most Extreme Reduction of Phosphorus (MERP) and TMDL scenarios with alternate LTAs and seasonal phosphorus reduction are needed. These analyses would provide an understanding of how the reservoir chlorophyll-*a* is influenced by management of the Passaic River phosphorus. (12)

40. Comment: The final Wanaque Reservoir TMDL was determined with a single reservoir model projection. It was not used to determine load reductions, including diversion loads, required to meet the new chlorophyll-*a* standard; a TMDL has not been established. (13)

41. Comment: Only one run of LA-WATERS was done to confirm that the chlorophyll-*a* in the reservoir would not exceed 10 ug/L with the LTA of 0.4 mg/L and 60% NPS reduction. This does not establish that the criterion could not be met by less stringent LTAs. (10)

Response to Comments 39-41: More than one TMDL scenario was evaluated to arrive at the TMDL for Wanaque Reservoir. As stated in Omni 2007, p. 172, "Time series of phosphorus concentration predictions were provided to NJDEP and their technical consultant for the Wanaque Reservoir TMDL Study (Najarian and Associates) in order to predict the summer average phytoplankton in the Wanaque Reservoir associated with each phosphorus reduction scenario. Several combinations of point source effluent concentrations and nonpoint source phosphorus reductions were tested. Through an iterative process, it was determined that a point source long-term average (LTA) effluent concentration of 0.4 mg/l TP and a 60% reduction of phosphorus loads from runoff associated with urban and agricultural land uses will satisfy the water quality end point in the Wanaque Reservoir." According to the iterative simulations performed by Najarian and Associates based on Wanaque South intake concentration boundaries provided by Omni Environmental, the wasteload allocations and load allocations established by the TMDL were the highest allowable while still satisfying the water quality target, with a margin of safety and an allowance for reserve capacity, in the Wanaque Reservoir.

42. Comment: LA-WATERS does not directly model chlorophyll-*a*, unlike current state of practice using mathematical models to predict the impacts of nutrient dynamics. The model was calibrated to total phosphorus data with chlorophyll-*a* based on organic phosphorus. It is therefore not an appropriate tool to determine the chlorophyll-*a* levels under alternative loading conditions. (13)

Response: The reservoir model does not directly model chlorophyll-*a*, however, the model does adequately predict observed chlorophyll-*a* concentrations by using the observed relationship between the simulated organic phosphorus and observed chlorophyll-*a* concentrations. A full discussion of the phosphorus-chlorophyll-*a* relationship was provided in the supplemental report for the Wanaque Reservoir modeling (Najarian, 2007). Because the model prediction of observed chlorophyll-*a* concentrations is based on nutrient loading, which is directly modeled, the model is an appropriate tool for use in developing the TMDL.

43. Comment: The basis of Najarian Wanaque Reservoir Model is flawed by incorrect loading assumptions for its calibration. The calibration/validation of the Wanaque Reservoir Model was presented in Najarian 2000 and Najarian 2005 as based on the assumption that total phosphorus is conservative in the Passaic River and that point source phosphorus is not attenuated. Reservoir loads used for the calibration and validation were calculated based on the assumption of phosphorus as conservative. Najarian 2000 and Najarian 2005 acknowledge the shortcoming of the load development methodology. Therefore, in the Phase 2 TMDL, the Wanaque Reservoir Model calibration and validation should have been checked using Passaic Model total phosphorus and ortho-P results at Two Bridges for all model years. Since this was not done, the

model may not be properly calibrated. Use of the Reservoir Model is questionable when calibration and validation may be in doubt. Additional Wanaque Reservoir Model runs should be performed to address this concern. (12)

Response: The prediction of phosphorus concentration at the Wanaque South intake used to provide a boundary condition for the Wanaque Reservoir model in the Phase 1 TMDL, while based on a simplified dilution model, is consistent with the prediction generated by the Passaic River model (Omni 2007) for the existing condition in the Phase 2 TMDL. The Passaic River TMDL model, which accounts for attenuation and other kinetics throughout the system, was used to generate the future condition phosphorus concentrations at the Wanaque South intake for the Wanaque Reservoir simulations. Both models compare favorably with one another and with the observed data. This is expected, since both models are calibrated to match the observed conditions. The reservoir model calibration/validation was based on actual data. The calibrated model is then used to simulate what would happen in the reservoir if inputs are altered. How future loads are estimated does not affect the calibration; the reservoir model simulates the effect of phosphorus loads once delivered into the reservoir.

44. Comment: The LA-WATERS model was developed to determine the impact of diversion waters on the water quality it the reservoir. The same model determined that diversions to the reservoir would not cause an excessive detriment to water quality (Najarian 1988). The current results contradict the previous results. (13)

Response: It is not correct to assume that the Najarian 2005 TMDL study using LA-WATERS represents a direct continuation of the methodologies of previous relevant studies using LA-WATERS, such as the study of the impact of diversion waters on the water quality of the reservoir in 1988. The Najarian 2005 TMDL study and refinement of LA-WATERS represents the culmination of a series of studies dating back to 1987 regarding water quality issues in the Wanaque Reservoir and its intake site. In each successive study, improvements were made to address limitations of the previous studies. Thus, comments regarding previous study limitations and inconsistencies are irrelevant. The primary intent of the Najarian (2000) Report (entitled "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model") was to assess the water quality status of the River. Thus, its analysis of the Passaic River dealt with a statistical assessment of water quality data. While this approach successfully addressed water quality status issues, it was of limited use in addressing the long-term loading regime of the river. Difficulties included the limited availability of data for selected analysis periods and uncertainties in the calculation of monthly average loads based on a limited number of observations. For such reasons, the Najarian 2000 Report did not form the basis for the 2005 Najarian TMDL study. Rather, a new model-based approach was developed during the 2002 Watershed Characterization studies for WMA 3, 4 and 6. This mass-balance approach was then refined and enhanced as part of the Najarian 2005 TMDL study. This method provides a simulation of daily in-stream total phosphorus concentrations and diversion loads. The approach was then verified using the entire set of available data – a procedure that sidestepped the limitations of the 2000 report. As such, the Najarian 2005 TMDL study does not represent an outgrowth of the 2000 study but, rather, a totally different approach developed to reduce the limitations of the 2000 study. Thus, as the result of subsequent model validation studies, the accuracy and reliability of the model was improved as new information became available. As the improved simulation of the river-loading regime allowed for a more accurate simulation of Reservoir inputs, the Najarian 2005 TMDL and the supplemental report to the Wanaque TMDL, (Najarian, 2007), supersede the relevant findings of the earlier reports.

45. Comment: A number of model constants and coefficients have large variations over the model domain or are unusual, as follows:

-The settling applied to particulate inorganic phosphorus ranges from 0-40% depending on location. Although the model report states that the fraction available for settling is 60%, the model inputs have a fraction dissolved of 0.6 and therefore a fraction particulate of 0.4. This would only be calculated with partition coefficient values on the high end of the range combined with the 97th percentile of the solids measurements made for the TMDL study.

-Organic phosphorus is subject to settling in the same reaches, but only at a rate of 10%. The fraction particulate for BOD, algae and organic nitrogen is zero and they are not subject to settling. These inconsistencies have not been explained.

-The rates at which phosphorus variables settle changes dramatically from segment to segment. Settling is entered as flows, which can be considered settling velocity multiplied by the surface area of the segment. The model has some large sections of the river with constant settling flows, which results in variations in settling velocity from segment to segment. Other sections of the river have velocities that may change by a couple of orders of magnitude and back over only a few segments as well as many areas with zero settling flows.

-The SOD values and ammonia fluxes also vary greatly on a spatial basis. These values are model inputs and do not respond to changes in loads, although the WASP model is capable of calculating nutrient and SOD fluxes. By specifying fluxes as model inputs, the TMDL analysis cannot track mass rigorously.

-There are a number of model parameters that the Wanaque Reservoir and Passaic River models have in common. Some values are consistent, but others are not: The growth rate used in the WASP model is nearly half the value used in LA-WATERS. Respiration and death are lumped in LA-WATERS and considered separately in the river model; the combined values from the river model are 2.5 times greater at 20 degrees Celsius and show much greater temperature dependence. The phosphorus half saturation values are inconsistent; the value used in the Wanaque Reservoir would require ten times the phosphorus to reach half of the maximum growth rate, thereby inducing a phosphorus growth limitation at a much higher concentration. The river model considers the impact of nitrogen concentration on algal growth, which the reservoir model cannot account for. Both models settle organic phosphorus, but in the reservoir model, organic phosphorus represents algal biomass, which does not settle in the river model. (13)

Response: The Passaic River WASP model was a complex undertaking that involved combining multiple processes and datasets within a single modeling framework. The model choice, calibration and validation were performed using the most appropriate scientific tools available. The modeling framework developed exclusively for the Passaic River Basin is described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007). Assumptions used in a river model may reasonably differ in a model designed to simulate a reservoir, given the significant differences in hydrology. Regarding phosphorus settling and SOD in the river model:

Phosphorus Settling

Inorganic phosphorus settling in the Passaic River comprises more than physical settling of particulate material. It also incorporates processes occurring in the river that are not explicitly simulated by WASP7. "Settling rates were used to represent the physical settling of organic and inorganic particulate phosphorus, adsorption of orthophosphate to the sediment bed and extra phosphorus uptake by macrophytes in certain areas of the Passaic River and its tributaries due to influence of wetland meadows." (Omni 2007, p. 102)

The settling of inorganic phosphorus involves two parameters: the fraction of particulate inorganic phosphorus available for settling and settling velocities. Figure 1 of the supplemental comments by HydroQual relates water column TSS with particulate inorganic phosphorus, which is not applicable to the context of inorganic phosphorus settling adopted in the model. Since the phosphorus settling component lumps multiple wetland meadow processes involving inorganic phosphorus uptake which are not explicitly represented in WASP7, settling rates used for inorganic phosphorus can not be used as a basis for the particulate settling of other water quality constituents. Applying similar settling rates to particulate BOD, organic nitrogen and organic phosphorus would be incorrect.

Natural processes such as the excess phosphorus uptake by algae and the adsorption of inorganic phosphorus to the bottom sediment vary spatially in large and diverse systems such as the Passaic River Basin. The different settling rates were applied to the Passaic River Basin in order to capture the spatial variability of natural processes represented in the settling component.

The usage of the settling component to address processes that are not explicitly simulated in WASP7 does not jeopardize the model performance for establishing the TMDL. The calibration of inorganic and organic phosphorus is excellent for the great majority of sampling stations. This is evidence that all sources, sinks and processes affecting the phosphorus transformations in the system are being accounted for adequately in the model.

Sediment Oxygen Demand

Sediment Oxygen Demand (SOD) and Ammonia fluxes were assumed as steady state and spatially variable parameters in the Passaic River model. Previous versions of the WASP model were able to simulate the diagenesis of organic matter in the sediment. However, WASP7 does not have this capability. WASP7 was the most recent version of the model when the Passaic River modeling was initiated. WASP7 included several improvements from its previous versions, most importantly the inclusion of benthic algae as a state variable. The simulation of benthic algae was a key factor for the Passaic River modeling. Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. The previous versions of the WASP model were not able to simulate the effect of attached algae and plants. Given the importance of primary productivity for the TMDL, the WASP7 framework was the appropriate choice for the Passaic River modeling.

In addition, the dynamic simulation of SOD is not justified for the Passaic River Basin. Simulating SOD response based on measurements introduces substantial uncertainty into the modeling framework. A meaningful calibration requires several SOD measurements over time and in multiple locations. In the case of the Passaic River, SOD results from the decomposition of macrophytes and residual organic matter that are accumulated in the sediment bed. Major floods could cause significant re-suspension of this particulate material. A sediment transport model would be necessary to account for these losses. Settling of organic matter discharged by treatment facilities is significant when BOD concentrations are high. Presently, the discharge of organic material by treatment facilities is not significant and BOD concentrations are very low throughout the Passaic River Basin.

Decomposition of particulate organic material from phytoplankton is clearly not impacting SOD in the lower Passaic River. Phytoplankton is of significance only at the most downstream sections of the Passaic River where SOD is low. Relatively low SOD levels measured by HydroQual in 2003 at sampling station PA11 (1.4 and 0.4 g/m2/day) support the assumption that phytoplankton settling and decomposition is not affecting SOD in the downstream branches of the Passaic River.

There are no short-term processes affecting SOD in the Passaic River Basin. Organic material from attached algae and plant decomposition is not significantly mobile, BOD levels are very low, and phytoplankton decomposition is believed to be of importance in the lower sections of the Passaic River. In addition, there are not enough data to support a formal calibration of the dynamics of SOD in the Passaic River Basin. Therefore, it is very reasonable to assume SOD and ammonia fluxes as spatially variable and steady state parameters.

46. Comment: The Dundee Lake portion of the Passaic TMDL model was not well-calibrated for chlorophyll-*a*, tending to over-predict by a factor of 2. (11)

Response: As explained in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 116-118), the Passaic TMDL model is well-calibrated for chlorophyll-*a* particularly in the most downstream branch of the Passaic River, in which Dundee Lake is located. It does not over-predict chlorophyll-*a* by a factor of two. Several factors influencing phytoplankton growth are not subject to calibration, namely stream water temperatures and solar radiation inputs. Similarly, transport-related inputs, which are defined by the flow model and were previously calibrated, also influence phytoplankton growth. Phytoplankton growth rate is the most important chlorophyll-*a* calibration parameter; a value of 1.25/day was chosen as the final calibrated parameter, which is within the range suggested by the literature for phytoplankton growth rate. Two PVSC stations with a significant number of chlorophyll-*a* data throughout the simulation period were chosen for calibration: PVSC1 (Passaic at Totowa Avenue) and PVSC4 (Passaic at Market St.). Omni chlorophyll-*a* data, which consisted of three low flow events sampled in 2003, were used for validation purposes. A good fit of chlorophyll-*a* was obtained for the entire basin. The peak measured chlorophyll-*a* concentration of 97 µg/l at PVSC4 on 8/14/2002 was captured perfectly. Furthermore, the mean errors were -3.3 and 4.7 µg/l at PVSC1 and PVSC4, respectively.

47. Comment: The Passaic River TMDL model does not include any settling for algae. The settling of algae can be an important component of algal loss, especially in shallow waterbodies and/or water bodies with a long detention time (low flow). A run of the model introducing a modest settling rate dramatically reduces the chlorophyll-*a* concentration in the lake. If an

important process such as algal settling that is normally included in eutrophication modeling is absent, an explanation is needed. (11)

Response: Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. Phytoplankton settling could potentially increase seasonal sediment oxygen demand (SOD) at shallow and slow moving water bodies. However, the decomposition of particulate organic material from phytoplankton clearly does not impact SOD in the Passaic River, since measured SOD is low at the sections of the Passaic River where phytoplankton growth is significant. Model calibration demonstrates that settling of phytoplankton in the relatively limited branch of the Passaic where significant phytoplankton growth occurs is not important to capture observed phytoplankton growth patterns.

Attenuation:

48. Comment: The TMDL does not take location and/or size of point sources into account. The TMDL assigned the same wasteload allocation to all dischargers based on an LTA of 0.4 mg/L of total phosphorus. There is no attempt to take into account attenuation of phosphorus loads in the Passaic River. Total phosphorus (TP) is not conservative in the Passaic, especially at low-flow conditions. Using the watershed model, the effect of the WTSA plants at the point of discharge and at the identified endpoints was calculated. At current concentrations, the WTSA contribution to Wanaque South load is less than 5 percent and at the 0.4 LTA less than 1 percent. The graphs submitted show the negligible impact of WTSA facilities. The phosphorus discharged by WTSA, whose three plants are located a significant distance from both endpoints, attenuates before it reaches the endpoints. A properly formulated Passaic TMDL must account for the attenuation associated with these long distances in determining the LTAs for the various dischargers. The TMDL should be less stringent than the LTA of 0.4 mg/L proposed basin-wide. (12)

49. Comment: The commenter expressed appreciations for the efforts made by the NJDEP and Omni Environmental that resulted in the 2007 TMDL, but believes that it is still seriously flawed and does not represent the sound science needed to justify imposing limits. Specifically, the 2007 TMDL fails to account for attenuation, instead imposing a "uniform" effluent limit on all STPs. For treatment plants, which are 35, 39 and 41.5 miles upstream of the Wanaque Reservoir end point and 50, 54, and 57 miles upstream of the Dundee Lake endpoint, HydroQual's utilization of the model establishes that essentially only 1% of the phosphorus in the effluent from these three plants reaches either of the two endpoints. The 2007 TMDL improperly assumes that *all* of the phosphorus from the WTSA sewage treatment plants, located 35, 39 and 41.5 miles upstream from the confluence of the Pompton and Passaic River, and 50, 54 and 57 miles upstream of Dundee Lake, reaches these TMDL endpoints. A 0.4 mg/l LTA for *all* dischargers is inappropriate, inequitable and not supported by the very science on which the TMDL purports to be based. Individualized LTAs can and should be calculated, reflecting each sewage treatment plant's effective phosphorus load contribution to the endpoints. The WTSA plants' contribution is *de minimus* and they should only be required to continue to meet their EEQ-calculated limits. It would be arbitrary, capricious and unreasonable for the Department to adopt a TMDL that would require the expenditure of significant public funds and production of

adverse environmental impacts from the addition of chemicals and the increased generation of sludge to remove phosphorus given attenuation that established in the model. (10)

Response to Comments 48 and 49: The Passaic River Basin model does not assume phosphorus is conservative and does account for attenuation. As described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007), the dynamics of nutrient cycling as well as loss mechanisms for water column phosphorus-attenuation mechanisms were simulated using the Water Quality Analysis Program 7.0 (WASP7). Model results show that the degree of attenuation depends greatly on the flow and diversion conditions, and most of the phosphorus load that originates in the Dead River persists to both of the end points. For example, approximately 70-80% of the phosphorus load from point sources that discharge to the Dead River reaches Two Bridges. In 2001, over 60% of the phosphorus load from point sources that discharge to the Dead River reached Dundee Lake; in 2002, just under 40% of the phosphorus load reached Dundee Lake. The difference between the two years is primarily due to increased water supply diversions from the Passaic River in 2002.

Therefore, attenuation does not render phosphorus originating in the Dead River watershed irrelevant to the end points in Wanaque reservoir and Dundee Lake. The commenter's analysis of the influence of WTSA phosphorus load on phosphorus concentration at the endpoints is inappropriate, since it uses the annual maximum total phosphorus concentration as the basis of comparison. However, the commenter's analysis does demonstrate the importance of WTSA phosphorus load to the phytoplankton concentration at Dundee Lake: Figure 3 in the July 6, 2007 comment letter provided by HydroQual on behalf of Warren Township SA depicts chlorophyll-*a* concentrations with different contributions from Warren Township's treatment facilities. This figure shows that, even if all other point sources in the entire basin were reduced to an LTA of 0.4 mg/l total phosphorus, allowing WTSA to discharge at its permitted maximum concentration would increase the growing season average phytoplankton concentration at Dundee Lake by about 25%.

In accordance with USEPA's Protocol for Developing Nutrient TMDLs (1999), "the administering agency must find an acceptable combination of allocations that adequately protects water quality standards (p. 7-1)." There are many factors that might affect the allocation decisions, including economics, equitability, and implementation. Alternatives in terms of assigning wasteload allocations among multiple dischargers include: equal percentage treatment; equal effluent concentration, and various allocation schemes that result in variable wasteload allocations. In the case of the Passaic River TMDL, an equal effluent concentration was assigned to all wastewater dischargers as the most equitable alternative for the wasteload allocation scheme.

Notwithstanding the above, given the large number of dischargers in the basin, the affected dischargers are best equipped to evaluate the capabilities of the individual facilities and determine if there are ways to maximize efficiency and cost effectiveness in achieving the water quality objectives through water quality trading. This was a key reason that this basin was selected for award of a Targeted Watershed Grant from EPA to develop such a program. Dischargers will have one year from the date of NJPDES permit issuance to negotiate trades, which, upon approval, would be incorporated into NJPDES permits.

Alternatives:

50. Comment: The Passaic TMDL was developed without consideration of alternatives. The impacts of phosphorus within the Passaic River Basin can be addressed in a more cost-effective manner. No other reservoir management alternatives beyond the historic pumping and diversions that took place during the 1993-2002 time period were considered. Alternate management scenarios could include reduced pumping during severe drought conditions, examination of the use of the Monksville Reservoir stored water instead of diversions, and/or direct routing of the diversion to the NJDWSC water treatment plant during severe or critical situations where diverted water never enters the reservoir while delivering the same amount of pumped water for raw water supply. Due to the enormous cost of implementing the proposed Passaic TMDL, the NJDEP must explore these cost-effective alternatives to satisfy the TMDL goals. The Passaic TMDL was developed for reduction of Wanaque South phosphorus load without consideration of the relocation of the Two Bridges Wastewater Treatment Facility outfall downstream of the intake. A preliminary analysis indicates this action could result in a 20% reduction in phosphorus load to the reservoir, and could well result in significantly less stringent, less costly LTAs. In light of the costs associated with implementing this TMDL, it is in the best interest of all affected parties to address the impacts of phosphorus in the most cost effective manner. (12)

51. Comment: The TMDL should include a thorough analysis of alternatives for achieving the chlorophyll-*a* criteria at both endpoints that reduce the phosphorus removal requirements for the STPs and for the nonpoint sources. *N.J.A.C.* 7:15-7.2(h) requires that, where feasible, "the TMDL proposal shall include the various management options and alternatives which will ensure that the surface water quality standards will be attained." Thus, the Department is obligated to provide such option and alternatives, or demonstrate why doing so is not feasible. The TMDL must address: NJDWSC operational modifications, water treatment by NJDWSC prior to diversion or release into the Wanaque Reservoir, relocation of the Two Bridges STP outfall and aeration at Dundee Lake. Aeration could be put in place on a trial basis to ascertain its viability and impact on chlorophyll-*a* levels, which could reduce the TP reduction needed at the STPs. The burden of establishing the viability of more cost-effective alternatives should not be on the dischargers or members of the public. The objective should be to properly identify the problem created by phosphorus loads within the river system and determine the most cost-effective manner to address that problem. The Department needs to devote the time and resources to evaluate the viability of aeration at Dundee Lake. (10)

52. Comment: The Department failed to consider the use of in-stream aeration as a cost effective alternative technology. Citing *N.J.A.C.* 7:15-7.6(d)4, *N.J.A.C.* 7:9B-1.5(e)1, and *N.J.A.C.* 7:15-7.2(h)1, the Department did not select the most cost effective and environmentally sound means of addressing water quality concern in Dundee Lake. The TMDL report contains no study of the costs of achieving those goals, nor of any alternatives, and does not address the negative environmental consequences of imposing more stringent limits on all wastewater facilities. In accordance with its regulations, the Department should have considered the allocation of an equal effluent concentration to each source, the allocation of an equal percent removal to each source, the allocation of an equal effluent mass loading to each source and the minimization of

the total treatment expenditure for the entire waterbody segment. Surface Water Quality Standards state that water-quality based effluent limitations should be established in a cost effective manner "so as to minimize total expenditures." Regulations require that TMDLs should take into consideration all management options and alternatives for ensuring that the water quality standards will be attained and that "[m]inimization of the total treatment expenditure for the entire waterbody segment" is one of the approaches to be considered in the development of allocation options. *N.J.S.A.* 58:10A-8 states that prior to establishing more stringent effluent limits the DEP must "determine if there is a reasonable relationship between the economic and social costs of achieving such limitation,…and the social and environmental benefits to be obtained…" The Department requested that dischargers report on costs to achieve potential effluent limits. A review of the reports reveals the costs are staggering. In-stream aeration, by contrast, would meet water quality objectives at a fraction of the cost. The TMDL report should be withdrawn and a roundtable of interested parties (should be) convened to explore the use of innovative solutions to meet the identified water quality objectives. (18)

53. Comment: The Passaic TMDL for the Dundee Lake endpoint was developed without consideration of any other alternatives beyond phosphorus removal. One such alternative is in-stream aeration. Reducing supersaturation of dissolved oxygen through mechanical means may disrupt algal productions as well. Manufacturers of aeration equipment were contacted and costs associated with installation and O&M are significantly less than those for phosphorus removal. Further, aeration equipment could be installed and begin achieving water quality improvement much more quickly. The next step would be to determine specifications for installation in Dundee Lake and possibly piloting the operation. (11)

54. Comment: The Department did not address other alternatives to achieve appropriate controls to achieve the Wanaque Reservoir endpoint, such as altering the withdrawal and and pumping scenarios used by NJDWSC, as recommended in the New Jersey EcoComplex July 30, 2002 Interim Report. (1), (2), (15), (23)

Response to Comments: 50-54: *N.J.A.C.* 7:9B-1.5(e)1 states policies for applying water quality-based effluent limitations and does not apply to TMDL development. This provision allows for assignment of different WQBELs to different dischargers, provided the overall water quality objectives are met, to achieve a more beneficial solution on a study area basis. The Department is providing an opportunity, through water quality trading, to achieve the TMDL objective in a more cost effective way. *N.J.A.C.* 7:15-7.2(h) refers to the Department's commitment to identify the management measures that are expected to attain the load reductions called for through the TMDL study, not a requirement for a cost effectiveness analysis of alternative means to attain the load reductions. The Department sets forth these measures in the implementation plan section of the TMDL. Within the implementation plan, the Department identifies regulatory and non-regulatory tools to achieve the reductions, matches management measures with actual or potential implementing entities, and identifies possible funding sources for non-regulatory measures.

Regarding the cost for phosphorus removal at wastewater treatment facilities, a recent report, "Advanced Wastewater Treatment to Achieve Low Concentrations of Phosphorus" (EPA 910 R 07 002, April 2007), contains findings indicating phosphorus removal at the levels called for in these TMDLs is feasible, low cost on a per user basis and provides ancillary benefits by enhancing removal of other pollutants, such as pharmaceuticals. Specifically, phosphorus removal to 0.3 mg/L was achievable using enhanced biological nutrient removal and the monthly residential sewer rates charged ranged from $18 to $46. Several treatment authorities did respond to the Department's request to provide cost estimates for achieving phosphorus reductions. While the total cost for upgrading all of the facilities was stated to be in the millions of dollars, the number of people and businesses served by the collected facilities is very large and the costs spread out over a number of years, so that the impact to an individual user is not expected to be significant.

Several alternative approaches were suggested by commenters in lieu of requiring reductions from the point source discharges. Under the Clean Water Act, the expectation is that, where a TMDL identifies that pollutant loading is causing exceedance of water quality standards, attainment of the standards will be achieved by reductions of the pollutant load. Further, the pollutant load reduction is expected to come primarily from regulated sources. Where non-regulated sources contribute to the load and load reductions from these sources are identified in lieu of obtaining all needed reductions from regulated sources, there must be reasonable assurance that reductions from non-regulated sources will be achieved. Other outcomes are possible where exceedances are due to natural conditions (standards are adjusted), technology does not exist to attain the water quality standards (variance option), or there is no reasonable way to attain the standards and support the designated use (use attainability option). Here, point sources are responsible for a substantial amount of the phosphorus loading to the system and the load reductions required are clearly achievable.

With regard to the specific alternatives suggested: In-stream aeration might mask a portion of the problem by ameliorating some of the adverse water quality effects, such as attenuating dissolved oxygen swing, but there is no evidence that it would reduce excessive primary productivity sufficiently to achieve the water quality objectives. In addition, there would be implementation issues with such an approach: installing infrastructure within a riverine system subject to flooding would be problematic; and there is no regulatory or institutional framework to cause such a system to be built, maintained and compliance assured. Therefore, options that do not address the root cause of the water quality problem or use the stream for treatment, such as in-stream aeration or addition of alum directly to the waterbodies, cannot be entertained. Relocation of the TBSA outfall, if proposed, would be considered. However, if proposed, the model would have to be rerun with new assumptions since loading to the Dundee Lake endpoint would increase if TBSA effluent is no longer diverted into Wanaque Reservoir. Regarding the role of NJDWSC operations, there are two factors to be considered. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must support the drinking water use, with or without diversion activities.

55. Comment: The endpoint in Dundee Lake is to be measured between June 15 and September 1, but the effluent limit is intended to apply from May through October. Based on an independent run of the model, the target condition was met with effluent limits at 0.4 mg/L only in June, July and August. To meet the Passaic TMDL for Dundee Lake, phosphorus removal at the Lower Passaic treatment plants is only necessary from June through August. (11)

Response: It is true that during the critical simulation year of 2002, conditions favorable to produce high phytoplankton concentrations were limited to July and August. However, the TMDL is intended to be protective during future summer conditions. While summer algal blooms are most common during July and August, periods conducive to high algal production can occur anytime from May through October. For instance, the most critical months for algal growth during 2001 were September and early October. In 2004, late June through the first week of July was the most critical periods. While the model demonstrates the fact that seasonal phosphorus reductions provide the same level of protection at Dundee Lake as year-round reductions, it would be short-sighted and incorrect to apply the seasonal limits only to the months that happened to be critical during the 2002 simulation year.

56. Comment: Was the potential for the permanent lowering of Dundee Dam, which was as possible outcome of a study conducted by the Federal Energy Regulatory Commission (FERC), considered as part of the TMDL process? (18)

Response: The Federal Energy Regulation Commission (FERC) and the Department have not received an application for a permanent lowering of the Dundee Lake dam. Although the dam owner has removed the hydroelectric operation, the owner has maintained the FERC license. The dam was recently repaired and the Department has determined that it is in safe condition. Therefore, the lowering of Dundee Dam is not an imminent physical change to the system that should be considered in the TMDL.

57. Comment: Efforts should be concentrated on protecting and restoring the "Green Infrastructure" in the Passaic River Basin, especially in the Highlands, as it has been shown that water treatment costs increase as forest cover in the watershed decreases. (9)

Response: The Department concurs that maintaining and replacing areas of natural vegetation ("green infrastructure") have a positive impact on water quality. While preserving land with natural land cover can help with minimizing future degradation, it will not address existing water quality concerns. The Department recognizes this in the discussion of Category One waters and the associated Special Water Resource Protection Areas in Section 8, Reasonable Assurance. Restoring riparian vegetation can help improve existing water quality and is included as one of the measures identified in Section 7, Implementation Measures. This section has been enhanced to identify the known stream bank restoration and similar management measures that have been completed within the basin.

NJDWSC Responsibility:

58. Comment: The Department should require that the North Jersey District Water Supply Commission (NJDWSC) also assume appropriate responsibility for the level of phosphorus that enters the Wanaque Reservoir. The NJDWSC plays a central role in the phosphorus issue as it relates to the Wanaque Reservoir endpoint, yet the Department does not require that NJDWSC take any responsibility for reducing the phosphorus load it diverts into the Reservoir. NJDWSC must participate in the solution to its phosphorus problem. The TMDL suggests that NJDWSC might be a trading partner, yet provides no description of how that might occur. Potentially, NJDWSC can undertake treatment or some other measures that will significantly reduce the TP reaching this endpoint (or which will ensure that the 10 ug/L chlorophyll-*a* seasonal average criterion is met) that are less costly than requiring the STPs to reduce phosphorus to a year-round LTA of 0.4 mg/l. Unless the Department imposes obligations on NJDWSC to take actions to reduce the TP load, NJDWSC will have no incentive to do so, and no incentive to "trade" with the STPs. As part of or in conjunction with this TMDL, the Department should exercise the authority it has over NJDWSC to address phosphorus. There are at least two sources of such authority. The first is found in the statutory and regulatory provisions that govern NJDWSC's water diversion permit. The second is found in the federal Clean Water Act's pollutant discharge elimination system permit requirements, when those requirements are properly applied in a manner consistent with the recent United States Supreme Court holdings and those of the federal Court of Appeals. (10)

59. Comment: The North Jersey District Water Supply Commission should be required to secure a NJPDES permit for diversion of Passaic River waters into the Wanaque Reservoir. WTSA respectfully submits that the Department must impose responsibility on NJDWSC by requiring NJDWSC to obtain a NJPDES permit for its addition of a phosphorus load to the Wanaque Reservoir. In light of judicial interpretations of the CWA, including South Florida Water Mgt. Dist. v. Miccosukee Tribe of Indians, 541 U.S. 93, 124 S.Ct. 1537 (2004) ("Miccosukee"), (also cited were *National Wildlife Federation v. Gorsuch*, 693 F.2d 156, 165 (D.C.Cir. 1982), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77 (2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District*, 2006 WL 3635465 (S.D.Fl. 2006)), the need to address phosphorus in the Wanaque Reservoir, and the critical role NJDWSC plays in introducing the phosphorus load into the reservoir, the Department should not "defer" to the 2005 EPA Memorandum. Instead, the Department should require that NJDWSC obtain a NJPDES permit. The diversion of water from the Passaic River by pumping it some 17 miles north into the Wanaque Reservoir is a transfer into a distinct water body. Water from the Passaic is only diverted when NJDWSC elects to draw off water at a rate that exceeds the Pompton River flow, causing an uptake of Passaic River water into the Pompton River, and, hence, into the intake. Therefore, the NJDWSC operates a "point source" that "discharges pollutants," in that phosphorus is "added" to the Reservoir as a result of the transfer of waters from the Passaic to the Reservoir. This being the case, the Department should require that NJDWSC obtain a NJPDES permit. Such a permit would not necessarily mean that NJDWSC would be solely responsible for reducing the phosphorus load into the Reservoir so as to achieve the 10 ug/l chlorophyll-*a* seasonal average, but it would require that NJDWSC meaningfully participate in achieving the required reduction. (10)

60. Comment: Even if it were determined that a NJPDES permit is not required, under its water diversion permit, North Jersey District Water Supply Commission should be required to reduce the amount of phosphorous coming into the Wanaque Reservoir from the Passaic River so as to mitigate any adverse impacts that such phosphorus has on water quality in the Reservoir. The Department's current regulations expressly state that the party transferring water from one body to another "is responsible for mitigating adverse impacts…caused as a result of the diversion." *N.J.A.C.* 7:19-2.14. Nothing in the 2005 Najarian TMDL Report, the 2005 TMDL, or the proposed 2007 TMDL addresses that NJDWSC's diversion practices have caused the alleged impairment of the Reservoir. The 2007 TMDL was developed without consideration of any other Reservoir management alternatives, instead accepting as a "given" the historic pumping and diversions that took place during the 1993-2002 time period. No attempt was made to investigate other possibilities, either in the pumping protocol or in direct treatment of the diverted water. The 1988 Najarian Report concluded that, provided that NJDWSC implemented appropriate management and diversion practices, there would be no cause for concern with impacts of the diversion on water quality within the Reservoir. If the 2005 Najarian TMDL Report is correct in its conclusion that the diversion of water from the Passaic has adversely impacted the water quality within the Reservoir, the obvious and critical questions are why haven't NJDWSC's diversion practices achieved the result predicted in the 1988 Najarian Report and can NJDWSC better monitor those practices so as to mitigate adverse impacts, as required by the Department and regulation? The conclusions in the 2005 Najarian TMDL Report are inexplicably at odds with the conclusion reached in the 1998 Najarian Report. No explanation has been given for abandoning the conclusions in the 1988 Najarian Report that, when properly managed, diversion of water from the Pompton and Passaic Rivers, even "under the severest of operating conditions," and "at times of unusual flow periods" and "[d]uring unusual hydrologic events associated with prolonged dry years," will not have any long term impact on water quality in the Wanaque Reservoir. If the answer is that Dr. Najarian's 1988 conclusions, based on the simulations conducted at that time, have proven to be incorrect, then surely the Department is justified in now requiring NJDWSC to take some direct responsibility for addressing the impacts of the diversion of water from the Passaic. Had the 1988 simulations demonstrated such adverse impacts, either the Department would not have approved the diversions, or it would have conditioned such approval on specific, affirmative actions to address those impacts. In addition to more responsible management of its diversion practices, NJDWSC should be the party responsible for ensuring the quality of the water it discharges into the Reservoir by its diversion of water or certainly participate in that responsibility. (10)

61. Comment: Commenter believes the Supreme Court decision in Miccosukee (*South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004)), requires a NPDES permit be issued to NJDWSC because they divert river water to the Wanaque Reservoir. The Department must justify why it believes this is not required and has failed to modify its position to meet the US Supreme Court decision. NJDWSC should be required to mitigate any effects of their discharge on the reservoir. Further, NJDWSC should have a NPDES permit to discharge reservoir water to the river, based on a recent Federal Court decision (cited were *National Wildlife Federation v. Gorsuch*, 693 F.2d 156, 165 (D.C.Cir. 1982), *South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77

(2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District*, 2006 WL 3635465 (S.D.Fl. 2006)). After applying permit requirements to NJDWSC, the Department should recalculate the TMDL based upon the limitations that would be imposed on other dischargers. (10)

Response to Comments 58-61: The Department does not interpret the Supreme Court decision in Miccosukee as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department's interpretation is consistent with EPA's determination that water diversions are not point sources requiring a NPDES permit under the Clean Water Act. See, USEPA, Agency Interpretation on Application of 401 of the Clean Water Act to Water Transfers. EPA has proposed its interpretation as a rule. 71 Fed. Reg. 32887. In support of their position that EPA's interpretation of the Clean Water Act and the Miccosukee decision are incorrect, the commenters refer to other federal court decisions, such as Catskill Mountains Ch. Of Trout Unlimited, Inc. v. City of New York, 451 F. 3d 77 (2d Cir. 2006) and Friends of the Everglades, Inc. v. South Florida Water Mgt Dist. 2006 WL 3635465 (S.D.Fl. 2006). They contend that, based on these decisions, the Department is obligated to issue a NJPDES permit to the NJDWSC for its water diversion permit. However, the federal court decisions the commenters cite involve different facts, and these decisions are not from the Third Circuit. Therefore, the decisions do not create controlling precedent.

The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. The role of NJDWSC operations is discussed above in response to comments 49-53. To reiterate, NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

The load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. Commenters suggest that some or all of the burden of achieving the phosphorus load reductions outside the May through October season should be borne by NJDWSC because it is the act of diverting water into the Wanaque Reservoir that dictates year round reductions from dischargers in the portion of the river basin affected by the diversion. With reference to the decision on the Wanaque South Diversion, background on this permit decision is in order. The grant application for the Wanaque South project diversions was approved by the New Jersey Water Supply Council on September 25, 1978. The initial evaluation of water quality impacts due to the Wanaque South Project was presented as an appendix within the "Wanaque South Project Economic Feasibility Study" (1981). This assessment indicated that there may be impacts to temperature and dissolved oxygen in the Passaic River due to diversions at the Two Bridges site. As the Department's total phosphorus (TP) standard was not established until 1980 (after the initiation of the Feasibility Study), impacts due to TP were not assessed at that time. In 1981, the Department did conduct an in-house screening-level (Vollenweider) assessment of TP impacts that suggested that the reservoir could be in a mesotrophic state and that expanded diversions could result in possible degradation of the reservoir's trophic state. Thus, the Department included a provision for a "reservoir phosphorus management study" within the Wanaque South water diversion permits (No. 1651 and 1685), which were issued on April 30, 1982. The 1988 Najarian report was developed in response to this permit condition. The 1988 study concluded that "…the proposed Wanaque South diversion would not have a lasting impact on the water quality of the Wanaque Reservoir." The study also found no long-term impairment with respect to the trophic state of the Reservoir. This predicted result was attributed in part to the reservoir's relatively short residence time (approximately 6-8 months). However, while the residence time is short based on a mathematical comparison of volume in and volume out, in practice, the reservoir is not pumped dry. There is always a residual pool and settled phosphorus can accumulate and be available for biological activity as the result of turnover events. Measured and predicted levels of chlorophyll-*a* are in excess of those associated with maintenance of a mesotrophic condition. This is likely due to the fact that the NJDWSC has needed to divert river water at frequencies and rates that were not anticipated in 1988 -- due to extended dry-weather (drought) conditions over much of the past decade. In response, over the past decade, NJDWSC has implemented various management strategies to reduce transient water quality impacts to the reservoir from river diversions. These strategies have been helpful in the control of peak phosphorus concentrations and nuisance algal blooms within the Reservoir. However, such management programs can, at best, only partially mitigate worst-case conditions. Further, the addition of chemicals (alum) on an ongoing basis is not an appropriate approach for reservoir management. Additional means are needed to protect reservoir water quality.

Impacts from TP Removal:

62. Comment: The TMDL fails to consider the following negative impacts associated with pretreatment for phosphorus: increase in sludge production; increase in total dissolved solids; negative impacts on incinerator operation; an increase in aluminum in plant effluent as a result of chemical addition. Public policy is not well served where a water quality enhancement is attained at the expense of a diminution of other water quality criteria or other negative environmental impacts. There are alternatives to imposing phosphorus limits that would achieve the desired environmental benefit without the negative consequences. (18)

63. Comment: There are several negative impacts that would result from phosphorus removal, as follows:

-As a result of chemical treatment to meet the phosphorus LTA of 0.4 mg/l, STPs will have significant increased sludge disposal costs from increase sludge production, estimated to increase from 19% (with biological removal) to 37% (chemical removal only).

-Total Dissolved Solids (TDS) will increase in the effluent when meeting phosphorus LTA of 0.4 mg/l. TDS will negatively impact water quality, which will impact drinking water supplies and drinking water quality through potential additional treatment requirements.

-Chemical sludge from the phosphorus removal process will impact incinerators. It will increase ash production and possibly produce "clinkers" which plug drop holes of multiple hearth incinerators and may require certain incinerator improvements.

-Chemical treatment for phosphorus removal will increase aluminum (or iron) in effluent. (11)

Response to Comments 62 and 63: The TMDL specifies WLAs in terms of total phosphorus to achieve the water quality goals for the Wanaque Reservoir and Dundee Lake. The comments presume that the only available treatment technology is chemical addition. However, the Department believes that the WLAs can be achieved through a variety of treatment options. The Department encourages permittees to utilize biological nutrient removal (BNR) wherever feasible based on site and process constraints. The use of BNR has the benefit of reducing nitrates while avoiding increases in the levels of TDS and affecting sludge treatment and disposal options. The Department is working with New York DEC and the EPA to develop a TMDL to address dissolved oxygen issues in the New York/New Jersey Harbor, which may require the NJPDES facilities in the Passaic River Basin to implement nitrogen removal. This is a further incentive to use BNR wherever feasible to achieve the required phosphorus reductions. Further, by developing and applying a dynamic model within the Passaic basin, the Department has taken care to require only the level of phosphorus load reductions needed in order to achieve water quality objectives. By carefully evaluating the model simulations, the Department was able to determine the critical locations where primary productivity is causing water quality problems and develop criteria in terms of the response indicator, chlorophyll-*a*, that equate to protection of the designated uses. Seasonal limits are also offered where appropriate.

64. Comment: The Department should consider a particular trademarked commercial product identified by the commenter which the commenter indicates has proven to be extremely effective and economical at controlling phosphate levels in contaminated water and contaminated soil, in the plans to establish phosphate contamination limits for the Passaic River Watershed. (19)

Response: The Department appreciates that information provided by the commenter, but can not endorse any proprietary water quality device or material. The New Jersey Corporation for Advanced Technology (NJCAT) has a procedure by which developers of new technology can demonstrate performance claims. Additional information is available at www.njcat.org.

65. Comment: Achieving the significant phosphorus reductions called for in the TMDL may not be technologically, ecologically, economically or socially achievable. Therefore, commenter suggests dischargers evaluate their systems and determine the retrofits that will reduce phosphorus and nitrogen loadings to the extent feasible, given these considerations, similar to the improvements made at RVRSA. (9)

66. Comment: Biological technologies should be selected over "chemical" technologies for nutrient removal. (9)

67. Comment: The Department should investigate innovative technology that will reduce phosphorus loadings with fewer undesirable side effects and at reduced cost, like RVRSA did. (7)

Response to Comments 65-67: The Department believes the phosphorus reductions called for in the TMDL are fully achievable and at reasonable cost. The Department supports biological nutrient removal because it is a more cost effective removal technology that produces fewer harmful by-products than chemical treatment. The Department recognizes the innovative work of RVRSA and Wayne Township in incorporating such approaches for nutrient removal and will continue to rely on the regulated community to determine the best means to achieve permit limits, given site and process constraints that apply to each one, as well as outcomes that may come from water quality trading.

Permit Requirements:

68. Comment: Five of the sewage treatment plants listed in the proposed TMDL are located in West Milford and are regulated under the Greenwood Lake TMDL for Phosphorus. These facilities should also be required to meet whatever standards are set for total phosphorus, nitrate and ammonia in the Passaic TMDL. Further, the WMP for this area has not been done in 20 years. The Department needs to do its part in getting the load reductions by enforcing the requirement to do a WMP. (7), (9)

Response: The allocation of loading capacity for Greenwood Lake was addressed in the September 2004 TMDL and included WLAs for the associated NJPDES discharges. The allocation of loading capacity established in the Greenwood Lake TMDL is protective of the SWQS and did not need to be reassessed by the Passaic TMDL. Rather, the loadings that would result from successful implementation of the TMDL in this watershed were taken as a boundary condition input to the Passaic River basin TMDL. Requirements for load reductions are required whether or not there is a current WMP.

69. Comment: Monthly average permit limits based on a long term average in the stream should be used. No limitation based on a shorter time period is necessary or warranted. (23)

Response: The long term average used in the modeling study is that required in wastewater treatment effluent in order to achieve the watershed criteria, expressed as seasonal average concentrations of chlorophyll-*a* at the two critical locations. There is no long term average stream concentration objective expressed in this study. As indicated in the TMDL, the Department intends to express the WLAs set forth in the TMDL in terms of monthly average effluent limits.

70. Comment: A TMDL must be expressed in terms of daily limit. How can a long term average be compliant with CWA requirements? The proposed 0.76 mg/L limit is 7 times less stringent than the criterion. The Department should enforce the 0.1 mg/L that is required unless the phosphorus protocol demonstrations are made, which has not occurred. (22)

71. Comment: The 0.4 mg/L limit is too liberal and should be 0.1 mg/L, as is recommended for impaired waters. Commenter is disturbed about the concept of averaging and believes it doesn't really work. (20)

Response to Comments 70 and 71: According to an USEPA memorandum issued November 15, 2006, all TMDLs and associated load allocations and wasteload allocations should be expressed in terms of daily time increments, which these TMDLs do. The November 15, 2006 memorandum further states that TMDL submissions may include alternative, non-daily pollutant load expressions in order to facilitate implementation of the applicable water quality standards. It should be noted that the November 15, 2006 memorandum makes clear that although TMDLs are to be expressed in terms of a daily load, this does not affect a NPDES permitting authority ability to establish permit effluent limits, which "… may be written in a form that derives from, and complies with, applicable water quality standards…". Additionally, The National Pollutant Discharge Elimination System (NPDES) regulations at 40 CFR 122.45(d) allow numerical NPDES effluent limitations for continuous discharges to be expressed, unless impracticable, as average weekly and average monthly discharge limitations for publicly owned treatment works (POTWs) and as daily maximums and monthly averages for other dischargers. The EPA Protocol for Developing Nutrient TMDLs, EPA 841-B-91-007 (pg. 7-3) also describes these acceptable practices. The current TMDL and proposed approach for applying effluent limits comply with USEPA guidance and the requirements of the Clean Water Act.

As the result of the Passaic River basin TMDL, the 0.1 mg/l total phosphorus SWQS has been superseded within the modeled domain by watershed criteria expressed in terms of chlorophyll-*a* at the identified critical locations. Commenters appear to refer to the practice of applying the SWQS as an end-of-pipe effluent limit where the discharge of a pollutant from a facility is in quantifiable amounts and is to a waterbody identified as impaired with respect to that pollutant. Because of the narrative criteria that accompany the in-stream numeric criterion for phosphorus, a phosphorus evaluation protocol was developed to determine when the numeric criterion does not apply in light of the narrative criteria, which is commonly known as the phosphorus protocol. As a result of the Phosphorus Settlement Agreement, WQBELs for phosphorus are not to be applied except through a TMDL study with respect to most significant dischargers in the Passaic River basin. Therefore, the end-of-pipe limit approach and phosphorus protocol do not apply. In any case, NJPDES effluent limits must conform with a WLA from an adopted TMDL, in lieu of a WQBEL established any other way. The TMDL establishes WLAs based on a total phosphorus long-term average (LTA) effluent concentration of 0.4 mg/L for most dischargers, to achieve the watershed criteria set in order to be protective of the designated uses of the affected waterbodies. The Department has also stated the intent to express this LTA as a monthly average of 0.76 mg/L in the NJPDES permits for the identified facilities, subject to water quality trading.

Seasonal Limits:

72. Comment: Seasonal limits have been found to be sufficiently protective of the river, yet phosphorus removal on a year-round basis has been imposed on dischargers upstream of the reservoir intake. Seasonal limits, either tied to the use of the Wanaque South Pumping Station, or a reservoir level, would be sufficiently protective of the environment and would result in a

significant cost savings to the public and decreased pollutant load to the environment. The Department has imposed additional requirements upon dischargers without regard to whether the discharge is being pumped into the reservoir. The determination to treat effluent when water is not transferred to the reservoir must be revisited. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that increases sludge production and Total Dissolved Solid discharges. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. Seasonal effluent limits should be applied to dischargers upstream of the Wanaque South Pump Station because of the intermittent but predictable diversion of water to the Wanaque Reservoir. The application of effluent limits should be related to water supply needs, as indicated by the pumping schedule or reservoir water level. (2) (15)

73. Comment: The Department has failed to provide relief from stringent limits during periods when phosphorus control cannot provide a benefit to the Wanaque Reservoir. Strict adherence to year round phosphorus removal does not bear any relationship to goal of protecting the Reservoir. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that are not warranted. Chemical precipitation and additional TDS and sludge production can be avoided through judicious establishment of compliance levels, tied to the use of the Wanaque South pump station or a reservoir level, to achieve benefit at cost savings to the public. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. (1)

74. Comment: The limit of 0.76 mg/L, which is applied seasonally to protect the River, should be applicable to all dischargers, not just those downstream of the Reservoir intake. The Department has proposed limitations to protect the Wanaque Reservoir from diversions from the river system. It is believed that such diversions have not occurred in approximately four years. It does not seem appropriate to protect this use on a continuous basis when diversion does not occur at any reasonable frequency. (23)

Response to Comments 72-74: As discussed in the response to Comment 55, the Department believes seasonal limits are only appropriate for discharges below the confluence of the Pompton and Passaic River. Tying effluent limits to an unpredictable pumping regimen outside the control of the regulated entity is institutionally impracticable. Regarding the opportunity to provide input on the concept of seasonal limits, multiple opportunities were provided. In addition to the opportunity for formal public comment provided with the formal notice and public hearing for the proposed watershed criteria, TMDL and anticipated effluent limits that will emanate from the TMDL, prior to the proposal, there were at least two opportunities for public comment on these issues. At the May 19, 2006 Data Exchange Meeting on the Passaic River Basin TMDL, the Department requested input on the watershed criteria. At the June 4, 2007 meeting between the Department and the affected dischargers, a presentation was made on the Non-tidal Passaic and Pompton Lake TMDLs in which the Department presented information regarding the intent to apply seasonal limits for some discharges as well as the basis for seasonal limits. Some of these points were raised and responded to at those events.

Margin of Safety:

75. Comment: Confirmation is requested that the issue of margin of safety will be revisited once the TMDL is implemented and that antibacksliding and antidegradation policies will not preclude the Department from undertaking appropriate remedies and revisions at that time if deemed warranted. (1), (2)

Response: Antidegradation policies are required to be implemented should a permittee request to expand its discharge beyond the levels currently authorized. As the TMDL has allocated the total the phosphorus loading for the Passaic River Basin, a request for a new or expanded treatment plant would need to: maintain the phosphorus loading authorized in its NJPDES permit, obtain an allocation of the loading contained in the reserve capacity or obtain a reallocation of load from another NJPDES facility. With regard to antibacksliding, under Section 402(o) of the Federal Act (33 U.S.C. §1342(o)), "A permit may not be renewed, reissued, or modified… to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit." However, as described by the regulation and the USEPA Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001), establishing less stringent limits based on water quality is allowed where: material or substantial facility changes justify relaxation, events beyond control can not be remediated, the permittee has installed and properly operated the facility and is still unable to meet the limit, or new information (such as a revised TMDL) justifies relaxation of water quality-based permit limitation. In either situation, it is not expected that the loading capacity contained in the MOS for these TMDLs would be further reallocated as WLAs and LAs. If the water quality response based on follow-up monitoring warrants and a subsequent TMDL study that includes improved predictive capabilities is developed, it is possible that revised WLAs and LAs could result.

76. Comment: The TMDL's numerous conservative assumptions, including inclusion of the 2002 drought conditions, comprise a sufficient Margin of Safety, so as to meet the definition of an "implicit" Margin of Safety and are thus sufficient to meet EPA's requirements for a TMDL calculation. The addition of an "explicit" Margin of Safety is unnecessary. The MOS is used to assign load allocations that are protective of a water quality endpoint, based upon uncertainty in the TMDL calculation, and should not be embodied additionally in the site-specific criterion itself. (15)

Response: In this study, the MOS and reserve capacity are provided for by setting a target lower than the established watershed criteria, not in addition to a specified additional allocation of the loading capacity as suggested by the commenter. EPA guidance does allow an MOS to be implicit, explicit or a combination of both. An MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). EPA directs that it may "prove feasible to include margins of safety in more than one TMDL analytical step. For example, relatively conservative numeric targets and source estimates could be developed that, in combination, create an overall margin of safety adequate to account for the uncertainty of the analysis" (Protocol for Developing Nutrient TMDLs, EPA). EPA requirements for an approvable TMDL also require consideration of critical conditions and seasonal variation when setting the TMDL and associated WLAs and LAs, neither of which is allowed to serve as the MOS. The fact that the TMDL study complies with requirements for critical conditions and seasonal variations does not constitute an implicit MOS.

Water Quality Trading:

77. Comment: Water quality trading is opposed and this provision should be eliminated from the proposed TMDL for the following reasons:

- Discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge, not miles away where another discharge occurs.
- Changes in the composition of a discharge will change the ecology of the receiving water. This is especially true if there are changes in nutrient loadings. In a trading situation, evaluating the benefits and damages to the ecology at two different locations will be impossible.
- If some dischargers can buy credits, then the overall reductions in loadings will be less, and the water will be less clean than if all dischargers meet the same requirements.
- Marketing credits will result in inequities that will probably be controlled by political and economic forces.
- Everyone needs clean water to drink, but who will bear the costs of cleaning up the water from dischargers who buy credits?
- Enforcement of trading agreements has been poor in other parts of the United States.
- No environmental organizations were invited to be part of the review team established by Rutgers on the trading project; thus the study completed by Rutgers did not have the oversight of a critical stakeholder for the Passaic River, and has a tendency to represent only sewerage authority interests and not those of the general public.

(7), (9)

Response: In the case of nutrient impacts on dissolved oxygen and phytoplankton, it is not true that "discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge." In fact, it is far more common for dissolved oxygen and productivity impacts to occur substantially downstream from nutrient point sources. Phosphorus is considered a pollutant because it can stimulate excessive productivity. The TMDL analysis demonstrated the two locations where phosphorus is responsible for excessive primary productivity. Water quality targets were developed for these two discrete locations. The trading program will consist of a trading currency among point sources that will result in a condition the same as or better than the TMDL premise, as demonstrated by modeling runs of trading scenarios. Under the trading program, if some dischargers buy credits, then by definition there must be a discharger or dischargers that are selling credits in order to maintain the TMDL outcome at the critical locations.

With respect to creating untenable economic circumstances for some users, the Department believes that the responsible entities for each discharge will only seek trades that are consistent with discharge of their fiscal responsibility, which includes managing the system so that user costs are set only as high as necessary to satisfy water quality as well as public health and safety obligations.

The scientific, economic, and legal feasibility of water quality trading in the non-tidal Passaic River basin is under study. With finalization of the TMDL specification, the research on trading can be finalized. The final trading proposal, including trading ratios and rules, will be presented to the public for comment and must be approved by both the Department and EPA prior to implementation through NJPDES permits.

78. Comment: The trading concept is opposed. It doesn't belong in New Jersey. We should be cleaning up the sources. (20)

Response: The Department believes that water quality trading represents a viable means to determine if more efficient and cost effective means are feasible to attain water quality objectives and to implement them. The Department anticipates providing a 1 year period from the date of permit issuance to negotiate trades, provided the trading tool and rules have been approved by the Department and EPA. To be approvable, a viable trading option would have to ensure that the TMDL condition in the Wanaque Reservoir and Dundee Lake are met and that there is full enforceable accountability for required load reductions.

79. Comment: If available, the trading ratios developed under the trading program should be included in the TMDL report. If these ratios are not yet available, then the trading ratios will need to be separately public noticed and sent for EPA approval. (21)

Response: Rutgers Cooperative Research and Extension received an EPA Targeted Watershed Grant in 2005 to develop, evaluate and implement a water quality trading program for the non-tidal Passaic River Basin. Upon completion of the trading study, there will be an opportunity for public comment on the study, and both the Department and EPA will need to approve the trading tools and rules prior to their use in formulating a trade. In addition to the public comment on and agency approval of the tools and rules, the public will have the opportunity to comment on specific trades as they are reflected in NJPDES permits.

80. Comment: The voluntary "Water Quality Trading Program" suggested in the TMDL cannot be substituted for properly addressing the attenuation of phosphorus, particularly when the preliminary indications are that the Department has or will impose artificial constraints and requirements on key components of such a trading program. Given its failure to properly allocate loading as part of the TMDL, the Department must entertain comments on the trading project and address such comments in formulating the eventual TMDL that will be submitted to EPA for approval. The Department cannot relegate to a potential, voluntary trading program the scientifically sound allocation of initial responsibility for phosphorus reductions. Once the proper initial responsibility for phosphorus removal is established, water quality trading may be appropriate. The unsoundness of relying on trading is compounded by the uncertainty of whether the trading project will be implemented and whether there will be sufficient parties reducing phosphorus in effluent enough to trade with potential credit "purchasers" is unknown. (10)

81. Comment: The Department is considering imposing unsound, artificial, and unfair conditions or restrictions on trading. First it proposed that there would be a maximum trading ratio of 1.0, which is not supported mathematically and will discourage STPs that are further from the model endpoints to trade with closer STPs to have the closer STPs remove additional phosphorus. The

Department is also considering that credits be accumulated and recalculated annually, based not on actual flow but on permitted flow. For an STP that is operating close to its permitted flow, this calculation of credits may not be particularly troublesome. However, for an STP whose actual flow is far below its permitted flow, this formula will significantly discourage trading from the buyer's perspective. Where, as under the proposed trading project, such credits are calculated annually, this trading disincentive does not serve any rational purpose. The effect on effluent limits that would follow from attenuation cannot be relegated to a voluntary trading program and must be addressed in the phosphorus effluent limit for each STP. If trading is to occur, the "trading ratios" will then be incorporated within each STP's limit, which actually simplifies the trading calculations. The disincentives to trading reverse the Department's concept of "cost efficiency," which the trading project would try to promote. (10)

82. Comment: Unless the Department requires that NJDWSC take responsibility, it will not do so and it will have no incentive to "trade" with other dischargers. The entity that should pay for such treatment of the diverted river water is NJDWSC, the party diverting it. Only by providing NJDWSC with its own financial incentive to reduce the phosphorus load coming into the Wanaque Reservoir will this critical party have an interest in participating in any trading program. WTSA agrees that a properly formulated trading program can help achieve the most cost-effective approach to reducing phosphorus loads at the critical endpoints. To be effective and fair, all potential trading partners must have appropriately determined financial incentives to participate. (10)

83. Comment: NJDEP has indicated that trading ratios will be capped at 1.0. That clearly is not appropriate for WTSA in view of the significant attenuation of WTSA loads. If trading ratios are indeed capped at 1.0, there will be no reason for WTSA to participate. If the Department were to insist on "capping" the trading ratios at 1.0, the result would be ignore the significant attenuation that occurs, and would be unfair to WTSA, as it would improperly assign a much greater contribution of TP than WTSA's facilities in fact contribute. (12)

Response to Comments 80-83: No final determinations on the trading program have been made. When the trading study is complete, it will be subject to public comment as well as Department and EPA approval. Issues related to attenuation and alternatives to phosphorus reduction are addressed in responses to Comments 48-54.

Nonpoint Source Load Reduction:

84. Comment: The Department should support and help implement programs which will provide a reduction of phosphorus and nitrogen. An open and forthright planning process is needed to attain meaningful reductions. (9)

85. Comment: A real commitment from the State of New Jersey, both regulatory and financially, would be needed to deal with point and nonpoint problems in this reservoir. A 60% reduction cannot be assured when septic management systems are not mandated; when goose management and riparian buffer restoration efforts are voluntary and underfunded, with inputs from these sources uncontrollable and unmanageable; and when conservation plans and resource

management plans on farmland to reduce agricultural inputs are not mandatory. Given the lack of confidence in achieving the NPS load reduction, more must be required of point sources. (22)

86. Comment: Commenter is concerned about how reductions will be achieved. Parking lots will not be ripped up. Money is running out to buy up stream corridors. We don't require retrofitting of stormwater when we do redevelopment. A regulatory and financial commitment is needed from the Department to get the NPS reductions. Goose management and fertilizer ordinances are not going to do it. (20)

87. Comment: There is concern about achieving NPS reductions; commenter is relying on Department's assertion that these reductions are feasible. (14)

Response to 84-87: The Department has been and continues to be committed to reducing phosphorus sources derived from stormwater point sources as well as nonpoint sources through best management practices. Stormwater sources regulated as NJPDES point sources are subject to several measures that are expected to significantly reduce phosphorus loads from urban areas. Through their NJPDES permit, Tier A communities are required to implement street sweeping and outlet cleaning, as well as to adopt ordinances regarding proper yard and pet waste management, and limiting wildlife feeding. In addition, municipalities within the spatial extent of the model will be required to adopt the fertilizer management ordinance limiting the application of phosphorus through lawn fertilization. Based on studies in other areas, implementation of a fertilizer ordinance alone is expected to achieve a 20% reduction in phosphorus inputs to the Passaic River and its lakes and tributaries. Additionally, each year the Department funds NPS reduction projects through the federally funded 319(h) program. These funds are to be used to implement programs and projects designed to reduce nonpoint source pollution. Projects include, but are not limited to, riparian buffer restoration and stormwater retrofits. Relevant projects in the drainage area have been cited in the TMDL document. Although agriculture is not a significant land use in the drainage area, the Department regularly coordinates with the Department of Agriculture to address water quality issues related to agricultural land uses and there are a number of cited funding programs available to accomplish agricultural BMPs. Finally, the Department recognizes the importance of continued public education as key to the overall abatement of NPS pollution. To aid in the public education, the Department continues to support the New Jersey Watershed Ambassadors program. The NJWA program is a community-oriented AmeriCorps environmental program designed to raise awareness about water issues, including nonpoint source pollution in New Jersey.

88. Comment: What assurance is there that New York will address the need to reduce phosphorus load entering New Jersey, without which the TMDL objectives cannot be met. (7), (20)

Response: New York has already applied a phosphorus limit on the Western Ramapo treatment facility that will begin the process of reducing phosphorus loads entering New Jersey. New Jersey believes this permit action signifies a willingness to cooperate and expects to continue to work with New York to assess the loading reduction accomplished and the extent to which additional load reductions are needed.

89. Comment: Commenter recognizes that the cost for achieving required point source controls is not insignificant and wants to be sure that it is well spent, since ratepayers and taxpayers would need to pay for it. Regarding nonpoint source control, while the commenter is willing to pass the proposed fertilizer ordinance, there is concern that in some affected municipalities, much of the fertilizer application occurs by way of landscapers. Landscapers apply fertilizer from tanks and there is no way to know what is in them, which will make enforcement challenging. Limiting the application of phosphorus from fertilizer is better accomplished regionally or statewide and though legislation or rules, even if new legislation or rules are needed to address this issue. (16)

90. Comment: The Department should regulate landscapers to get reductions from the fertilizer source. (14)

91. Comment: The Department should urge the State Senate and Assembly that a more productive tactic would be to introduce and pass legislation controlling non-point source phosphorus contribution via banning the sale and use of phosphorus laden fertilizers and detergents in New Jersey. (3)

Response to comments 89-91: As a requirement of the TMDL, municipalities listed in Appendix B of the TMDL documents must adopt and enforce a fertilizer application ordinance. The fertilizer ordinance applies to all persons, defined as any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction. The landscaping industry falls under this definition and is required to comply with the conditions of the ordinance. The purpose of the fertilizer ordinance is to regulate the outdoor application of fertilizer so as to reduce the overall amount of excess nutrients entering waterways, thereby helping to protect and improve surface water quality. The Department agrees that a regional or statewide plan may be a more effective means to manage the fertilizers source of phosphorus. An initial step towards this approach is the Memorandum of Understanding (MOU) between the Department and members of the lawn care industry to reduce phosphorus by 50 percent the pounds of phosphorus applied in lawn care products in New Jersey Watersheds by 2010 as compared to a 2006 base year.

92. Comment: The City of Garfield has adopted a Fertilizer Management Ordinance and will provide a certified copy when passed by the Mayor and Council. (6)

Response: The Department appreciates the initiative demonstrated by the City of Garfield to reduce phosphorus loads in advance of adoption of the TMDL.

93. Comment: The proposed TMDL requires a basin-wide uniform reduction in non-point source phosphorus of 60%. Municipalities identified in Appendix B will be required to adopt a Fertilizer Management Ordinance and to undertake other phosphorus reducing measures. The uniform NPS reduction ignores phosphorus attenuation that occurs in the river system. Given the 99% attenuation and greater settling of organic phosphorus which makes up most of NPS phosphorus, it is likely that none of the NPS phosphorus from Warren arrives at Two Bridges, which is some 35 miles away, or at Dundee Lake which is 50 miles distant. There is no reason to require that Warren Township to adopt a Fertilizer Management Ordinance or undertake other NPS phosphorus reducing measures. (10)

Response: The commenter is incorrect to assume that none of the stormwater phosphorus load from Warren arrives at Two Bridges. In fact, attenuation of wet-weather phosphorus loads is much less than dry-weather, so nearly all of the wet-weather load from Warren will reach Two Bridges. Attenuation, while not as significant for stormwater loads, is fully accounted for by the Passaic River TMDL model.

95. Comment: There is substantial uncertainty as to whether the nonpoint and stormwater point source load reduction targets can be achieved. Therefore, Wayne requests confirmation that those phosphorus effluent limits applicable to the point source dischargers, which derive from the TMDL process, will not be amended in the future in the event that the nonpoint and stormwater point source load reduction targets are not met. (18)

96. Comment: The NPS load reduction for Township of Wayne may not be achievable. Wayne already has a fertilizer ordinance in place. If the nonpoint source reduction is not achieved, there is concern that the impacts of the lack of water quality improvements will be placed on the STPs by additionally lowering their loadings. (11)

Response to 95 and 96: The Department fully expects through the various management measures outlined in Section 7 Implementation Plan of the TMDL report that nonpoint and stormwater point source target reductions will be met comprehensively throughout the basin. The Department is committed to assisting with achieving these reductions through enforcing the municipal stormwater permit requirements, requiring the fertilizer management ordinance, the fertilizer MOU, and funding projects. The Department does not anticipate that the STPs will have to additionally lower their loadings in the future to meet the TMDL requirements. However, there can be no guarantee regarding future permit limits that may be imposed given the many physical variables, as well as potential for changes in regulatory requirements that may occur. Water quality response to implementation of the load reductions in the TMDL will be assessed and the need for adaptive management will be determined over time.

Data Availability:

97. Comment: Because the supporting documentation for the Wanaque Reservoir Model is not sufficient to facilitate a detailed technical review, the proposed TMDL should not be adopted. The model contains uncertainty in the loading to the Wanaque Reservoir from diversions and in how well the model responds to the diversion loads discharged to the reservoir. Although this particular model is proprietary to Najarian and Associates, input and output files for the 1/1/93 to 12/31/02 calibration can be provided. This includes daily 1993-2002 diversion inputs used for the baseline model case (date, location, flow, phosphorus concentration), the monthly diversion data. In addition, an integral component of the Passaic TMDL modeling analysis, the USGS DAFLOW Model and report has yet to be released. (12)

98. Comment: The Department has continued to withhold information critical to a thorough evaluation of the TMDL, which is necessary to enable the submission of all relevant comments. The Department continues to refuse to make available the LA-WATERS Wanaque Reservoir Model. Given the significant expenditure of public funds that the proposed TMDL is likely to

require of the dischargers, it would be in the public's interest to make the model and the water quality inputs available. Based on the meaningful input provided given availability of the Phase 2 model, allowing public access to models is the only way to ensure that the Department will have the benefit of an open and transparent TMDL process. (10)

99. Comment: It is not possible to perform a complete technical and scientific evaluation of the TMDL due to lack of access or delayed access to data and model inputs. Insufficient information is provided about observed algal concentrations, their relationship to diversion inputs in the Wanaque Reservoir, and the reservoir concentration of phosphorus that would maintain acceptable algal concentrations for the protection of drinking water. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. Data provided in figures in insufficient. The Omni modeled was not made available until late in the public comment period. (15)

100. Comment: The Department has failed to provide the data that supports key determinations made with respect to the Wanaque Reservoir. This information must be provided in accordance with OPRA. Lack of access to requested information is particularly egregious because RVRSA paid its fair share toward development of the TMDL. (1), (2)

Response to Comments 97-100: The Department has addressed all OPRA requests that were made with respect to the Phase 1 TMDL and provided all information in its possession in response to these requests. Certain information is not available in the form requested; however, the Department believes that the available information is sufficient to allow an assessment that the studies provide a sound basis for the TMDL and the WLAs and LAs established as an outcome. As stated previously, the Najarian 2005 TMDL study report provides sufficient data for the evaluation of model results. Data is provided in the form of graphical outputs, summary loading budgets, and error analysis. Tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam were also provided in the supplemental report for the Wanaque Reservoir modeling, (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788). With regard to the Passaic River basin model, the comment period was extended to allow additional time to evaluate to that model. The flow Model Diffusion Analogy Surface-Water Flow Model, published by USGS in 2007, entitled, "Simulation of Surface-Water Conditions in the Non-Tidal Passaic River Basin, New Jersey Scientific Investigations Report 2007-5052" was used to simulate flow in the non-tidal Passaic River and its major tributaries.

In addition, this TMDL has been the subject of more public involvement than any other in the State, as described in the TMDL document and reiterated in response to Comments 101-102. The Department has conducted stakeholder discussions on phosphorus TMDLs for the Passaic

River Basin as far back as 1996. One outcome of that extensive process was selection of LA-WATERS as the appropriate tool to assess nutrient and productivity in the Wanaque Reservoir under current conditions and to determine phosphorus loading reductions needed to achieve water quality objectives. This determination was made with full knowledge that this model was proprietary. Specifically, the October 2001 "Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin", memorialized the outcome of the discussions with stakeholders and the work of the Passaic River Basin TMDL Work Group regarding the plan to develop the TMDL. Included was the recommendation to use LA-WATERS to develop a water quality objective for the Wanaque Reservoir to protect designated uses.

Public Participation:

101. Comment: Public participation has been severely restricted in the process of developing this proposal. Before further action is taken the Department should undertake the following activities:

- Convene a Technical Advisory Committee to peer review the scientific investigations and the conclusions that have been reached in this process;
- Convene a Public Advisory Group to study and evaluate the economic and ecologic costs and benefits to be derived from the implementation of this proposed TMDL;
- Ask for public comment on the outputs from these groups.

(8)

Response: The Department does not agree that public participation has been severely restricted in this TMDL development process. In fact no other TMDL has had the degree of participation and discussion that is the hallmark of the Passaic River Basin TMDL. Section 9 Public Participation in both TMDL documents chronicle the various workgroups and key meetings that the Department has convened and had with all stakeholders groups (including the commenter) throughout the past 14 years. The Passaic TMDL Work Group, which met monthly from 2001-2003, was a technical advisory committee that led to the development of the proposed Passaic TMDLs as articulated in the *Passaic Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin* document. From 2004 to 2007 the Department convened stakeholder meetings to present and discuss key findings and to seek input from the public on the TMDL. Information obtained from this process informed the development of the Passaic TMDLs. Components of the TMDL were also reviewed by the NJ EcoComplex academic panel and presented at conferences and in peer reviewed journals.

A cost benefit analysis is not a requirement of the State's TMDL process. Nevertheless, the Department did request cost estimates from dischargers in September 2007. Responses were received from some dischargers, which indicate that phosphorus removal costs will be significant, but the needed phosphorus reductions are both achievable and reasonable. Use of BNR technology at plants where this technology is feasible can accomplish needed reductions that will require an initial capital cost and low operation and maintenance costs and will have minimal adverse side effects associated with chemical removal. , The TMDL provides that, upon approval of a trading tool, the Department will make water quality trading an option for specified treatment plants within the Passaic River Basin, which may identify viable cost effective options beyond a uniform reduction of phosphorus at each facility.

102. Comment: The Department violated the premise of the Clean Water Act by not publicizing the development of the TMDL for the fresh water Passaic and the Ramapo. There should have been briefings during development. The TMDL would have benefited from broader public participation. (7)

Response: In addition to the Clean Water Act's public process requirement, the Department's Water Quality Management Planning rules at *N.J.A.C.* 7:15-7.2(f) require the Department to informally initiate a public process prior to the development of each TMDL including informational sessions as needed. The Department has fully complied with both the spirit and intent of the requirement to provide opportunities for public comment. As set forth in the response to Comment 101, the Department has gone to extraordinary lengths to maintain an open public process in the development of these TMDLs. The Department publicized the development of the Passaic River Basin TMDLs by including stakeholders in the TMDL development process throughout the past 14 years through various workgroups and milestone informational sessions as set forth in Section 9 of both TMDL documents. In preparation of the TMDL proposal, the public was formally noticed: through direct correspondence by the Department, by public notice as published in the May 7, 2007 New Jersey Register; and through newspapers of general circulation in the affected area. In addition, a public hearing was held on June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ. Notice of the proposal and hearing was provided to affected Designated Planning Agencies, municipalities, dischargers, and purveyors in the watershed.

TMDL Administrative Comments:

103. Comment: There are data and information required for defining the Passaic River Basin TMDL equations that are missing from the TMDL report. While this data and information may be found in the supporting documents, the TMDL report should provide this information in order to present and support these TMDL equations. (21)

Response: Highly complex TMDL studies that cover large areas, such as the subject TMDL studies, preclude inclusion of the supporting data and other information within the TMDL document itself. As noted by the commenter, the data and information upon which the TMDLs are based are found in the cited support documents, which were made available along with and are part of the TMDL reports. The commenter is referred to other complex studies, such as the Delaware Estuary PCB TMDLs established as a collaborative effort among EPA, the affected states and DRBC, wherein the TMDL document summarizes the findings and the detailed information is found in several volumes of supporting information.

104. Comment: For the Passaic River basin TMDL, the entire TMDL equation must be presented by assigning numeric values to the wasteload allocation (WLA), load allocation (LA), explicit margin of safety, and reserve capacity. Some of this essential information is missing from the TMDL report, most notably in Table 12, which provides the TMDL for the area between the Wanaque Reservoir and Dundee Dam, and Table 13, which provides the TMDL for the Wanaque

Reservoir. Table 12 currently provides allocations of TP per day in the following broad categories: headwaters, NPS runoff, NPS baseflow, CSO discharges and STP discharges. These allocations are divided between three geographic areas: Pompton, Upper/Mid Passaic and Lower Passaic. These categories must be broken down further to include: the names of the affected tributary waters along with the individual LA for each tributary, the identification of the different New Jersey land use categories by size with their current loads, percent reductions, and TMDL allocations, the method for identifying MS4 areas and identification of their loads in the WLA by MS4 name and permit number, and the names, permit numbers, and individual WLAs of the other permitted discharges in the contributing watershed. (21)

Response: Tables 12 and 13 have been modified to clarify the TMDL and WLAs and LAs for each endpoint and to correct minor errors. It should be noted that the MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the criterion. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance (May 20, 2002 Sutfin Memorandum). A more detailed areal breakdown is not appropriate or necessary because a key finding of this TMDL study is that the in-stream numeric criterion does not apply within the modeled domain. Watershed criteria have been established at the two critical locations, the Wanaque Reservoir and Dundee Dam Lake. A tributary by tributary breakdown of loading allocation would only be appropriate to demonstrate attainment of the in-stream criterion, which clearly does not apply here. Regarding specific requested additions, the Department notes the following points. Permitted point sources, other than stormwater point sources, were identified by permit number in Tables 7 and 14. The location of dischargers was provided in Figure 4 and footnotes to Table 14 provide information relevant to the established WLA (e.g., location in outside boundary of modeled domain, location below confluence of Pompton and Passaic Rivers thereby warranting seasonal limits). For additional clarity, Table 14 has been modified to indicate within which TMDL Approach Area each discharge is located, and to correct minor errors. Tables 12 and 13 have been revised to identify the assignment of WLAs and LAs to distinguish stormwater point sources from nonpoint sources by land use type, as described in the text, including existing loads and loads under the TMDL specification. Permit numbers have been added for stormwater point source permittees in Appendix B. Land use information was provided in Table 6 and Figure 3 for the overall Passaic River drainage area. A land use breakdown for the Pompton Lake drainage area is provided in Table 6.9 of Najarian 2005. Note that the method for Approach Areas 1, 3 and 4 is described in Section 4, Source Assessment, and explained in greater detail in Omni 2007. For Approach Area 2, the UAL coefficients were used to derive an EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method to obtain nonpoint source loads.

105. Comment: In the Passaic River Basin TMDL, Table 13 is missing the following from the TMDL equation: explicit margin of safety, reserve capacity (if any), the identification of the specific permitted discharges located in this TMDL's contributing watershed, a table assigning the different land uses to either the WLA or the LA portion of the equation, and the distribution and size of the different land uses in this contributing watershed. (21)

Response: Table 13, which provides information for the Wanaque endpoint, has been revised to distinguish between WLAs and LAs for stormwater point sources and nonpoint sources, respectively. The MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the established watershed criteria. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance Sutfin 2002. Regarding land use information, the land use areas are found in Najarian 2005, Table 6.9, as indicated in footnote 7 of Table 13. As described in response to Comment 104, for Approach Area 2, UAL coefficients were used to derive an EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method, to obtain nonpoint source loads. Existing and TMDL loadings derived from these methods are provided in Table 13. Point sources, other than stormwater point sources, were identified in Table 14 by permit number. This table has been modified as described in response to Comment 104 for additional clarity. Stormwater point sources are identified by permit number in Appendix B.

106. Comment: In the Passaic River Basin TMDL, the data used to develop the TMDLs must be identified in a general way in the TMDL report. A summary of the major observations, such as dissolved oxygen and chlorophyll-*a* levels in the Passaic River at Dundee Dam and the Passaic River at Two Bridges, should also be provided. (21)

Response: Detailed observations and data are included in the supporting documents. The TMDL does provide a summary of key water quality findings in Section 3. The findings identify locations where phosphorus is causing excessive primary productivity and where it does not and why, and where observed low dissolved oxygen is the result of naturally occurring conditions. A summary statement about chlorophyll-*a* levels in Wanaque Reservoir has been added for completeness.

107. Comment: In the Passaic River Basin TMDL, a summary of boundary conditions should be provided in the TMDL report. (21)

Response: The boundaries are identified in Figure 2 entitled “Spatial extent of non-tidal Passaic River basin study and related studies with modeling approach applied” (page 23). A discussion of the TMDL approaches is found in section “Area of Interest” (page 18-19). Boundary conditions are summarized on page 11 and then discussed in greater detail on page 123-124 of the Omni Environmental Final Report. Boundary conditions are also addressed in section 5.4 Conditions for TMDL Development in the Najarian Report (page 5-3).

108. Comment: In the Passaic River Basin TMDL, other information and data which support the TMDL analysis and delisting conclusions must be identified in the TMDL report by providing adequate references, including document name and relevant page number(s), to the supporting documents. For instance, when the TMDL report states that 2004 Sublist 5 listings were shown to not be impaired by TP, the reference to the data or information supporting this claim must be provided in the body of the TMDL report. (21)

Response: Section III, Watershed Modeling Analysis, of the Passaic River Basin TMDL document (Omni, 2007) provides adequate discussion and relevant graphs for the interpretation of the narrative criteria for phosphorus for all of the five sub-watersheds studied that leads to the conclusion that phosphorus is only "rendering unsuitable" in the identified critical locations. In addition, comprehensive graphical model simulation outputs in terms of the response indicators, dissolved oxygen and chlorophyll-*a* concentration under different model conditions, are provided in Appendix J in the Passaic River Basin TMDL Appendices (Omni, 2007). References to these sections will be included in the TMDL document.

109. Comment: In the Passaic River Basin TMDL, for reasonable assurance, please provide as much detail as possible regarding the reductions in phosphorus loading expected from the implementation actions identified in the TMDL report. (21)

Response: The Department expects to achieve the needed levels of nonpoint source reduction through a suite of management measures, as described in the implementation section. Significant reductions in phosphorus load are expected from implementation of the measures required under the municipal stormwater regulation program. These include street sweeping, yard and pet waste management, and limitations on wildlife feeding. For example, the US Department of Transportation Federal Highway Administration cites a State of California study on vacuum sweeper efficiency where 74% TP was removed, with an efficiency rate of 40% attributed to mechanical sweepers– see www.fhwa.dot.gov/environment. In addition, adoption of the fertilizer management ordinance will be required of those municipalities that are within the model domain. The literature supports that a significant (20%) overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. After 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because of the finding that most soils had enough phosphorus to keep a lawn healthy. This mirrors information available about soils in New Jersey as well. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

In addition to measures to be implemented through the Municipal Stormwater Regulation Program, the implementation section describes numerous restoration projects funded with 319(h) funds that are located within the study drainage area. The National Grants Reporting Tracking database provides a tool for estimating load reductions from measures, including those that achieve phosphorus reduction. For example, a 1998 319(h) funded detention basin retrofit project in Mendham Township estimated using the "Spreadsheet Tool for Estimating Pollutant Load" or "STEPL" model that a 160 pound per year reduction in phosphorus may be expected as a result of the completion of the project. The cumulative effect of these projects will enhance the phosphorus reduction achieved through regulated stormwater and contribute to the overall reduction required. The Department remains committed to targeting future 319(h) funds, as well as available State funds, for example, Corporate Business Tax, to achieve water quality objectives.

110. Comment: In the Passaic River Basin TMDL, please explain the difference between the Ortho-P values in Tables 9 and 10 when both tables have the heading "Tributary Baseflow Concentrations for Contributing Watersheds." (21)

Response: Table 9 was intended to provide tributary baseflow values for parameters other than phosphorus, while Table 10 was intended to provide tributary baseflow values for phosphorus species, which vary by watershed. The titles of the tables will be revised to be more clear and the phosphorus value will be omitted in Table 9, as this was an error.

111. Comment: In the Passaic River Basin TMDL, why is there no decrease in P loading from CSO discharges? (21)

Response: As background, the Department regulates all portions of combined sewer systems by general permit. The permit relies upon the development and implementation of best management practices, technology-based control measures, self-monitoring, and permit compliance certification to comply with the requirements of the Federal Clean Water Act (CWA) as defined by the National CSO Control Policy. The TMDL addressed CSO discharges in section 4.0 Source Assessment (page 29) under the discussion on Point Sources. It was determined that the CSO load was insignificant in that elimination of this load would result in no significant difference in the outcome of the TMDL. Therefore, because the means for achieving load reductions would entail costly measures such as eliminating CSOs or providing end of pipe treatment, such reductions were deemed an inefficient means of achieving the objective and were not required or factored into the TMDL. Nevertheless, some reductions are expected to be achieved through the Long Term Control Plans for the affected CSOs, which will provide a conservative assumption within the TMDL.

112. Comment: In the Passaic River Basin TMDL, "Baseline Future Condition" is better described as "Upper Bound Condition" on phosphorus loading since it assumes that every NJDPES is discharging at their permitted limit to the watershed (p. 120 of technical document). (21)

Response: Both expressions, baseline future conditions and upper bound conditions, were used interchangeably throughout the study. The descriptor suggested by the commenter for the table would be accurate; however, no change has been made because the descriptor in the TMDL is fully explained as to meaning and is used extensively in the TMDL and supporting documentation. There would be no value added from the effort to change the descriptor throughout the documents.

113. Comment: In the Pompton Lake/Ramapo TMDL document, there should be explanatory text to describe how both the Reckhow model and the mass balance model are used in order to determine the final loading capacity, WLAs, LAs, and margin of safety. How was one modeling approach selected over the other for the TMDL values? If the mass balance model alone was used to determine these, then the discussion must be based on the use of the mass balance model and calculation of implicit margin of safety, the 6% explicit margin of safety, and the 1% reserve capacity. (21)

Response: Section 6 of the TMDL document provides an explanation of the two technical approaches considered as well as an explanation for selection of the mass balance approach over the Reckhow approach. The two approaches gave similar outcomes. However use of the mass balance approach for the Pompton Lake/Ramapo River TMDL would allow the use of a consistent approach throughout Approach Area 2, the remainder of which is addressed in the Passaic River basin TMDL. In addition, the mass balance approach was able to provide daily loadings as a boundary condition input to the Passaic River basin TMDL, while the Reckhow approach does not. Section 6.2 will be revised to provide greater clarity on the integration of the approaches as well as this additional elaboration on the selection of the mass balance approach. With regard to the MOS and the Reserve Capacity, a significant MOS is integral to the Reckhow model and an additional 6% MOS was stipulated values with respect to loadings under the mass balance approach. The mass balance MOS value was deemed sufficient, given the significant MOS already incorporated in the Reckhow model. The 1% Reserve Capacity was provided to allow for the possibility that there may be a new or expanded wastewater treatment facility in the future, although there are no planned new or expanded facilities at this time.

114. Comment: Pertinent information currently in the Wanaque TMDL needs to be presented in the Ramapo River-Pompton Lake TMDL document and this document should be able to "stand alone." These items are currently described with regard to the Reckhow model alone. (21)

Response: The information in the Wanaque TMDL, or Passaic River basin TMDL, is not pertinent to the Ramapo River-Pompton Lake TMDL calculations. The latter study addresses a distinct drainage area that contributes, in terms of a boundary condition, to the Passaic River basin TMDL study, but the converse is not true. Therefore, the Pompton Lake/Ramapo River TMDL is a stand-alone document. Because the Pompton Lake/Ramapo River document has not yet been approved and contains information relevant to the Passaic River basin TMDL, the pertinent information from the Pompton Lake/Ramapo TMDL document is included in the Passaic River basin TMDL so that it is also a stand alone document.

115. Comment: In the Pompton Lake/Ramapo TMDL, on page 15-16, the Najarian Mass Balance Model is described in the Source Assessment Section. This should be located in Section 6.0, Technical Approach. Furthermore, the results of the model, including graphs of observed versus simulated loadings and coefficient of correlation, should be included. (21)

Response: The Department agrees that some of the discussion under Source Assessment is more appropriate in Technical Approach and will modify the document accordingly. However, the Department believes that the supporting details are more appropriately provided in the support document, Najarian 2005, which is part of the TMDL.

116. Comment: In the Pompton Lake/Ramapo TMDL, NJDEP states the following regarding phosphorus concentrations for the Ramapo River between Mahwah and Pompton Lake (see Page 23): “Given the required boundary condition of water quality meeting the standard of 0.1 mg/L at the state border/Mahwah station and the fact that the Ramapo River is a “losing” stream, the in-stream standard of 0.1 mg/L will be met in the Ramapo River, without further demonstration.” The term “losing stream” is unclear. This concept could be demonstrated by including graphs comparing the phosphorus concentrations in the Ramapo River at Mahwah versus downstream at Oakland. In general, meeting a stricter WQS in a downstream lake doesn’t necessarily mean that a higher WQS in an upstream segment will be met due to greater variability and higher peak to average P ratios in river phosphorus concentrations. In addition, Ramapo River is a “losing stream” given current phosphorus loads, but will it remain a “losing stream” once the TMDL is implemented? Please explain this linkage and identify mechanisms by which the Pompton River’s phosphorus concentration decreases further downstream from Mahwah. (21)

Response: A losing stream is one in which stream flow is lost to ground water at a greater rate than groundwater enters the stream. In the relevant portion of the Ramapo River, a well field is located which draws water at a rate so as to induce the losing stream condition. The stream flows, which contain higher concentrations of phosphorus, are drawn into the ground water and are replaced with ground water, which contains lower concentrations of phosphorus. This hydrologic condition is not expected to change as the result of implementing the TMDL. The supporting document, Najarian, 2005, pages 3-4,3-5, and Figures 3.6a, 3.6b, 3.7a and 3.7b, provide a detailed explanation and justification for the conclusion drawn that the Ramapo River is a losing stream. In addition, water quality sampling conducted for the Passaic River TMDL study demonstrates the same result. Commenter is referred to the synoptic sampling done at the two locations, as illustrated in the graph provided in the Passaic River Basin TMDL- Phase I data summary and analysis (Omni, 2004) page 7 slide 6. It should be noted that the called for reduction from New York is of primary importance in meeting the in-stream criterion at the Mahwah station, as it is very close to the border. The reductions called for in New Jersey are to attain the more stringent lake criteria in Pompton Lake. Comparison of the observed TP concentrations between Ramapo River and Mahwah and Ramapo River at Pompton Lake show a clearly significant decrease in TP concentrations.

117. Comment: For Pompton Lake, the Qa, Areal Water Load (m/yr), is 375 m/yr, which exceeds the recommended range for the Reckhow model of 1.2-190 m/yr. Please discuss using the Reckhow approach when this discrepancy exists. (21)

Response: Although the areal water load for Pompton Lake is outside the calibration range (375 m/year), the model still remains a good choice since it has the broadest range of lake characteristics in its database. While the target concentration for the lake is well within the range, the areal phosphorus load provides a better representation of a lake's intrinsic loading characteristics. Also, it is the model's prediction of target condition that would be used to calculate the TMDL. If current loads are higher than the range that can produce reliable model results, this has no affect on the model's reliability to predict the target condition under reduced loads.

118. Comment: In the Pompton Lake/Ramapo TMDL, the current title of Table 13 does not make sense. The title should explain that this is the loading capacity or TMDL for total phosphorus including WLAs, LAs, explicit margin of safety and reserve capacity for the New Jersey portion only of the Pompton Lake watershed. (21)

Response: The referenced table includes information regarding both New Jersey and New York sources, providing a summary of all source loads, as reflected in the title. The title will be modified to indicate that the table provides the TMDL components for the Pompton Lake endpoint and WLAs and LAs that apply to sources originating in New Jersey.

119. Comment: In the Pompton Lake/Ramapo TMDL, the allocations in the column labeled "TMDL Specification" add up to 17.4, not 17.3 kg TP/day which has been identified as the loading capacity. Please reconcile these two numbers. (21)

120. Comment: The "TMDL Specification" for "Point Sources other than Stormwater NJPDES Dischargers" is given as 0.4 kg TP/day yet the summation of these individual WLAs in Table 12 is 0.37 kg TP/day. Please reconcile these two numbers so that the same number is used in both tables for this category of sources. (21)

Response to Comments 119 and 120: The difference between the values in Table 12 and Table 13 is negligible. However, the Department has resolved the imprecision caused by conventional rounding as requested by the commenter.

121. Comment: In the Pompton Lake/Ramapo TMDL, there are certain allocations under the "Land Use Surface Runoff" section which appear to conflict or are not identified. Clarify how "low intensity residential" and "high intensity residential" do not overlap with the category called "mixed urban/recreational." Please provide some description in the document of the source category "disturbed areas." Please explain why it is reasonable to assign a load of 0 kg TP/day to the category "Crops/Pasture/Hay." Finally, please explain the Sediment/Base Flow load and how is it estimated. In the Source Assessment Section whether this load is a sediment flux load, a groundwater inflow load, or a combination thereof could be provided. (21)

Response: Table 5 provides the Anderson Land Use/Land Cover codes that were grouped into each land use category descriptor used in the document. The descriptions of what is covered under each code can be found in LAND USE LAND COVER CLASSIFICATION SYSTEM, (Derived from: A Land Use and Land Cover Classification, System for Use with Remote Sensor Data, U. S. Geological Survey Professional Paper 964, 1976; edited by NJDEP, which is available at http://www.nj.gov/dep/gis/digidownload/metadata/lulc95/anderson.html. A footnote will be added to Table 5 referring to this source, which will be added to the References Section. For convenience, the Department had grouped several code types under an unofficial descriptor, "mixed urban/recreational". There is no overlap with the residential land uses, as the codes included in "mixed urban/recreational" include "transportation, communication and utilities", "other urban or built-up" and "recreational land." "Disturbed areas" are the same as "barren land" commonly used in other TMDLs. The "crops/pasture/hay" category appears to have a zero value in the future because, after the 80% reduction, the value is less than 0.05 and is lost due to rounding to maintain significant figures. The table will be revised to clarify this. The term "sediment/base flow" refers to the portion of the mass balance equation that represents ground water base flow and storm water flows, derived as described in the TMDL document.

122. Comment: In the Pompton Lake/Ramapo TMDL, the names of the land use categories which have been assigned daily loads do not match the names of the categories which were divided into WLAs and LAs. Please make clear, for the categories actually used, which are in the WLA and which are in the LA. (21)

Response: The Department has revised the table to clarify WLA and LA by category.

123. Comment: In the Pompton Lake/Ramapo TMDL, Table 12 (page 25) does not identify that the units represent total phosphorus. (21)

Response: The Department has revised the table to clarify that the units represent total phosphorus.

124. Comment: In the Pompton Lake/Ramapo TMDL, Table 4 (page 13) provides the size of each land use area in the entire Pompton Lake watershed. There must be a table which provides these sizes for the focus of the TMDL which is only the New Jersey portion (47 mi^2) of the total watershed (160 mi^2). Also, the 1995/97 land use coverage should be replaced with the 2002 land use coverage. (21)

Response: The values shown in the TMDL for land uses used in the Reckhow approach are from the Pompton Lake and Ramapo River TMDL Study, QEA 2004. The consultant combined the 1995/1997 land use/land cover for New Jersey and the 2000 New York land use information to develop nonpoint source loading. Comparison of the 1995/1997 and 2002 coverage showed no significant change in the New Jersey land use assessment by category. In any case, the Reckhow approach was not ultimately used to calculate the TMDL. In the mass balance approach, land use from New Jersey only was used to estimate the baseflow versus groundwater values for phosphorus, as described in the TMDL.

125. Comment: In the Pompton Lake/Ramapo TMDL, Figure 2 (page 11), the map of the New Jersey portion of the watershed, does not identify the approximate location for the collection of monitoring data from the Passaic Valley Water Commission and from the North Jersey District Water Supply Commission. Also, there is a monitoring location labeled "AN0267" on the map that is not discussed. Is this possibly the location for collection of benthic macroinvertebrate (AMNET) data? What were the results? (21)

Response: In the Pompton Lake/Ramapo TMDL, the sample locations used for the TMDL have been included. The benthic macroinvertebrate (AMNET) site labeled "AN0267" is irrelevant to the TMDL and has been removed from Figure 2. The PVWC (at Pompton Lake inlet) and NJDWSC (same as 1388000 – additional label) sample locations will be added.

126. Comment: In the Pompton Lake/Ramapo TMDL, on page 7, the last sentence of the third paragraph states "Attainment status with respect to designated uses and the parameters identified as responsible for the non-attainment for the assessment units in Table 2 are identified in Appendix B." The designated use impairments do not appear in Appendix B. (21)

Response: This information will be added to Appendix B.

127. Comment: In the Pompton Lake/Ramapo TMDL, at the top of page 16, is the statement "Two stations within the Pompton Lake watershed were selected as the critical locations, Ramapo River at Pompton Lake and Ramapo River at Mahwah." The two monitoring stations used as the critical locations were called "Ramapo River at Dawes Highway" and "Ramapo River near Mahwah" in the 2004 303(d) list. Should these names be used? (21)

Response: The "Ramapo River at Pompton Lake" is a station that is no longer sampled, replaced by one nearby entitled "Ramapo River at Dawes Highway", which is the name used in the 2004 listing. "Ramapo River at Mahwah" was inadvertently used and should be "Ramapo River near Mahwah". This will be changed in the document.

128. Comment: In the Pompton Lake/Ramapo TMDL, the opening description of reasonable assurance, provided in this section on page 33, does not accurately describe the EPA definition or use of reasonable assurance. Since this information is identified on page 8 as "an EPA requirement for approval which will be addressed in the TMDL document," a more accurate definition should be provided. EPA uses reasonable assurance to determine that TMDL reductions in nonpoint sources are reasonable when they are offsetting required reductions from point sources. Please provide as much detail as possible in terms of the reductions expected from the implementation actions identified in the TMDL report. (21)

Response: The opening of the Reasonable Assurance Section was not intended as a restatement of the EPA definition. The Department understands the purpose of reasonable assurance and sees no conflict between that requirement and the statement in the TMDL document. Regarding the means to achieve the identified nonpoint source and stormwater point source reductions, please refer to the response to Comment 109. In this drainage area, an even more ambitious reduction is called for and is expected to be achieved by, in addition to the measures described, an emphasis on funding riparian restoration projects, which is consistent with measures identified to be needed to address temperature impairments in the Pequannock River temperature TMDLs approved by EPA in 2004.

129. Comment: In the Pompton Lake/Ramapo TMDL, on page 21, the discussion of the explicit margin of safety focuses on the Reckhow model's 33.3% MOS yet the final TMDL is based on a 6% MOS using the mass balance approach. The document does not provide discussion of the 6% MOS which was used. Please provide this information. (21)

Response: The 6% MOS was chosen to reflect the degree of confidence in the data and model used and is comparable to the explicit MOS used in other TMDLs.

130. Comment: In the Pompton Lake/Ramapo TMDL, the fourth paragraph on page 21 begins "An implicit margin of safety is provided by using conservative critical conditions…" This section needs discussion of the conservative assumptions that may have been employed to determine the critical condition(s). The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is correct. The implicit margin of

safety is not associated with the selection of critical conditions or the use of total phosphorus as the target pollutant versus dissolved or particulate phosphorus (since water quality standards have taken this into account already), but with conservative modeling assumptions. (21)

Response: The comment appears to be internally inconsistent. It is assumed the commenter intended to state that "The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is *not* correct." The implicit MOS section will be revised to eliminate the discussion of total versus dissolved phosphorus.

131. Comment: In the Pompton Lake/Ramapo TMDL, The discussion of reserve capacity on page 23 should also state the number, that is, 0.2 kg TP/day (1% of the TMDL) that has been chosen for reserve capacity. (21)

Response: This information is provided in Table 13, but will be added to the Reserve Capacity Section for completeness.

132. Comment: In Figure 1 of the Pompton Lake/Ramapo TMDL document (page 10), the map should include Wanaque Reservoir and the diversion pipe since it is a part of the hydrological system. (21)

Response: The Wanaque diversion location is not within the spatial extent of the Pompton Lake/Ramapo River TMDL study and therefore it is not necessary to add this information to the cited map.

TMDL Should Address Nitrogen:

133. Comment: The TMDL does not deal with all the issues. In 1999, the nitrogen got so high that it nearly shut down PVWC. (20)

134. Comment: Given the long standing objective of the Public Advisory Committee for WMA 6 to set appropriate target levels for nitrogen, as well as phosphorus, through scientific investigation, the commenter believes that the studies upon which this TMDL proposal is based should have evaluated the impacts of nitrogen concentrations with respect to dissolved oxygen and chlorophyll-*a*. Both nitrogen and phosphorus are nutrients that contribute to algal growth and affect suitability of waterbodies for use as water supplies, which is the highest use and must be protected. Phosphorus was found not to be limiting productivity in a number of locations. In these locations, reducing both nitrogen and phosphorus should reduce algal growth. Consequently, the Department should address nitrogen in the Passaic TMDL. The goals of chlorophyll-*a* for the Wanaque Reservoir and Dundee Lake will not be achieved unless loadings of both phosphorus and nitrogen are reduced. The Highlands Draft Regional Master Plan and the NY/NJ Harbor TMDL are targeting nitrate as a parameter that must be limited or reduced. It is bothersome that the Highlands do not have a database that could inform the TMDL plan to make it more comprehensive; instead the TMDL proposal is piecemeal and has inaccuracies. Nitrogen and ammonia reductions are needed to assist the Lower Passaic River Restoration project

because, in that part of the river, nitrogen is the nutrient of concern to control algal growth. (7), (8), (9)

Response to Comments 133 and 134: The modeling study for this TMDL did include nitrogen species. However, a TMDL for nitrogen species in the Passaic River itself is not warranted at this time because the waters are not listed as impaired with respect to nitrogen species. It is important to note that ammonia is currently very low throughout the Passaic River basin due to existing point source requirements. As noted in *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, vetted and approved by the Passaic TMDL Workgroup Workgroup, October 31, 2001, and still true today, there are no documented exceedances of the 10 mg/l SWQS for nitrate. However, nitrate is identified as an emerging issue with a critical location at Little Falls where water is withdrawn directly into a drinking water facility. Currently, purveyors are required to perform additional monitoring if nitrate levels above 5 mg/l are found. Furthermore, the Department has begun to implement water quality based effluent limitations (WQBELs) for nitrate upon renewal of NJPDES permits based on compliance with the 10 mg/l nitrate criterion under low design flow conditions (7Q10). The Department is assessing what additional measures may be appropriate to address the issue statewide.

The focus of this TMDL is the phosphorus impairment as it relates to excessive primary productivity and related water quality effects. While it is true that both nitrogen and phosphorus are necessary to support plant and algal growth, it is not true that nitrogen reductions are necessary to achieve the phytoplankton chlorophyll-*a* goals for the Wanaque Reservoir and Dundee Lake. Since both nitrogen and phosphorus are necessary to support plant and algal growth, reducing either or both nutrients to low levels could theoretically limit plant and algal growth. In practice, however, phosphorus is generally targeted to constrain productivity in freshwater systems. Natural and nonpoint sources of nitrate in freshwater systems are generally sufficient to support high levels of productivity, and are more difficult to control than phosphorus. In addition, it would not be desirable to induce nitrogen limitation, which tends to promote nuisance algae in freshwater systems. While neither nitrogen nor phosphorus is low enough currently to limit primary productivity, by establishing watershed criteria in terms of the response indicator chlorophyll-*a* in the two critical locations, Dundee Lake and Wanaque Reservoir, and requiring phosphorus reductions that will attain these criteria as demonstrated by the models, the water quality objectives for this study will be met.

While watershed-wide nitrogen reductions are not necessary to achieve water quality objectives in the non-tidal Passaic River system, they may be necessary to achieve water quality objectives in the NY/NJ Harbor. The model developed for the Non-Tidal Passaic River Basin Nutrient TMDL Study is calibrated for ammonia, nitrate, and organic nitrogen, and can therefore be used to translate a load allocation for the Passaic River at Dundee into wasteload and load allocations throughout the system. Upon completion of the New York/New Jersey Harbor Estuary TMDL, carbon and/or nitrogen reductions may be called for to achieve dissolved oxygen standards in the harbor. If so, the non-tidal Passaic River basin model can be used to allocate loads among sources in the non-tidal Passaic River basin.

135. Comment: The commenter asks what the maximum long-term average concentration of total nitrogen would be to keep summer averages of chlorophyll-*a* below 10µg/L or 20 µg/L. (9)

Response: It was determined in this TMDL study that phosphorus is causing excessive primary productivity in two locations in the Passaic River Basin, the Wanaque Reservoir and Dundee Lake. In these locations, the Department has established watershed criteria in the form of chlorophyll-*a* as well as the phosphorus reductions needed to attain these criteria. As discussed in the response to Comments 133-134, nitrogen reductions are not needed in order to attain the water quality objectives in the non-tidal Passaic River with respect to eutrophication. However, nitrogen reductions may be required in the future, in response to the NY/NJ Harbor TMDL or as determined necessary to ensure the drinking water use is protected.

General Comments:

136. Comment: The existence of a phosphorus problem in the Wanaque Reservoir has not been supported. No limitation based upon discharge to the Reservoir should be imposed until it is demonstrated that phosphorus is causing the impairments. (23)

Response: Water quality data clearly identifies violations of water quality criteria for phosphorus.

137. Comment: The Great Swamp Watershed Association and Ten Towns Great Swamp Watershed Management Committee (TTC) collaborated on the collection of water quality sampling for the Omni Environmental February 2007 Report (Appendix D, Page D-2 of the Omni Report). Specifically, sample collection at certain sites that was conducted by TTC are improperly attributed to GSWA at sites PRin, PB1, LB1, GB1, BB1 and PRout. (4)

Response: The Department has posted a revised Appendix D of the 2007 Omni Report in order to make it clear that the data used for the analysis were provided through collaboration between the Ten Towns Great Swamp Watershed Management Committee and the Great Swamp Watershed Association.

138. Comment: A State mandated program requires water purveyors to add polyphosphate to potable water for corrosion control. This practice increases total phosphorus in STP influent. (11)

Response: Currently there is no mandated State program for the addition of polyphosphate to drinking water. The commenter may be referring to the National Primary Drinking Water Regulations for Lead and Copper (40 C.F.R. 9, 141 and 142), which, since the early 1990's have required all public community water systems serving populations greater that 50,000 to do a corrosion optimization study and then after state approval implement the recommendations of the study. In many cases the study outcome was the addition of polyphosphate, sometimes with pH adjustment. However, other outcomes also included increasing existing pH levels with lime or soda ash, adding silicates, or no action at all. Additionally, for systems serving less that 50,000, if more than 10 % of sampling results exceeded established action levels during semiannual testing for lead and copper, those systems also were required to consider treatment to reduce corrosion with the distribution system.

For the systems that opted to use polyphosphates, the amount of polyphosphate dosed to the system would be that needed to achieve the goal of minimizing the levels of lead and copper in the water system. This amount can vary significantly depending on the quality of the raw water, but is not known to be a significant source of phosphorus in sewage influent.

139. Comment: The TMDL is contrary to the settlement agreements reached with various Passaic River Basin dischargers, including WTSA. The spirit of those agreements has been disregarded and sound science and economic responsibility has been ignored. (10)

Response: The Department believes that both the intent and specific requirements of the Phosphorus Settlement Agreements have been met. Per their individual Stipulation of Settlement, each of the permittees agreed to participate in the watershed planning process, including the TMDL development process. All dischargers, as well as other affected parties, were invited to participate in this process. As a component of this process, the Department developed *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, with the Passaic River TMDL Work Group to identify the technical approaches to address impairments as identified in the 303(d) list in the non-tidal Passaic River Basin. The Passaic Technical Approach was vetted at several workgroup meetings and consensus was reached at the October 31, 2001 Passaic River TMDL Workgroup on its content. It was agreed that a watershed modeling effort was needed in order to determine where within the Passaic River basin phosphorus was causing excessive primary productivity and what level of phosphorus reduction would be needed to address this response where it was determined to be occurring. Dischargers who were a party to the settlement agreed to participate in the cost of developing a workplan for the study and for carrying out the study itself as well as identifying and implementing low cost phosphorus reductions measures until the TMDL study was completed. The Department agreed to establish phosphorus effluent limits only as determined needed as a result of the TMDL. These steps have been accomplished. The resultant Passaic River basin TMDL is the outcome of the application of sound science to study the problem, with ample opportunities for review and input from affected parties. By establishing watershed criteria that in terms of the response variable chlorophyll-*a*, at levels that will support the designated uses, and providing for seasonal limits where appropriate, the Department has fine tuned the pollutant reductions to require only that expenditure needed to attain water quality standards. After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

140. Comment: Please consider issues of concern to Pompton Lakes Borough MUA as you move forward with the TMDL implementation process: The plant continues to operate within its current permit limits; our customer base is limited to the residents—11,000; a more stringent phosphorus limit will place an enormous burden on our customers; there is no room at the plant site to construct and operate additional treatment units. (5)

141. Comment: Please consider issues of concern to Wanaque Valley Regional Sewerage Authority as you move forward with the TMDL implementation process: The plant continues to

operate within its current permit limits; our customer base is limited to the residents—10,616; a more stringent phosphorus limit will place an enormous burden on our customers. (3)

142. Comment: TBSA supports and applauds NJDEP's efforts to develop a scientifically defensible solution to water quality issues in the Passaic River Basin. Significant amount of time, money and effort have been expended to determine the appropriate regulatory response to nutrient enrichment in the Passaic and TBSA is anxious to commence implementation of the TMDL and to continue to work in partnership with the NJDEP to achieve water quality improvements in the Passaic, provided identified issues are addressed re: data availability, alternative approaches and seasonal limits. (2)

Response to Comments 141 and 142: The Department has made every effort to ensure that the pollutant load reductions called for are needed to attain surface water quality standards. Further, by establishing watershed criteria in terms of the response variable chlorophyll-*a* at levels needed to support designated uses and providing for seasonal limits where appropriate, the Department has fine-tuned the pollutant reductions to require only that expenditure needed to attain water quality standards. After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will also provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

143. Comment: Commenter is happy to see progress in achieving a proposal with a scientific basis. (16)

144. Comment: The Department is commended for its efforts to resolve the issue of Phosphorus regulation in a scientifically defensible manner and for moving forward with the Phase 2 TMDL study. RVRSA is fully committed to making the investment necessary to discharge its obligation to protect the environment and reaffirms its desire to work cooperatively with the NJDEP to achieve improvements in water quality. (1)

145. Comment: Although it comes after years of attempting to implement phosphorus control without a study, the Department is commended for moving forward with the current study. (23)

146. Comment: Commenter thanks the Department for going the extra measure to complete the Phase 2 TMDL. Some areas can be criticized, but this is a good starting point and we should move forward. (17)

147. Comment: While there are some missing data and issues to address, we have enough here, grounded in science, that we can move forward. (14)

Response to Comments 142-147: The Department acknowedges the commenters' support for the comprehensive modeling of the Passaic River Basin which has produced a science-based solution that will address water quality impairments in the basin.

148. Comment: Phosphorus removed from effluent should be reused as fertilizer. (9)

Response: Residuals are generated by domestic and industrial wastewater treatment plants. Residuals are managed in variety of ways, including the development of marketable residuals products (also called biosolids) that are used to fertilize or condition the soil. Examples include pellets, compost, and alkaline materials. Beneficial use of residuals as a fertilizer or soil conditioner is regulated under the New Jersey Pollutant Discharge Elimination System regulation at *N.J.A.C.* 7:14A-20. Subchapter 20 of the NJPDES rules defines the standards for the use or disposal of residual. The Department encourages beneficial reuse of sludge. However, as described in these TMDLs, application of phosphorus fertilizer is intended to be limited as one of the management measures needed to achieve pollutant load reductions. Therefore, extensive use of phosphorus containing biosolids would be counterproductive in the basin.

149. Comment: Phosphorus may be coming from leaking sewer pipes; this source may be reducible. (9)

Response: While the potential that leaking sewers exist in the study area cannot be discounted, the model is adequately calibrated without considering this source. In general, sewerage treatment facilities are responsible for the proper collection, treatment, analysis, and discharge of wastewater received from separate sanitary or combined sewer systems. To assure compliance, the Department imposes significant penalties and/or requires remediation for unpermitted discharges to the waters of the State. Responsible entities must undertake an active monitoring and preventive maintenance program to identify problems, install new sewer lines, clean blocked lines, repair lines that are subject to leaks and infiltration, and conduct all maintenance activities to assure maximum system capacity and to prevent sanitary sewer leaks and overflows. Treatment facilities are required to report all overflows and flooding, whether from sanitary or combined sewage systems, so that repairs and preventive action can be taken to minimize the extent of environmental and human health impacts.

Phase 1 TMDL

150. Comment: The Proposed TMDL continues to ignore key criticisms made by Rutgers New Jersey EcoComplex TMDL Advisory Committee ("NJEC"). A review of the New Jersey EcoComplex interim reports, which were issued in conjunction with the 2005 TMDL, continues to raise serious questions with the newly proposed 2007 TMDL. An examination of the proposed 2007 TMDL reveals that the Department, without explanation, has elected to continue to ignore key questions and criticisms raised by NJEC in 2005. Two examples stand out:

1. In NJEC's Interim Report to the Department, dated November 13, 2003, NJEC recognized that the year 2002 (when a severe drought occurred), could have been an anomaly and questioned whether it should be included or rejected as an outlier. The NJEC later estimated that the 2002 rainfall did correspond to the lowest 10th percentile of precipitation over 100 years and thus represented an anomaly that would result in too stringent a condition. Also, the 9-year simulation (omitting 2002) was not provided as requested by NJEC.
2. In its July 30, 2002 Interim Report, NJEC identified one task of the Department as being the analysis of the relationship between phosphorous concentrations and indicators of primary productivity, as a way to better establish quantifiable endpoints. In doing so, NJEC recommended use of the LA-WATERS model in order to study management strategies and specifically alternative pumping scenarios for NJDWSC. (10)

Response: The comments made by the NJEC were assessed and modifications made, as appropriate, to the TMDL study. With regard to the specific issues identified, the Department believes inclusion of 2002 in the simulation is appropriate, as addressed more fully in the response to Comments 16 and 17. The appropriateness of alternative management measures to achieve the watershed criteria in Wanaque Reservoir is addressed more specifically in response to Comments 58-61.

151. Comment: Commenter includes by reference comments made on the proposed July 5, 2005 *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* contained in letters dated September 6, 2005 and November 21, 2005 as comments on the current TMDL proposal. The Department agreed not to adopt the Phase 1 TMDL under a Superior Court Order and should not use Phase 1 TMDL information until comments on that document are addressed and information requested through OPRA is provided. Issues include:

a) Evidence of a phosphorus impairment in the Passaic River basin has not been provided

b) The purpose of the Passaic phosphorus studies was to determine the level of phosphorus that causes impairment; attainment of 0.05mg/L numeric criterion was never envisioned. The Phase 1 TMDL eliminated the option to demonstrate that phosphorus was not causing an observed impairment.

c) The Phase 1 TMDL was not identified by the Department as a tool intended to address phosphorus impairment in the Passaic River; as provided for in the Phosphorus Settlement Agreement, the workplan to do so was to be provided for review by the affected parties.

d) It is noted that the Department used the LA-WATERS model for the Reservoir, the NJDEP mass balance model from 1987 and water characteristic studies done by NJDWSC. In response to questions at the DEP's presentation on June 23, 2005, representatives of Najarian Associates indicated that the LA-WATERS model incorrectly predicted the effects of adding Passaic River water to the Reservoir. This being the case, why continue to use the model? The 1987 model did not include a study of phosphorus and has been considered unsuitable for the purpose until the present time. The NJDEP study that resulted from the 1987 model specifically indicates that a comprehensive model of the river is needed. Why is this model now suitable?

e) The TMDL requires an 80% reduction in nonpoint sources. This does not appear to be achievable. The Department sent a misleading letter to municipalities telling them their only obligation was to adopt a fertilizer ordinance.

f) The diversion of water into the Wanaque Reservoir by North Jersey District Water Supply Commission is responsible for any impairment that exists there. They should be the entity responsible for load reductions and receive a NJPDES permit for the diversion, in accordance with the recent Supreme Court ruling.

g) Throughout the Phase 1 process, the Department has indicated that the Phase 2 TMDL could result in less stringent limits, but was unable to explain how at the August 4, 2005 public hearing. The Department then stated that, when the study of the lower section of the river is completed, a 0.1 mg/l limit will be established. It appears that the Department again intends to impose more stringent limits without any scientific study or basis.

h) The Department has not responded to the OPRA requests filed in order to be able to review data and documents related to the study; the comment period should continue to be extended for at least 30 days from the time that the information is provided for review.

i) NJ Ecocomplex comments on the studies that provided the basis for the Phase 1 TMDL were not addressed. There was no final NJEC report provided on the Phase 1 TMDL.

j) As it appears the work for the Phase 2 TMDL is nearing completion, the Phase 1 TMDL should not be adopted. The Phase 2 TMDL results should be presented to the public. (23)

Response: As stated in the TMDL, the July 5, 2005 proposals entitled *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* were withdrawn and pertinent information from those proposals incorporated into the current TMDLs. Many of the comments made on the Phase 1 TMDL had as their resolution proceeding with the Phase 2 TMDL in lieu of the Phase 1 TMDL. Proposal of the current TMDLs along with the withdrawal of the Phase 1 TMDL renders moot most of the issues identified in the previous comment letters. Responses to specific points in the cited letters are as follows:

a) The purpose of the Phase 1 TMDL was to address phosphorus impairment in the Wanaque Reservoir, not the entire Passaic River basin. The Wanaque Reservoir was identified as an expected critical location early in the larger Passaic River basin TMDL planning process and, in the course of TMDL development, it was determined that water quality in the Wanaque Reservoir, in addition to several locations in the river system, exceeded the Surface Water Quality Standards in terms of the numeric criteria and data was provided in the Phase 1 TMDL support documents. This constitutes impairment, absent establishment of a watershed or site specific criterion. As a result, a TMDL was required to be and was developed for the reservoir.

b) The Passaic phosphorus studies were to determine what action was needed to address phosphorus impairment in the Passaic River, which means to attain the SWQS. In accordance with the SWQS, the Phase 1 and Pompton Lake TMDLs used the numeric criterion as a target, absent documentation that a watershed specific criterion was appropriate. The Phase 1 TMDL necessarily required load reductions from discharges to the Passaic River system, but did not attempt to reach conclusions about attainment of the in-stream numeric criterion of 0.1 mg/L. The option to conduct a study under the *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* is provided in the SWQS only with respect to the in-stream numeric criterion, not for the lake/reservoir numeric criterion. Therefore, the Phase 1 TMDL neither created nor eliminated an opportunity with respect to the phosphorus protocol. In any case, in accordance with the findings of the current proposal, watershed specific criteria have been developed in place of the numeric criterion for the Wanaque Reservoir and Dundee Lake critical locations and the watershed criteria have been used as the endpoints in these locations.

c) The intention to use the LA-WATERS model to determine the loading capacity of the Wanaque Reservoir had been established in the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, which was shared through extensive public participation that included the regulated parties. The Phase 1 TMDL accomplished that objective of the Technical Approach and did not address the reductions needed to address phosphorus impairment in the river itself. As was always intended, the Phase 2 TMDL is the tool that addresses the listing of the river as impaired for phosphorus.

d) This comment is moot in that the model used to simulate river loadings in the Phase 2 TMDL was developed as an outcome of the workplan designed to address the in-stream phosphorus impairments and the Phase 1 TMDL has been withdrawn. Nevertheless, as regards the Phase 1 TMDL, representatives of Najarian Associates never stated that the Reservoir TMDL model incorrectly predicted the effects of adding Passaic River water to the Reservoir. NJDEP's 1987 model addressed all relevant water quality constituents, including phosphorus. However, the NJDEP study was not part of the Najarian 2005 TMDL study. An independently developed mass-balance model for the watershed was used to simulated relevant river conditions for the Phase 1 TMDL.

e) The TMDLs within the spatial extent call for a range of nonpoint source and stormwater point source reductions that range from 0 to 85. The Department identifies the suite of measures that are expected to achieve those reductions. Some measures are non-regulatory while other are regulatory in nature, such as the phosphorus ordinance. Both the Phase 1 and current TMDL clearly state that the measures required under the Municipal Stormwater Regulation permit are the primary means expected to result in the necessary phosphorus reductions from urban areas. The letter sent to municipalities for both the Phase 1 and the Phase 2 TMDL was the required notification that an additional requirement would be added to their Municipal Stormwater Permit, upon adoption of the TMDL. Through adaptive management, in response to follow-up monitoring, it may be necessary to institute other nonpoint source or stormwater point source control measures, but this is not currently proposed. The commenter's suggestion that the Department misled municipalities as to their obligations as a result of the TMDL is incorrect.

f) As stated in the response to Comments 58-61, the load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. With regard to NJDWSC responsibility to remove phosphorus prior to diverting it to the Wanaque in order to achieve water quality requirements, the Department does not interpret the Supreme Court decision in Miccosukee as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

g) The basis of the commenter's assertion is unclear. At the time the Phase 1 TMDL was proposed, the outcome of the Phase 2 work was not known and could not be predicted with accuracy. This necessarily would mean that the WLAs and associated effluent limits resulting from the Phase 2 work could be more or less stringent than identified in the Phase 1 TMDL. Again, the Phase 1 TMDL has been withdrawn and is superseded by the currently proposed TMDL.

h) The Department has fully responded to the OPRA request. Because the Phase 1 TMDL has been withdrawn, extension of the comment period for that TMDL is moot. The currently proposed TMDL was presented prior to the public hearing and a 30 day comment period was provided. The comment period was further extended by 30 days to provide additional time for commenters to assess the Passaic River basin model.

i) The NJEC comments on the Phase 1 TMDL that remain relevant with respect to the Phase 2 TMDL have been addressed within the Phase 2 TMDL document.

j) Again, the Phase 1 TMDL has been withdrawn and the currently proposed TMDL supersedes it.