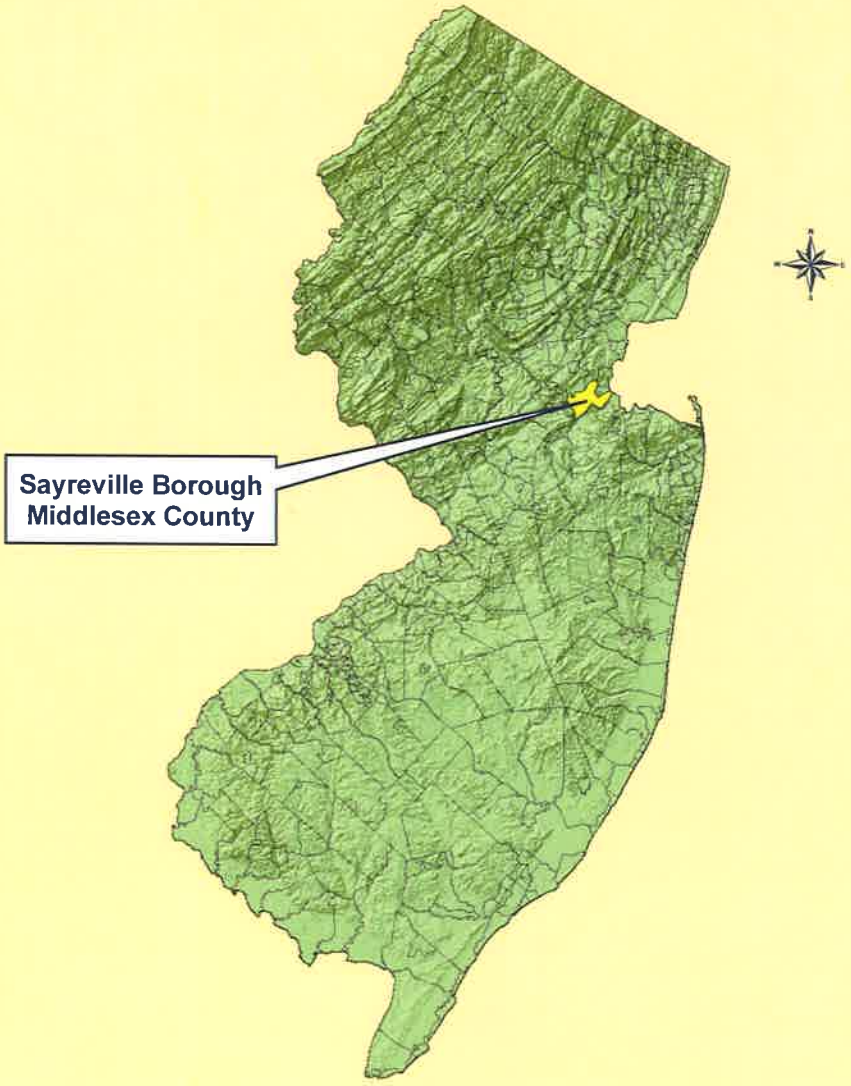
Municipal Stormwater Management Plan
Master Plan Element

for the:

Borough of Sayreville

Middlesex County, New Jersey



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Introduction

This Municipal Stormwater Management Plan (MSWMP or the "Plan") documents the strategy for the Borough of Sayreville ("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 all of 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 development, generally defined as projects that disturb one or more acre of land. 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 base-flow in receiving waterbodies.

The plan addresses long-term operation and maintenance measures for existing and future stormwater facilities. The final component of this plan is a mitigation strategy for when a variance or exemption of the design and performance standards is sought. As part of the mitigation section of the stormwater plan, specific stormwater management measures are identified to lessen the impact of existing development.

Goals

The goals of this MSWMP are to:

- reduce flood damage, including damage to life and property;
- minimize, to the extent practical, any increase in stormwater runoff from any new development;
- reduce soil erosion from any development or construction project;

- assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
- maintain groundwater recharge;
- prevent, to the greatest extent feasible, an increase in nonpoint pollution;
- maintain the integrity of stream channels for their biological functions, as well as for drainage;
- 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;
- protect public safety through the proper design and operation of stormwater basins; and
- promote public education and involvement, via the Stormwater Pollution Prevention Plan as implemented by the Borough (last revised as of November 2018).

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.

Consideration should be given to a reasonable, efficient funding mechanism for the implementation of stormwater management by all levels of government. Developers will be required to absorb some of the associated costs. State law should be established to permit use of mechanisms such as a stormwater utility.

Stormwater Discussion

Land development can dramatically alter the hydrologic cycle (*See Figure 1: Groundwater Recharge in the Hydrologic Cycle*) 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. 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. 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. 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.

Background

Borough Demographics

The Borough encompasses an 18.75 square mile area in Middlesex County, New Jersey; see *Figure 2: Sayreville Vicinity Map*. In recent years, the Borough of Sayreville's population has increased moderately, increasing from 40,377 persons in 2000, to 42,704 persons in 2010. Thus, the population increased by six percent (6%) from 2000 to 2010. The population density has consequently increased from 2,539 persons per square mile of land area in 2000 to 2,696 persons per square mile of land area in 2010. This population density has resulted in considerable development and affects waterway systems and their function. *Figure 3: Existing Land Use* depicts the Borough's current land use and the existing land area that has been developed.

Figure 4: Zoning Districts displays the existing zoning districts and dictates the extent at which the existing undeveloped land can be developed. In general, Borough water features abut land zoned for marine/waterfront development. The zoning districts adjacent to water features range from, but are not limited marine waterfront, waterfront development, industrial, prime and sparse areas of residential and commercial development.

Borough Water Features

There are twelve (12) named streams within the Borough. The streams are as follows:

- Deep Run
- Tennent Brook
- Raritan River
- South River
- Washington Canal
- Selovers Brook
- Duck Creek
- Pond Creek
- Burt Creek
- Crossway Creek
- Cheesequake Creek
- Melvins Creek

There are two (2) named waterbodies;

- Raritan Bay
- Majors Pond

Raritan River forms the Borough's northern border, while the eastern border is formed by South River. Cheesequake and Melvins Creeks form a portion of the southwest border. There are seven (7) municipalities bordering the Borough:

- Township of Old Bridge
- Township of East Brunswick
- Borough of South River
- Township of Edison
- Township of Woodbridge
- City of Perth Amboy
- City of South Amboy

The Borough is situated within two (2) watershed management areas (WMA): Lower Raritan, South River and Lawrence WMA 9 to the west, and Monmouth WMA 12 to the east. See *Figure 9: Hydrologic Unit Code 14* for the WMA boundaries.

See *Figure 5: Borough Waterways* for relative location of waterways within the Borough. Category One waterways are situated outside of Borough borders within Old Bridge Township, upstream of Cheesequake Creek. *Figure 6: Category One Waterways* provides a general location of Category One waterways in relationship to the Borough's boundary and water features. *Figure 7: Boundary on USGS Quadrangle* depicts the Borough boundary on the USGS quadrangle maps and provides a spatial representation of the Borough in relation to the surrounding areas.

Future Developable Land

As presented in *Figure 8: Developable and Un-developable Land*, there are 3.48 square miles of future developable land within the Borough. Future developable land is calculated from information provided by the New Jersey Department of Environmental Protection (NJDEP) 2012 Land Use Geographic Information Systems (GIS) data. Since the area of future developable land is greater than one square mile, the Borough is required to reevaluate the Master Plan and provide future non-point source pollution loads assuming full build-out analysis, in accordance with N.J.A.C.7:8-4.3(a). The Borough will provide these requirements and adopt an amended MSWMP to reflect the inclusion of the same.

Existing Water Quality Issues

Ambient Biomonitoring Network (AMNET) Study

Changes in the landscape caused by development have increased stormwater runoff volumes and pollutant loads to the waterways of the municipality. It is necessary to monitor the health of waterways and determine methods to mitigate pollution where encountered. Studies, programs and networks have been developed to document the health of waterways, such as the Ambient Biomonitoring Network (AMNET) established by the NJDEP. There are over 760 AMNET

sites throughout the state of New Jersey. The AMNET stations employs sampling and taxonomic analysis of in-stream macroinvertebrates communities to assess the ecological conditions at each station. An integrated index of "biometrics", based on community composition and pollution tolerance levels of individual taxa, is used to assign assessment ratings. Starting with the mid 2004 data, three indices are used for assessment; High Gradient Macroinvertebrate Index (HGMI), Coastal Plain Macroinvertebrate Index (CPMI), and the Pinelands Macroinvertebrate Index (PMI); replacing the New Jersey Impairment Score (NJIS). These indices account for the State's geophysically different ecoregions and allows for more resolute and accurate results at four assessment rating levels; "excellent", "good", "fair", and "poor".

There is one (1) AMNET site located within the analysis area. The level of impairment for this site is poor. See *Figure 10a: AMNET Water Quality Assessment Locations* for AMNET assessment locations.

AMNET station, AN0454, is located upstream of the Borough's border on Deep Run. This site has been assigned a Coastal Plain Macroinvertebrate Index (CPMI) rating "poor" and is located at Deep Run and Route 516.

Several AMNET site locations were tested for benthic macroinvertebrates abnormalities. Samples taken from specified AMNET assessment stations were examined for physical abnormalities via visual inspection. Morphological abnormalities are noted in the AMNET study because they may signify the possibility of stressful conditions or contaminants in the existing ecological environment, which, in turn, has affected their development. A site is identified as exhibiting significant or chronic macroinvertebrate abnormalities when greater than five percent (5%) of the taxa observed are deformed.

Sites identified with chronic macroinvertebrate abnormalities indicate that deformities were encountered during the most recent and previous site assessments. Significant macroinvertebrate abnormalities indicate that taxa deformities were only encountered during the most recent site inspection. Significant macroinvertebrate abnormalities were not detected in the examined AMNET stations.

See *Appendix B* for the above referenced AMNET site data obtained from the *Ambient Biomonitoring Network (AMNET)* report for *Watershed Management Areas 7, 8, 9 and 10: Raritan Region, 2009 Benthic Macroinvertebrates Data* issued by the NJDEP December 2012. See *Figure 10a: AMNET Water Quality Assessment Locations* for AMNET assessment locations.

New Jersey Integrated Water Quality Monitoring and Assessment Report

In addition to the AMNET data, the NJDEP and other regulatory agencies collect water quality chemical data on streams within the state. 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.

Waterways are categorized into Sublists, ranging from Sublist 1, which indicates a healthy functioning waterway, to Sublist 5, which indicates an unhealthy waterway not meeting its intended use. Sublist 1 waterways attain water quality standards and none of the designated uses are threatened. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants for which one or more Total Maximum Daily Loads (TMDLs) are needed. Waterways are placed on Sublist 3 because there is insufficient data or the guidelines/criteria to conduct a use attainment assessment is unavailable; therefore, it can not be determined if a designated use is

threatened. Sublist 4 waterways are those impaired or threatened for one or more uses, but do not require the development of a TMDL, or a TMDL has been developed and water quality is being attained.

Sublist 2 of the Integrated List was utilized in past studies to designate if waterbody uses are attained, no uses were threatened and there was insufficient or no data to determine if the remaining uses were threatened. Waterbody assessment has been revised and is now done according to individual use status and not total waterbody use status. The elimination of Sublist 2 occurred when the Integrated List was categorized according to waterbody and pollutant (parameter).

A TMDL is the amount of a pollutant that can be accepted by a waterbody without exceeding water quality standards or interfering with the ability to use a waterbody for one or more of its designated uses. The allowable load is allocated to the various sources of the pollutant, such as stormwater and wastewater discharges, which require a NJPDES permit to discharge, and nonpoint sources, which includes stormwater runoff from agricultural 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 will be developed to identify how the various sources will be reduced to the designated allocations. Implementation strategies can include improved stormwater treatment plants, adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other BMPs, structural and non-structural.

The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)), issued May 2014, examined:

- South River
- Deep Run
- Tennent Brook

The Integrated List shows South River below Duhernal Lake attaining water quality for temperature, dissolved oxygen, pH level and unionized ammonia. The report shows insufficient data pertaining to chloride, sulfate, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

The Integrated List shows Deep Run below Route 9 attaining water quality standards for temperature, total dissolved solids, total suspended solids and unionized ammonia. The report shows insufficient data pertaining to chloride, sulfate, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

As noted in the AMNET study, Deep Run at Route 516 and Tennent Brook at Bordentown Avenue are on Sublist 5 for not attaining water quality standards for benthic macroinvertebrates.

See *Figure 10b: Integrated List Water Quality Assessment Locations* for the location of monitoring sites examined in the Integrated Water Quality Monitoring and Assessment Report. Also, see *Appendix C* for the Integrated Water Quality Monitoring and Assess Report data analyzed.

Existing Water Quantity Issues

In addition to water quality problems, the Borough has exhibited severe water quantity problems including flooding, stream bank erosion, and diminished base-flow in its streams. Many of the culverts associated with road crossings in the Borough are undersized. During storm events, these undersized culverts and other stormwater drainage features do not have adequate capacity, thereby causing a backwater effect and flooding upstream. See *Figure 15: FEMA Flood Prone Map* for localized areas of flooding.

The Borough's stormwater drainage features have been designed for much different hydrologic conditions (i.e., less impervious area) than presently exist in the Borough and upstream of the Borough. As the impervious coverage increased, the peak flows and runoff volumes of the

stream also increased. The increased amount of water resulted in stream bank erosion, which resulted in unstable areas at roadway/bridge crossings, degraded stream habitats and caused chronic flooding. The high impervious coverage of the Borough has significantly decreased groundwater recharge; hence, decreasing base flows in the streams during dry weather periods. Lower base flows can have a negative impact on stream habitat during the summer months. A map of the groundwater recharge areas is provided; see *Figure 11: Groundwater Recharge Areas.*

Hydrologic Unit Code 14 (HUC14)

Watersheds are defined by the United States Geological Survey (USGS). The most basic defined watershed area or hydrologic unit is a unique defined feature having a minimum size of 3,000 acres. The base hydrologic unit is given a unique hydrologic unit code (HUC) fourteen (14) digits long; hence, the terminology Hydrologic Unit Code 14 (HUC14). The hydrologic unit network is hierarchical. HUCs are combined to identify larger watershed areas such as HUC11, HUC8, HUC6, HUC4, watershed management areas (WMAs), watershed regions and so on.

There are five (5) HUC14 areas within the Borough. The Borough's HUC14s fall within two (2) watershed management areas (WMAs). The western portion of the Borough falls within the Raritan Watershed Region, Lower Raritan, South River & Lawrence watershed management area, WMA 9. The eastern portion of the Borough is within the Atlantic Watershed Region, Monmouth watershed management area, WMA 12. See *Figure 9: Hydrologic Unit Codes 14 (HUC14)* for the Borough's HUC14 areas and WMA boundaries.

Borough Features

Wellhead protection areas are located throughout the Borough, focused in the Borough's southern and eastern sections. There are three (3) tiers associated with each wellhead protection

area. Tiers 1 through 3, delineate the extent of ground water captured by a pump at a specified rate calculated over a 2, 5 and 12-year periods, respectively. Wellhead protection areas are delineated by the NJDEP Source Water Protection Program (SWAP) and acted upon in response to the Safe Drinking Water Act Amendments of 1986 and 1996. Please see *Figure 12: Wellhead Protection Areas* for wellhead protection areas located throughout the Borough.

A map of the wetlands and other Borough constrained land is displayed in *Figure 13: Wetlands and Water Land Uses Constrained Land*. A soil map of the Borough is provided and references the latest Soil Survey Geographical (SSURGO) Database; see *Figure 14: Soil Survey Geographic (SSURGO) Database*.

Design and Performance Standards

The Borough will adopt the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5, via the Stormwater Control Ordinance, to minimize the adverse impact of stormwater runoff on water quality, water quantity and loss of groundwater recharge in receiving waterbodies for residential and commercial site development. Generally, projects meeting the definition of a major development are required to meet the regulations stated under N.J.A.C. 7:8-5. Said regulations address erosion control, groundwater recharge, runoff quantity standards, stormwater runoff quality standards, standards for calculating stormwater runoff and groundwater recharge, structural stormwater management standards, and maintenance requirements, as stated above. The major development must meet the established design and performance standards set forth in the Soil Erosion and Sediment Control Act.

Low Impact Development (LID) Techniques

The N.J.A.C. 7:8: Stormwater Management regulations promote stormwater management measures for major developments that minimize the adverse impact of stormwater runoff on water quantity, water quality and the loss of groundwater recharge to receiving waterbodies. In N.J.A.C. 7:8-5.3 and Chapter 2 of the *New Jersey Stormwater Best Management Practices (BMP) Manual 2004 (last revised September 2017),* stormwater management design techniques are focused on non-structural stormwater management strategies. Non-structural Stormwater Management Strategies, Low Impact Development (LIDs) techniques, are enumerated as follows:

1. "Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss; " (N.J.A.C. 7:8-5.3(b)1.)

   i.e., *preserve forested areas, riparian corridors and high groundwater or aquifer recharge capabilities and any other natural area with significant hydrologic function, specific legal and/or procedural measures to ensure areas remain preserved in the future and, reestablish wooded and forested areas that were disturbed*

2. "Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;" (N.J.A.C. 7:8-5.3(b)2.)

   i.e., *use vegetative filters and buffers, promote sheet flow over vegetated areas, use level and/or curb cuts at appropriate locations, utilize the minimum pavement widths, vegetate/landscape islands, utilize pervious materials at appropriate locations and locate parking underground or beneath buildings*

3. "Maximize the protection of natural drainage features and vegetation;" (N.J.A.C. 7:8-5.3(b)3.)

   i.e., *preserve forested areas, riparian corridors and high groundwater or aquifer recharge capabilities and any other natural area with significant hydrologic function and take specific legal and/or procedural measures to ensure areas remain preserved in the future*

4. "Minimize the decrease in the pre-construction "time of concentration;" (N.J.A.C. 7:8-5.3(b)4.)

   i.e., *increase sheet flow, disconnect impervious areas, use vegetative stormwater conveyance systems and dense vegetation at appropriate locations, utilize natural features and reduce slopes*

5. "Minimize land disturbance including clearing and grading;" (N.J.A.C. 7:8-5.3(b)5.)

   i.e., *preserve forested areas, riparian corridors and high groundwater or aquifer recharge capabilities and any other natural area with significant hydrologic function and reduce lawn areas*

6. "Minimize soil compaction;" (N.J.A.C. 7:8-5.3(b)6.)

   i.e., *use light weight equipment during construction and minimize disturbed land areas*

7. "Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;" (N.J.A.C. 7:8-5.3(b)7.)

   i.e., *use of native plants will result in lower fertilizer and water needs, will promote infiltration characteristics similar to those of natural area and can attract native wildlife and provide better habitat*

8. "Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas;" (N.J.A.C. 7:8-5.3(b)8.)

   i.e., *use vegetated channels and swales at appropriate locations to increase surface roughness and decrease flow velocities and ensure vegetative conveyance systems are tolerant to higher frequency storms*

9. "Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff." (N.J.A.C. 7:8-5.3(b)9.)

   i.e., *provide trash receptacles, litter fences, require regular sweepings, provide "pet waste stations," provide storm drain inlets and trash racks, utilize berms and secondary containment systems (This section is more specifically geared towards commercial and industrial areas or areas with high residential population densities.)*

The applicant submitting for review must address the nonstructural stormwater management strategies utilized in the proposed design. If these strategies are not incorporated into the design, the applicant must state reasons for contention. All nonstructural stormwater management strategies must be incorporated to the "maximum extent practical." An applicant should demonstrate the design has exhausted all measures to implement the nonstructural strategies prior to the use of the

structural methods.

> *"...nonstructural LID-BMPs are to be given preference over structural BMPs. Where it is not possible to fully comply with the Stormwater Management Rules solely with nonstructural LID-BMPs, they should then be used in conjunction with LID and standard structural BMPs to meet the Rules' requirements." (NJ Stormwater BMP Manual 2004, page 2-3)*

NJAC 7:8-5.3(a) states:

> *"To the maximum extent practical, the standards in NJAC 7:8-5.4 and 5.5 shall be met by incorporating nonstructural stormwater management strategies at NJAC 7:8-5.3 into the design. The persons submitting an application for review shall identify the nonstructural strategies incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management strategies identified in (b) below [NJAC 7:8-5.3(b)] into the design of a particular project, the applicant shall identify the strategy and provide basis for the contention."*

See Appendix A of the *NJ Stormwater BMP Manual 2004* for Low Impact Development Checklists provided by the NJDEP.

Stormwater Management Regulations Overview

Groundwater Recharge Requirements

Major developments must meet one of two standards for groundwater recharge, per N.J.A.C. 7:8-5.4(a)2.:

(1) maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site, or

(2) infiltrate the increase in the stormwater runoff volume from pre-construction to post-construction for the two-year storm.

Stormwater Quality Requirements

For water quality (N.J.A.C. 7:8-5.5), stormwater management measures shall be designed to reduce the post-construction load of *total suspended solids (TSS)* in the stormwater runoff generated by the water quality design storm by *eighty-percent (80%)* of the anticipated load from the major development.

Stormwater Quantity Requirements

To control stormwater runoff quantity impacts (N.J.A.C. 7:8-5.4 3.), a major development must meet one of three design standards:

(1) demonstrate at no point in time that the post-construction runoff hydrograph exceeds the pre-construction runoff hydrograph,

(2) demonstrate 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 event and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site, or

(3) demonstrate the post-construction peak runoff rates for the 2, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction runoff rates.

Maintenance, Safety and Ordinances

The design and performance standards include the language for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 Maintenance Requirements, and language for safety standards consistent with N.J.A.C. 7:8-6 Safety Standards for Stormwater Management Basins. These sections address long-term operation and maintenance measures for existing and future stormwater facilities.

The Stormwater Control Ordinance must be submitted to the county for review and approval within 24 months of the effective date of the Stormwater Management Rules, April 2006 (last amended 2016).

The following ordinances must be adopted by the Borough and meet the minimum requirements set forth in the Tier A Municipal Stormwater General Permit (NJ0141852). If these ordinances already exist then they must be reviewed and updated where necessary.
Those ordinances are as follows, but are not limited to:

1. *Pet Waste Ordinance* – Chapter 9-8.8 of the Sayreville Code of Ordinances requires owners and keepers to immediately and properly dispose of their pet's solid waste. Information provided by NJDEP to be distributed with pet licenses regarding said ordinance;
2. *Litter Ordinance* – Chapter 13-4 of the Sayreville Code of Ordinances regulates litter disposal in accordance with NJDEP model ordinance for litter control;
3. *Improper Disposal of Waste Ordinance* –Chapter 13-4 of the Sayreville Code of Ordinances will be updated to prohibit spilling, dumping or disposing of any materials other than stormwater into the municipal separate storm sewer system;
4. *Wildlife Feeding Ordinance* – will prohibit feeding of non-confined wildlife in any public park or property owned/operated by the municipality;
5. *Illicit Connection Ordinance* – will prohibit illicit connections to the municipal separate storm sewer system.

During construction, Borough inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed. Operation and Maintenance Manuals will be required for BMPs to ensure long-term maintenance strategies.

Plan Consistency

Regional Stormwater Management Plan (RSWMP)

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 plan(s) (RSWMPs). If at any time a RSWMP is adopted, the Borough will revise this MSWMP to be consistent with the RSWMP.

Total Maximum Daily Loads (TMDL)

At this time, the Borough has no TMDLs within its borders. The United States Environmental Protection Agency (EPA) has recommended establishment of TMDLs for two (2) waterways within the vicinity of the Borough. Accordingly, this MSWMP will be updated to be consistent if TMDLs are established. See *Appendix D, Total Maximum Daily Loads*, for TMDL reports.

Residential Site Improvement Standards (RSIS)

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

Freehold Soil Conservation District

The Borough's Stormwater Control Ordinance will require all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards. During construction, the Borough of Sayreville's Engineering Consultants in conjunction with Freehold Soil Conservation District (FSCD) inspectors will observe on-site soil erosion and sediment control

measures. The Borough has the power to enforce the Soil Erosion Control Standards subject to FSCD review.

Nonstructural Stormwater Management Strategies

The Borough has reviewed and evaluated the Master Plan including land use plan elements and development regulations to address compliance with nonstructural stormwater management strategies. The Borough has provided a list of the sections in the Land Use and Zoning Ordinances that are to be modified to incorporate said strategies.

Article V of the Borough Code, entitled *Development Regulations and Standards* was reviewed with regard to incorporating nonstructural stormwater management strategies. Several areas are recommended for review and revision to Article V in order to incorporate nonstructural stormwater management strategies.

Article V Section 26-96.1.g. General Design Standards: *Guidelines* It is recommended that a new section be incorporated into the existing Article stating all development shall implement to the maximum extent practical the nonstructural stormwater management strategies as outlined in NJAC 7:8-5.3(b) and Section 4.E. of the Stormwater Control Ordinance.

Article V Section 26-96.4: Supplement Design Standards in PO District requires front yard landscaping and a landscaped strip to be provided along side and rear property lines. It is recommended this section be revised to require the use of native vegetation provided in accordance with the New Jersey Best Management Practices Manual, dated February 2004, latest revision.

Article V Section 26-96.5: Public or Common Private Open Space Design requires the incorporation of shrubbery. It is recommended this section be revised to require the use of native vegetation within said areas. This section also promotes designs that will invite and attract the public. It is also recommended this portion be revised to promote the use of nonstructural stormwater management strategies within these open space areas.

Article V 26-96.6.a. Buffer Design provides for buffer to consist of fences, walls or landscaping to minimize adverse impacts or nuisance on the site. It is recommended this section be revised to promote the use of native vegetation for buffer areas and permit the use of walls and fences in conjunction with native vegetation only if the use of landscape buffering alone is exhausted and no longer deemed a practical application as determined by the Board Engineer.

Article V 26-96.7.b. Landscape Design requires that natural features such as trees, hilltops and views, natural terrain, open waters, natural drainage ridge lines and natural drainage channels shall be preserved. It is recommended that the word trees be expanded to forested areas.

Article V 26-96.7.d. Landscape Design states landscaping should provide a variety and mixture of plantings. It is recommended this section be revised to require the use of native vegetation material.

Article V 26-97.1.t. Street Design Standards: *Curbing* addresses the Borough curb standards. It is recommended this section to be revised to permit the use of flush curb to promote disconnected impervious stormwater runoff.

Article V 26-98.1.j. Off-Street Circulation, Parking and Loading provides all parking and loading areas abutting mixed use/residential areas shall be landscaped about their periphery with shrubs, trees and/or ground cover. It is recommended this section be revised to incorporate the use of native vegetation.

Article V 26-98.1.b.5. Off-Street Parking: *Curbing* requires curbing around the perimeter of parking lots and all loading areas. It is recommended this section be revised to state that flush curbing shall be permitted along the perimeter of parking lots and loading areas to promote the use of disconnected impervious and open channel swales to convey stormwater runoff.

Article V 26-98.1.c.1. Off-Street Parking: *Other Design Criteria* requires that landscaping in parking and loading areas be shown on the landscaping plan and should be sufficiently detailed to indicate species, size and spacing. It is recommended this section be revised to indicate the required use of native landscaping materials.

Article V 26-98.1.c.3. Off-Street Parking: *Other Design Criteria* requires all parking areas to be effectively screened on any side which abuts or faces any premises situated in any residential zone or existing residential use by buffering screen. It is recommended this section be revised to promote the use of native vegetation for buffer areas and permit the use of walls and fences in conjunction with native vegetation only if the use of landscape

buffering alone is exhausted and no longer deemed a practical application as determined by the Board Engineer.

Article V 26-99.3 Storm Drainage Facilities It is recommended that a section be inserted before item 26-99.3.a. stating that all developments meeting definition of a major development in accordance with the Section 2: Definitions of the Stormwater Control Ordinance shall meet the requirements set forth in said ordinance. It recommended a statement be inserted that *all* proposed development within the Borough should address all nonstructural stormwater management strategies as outlined in N.J.A.C. 7:8-5.3(b) and Section 4.E. of the Stormwater Control Ordinance to the maximum extent practical. It is recommended that a statement be inserted requiring the applicant to provide to the Board Engineer a statement identifying the nonstructural stormwater management strategies implemented and provide a basis for contention if not implemented to the maximum extent practical.

Article V 26-99.3 Stormwater Drainage Facilities It is recommended a section be inserted after the item as recommend in 9 above and before item 26-99.3.a. of this section stating that all development shall be designed in accordance with the New Jersey Best Management Practices (BMP) Manual dated February 2004, latest revision.

Article V 26-99.3.b. Stormwater Drainage Facilities requires that all streets shall be provided with catch basins and pipes where the same may be necessary for proper surface drainage. It is recommended this section be revised to indicate that flush curb, open channel swales and vegetated filters shall be implemented where applicable and deemed appropriate by the Board Engineer.

Article V 26-99.3.c.2.(l) Stormwater Drainage Facilities requires that concrete headwalls and precast flared end sections shall include precast, cast in place or grouted rip-rap energy dissipaters at the discharge point. It is recommended to revise this section to require that conduit outlet protection or energy dissipaters be provided in accordance with the most current Standards for New Jersey Soil Erosion and Sediment Control.

Article V Section 26-99.3.c.2.(m) Stormwater Drainage Facilities requires that all development be graded and swaled to secure proper drainage away from all buildings and to prevent the collection of stormwater in pools. It is recommended that this section be expanded to include the preservation of natural features.

Article V Section 26-99.3.c.2.(o) Stormwater Drainage Facilities addresses the dedication of stormwater management facilities, detention/retention ponds, in a drainage right-of-way easement. It is recommended this section be revised to

include all structural BMPs be dedicated in a drainage right-of-way easement dedicated to the municipality.

Article V Section 26-99.3.c.2.(q) Stormwater Drainage Facilities: *Vegetation* requires all drainage ditches, swales, channels, diversion dikes and berms shall be stabilized with vegetation. It is recommended this section be revised to incorporate the use of native vegetation material.

The Borough would like to advise that although the Borough enforces a maximum allowable impervious coverage requirement for each respective zone, the applicant and/or developer satisfying the percent impervious requirement is **not** relieved of the responsibility to comply with the nonstructural stormwater management strategies and associated stormwater ordinance.

Review of the implementation of nonstructural stormwater management strategies shall be up to the discretion of the Planning Board or Zoning Board of Adjustment based upon the advice of the Board Engineer to determine if nonstructural stormwater management strategies have been implemented to the maximum extent practical. If the Board deems the proposed development as not implementing the nonstructural stormwater management strategies to the maximum extent practical, the Board shall request additional measures be taken to further incorporate nonstructural stormwater management strategies to the maximum extent practical.

Land Use Build-Out Analysis

A land use build-out analysis is a planning tool to help the municipality evaluate anticipated pollutant loads resulting from future development, assuming full build-out potential and zoning requirements as of May 2012. Build-out pollutant load computations quantify the projection of pollutant loads from maximum build-out of developable areas and will provide insight on how it will environmentally impact the Borough, its watersheds and downstream water quality conditions. A build-out analysis is not only useful for communities with undeveloped land, but for areas with

significant redevelopment potential, as many urban and older suburban properties have the potential to be redeveloped in the future and are not currently developed to the full extent allowed under current zoning requirements.

The MSWMP is required to include a land use build-out analysis with information relative to the Borough and HUC14 boundaries. For every individual HUC14 drainage area in the Borough the following must be determined: (1) full development impervious coverage, (2) total developable area, either developed or undeveloped, and (3) anticipated pollutant loading based on full development.

The Borough is divided into five (5) HUC14 areas, as previously determined; see *Figure 9: Hydrologic Unit Code 14 (HUC-14)* for a visual representation of the HUC14 boundary areas relative to Borough boundary. The five (5) HUC14 drainage areas have been examined and a land use build-out analysis assuming full development meeting existing zoning criteria has been conducted for each HUC14, respectively.

The land use build-out analysis consists of two phases. The first phase visually depicts changes on a map by manipulating spatial data and associated attribute tables, efficiently performed utilizing current computer software application, Geographic Information System (GIS). GIS is a computerized system for developing, analyzing, and displaying spatial data. GIS allows the municipality to combine GIS based data sources into "layers" that can be visually represented to convey spatial information and analysis; such as zoning districts, tax maps, HUC14 drainage areas, land use parameters, and topography. The second phase calculates the pollutant loading for each zone within each HUC14 drainage area, again assuming full land use build-out for all developable land to the maximum extent allowed under zoning requirements.

The steps associated with the build-out analysis procedure are as enumerated below. Please note that the analyzed GIS data files were provided by the New Jersey Department of Environmental

Protection Bureau of Geographic Information Systems (GIS). GIS data is only as accurate as the sources it references. This information is not exact and should only be used for general comparison purposes; if further analysis within a HUC14 drainage area is required or requested, it is recommended that an analysis of a defined drainage area be conducted and thoroughly performed in accordance with the standards set forth by the Environmental Protection Agency (EPA) and the New Jersey Department of Environmental Protection (NJDEP).

Build-Out Analysis Procedure:

1) The following GIS shape files were obtained for geoprocessing, references as noted:
    a. State Municipal Coverage – obtained from NJDEP Bureau of GIS
    b. Zoning Districts – hard copy provided by the Borough
    (digitized by CME Associates for geoprocessing)
    c. HUC14 – obtained from NJDEP Bureau of GIS
    d. 2012 Land Use – obtained from NJDEP Bureau of GIS
    e. Wetlands – obtained from NJDEP Bureau of GIS
    f. Open Space – obtained by the NJDEP Bureau of GIS
    (copulation of municipal, county and state dedicated open space)
2) The Borough boundary was exported from the state municipality coverage via GIS.
3) A feature class was created in GIS consisting of the Land Use, HUC14 and Wetlands data layers. The feature class was then clipped by the Borough Boundary, as exported from the state municipal coverage data file.
4) The zoning district and HUC14 data files in GIS were intersected creating 'unique' polygons that associate zoning and HUC14 parameters to each 'unique' polygon making them suitable for further geoprocessing.
5) Separate land use classifications relative to each HUC14 and zone (i.e. urban and water polygons) were then exported via GIS from the Land Use data file creating new data sets for further geoprocessing.
6) Three (3) excel spreadsheets were created to properly establish the land use build-out calculations. Comparative HUC14 data relative to each zone was inputted into said spreadsheet as determined above.

a. *Table E1: Pollutant Loads by Land Cover* was created to determine pollutant loads relative to land cover for total phosphorus, total nitrogen and total suspended solids, as referenced by the *NJ BMP Manual*, February 2004.

b. *Table E2: Build-Out Calculations* was created to determine outputs of total developable area and maximum build-out impervious per zone for each associated HUC14 drainage area. Inputs values consist of total zone area within HUC14, percent existing impervious, wetlands/water area, open space lot area and percent allowable impervious.

c. *Table E3: Nonpoint Source Loads at Build-Out* was created to determine pollutant loads in lbs/yr for each zone and HUC14 for total phosphorous, total nitrogen and total suspended solids assuming full build-out potential.

7) Total areas for zones relative to HUC14 drainage areas were determined via GIS geoprocessing; said values were input into *Table E2*.

8) Land covers per zone were then classified in accordance with *Table E1* utilizing NJDEP 2012 Land Use land cover descriptions and practical engineering judgment; land cover classifications per zones were then input into *Table E2*.

9) Impervious coverage data, a field extracted from the land use data file, was analyzed and totaled for each zone within its relative HUC14 via GIS. The calculated data was then input into *Table E2*.

10) A visual examination of the land use coverage data was conducted by comparing the 2012 NJDEP Land Use descriptions for the 'unique' polygons to state aerials issued 2002-03. If necessary, land use coverage data was revised accordingly.

11) Wetlands and water land use data layers, fields extracted from the land use data file, were analyzed and summed for each zone within its relative HUC14 via GIS geoprocessing. The calculated data was then inputted into *Table E2*.

12) Open space areas relative to HUC14 drainage area were analyzed via GIS. The calculated data was then input into *Table E2*.

13) Allowable impervious coverage values were inputted into *Table E2*; information based upon Borough standards.

14) *Table E2* then automatically computed the developable area, build-out impervious area and all summations via inputted excel formulas.

15) *Table E3* then automatically computed all pollutant loads and summations via inputted excel formulas and references.

A detailed land use build-out analysis for the Borough was conducted as outlined above. See *Appendix E* for all associated tables; *Table E1: Pollutant Loads by Land Cover, Table E2: Build-out Calculations* and *Table E3: Nonpoint Source Loads at Build-Out*.

Mitigation Plans

This mitigation plan is provided for a proposed development that is granted a variance or exemption from the stormwater management design and performance standards. However, approval of variances or exemptions from N.J.A.C. 7:8 are a last resort and all non-structural and structural BMPs should be explored prior to a variance or exemption being granted. Non-structural BMPs are highly recommended and shall be the initial design technique utilized. It is up to the discretion of the Borough Engineer, Board and professionals to ensure all BMP options are explored prior to granting a variance or exemption. The Borough Engineer shall be consulted to determine availability of mitigation projects. All mitigation projects are subject to approval of the Borough Engineer, Governing Body and Borough Planning and/or Zoning Board.

Mitigation Project Criteria

The mitigation project must be implemented within the same area that would contribute to the receptor impacted by the project. If there are no specific sensitive receptors that would be impacted as the result of the grant of the waiver/exemption, then the location of the mitigation project can be located anywhere within the municipality, and should be selected to provide the most benefit relative to an existing stormwater problem in the same category (quality, quantity or recharge). Legal authorization must be obtained to construct the project at the location selected. This includes the maintenance and any access needs for the project in the future.

The project should be close to the location of the original project, and if possible, be located upstream at a similar distance from the identified sensitive receptor. This distance should not be based on actual location, but on a similar hydraulic distance to the sensitive receptor. For ease of

administration, if sensitive receptors are addressed, it is preferable to have one location that addresses any and all of the performance standards waived, rather than one location for each performance standard.

It must be demonstrated that implementation of the mitigation project will result in no adverse impacts to other properties. Mitigation projects that address stormwater runoff quantity can provide storage for proposed increases in runoff volume, as opposed to a direct peak flow reduction.

The project must provide additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed property, which does not currently meet the design and performance standards as 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 NJ Stormwater BMP Manual.

The Borough Engineer must be contacted to obtain a list of potential mitigation projects to compensate for the deficit from the performance standards resulting from the proposed project. More detailed information on the mitigation projects shall be obtained from the Borough Engineer. The Borough maintains the right to update the mitigation project list and is not held accountable for time frames or to construct any of the mitigation projects or potential mitigation projects addressing groundwater recharge, water quality and water quantity.

Mitigation projects are environmental enhancement projects that provide groundwater recharge, control flooding or control nonpoint source pollution. The Borough Engineer shall be contacted for availability, description and any other necessary information pertaining to mitigation projects.

Mitigation projects are subject to the approval of the Borough Engineer, Governing Body and Borough Planning and/or Zoning Board. Each project is approved upon an individual basis

considering the extent of the variance, waiver or exception granted. Mitigation projects may require cooperation with outside agencies such as the Freehold Soil Conservation District, Middlesex County Mosquito Commission, Army Corp of Engineers, NJDEP, etc.

The municipality may require a developer to provide funding or partial funding to the municipality for an environmental enhancement project that has been identified in a MSWMP, or towards the development of a RSWMP. Funding quantities are subject to the approval of the Borough Engineer, Governing Body and Borough Planning and/or Zoning Board. Funding quantities will include costs or partial costs, including those associated with purchasing a property or easement for mitigation, and those associated with the long-term maintenance requirements of the mitigation measure.

The Borough invites all public for input regarding possible mitigation projects. As a result of public education and involvement promoted through the Stormwater Pollution Prevention Plan, it is anticipated that the public will be knowledgeable of stormwater issues and will work towards preventing stormwater quality, quantity and groundwater recharge problems within the Borough.

References

Bureau of Freshwater and Biological Monitoring. Ambient Biomonitoring Network Watershed Management Areas 7, 8, 9, and 10. State of New Jersey: NJDEP, June 2000.

Water Assessment Team. New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report (305(b) and Monitoring and Assessment Report (305(b) and 303(d)) State of New Jersey: NJDEP, June 2004.

New Jersey Dept. of Environmental Protection. TMDLs for Fecal Coliform to Address 48 Streams in the Raritan Water Region. 2003. Division of Watershed Management: 25 Jan. 2005 <http://www.nj.gov/dep/watershedmgt/tmdl

U.S. Environmental Protection Agency. TMDLs- 2002 Section 303(d) List Fact Sheet for NEW JERSEY. 2003. USEPA: 25 Jan. 2005. http://oaspub.epa.gov/waters/state_rept.control

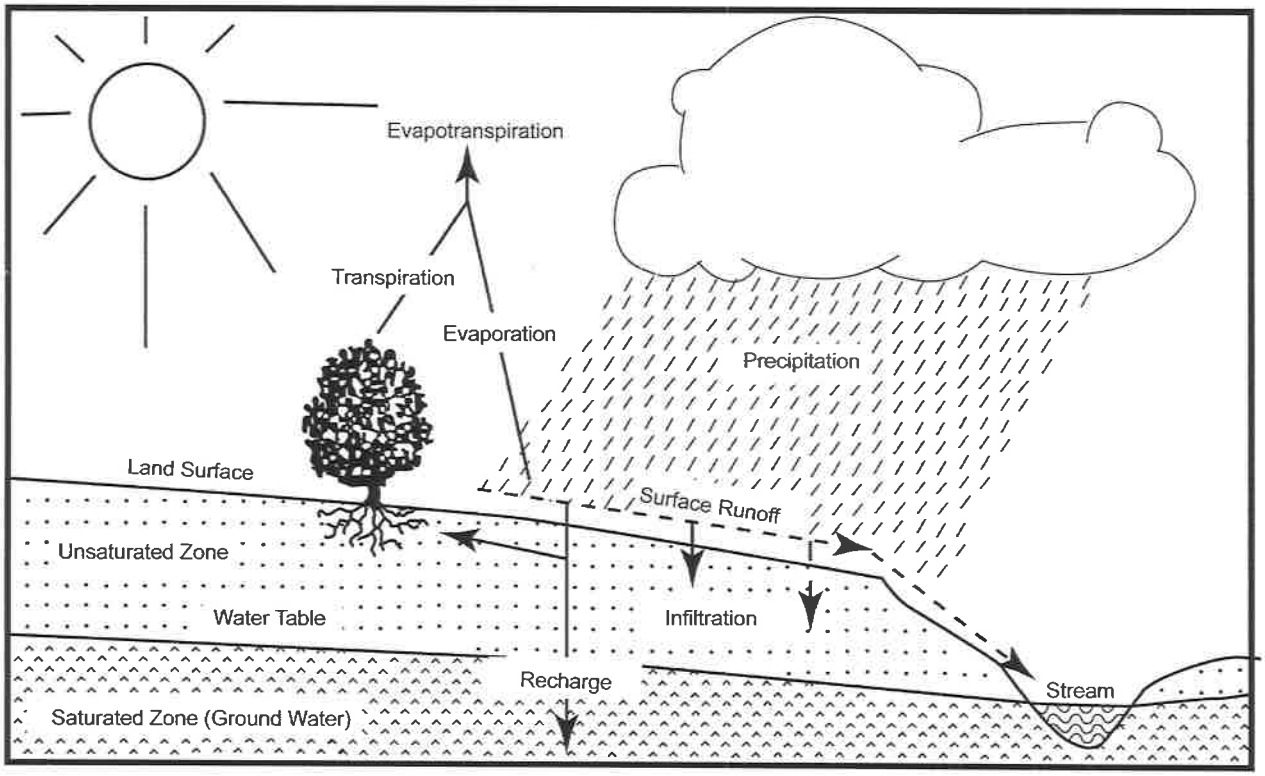
APPENDICES

APPENDIX A

Appendix of Figures

Figures 1 thru 16

Figure 1: Groundwater Recharge in the Hydrologic Cycle



Source: New Jersey Geological Survey Report GSR-32.

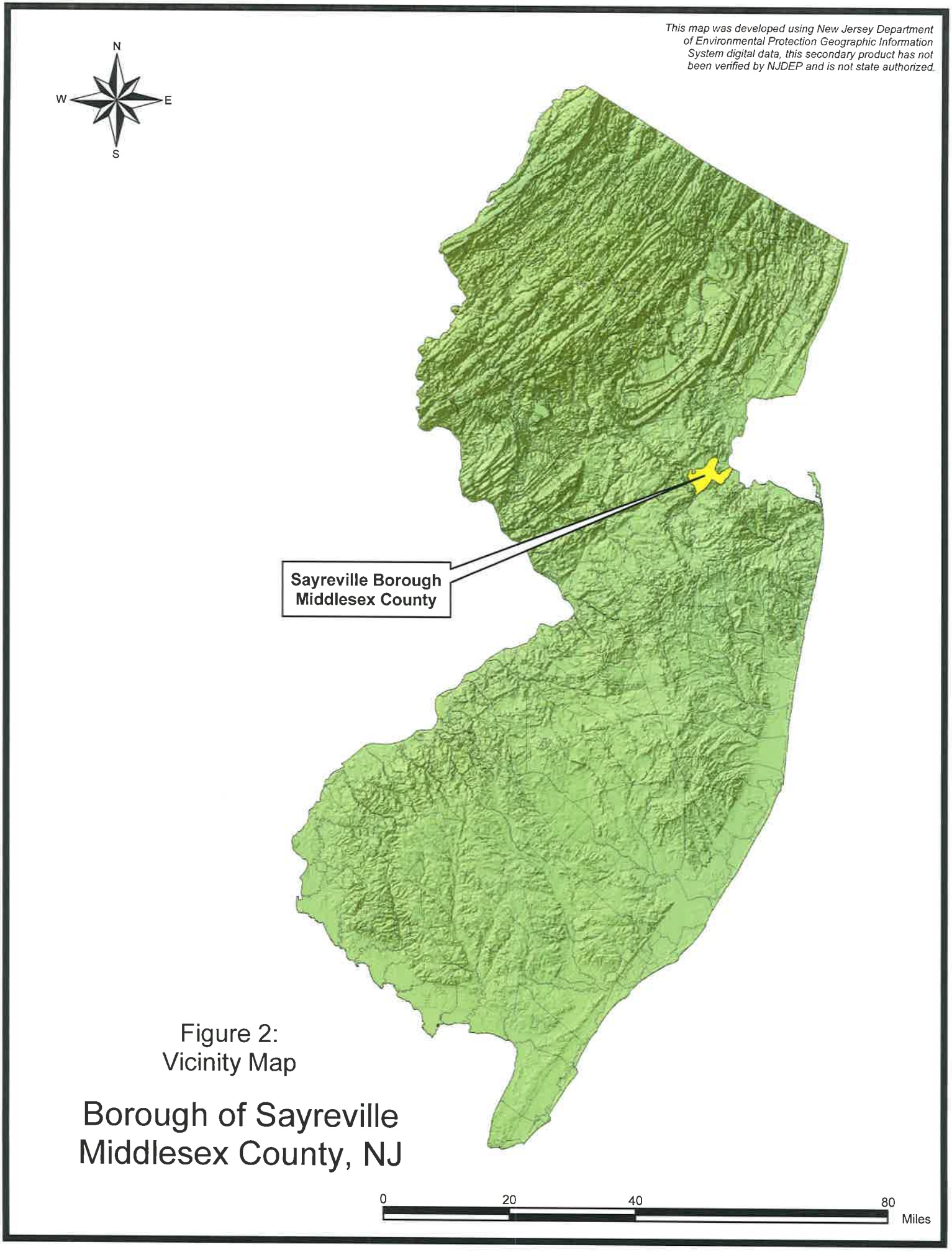


Figure 2:
Vicinity Map

Borough of Sayreville
Middlesex County, NJ

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Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

City of South Amboy

South River Borough

Old Bridge Township

East Brunswick Township

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

LAND USE (2012)

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS
- Sayreville Streams

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, this secondary product has not been verified by NJDEP and is not state authorized. The 2012 Land use/Land cover polygon shapefiles for New Jersey's Watershed Management Areas have been created by comparing the 2007 LU/LC layers from the NJDEP GIS database to the 2012 color infrared digital imagery, and delineating areas of change. In addition, an impervious surface (IS) code has been assigned to each polygon. All polygons retain the original 2007 land use code, as well as being given a 2012 land use code so that change analysis can be done directly from these data sets.

Figure 3:
Existing Land Use

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES

CONSULTING & MUNICIPAL ENGINEERS

3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
1460 ROUTE 9 SOUTH HOWELL, N.J. 07731
3759 ROUTE 1 SOUTH SUITE 100, MONMOUTH JUNCTION, NJ 08852
1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
WWW.CMEUSA1.COM

DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

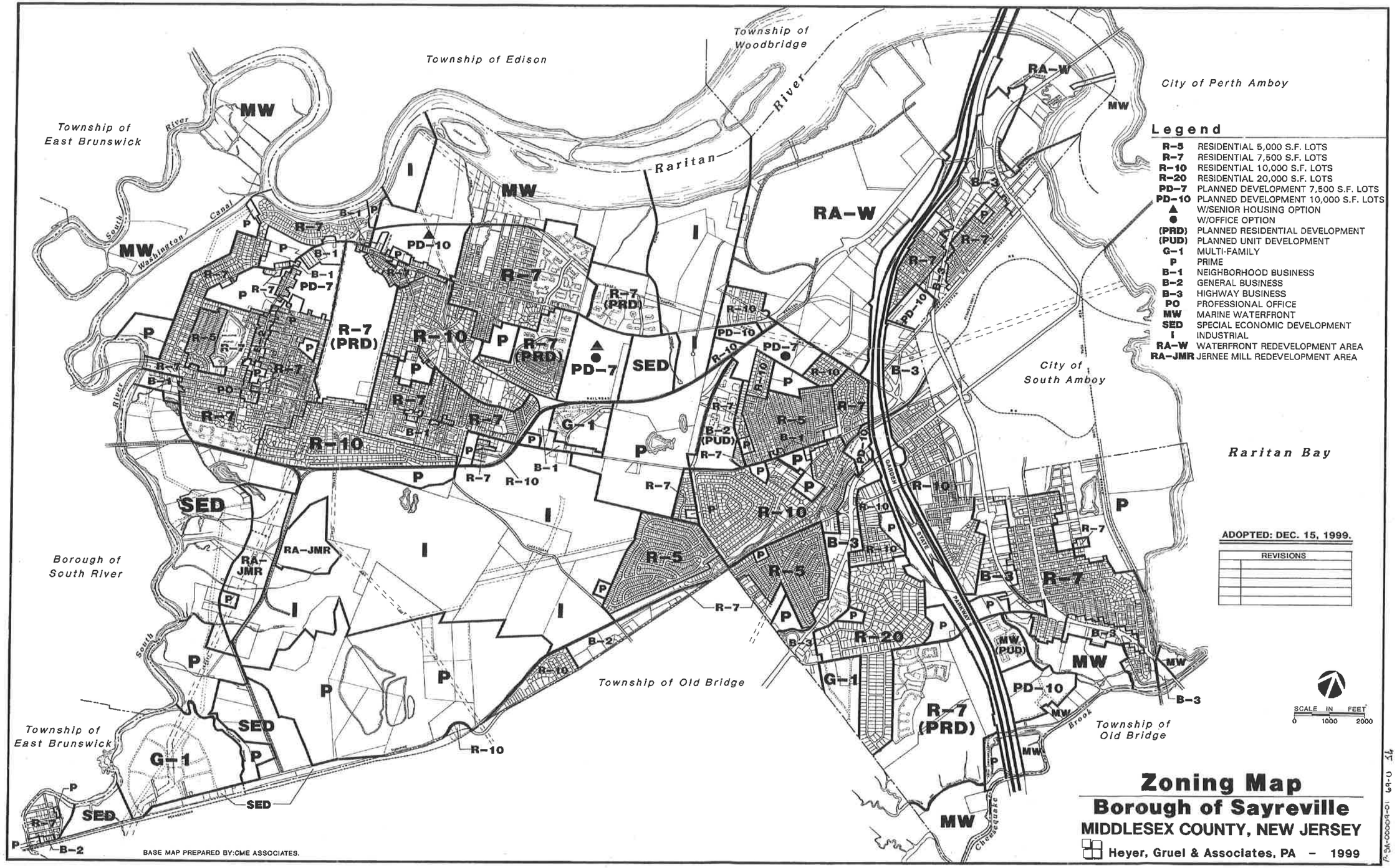
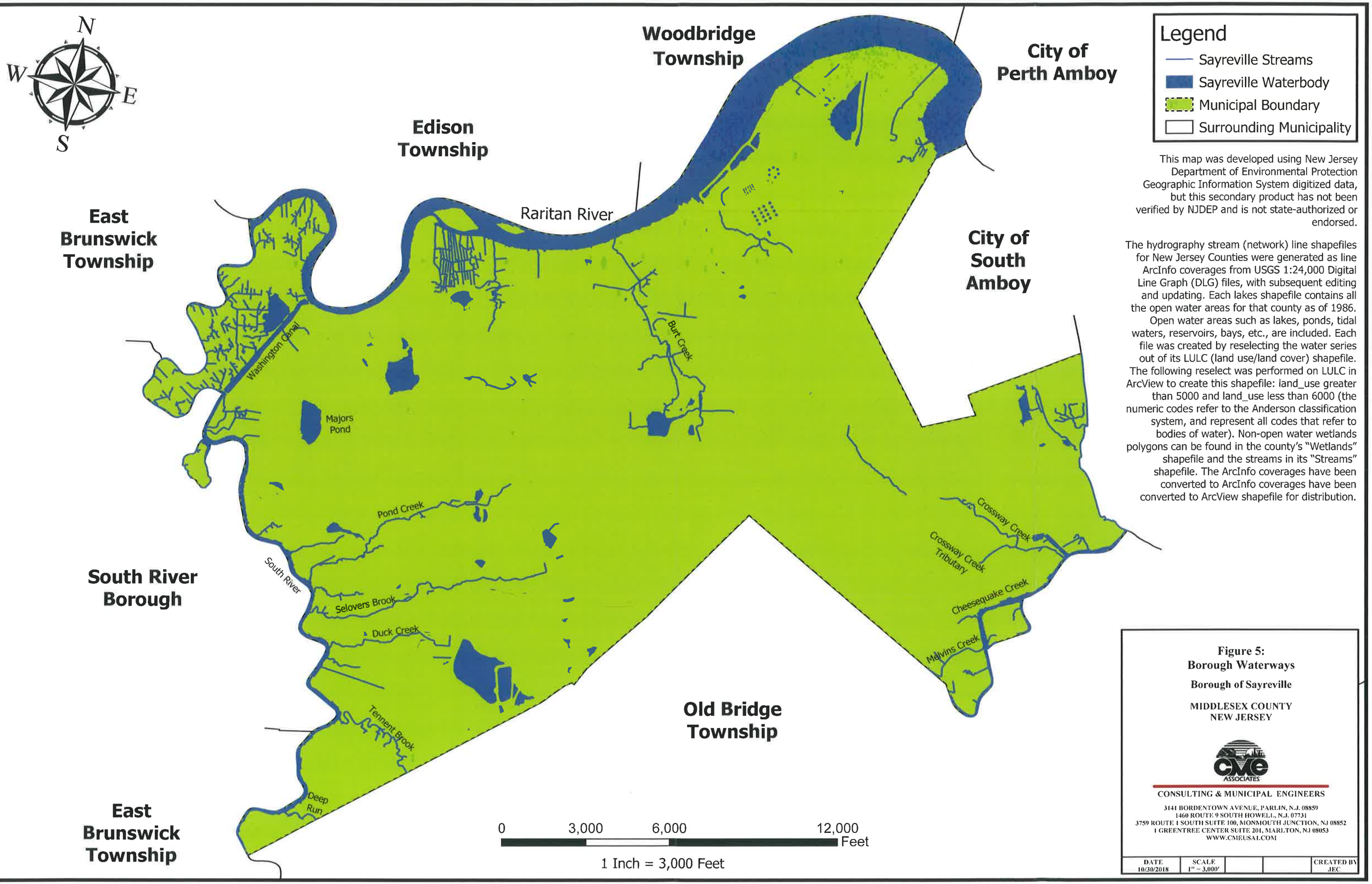


Figure 4: Zoning District
Borough of Sayreville



Legend

- Sayreville Streams
- Sayreville Waterbody
- Municipal Boundary
- Surrounding Municipality

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

The hydrography stream (network) line shapefiles for New Jersey Counties were generated as line ArcInfo coverages from USGS 1:24,000 Digital Line Graph (DLG) files, with subsequent editing and updating. Each lakes shapefile contains all the open water areas for that county as of 1986. Open water areas such as lakes, ponds, tidal waters, reservoirs, bays, etc., are included. Each file was created by reselecting the water series out of its LULC (land use/land cover) shapefile. The following reselect was performed on LULC in ArcView to create this shapefile: land_use greater than 5000 and land_use less than 6000 (the numeric codes refer to the Anderson classification system, and represent all codes that refer to bodies of water). Non-open water wetlands polygons can be found in the county's "Wetlands" shapefile and the streams in its "Streams" shapefile. The ArcInfo coverages have been converted to ArcInfo coverages have been converted to ArcView shapefile for distribution.

Figure 5:
Borough Waterways

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

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DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

City of South Amboy

South River Borough

Old Bridge Township

East Brunswick Township

Mill Brook

Bluff Creek

Raritan River

Washington Canal

Bluff Creek

South River

wmill Brook

Melvins Creek

Cheesequake Creek

Flat Creek

Spring Creek

Tennent Brook

Deep Run

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

- SAYREVILLE LAKES
- Municipal Boundary
- MIDDLESEX STREAMS
- Category One Waters

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

This data is a digital representation of New Jersey's Surface Water Quality Standards in accordance with "Surface Water Quality Standards for New Jersey Waters" as designated in N.J.A.C. 7:9 B. The Surface Water Quality Standards (SWQS) establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. These are reflected in use classifications assigned to specific waters. The linework has been broken/altered to reflect the location written in the standards text. When interpreting the surface water quality standards, the Surface Water Quality Standards regulations at N.J.A.C. 7:9B always take precedence. The GIS layer is supplemental only and is not legally binding. Dataset dated 2008.

Figure 6:
Category One Waters

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

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DATE	SCALE			CREATED BY
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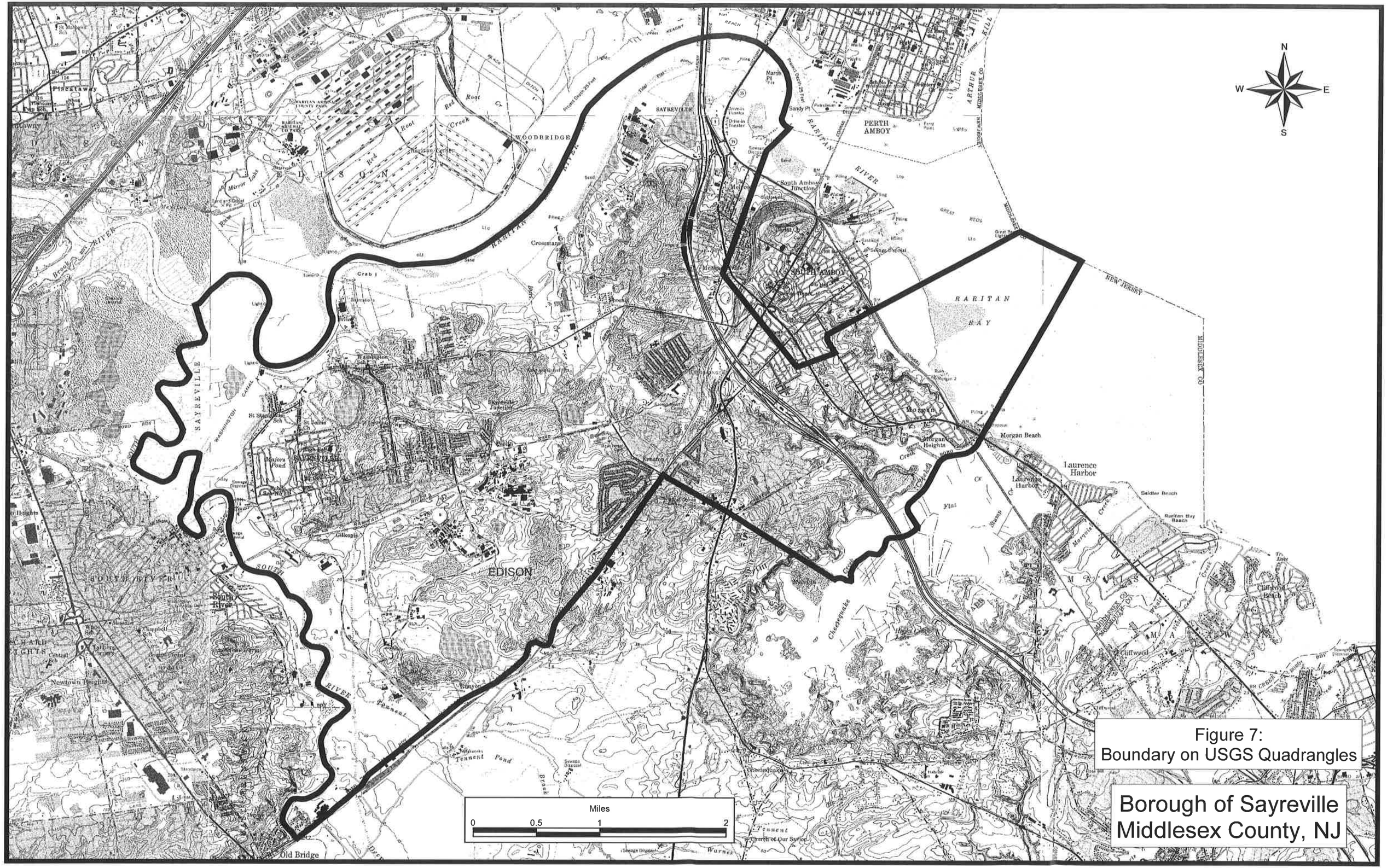
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2
Figure 7:
Boundary on USGS Quadrangles
Borough of Sayreville
Middlesex County, NJ

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

Raritan River

East Brunswick Township

City of South Amboy

South River Borough

South River

Old Bridge Township

East Brunswick Township

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

- Future Developable Land - 3.48 Sq. Miles
- Developed / Redevelopable Land - 9.16 Sq. Miles
- Preserved / Undevelopable Land - 4.95 Sq. Miles

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

Areas calculated utilizing the New Jersey Department of Environmental Protection Geographic Information System's 2012 Land Use/Land cover polygon shapefiles for New Jersey's watershed management areas.

Figure 8:
Developable and Un-Developable Land

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

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DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

Raritan River

City of South Amboy

02030105160100

Watershed Managment Area 9
(Lower Raritan, South River & Lawrence)

Washington Canal

Burt Creek

Majors Pond

Watershed Management Area 12
(Monmouth)

02030104060010

Pond Creek

02030105160070

Crossway Creek

Crossway Creek Tributary

South River

South River Borough

Selovers Brook

Duck Creek

02030105160060

Cheesequake Creek

Melvins Creek

02030105160060

Tennent Brook

Old Bridge Township

Deep Run

East Brunswick Township

02030105160040

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

HUC14

- 02030104060010
- 02030105160040
- 02030105160060
- 02030105160070
- 02030105160100
- Watershed Boundary

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

Watersheds (DEPHUC14) are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles. The delineations have been developed for general purpose use by USGS District Staff over the past 20 years. Arc and polygon attributes have been included in the coverage with basin names and ranks of divides, and 14-digit hydrologic unit codes. The New Jersey state boundary as originally defined in the USGS source coverage does not match that used by the NJDEP. Therefore the coverage was edited by the NJ Geological Survey to remove the USGS state boundary and insert the NJDEP state boundary, thus resolving most potential clipping errors. Database publication date: 2018

Figure 9:
Hydrologic Unit Code 14 (HUC 14)

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES
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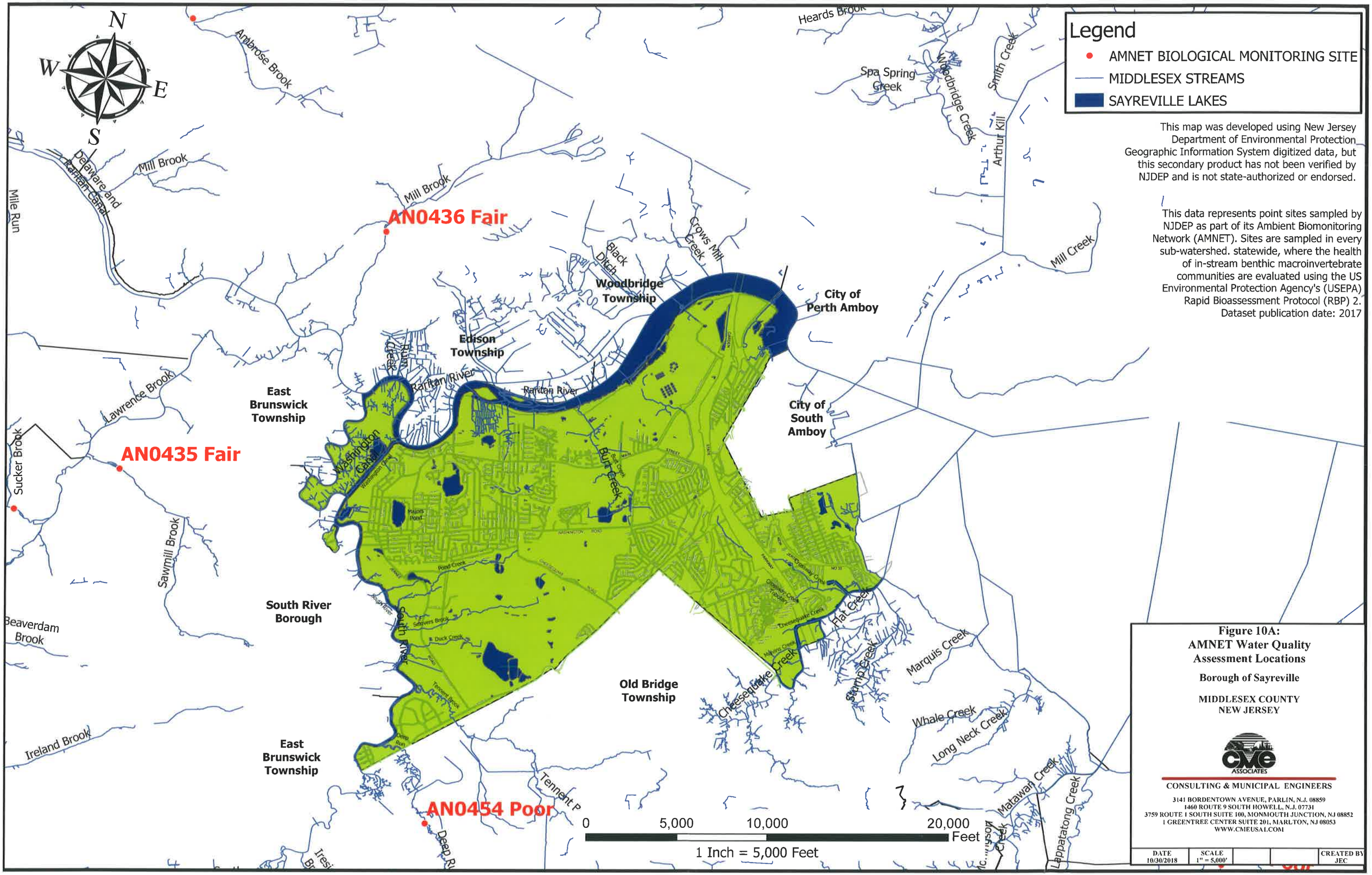
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Legend
AMNET BIOLOGICAL MONITORING SITE
MIDDLESEX STREAMS
SAYREVILLE LAKES
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.
This data represents point sites sampled by NJDEP as part of its Ambient Biomonitoring Network (AMNET). Sites are sampled in every sub-watershed. statewide, where the health of in-stream benthic macroinvertebrate communities are evaluated using the US Environmental Protection Agency's (USEPA) Rapid Bioassessment Protocol (RBP) 2. Dataset publication date: 2017
AN0436 Fair
AN0435 Fair
AN0454 Poor
Ambrose Brook
Heards Brook
Spa Spring Creek
Woodbridge Creek
Smith Creek
Arthur Kill
Mill Brook
Delaware and Raritan Canal
Mile Run
Lawrence Brook
Sucker Brook
Sawmill Brook
Beaverdam Brook
Ireland Brook
Black Ditch
Crows Mill Creek
Woodbridge Township
City of Perth Amboy
Edison Township
Raritan River
East Brunswick Township
City of South Amboy
Washington Canal
Burt Creek
Major's Pond
Pond Creek
South River Borough
Old Bridge Township
Mill Creek
Flat Creek
Marquis Creek
Cheesequake Creek
Whale Creek
Long Neck Creek
Matawan Creek
Lappatatong Creek
Tennent P
Deep R
0
5,000
10,000
20,000
Feet
1 Inch = 5,000 Feet
Figure 10A:
AMNET Water Quality Assessment Locations
Borough of Sayreville
MIDDLESEX COUNTY
NEW JERSEY
CME ASSOCIATES
CONSULTING & MUNICIPAL ENGINEERS
3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
1460 ROUTE 9 SOUTH HOWELL, N.J. 07731
3759 ROUTE 1 SOUTH SUITE 100, MONMOUTH JUNCTION, NJ 08852
1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
WWW.CMEUSA1.COM
DATE 10/30/2018
SCALE 1" = 5,000'
CREATED BY JEC

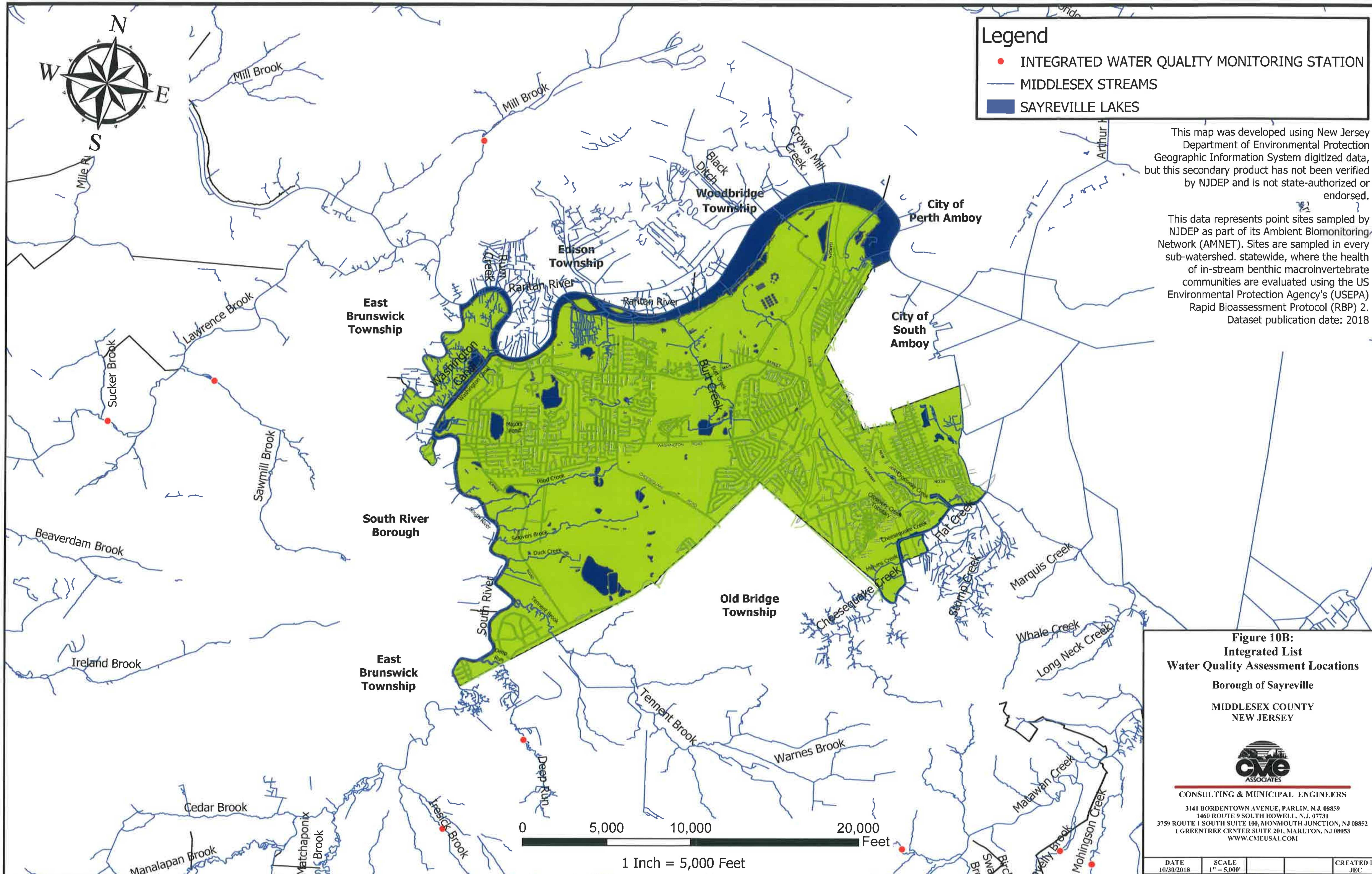

Figure 10B: Integrated List Water Quality Assessment Locations

Borough of Sayreville

MIDDLESEX COUNTY NEW JERSEY

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

Raritan River

City of South Amboy

South River Borough

South River

Old Bridge Township

East Brunswick Township

Legend

Groundwater Recharge (inches per year)

- 0.00
- 0.01 - 4.00
- 4.01 - 8.00
- 8.01 - 12.00
- 12.01 - 20.00
- SAYREVILLE LAKES
- SAYREVILLE STREAMS

Ground-water recharge (GWR) is defined as the water that infiltrates the ground and reaches the water table regardless of the underlying geology. It supports aquifer recharge, stream baseflow and wetlands. It is estimated in New Jersey using the methodology outlined in NJ Geological Survey Report GSR-32 "A Method of Evaluating Ground-Water-Recharge Areas in New Jersey" by E. G. Charles and others (1993). Application of this method using the Arc/Info geographic information system (GIS) produced 19* county and 20* watershed management area (WMA) ground-water recharge, GIS coverages. The county recharge coverages were created by overlaying three coverages; 1) soils, 2) land use and land cover (LULC); and 3) municipalities. These three coverages provided the following attributes: soil series names, land-use and land-cover categories, and climate factors; respectively. These data were then used to calculate ground-water recharge values using the following equation for each area in the coverage: ground-water recharge = (recharge factor x climate factor) - recharge constant. Information derived from the NJDEP 2012 Land Use/ Land Coverage.

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Figure 11:
Groundwater Recharge Areas

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES
CONSULTING & MUNICIPAL ENGINEERS
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DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

Raritan River

City of South Amboy

Washington Canal

Burt Creek

Majors Pond

Pond Creek

South River

South River Borough

Old Bridge Township

Melvins Creek

East Brunswick Township

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

TIER

- Tier 1
- Tier 2
- Tier 3
- SAYREVILLE STREAMS
- SAYREVILLE LAKES

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

A Well Head Protection Area (WHPA) is both an area modeled around an unconfined Public Community Water Supply (PCWS) well in New Jersey that delineates the horizontal extent of groundwater captured by a well pumping at a specific rate over two-, five-, and twelve-year periods of time for unconfined wells and a fifty foot radius delineated around each confined PCWS well (This corresponds to the water purveyor controlled wellhead area as defined in the Safe Drinking Water Regulations (see NJAC 7:10-11.7(b)1)). WHPA delineations are created in compliance to the Safe Drinking Water Act Amendments of 1986 and 1996 as part of the Source Water Area Protection Program (SWAP). The delineations are the first step in defining the sources of water to a public supply well. Within these areas, potential contamination will be assessed and appropriate monitoring will be undertaken as subsequent phases of the NJDEP SWAP. The WHPAs were previously defined using line and polygon coordinate files and the Arc/INFO Generate command. Individual WHPAs were then combined into county and statewide coverages with the Arc/INFO Union command. The WHPAs are currently created using the same coordinate files using a Python-based feature creation script producing an ArcGIS geodatabase feature. The individual features are then combined using ArcGIS merge command. Previous WHPA coverages were updated to features also and combined into a statewide WHPA feature. The WHPA feature is distributed as either an ArcGIS shapefile or a layerpack file. The 2011 and earlier WHPA delineation methods are described in "Guideline for Delineation of Well Head Protection Areas in New Jersey". WHPA delineation methods are described in "Guidelines for Delineation of Well Head Protection Areas in New Jersey". An ESRI point shapefile of associated PCWS wells is available as N.J. Geological Survey Digital Geodata Series DGS97-1, Information per 1986 & 1996 Source Water Area Protection Program (SWAP).

Figure 12:
Wellhead Protection Areas

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES

CONSULTING & MUNICIPAL ENGINEERS

3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
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1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
WWW.CMEUSA1.COM

DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

Raritan River

City of South Amboy

Washington Canal

Burt Creek

Majors Pond

Pond Creek

South River

Selovers Brook

Duck Creek

Crossway Creek

Crossway Creek Tributary

Cheesequake Creek

Melvins Creek

Tennent Brook

Deep Run

South River Borough

Old Bridge Township

East Brunswick Township

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

- SAYREVILLE LAKES
- SAYREVILLE STREAMS
- SAYREVILLE WETLANDS

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

This is a graphical representation of the Borough's wetlands data and are extracted from the Land Use 2012 Layer. While these wetland delineations are not regulatory lines, they represent important resource data in identifying potential wetland areas. The 2012 LU/LC data set is the fifth in a series of land use mapping efforts that was begun in 1986. Revisions and additions to the initial baseline layer were done in subsequent years from imagery captured in 1995/97, 2002, 2007 and 2012. This present 2012 update was created by comparing the 2007 LU/LC layer from NJDEP's Geographic Information Systems (GIS) database to 2012 color infrared (CIR) imagery and delineating and coding areas of change. LU/LC changes were captured by adding new line work and attribute data for the 2012 land use directly to the base data layer. All 2007 LU/LC polygons and attribute fields remain in this data set, so change analysis for the period 2007-2012 can be undertaken from this one layer. The classification system used was a modified Anderson et al., classification system. An impervious surface (IS) code was also assigned to each LU/LC polygon based on the percentage of impervious surface within each polygon as of 2007. Minimum mapping unit (MMU) is 1 acre.

Figure 13:
Wetland and Water Land Uses
Constrained Land

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES
CONSULTING & MUNICIPAL ENGINEERS
3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
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1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
WWW.CMEUSA1.COM

DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

Raritan River

East Brunswick Township

City of South Amboy

South River Borough

Old Bridge Township

East Brunswick Township

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Legend

- SAYREVILLE LAKES
- SAYREVILLE STREAMS

This map was developed using New Jersey Department of Environmental Protection Geographic Information System digitized data, but this secondary product has not been verified by NJDEP and is not state-authorized or endorsed.

The SSURGO soils layer was developed by the Natural Resources Conservation Service (NRCS), of the US Department of Agriculture, as part of the National Cooperative Soil Survey. The data are from the Soil Survey Geographic (SSURGO) database developed and maintained by the NRCS. This data set consists of georeferenced digital map data and computerized attribute data. All soil delineations and coding were performed by NRCS soil scientists. The NJDEP was responsible only for converting the original data to the ARCVIEW shapefiles in New Jersey State Plane Feet, NAD83, that are presented here. The New Jersey NRCS webpage (http://www.nj.nrcs.usda.gov) should be referenced for questions concerning the data. Data publication date: 2011

Figure 14:
Soil Survey Geographic (SSURGO) Database

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES
CONSULTING & MUNICIPAL ENGINEERS
3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
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1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
WWW.CMEUSA1.COM

DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

N
W
E
S

Woodbridge Township

City of Perth Amboy

Edison Township

East Brunswick Township

Raritan River

City of South Amboy

Washington Canal

Burt Creek

Majors Pond

Pond Creek

South River

South River Borough

Selovers Brook

Duck Creek

Tennent Brook

Deep Run

Old Bridge Township

East Brunswick Township

Crossway Creek

Crossway Creek Tributary

Cheesequake Creek

Melvins Creek

Legend

FEMA / FIRM Q3 FLOOD ZONES

- AE
- OPEN WATER
- VE
- X
- SAYREVILLE LAKES
- SAYREVILLE STREAMS

0 3,000 6,000 12,000 Feet

1 Inch = 3,000 Feet

Figure 15:
Flood Prone Map
(FEMA / FIRM Q3 Flood Data)

Borough of Sayreville

MIDDLESEX COUNTY
NEW JERSEY

CME ASSOCIATES

CONSULTING & MUNICIPAL ENGINEERS

3141 BORDENTOWN AVENUE, PARLIN, N.J. 08859
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3759 ROUTE 1 SOUTH SUITE 100, MONMOUTH JUNCTION, NJ 08852
1 GREENTREE CENTER SUITE 201, MARLTON, NJ 08053
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DATE	SCALE			CREATED BY
10/30/2018	1" = 3,000'			JEC

APPENDIX B

2012 AMBIENT BIOMONITORING NETWORK DATA: Raritan Region

Benthic Macroinvertebrate Report Data

AMNET Site # **AN0454** *Stream Name:* **Deep Run**

Location: **Rt 516; Madison Twp; Middlesex County**

Collection Date: ***9/1/2009*** *USGS Topo Map:* **South Amboy**

Genus	*Tolerance Value*	*Amount*
Limnodrilus	10	57
Tribelos	5	28
Tubifex	10	9
Ischnura	9	2
Polypedilum	6	2
Rheotanytarsus	6	2

** (EPT organism)* *Taxa Richness:* 6 *Population:* 100

%Dominance / Dominant Taxon(s): 57.0% Limnodrilus

Hilsenhoff Biotic Index (HBI): 8.42 *%Clingers:* 2.00%

** E+P+T:* 0 ( ) Ephemeroptera, ( ) Plecoptera, ( ) Trichoptera *%Ephemeroptera:* 0.00%

CPMI Rating: **0 Poor**

Habitat Analysis: 149 Suboptimal USEPA Protocol

Observations: Water temp: 18.37 C; Cond: 255 umhos; DO: 7.29 mg/L; pH: 4.96 SU

Clarity: turbid; Flow Rate: slow; Width/Depth: 34' / > 4'; Substrate: mud, silt

Canopy: open; Bank Stability: good; Bank Vegetation: trees, weeds

Stream Gradient: Low Gradient Stream; Land Uses: suburban, forested

Other: macrophytes, purple loosestrife, metal floc, gabion on bank

APPENDIX C

2014 Integrated Water Quality Assessment Report

Integrated List Report Data

WMA	Assessment Unit Number	Assessment Unit Name	Parameter	Station Number	Cycle 1st Listed	Designated Use	Sublist 5 Subpart (A, R, L)	Priority Ranking for TMDL
09	02030105160010-01	Deep Run (above Monmouth Co line)	Escherichia coli	MCHD-90	2014	Recreation		Medium
09	02030105160010-01	Deep Run (above Monmouth Co line)	Oxygen, Dissolved	01406040	2008	Aquatic Life		Medium
09	02030105160040-01	Deep Run (below Rt 9)	Arsenic	01406040	2012	Water Supply		Low
09	02030105160040-01	Deep Run (below Rt 9)	Escherichia coli	BFBM000004	2012	Recreation		Medium
09	02030105160040-01	Deep Run (below Rt 9)	Oxygen, Dissolved	01406040	2008	Aquatic Life		Medium
09	02030105160040-01	Deep Run (below Rt 9)	pH	01406040	2014	Aquatic Life		Medium
09	02030105160020-01	Deep Run (Rt 9 to Monmouth Co line)	Oxygen, Dissolved	01406040	2008	Aquatic Life		Medium
09	02030105160070-01	South River (below Duhernal Lake)	Arsenic	304(l)	1998	Water Supply		Low
09	02030105160070-01	South River (below Duhernal Lake)	Cadmium	304(l)	1998	Aquatic Life, Fish Consumption		Low
09	02030105160070-01	South River (below Duhernal Lake)	Chromium (total)	304(l)	1998	Fish Consumption		Low
09	02030105160070-01	South River (below Duhernal Lake)	Copper	304(l)	1998	Aquatic Life		Low
09	02030105160070-01	South River (below Duhernal Lake)	Dioxin (including 2, 3, 7, 8-TCDD)	HEP	2006	Fish Consumption		Low
09	02030105160070-01	South River (below Duhernal Lake)	Lead	304(l)	1998	Water Supply		Low
09	02030105160070-01	South River (below Duhernal Lake)	Mercury in Water Column	304(l)	1998	Water Supply, Aquatic Life		Low
09	02030105160070-01	South River (below Duhernal Lake)	PCB in Fish Tissue	South River at Sayreville, South River at Old Bridg	2006	Fish Consumption	L	Low

APPENDIX D

Total Maximum Daily Loads

TMDL Reports

EPA United States Environmental Protection Agency

Waterbody Quality Assessment Report

Return to home page

On This Page

- Water Quality Assessment Status
- Causes of Impairment
- Probable Sources Contributing to Impairments
- TMDLs That Apply to This Waterbody
- Previous Causes of Impairment Now Attaining All Uses

2014 Waterbody Report for Deep Run (below Rt 9)

State: New Jersey
Waterbody ID: NJ02030105160040-01
Location: WMA 09
State Waterbody Type: River & Stream
EPA Waterbody Type: Rivers and Streams
Water Size: 15.81
Units: miles
Watershed Name: Raritan

Waterbody History Report

Data are also available for these years: 2012 2010 2008 2006

Water Quality Assessment Status for Reporting Year 2014

The overall status of this waterbody is Impaired.

Description of this table

Designated Use	Designated Use Group	Status
Aquatic Life	Fish, Shellfish, And Wildlife Protection And Propagation	Impaired
Fish Consumption	Aquatic Life Harvesting	Not Assessed
Primary Contact Recreation	Recreation	Impaired
Public Water Supply	Public Water Supply	Impaired

Causes of Impairment for Reporting Year 2014

Description of this table

Cause of Impairment	Cause of Impairment Group	Designated Use(s)	State TMDL Development Status
Arsenic	Metals (other than Mercury)	Public Water Supply	TMDL needed
Dissolved Oxygen	Organic Enrichment/Oxygen Depletion	Aquatic Life	TMDL needed
Escherichia Coli (E. Coli)	Pathogens	Primary Contact Recreation	TMDL needed
pH	pH/Acidity/Caustic Conditions	Aquatic Life	TMDL needed

Probable Sources Contributing to Impairment for Reporting Year 2014

No probable source data have been reported to EPA for this waterbody.

TMDLs That Apply to this waterbody

No TMDL data have been recorded by EPA for this waterbody.

Previous Causes of Impairments Now Attaining All Uses

No causes of impairment are recorded as attaining all uses for this waterbody.

November 14, 2018

EPA United States Environmental Protection Agency

Waterbody Quality Assessment Report

Return to home page

On This Page

- Water Quality Assessment Status
- Causes of Impairment
- Probable Sources Contributing to Impairments
- TMDLs That Apply to This Waterbody
- Previous Causes of Impairment Now Attaining All Uses

2014 Waterbody Report for South River (below Duhernal Lake)

State: New Jersey
Waterbody ID: NJ02030105160070-01
Location: WMA 09
State Waterbody Type: Lake, River & Stream
EPA Waterbody Type: Lakes, Reservoirs, and Ponds, Rivers and Streams
Water Size: 33.56, 23.26
Units: acres, miles
Watershed Name: Raritan

Waterbody History Report

Data are also available for these years: 2012 2010 2008 2006

Water Quality Assessment Status for Reporting Year 2014

The overall status of this waterbody is Impaired.

Description of this table

Designated Use	Designated Use Group	Status
Aquatic Life	Fish, Shellfish, And Wildlife Protection And Propagation	Impaired
Fish Consumption	Aquatic Life Harvesting	Impaired
Primary Contact Recreation	Recreation	Not Assessed
Public Water Supply	Public Water Supply	Impaired

Causes of Impairment for Reporting Year 2014

Description of this table

Cause of Impairment	Cause of Impairment Group	Designated Use(s)	State TMDL Development Status
Arsenic	Metals (other than Mercury)	Public Water Supply	TMDL needed
Cadmium	Metals (other than Mercury)	Fish Consumption, Aquatic Life	TMDL needed
Chromium, Total	Metals (other than Mercury)	Fish Consumption	TMDL needed
Copper	Metals (other than Mercury)	Aquatic Life	TMDL needed
Dioxin (Including 2,3,7,8-TCDD)	Dioxins	Fish Consumption	TMDL needed
Lead	Metals (other than Mercury)	Public Water Supply	TMDL needed
Mercury in Water Column	Mercury	Aquatic Life, Public Water Supply	TMDL needed
PCB(s) in Fish Tissue	Polychlorinated Biphenyls (PCBs)	Fish Consumption	TMDL needed

Probable Sources Contributing to Impairment for Reporting Year 2014

No probable source data have been reported to EPA for this waterbody.

TMDLs That Apply to this waterbody

No TMDL data have been recorded by EPA for this waterbody.

Previous Causes of Impairments Now Attaining All Uses

No causes of impairment are recorded as attaining all uses for this waterbody.

November 14, 2018

Bureau of Nonpoint Pollution Control

Water Pollution Management Element

Bureau of Nonpoint Pollution ControL


Industrial Stormwater Permitting Program


Municipal Stormwater Regulation Program

- Tier A Municipalities
- Tier B Municipalities
- Public Complex
- Highway Agency
- Case Manager List
- Emergency Snow Removal and Disposal Policy
- De-Icing Storage Policy
- Cleanwater Multimedia
- Stormwater Training
- TMDL Lookup

Companion Links

- www.cleanwaternj.org
- www.njstormwater.org


Onsite Wastewater Management Program


Discharge to Ground Water Permitting Program


Stormwater Management


Green Infrastructure in New Jersey


General Permits


Individual Permits

Municipality and County
Sayreville Borough
Middlesex County

Total Maximum Daily Load(TMDL) Information for Selected Municipality:

Applicable Stream TMDL(s)

None

Applicable Lake TMDL(s)

None

Applicable Shellfish TMDL(s)

None

APPENDIX E

Land Use Build-Out Analysis

Table E1: Pollutant Loads by Land Cover
Table E2: Land Use Build-Out Calculations
Table E3: Nonpoint Source Loads at Build-Out

Table E1: Pollutant Loads by Land Cover

November 2018

Land ID Code	Land Cover	Total Phosphorus (TP) Load *(lbs/acre/yr)*	Total Nitrogen (TN) Load *(lbs/acre/yr)*	Total Suspended Solids (TSS) Load *(lbs/acre/yr)*
1	*High, Medium Density Residential*	1.4	15	140
2	*Low Density, Rural Residential*	0.6	5	100
3	*Commercial*	2.1	22	200
4	*Industrial*	1.5	16	200
5	*Urban, Mixed Urban, Other Urban*	1	10	120
6	*Agricultural*	1.3	10	300
7	*Forest, Water, Wetlands*	0.1	3	40
8	*Barrenland/Transitional Area*	0.5	5	60

Source: New Jersey Best Management Practices (BMP) Manual, dated February 2004, last revised September 2017

Table E2: Land Use Build-Out Calculations

November 2018

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Area *(acres)*	Existing Impervious *(%)*	Existing Impervious *(acres)*	Wetlands/ Water Area *(acres)*	Open Space Lots *(acres)*	Developable Area *(acres)*	Allowable Impervious *(%)*	Build-Out Impervious *(acres)*
HUC ID No. 02030104060010									
B-3	*Industrial*	154.89	46.9%	72.68	14.58	0.68	139.63	85%	118.69
G-1	*High, Medium Density Residential*	30.06	65.1%	19.56	0.00	0.00	30.06	45%	13.53
MW	*Forest, Water, Wetlands*	251.78	14.4%	36.31	115.35	10.72	125.71	40%	50.28
P	*Forest, Water, Wetlands*	324.42	11.6%	37.70	91.70	147.73	84.99	85%	72.24
PD-10	*High, Medium Density Residential*	55.15	29.1%	16.05	1.45	0.00	53.70	45%	24.17
R-10	*High, Medium Density Residential*	181.04	33.5%	60.72	2.03	0.00	179.01	45%	80.55
R-20	*High, Medium Density Residential*	204.80	32.4%	66.42	0.00	4.28	200.52	45%	90.23
R-7	*High, Medium Density Residential*	527.03	29.7%	156.31	94.65	0.57	431.81	45%	194.31
	Totals:	***1,729.17***	***26.9%***	***465.75***	***319.76***	***163.98***	***1,245.43***	***55%***	***644.01***
HUC ID No. 02030105160040									
G-1	*High, Medium Density Residential*	1.26	36.5%	0.46	0.00	0.00	1.26	45%	0.57
SED	*Forest, Water, Wetlands*	18.74	39.5%	7.40	3.88	0.00	14.86	40%	5.94
	Totals:	***20.00***	***39.3%***	***7.86***	***3.88***	***0.00***	***16.12***	***40%***	***6.51***
HUC ID No. 02030105160060									
B-2	*Low Density, Rural Residential*	11.84	37.7%	4.46	0.00	0.00	11.84	85%	10.06
B-3	*Industrial*	11.22	58.8%	6.60	0.00	0.00	11.22	85%	9.54
G-1	*High, Medium Density Residential*	84.46	45.5%	38.39	22.47	0.75	61.24	45%	27.56
P	*Forest, Water, Wetlands*	135.63	14.3%	19.38	18.71	57.71	59.21	85%	50.33
R-10	*High, Medium Density Residential*	16.09	19.1%	3.08	0.00	0.00	16.09	45%	7.24
SED	*Forest, Water, Wetlands*	119.28	40.2%	47.99	2.43	3.39	113.46	45%	51.06
	Totals:	***378.52***	***31.7%***	***119.90***	***43.61***	***61.85***	***273.06***	***62%***	***155.79***

Table E2: Land Use Build-Out Calculations

November 2018

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Area *(acres)*	Existing Impervious *(%)*	Existing Impervious *(acres)*	Wetlands/ Water Area *(acres)*	Open Space Lots *(acres)*	Developable Area *(acres)*	Allowable Impervious *(%)*	Build-Out Impervious *(acres)*
HUC ID No. 02030105160070									
B-1	*High, Medium Density Residential*	5.88	55.4%	3.26	0.00	0.00	5.88	85%	4.99
B-2	*Low Density, Rural Residential*	63.31	54.8%	34.71	0.00	0.37	62.94	85%	53.50
G-1	*High, Medium Density Residential*	117.47	52.1%	61.21	10.20	0.00	107.27	45%	48.27
I	*Industrial*	977.23	8.5%	82.70	159.70	40.61	776.92	40%	310.77
MW	*Forest, Water, Wetlands*	431.97	1.0%	4.21	271.69	1.31	158.97	40%	63.59
P	*Forest, Water, Wetlands*	656.91	5.7%	37.65	112.07	274.04	270.80	85%	230.18
PD-7	*High, Medium Density Residential*	1.66	4.7%	0.08	0.00	0.00	1.66	45%	0.75
PO	*Low Density, Rural Residential*	6.40	44.8%	2.87	0.00	0.22	6.18	85%	5.25
R-10	*High, Medium Density Residential*	188.48	31.8%	59.89	0.95	2.96	184.57	45%	83.05
R-5	*High, Medium Density Residential*	80.26	28.6%	22.94	0.00	1.63	78.63	45%	35.38
R-7	*High, Medium Density Residential*	541.03	34.7%	187.54	18.27	37.74	485.02	45%	218.26
RA-JMR	*Forest, Water, Wetlands*	150.98	5.1%	7.67	105.86	0.00	45.12	45%	20.30
SED	*Forest, Water, Wetlands*	396.90	13.8%	54.89	145.17	1.76	249.97	40%	99.99
	Totals:	***3,618.48***	***15.5%***	***559.61***	***823.91***	***360.64***	***2,433.93***	***51%***	***1,174.29***

Table E2: Land Use Build-Out Calculations

November 2018

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Area *(acres)*	Existing Impervious *(%)*	Existing Impervious *(acres)*	Wetlands/ Water Area *(acres)*	Open Space Lots *(acres)*	Developable Area *(acres)*	Allowable Impervious *(%)*	Build-Out Impervious *(acres)*
HUC ID No. 02030105160100									
B-1	*High, Medium Density Residential*	2.72	51.1%	1.39	0.00	0.00	2.72	85%	2.31
B-2	*Low Density, Rural Residential*	106.28	39.0%	41.40	7.84	9.27	89.17	85%	75.79
B-3	*Industrial*	244.25	47.5%	116.05	19.20	9.30	215.75	85%	183.38
G-1	*High, Medium Density Residential*	46.57	41.7%	19.42	0.00	2.48	44.09	45%	19.84
I	*Industrial*	459.69	15.6%	71.72	138.40	0.60	320.69	40%	128.28
MW	*Forest, Water, Wetlands*	587.23	0.5%	3.21	356.77	0.00	230.46	40%	92.19
P	*Forest, Water, Wetlands*	340.68	20.7%	70.67	10.30	98.77	231.61	85%	196.86
PD-10	*High, Medium Density Residential*	111.60	8.1%	9.04	13.88	0.00	97.72	45%	43.97
PD-7	*High, Medium Density Residential*	183.74	12.3%	22.65	6.16	0.00	177.58	45%	79.91
R-10	*High, Medium Density Residential*	494.04	27.6%	136.15	17.74	6.20	470.10	45%	211.55
R-20	*High, Medium Density Residential*	0.38	85.0%	0.32	0.00	0.00	0.38	45%	0.17
R-5	*High, Medium Density Residential*	275.96	37.6%	103.79	0.00	5.10	270.86	45%	121.89
R-7	*High, Medium Density Residential*	914.82	30.6%	279.54	33.05	22.99	858.78	45%	386.45
RA-W	*Industrial*	1,290.17	14.6%	188.84	62.72	66.73	1,160.72	40%	464.29
SED	*Forest, Water, Wetlands*	62.89	0.2%	0.13	9.63	0.00	53.26	40%	21.30
	Totals:	***5,121.01***	***20.8%***	***1064.32***	***675.69***	***221.44***	***4,223.88***	***48%***	***2,028.18***

Table E3: Nonpoint Source Loads at Build-Out

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Developable Area *(acres)*	TP Load *(lbs/acre/yr)*	TP *(lbs/yr)*	TN Load *(lbs/acre/yr)*	TN *(lbs/yr)*	TSS Load *(lbs/acre/yr)*	TSS *(lbs/yr)*
HUC ID No. 02030104060010								
B-3	*Industrial*	140	1.50	209	16	2,234	200	27,926
G-1	*High, Medium Density Residential*	30	1.40	42	15	451	140	4,208
MW	*Forest, Water, Wetlands*	126	0.10	13	3	377	40	5,028
P	*Forest, Water, Wetlands*	85	0.10	8	3	255	40	3,400
PD-10	*High, Medium Density Residential*	54	1.40	75	15	806	140	7,518
R-10	*High, Medium Density Residential*	179	1.40	251	15	2,685	140	25,061
R-20	*High, Medium Density Residential*	201	1.40	281	15	3,008	140	28,073
R-7	*High, Medium Density Residential*	432	1.40	605	15	6,477	140	60,453
	Totals:	***1,245***		***1,484***		***16,293***		***161,668***
HUC ID No. 02030105160040								
G-1	*High, Medium Density Residential*	1	1.40	2	15	19	140	176
SED	*Forest, Water, Wetlands*	15	0.10	1	3	45	40	594
	Totals:	***16***		***3***		***63***		***771***
HUC ID No. 02030105160060								
B-2	*Low Density, Rural Residential*	12	0.60	7	5	59	100	1,184
B-3	*Industrial*	11	1.50	17	16	180	200	2,244
G-1	*High, Medium Density Residential*	61	1.40	86	15	919	140	8,574
P	*Forest, Water, Wetlands*	59	0.10	6	3	178	40	2,368
R-10	*High, Medium Density Residential*	16	1.40	23	15	241	140	2,253
SED	*Forest, Water, Wetlands*	113	0.10	11	3	340	40	4,538
	Totals:	***273***		***149***		***1,917***		***21,161***

Table E3: Nonpoint Source Loads at Build-Out

November 2018

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Developable Area *(acres)*	TP Load *(lbs/acre/yr)*	TP *(lbs/yr)*	TN Load *(lbs/acre/yr)*	TN *(lbs/yr)*	TSS Load *(lbs/acre/yr)*	TSS *(lbs/yr)*
HUC ID No. 02030105160070								
B-1	*High, Medium Density Residential*	6	1.40	8	15	88	140	823
B-2	*Low Density, Rural Residential*	63	0.60	38	5	315	100	6,294
G-1	*High, Medium Density Residential*	107	1.40	150	15	1,609	140	15,017
I	*Industrial*	777	1.50	1,165	16	12,431	200	155,384
MW	*Forest, Water, Wetlands*	159	0.10	16	3	477	40	6,359
P	*Forest, Water, Wetlands*	271	0.10	27	3	812	40	10,832
PD-7	*High, Medium Density Residential*	2	1.40	2	15	25	140	233
PO	*Low Density, Rural Residential*	6	0.60	4	5	31	100	618
R-10	*High, Medium Density Residential*	185	1.40	258	15	2,768	140	25,839
R-5	*High, Medium Density Residential*	79	1.40	110	15	1,179	140	11,008
R-7	*High, Medium Density Residential*	485	1.40	679	15	7,275	140	67,902
RA-JMR	*Forest, Water, Wetlands*	45	0.10	5	3	135	40	1,805
SED	*Forest, Water, Wetlands*	250	0.10	25	3	750	40	9,999
	Totals:	***2,434***		***2,488***		***27,896***		***312,114***

HUC14 and Zone	Land Cover *Classified in accordance with Table E1*	Total Developable Area *(acres)*	TP Load *(lbs/acre/yr)*	TP *(lbs/yr)*	TN Load *(lbs/acre/yr)*	TN *(lbs/yr)*	TSS Load *(lbs/acre/yr)*	TSS *(lbs/yr)*
HUC ID No. 02030105160100								
B-1	*High, Medium Density Residential*	3	1.40	4	15	41	140	380
B-2	*Low Density, Rural Residential*	89	0.60	53	5	446	100	8,917
B-3	*Industrial*	216	1.50	324	16	3,452	200	43,149
G-1	*High, Medium Density Residential*	44	1.40	62	15	661	140	6,173
I	*Industrial*	321	1.50	481	16	5,131	200	64,138
MW	*Forest, Water, Wetlands*	230	0.10	23	3	691	40	9,219
P	*Forest, Water, Wetlands*	232	0.10	23	3	695	40	9,264
PD-10	*High, Medium Density Residential*	98	1.40	137	15	1,466	140	13,681
PD-7	*High, Medium Density Residential*	178	1.40	249	15	2,664	140	24,861
R-10	*High, Medium Density Residential*	470	1.40	658	15	7,052	140	65,815
R-20	*High, Medium Density Residential*	0	1.40	1	15	6	140	53
R-5	*High, Medium Density Residential*	271	1.40	379	15	4,063	140	37,921
R-7	*High, Medium Density Residential*	859	1.40	1,202	15	12,882	140	120,229
RA-W	*Industrial*	1,161	1.50	1,741	16	18,572	200	232,144
SED	*Forest, Water, Wetlands*	53	0.10	5	3	160	40	2,130
	Totals:	***4,224***		***5,342***		***57,980***		***638,073***