Amendment to the Lower Raritan/Middlesex, Mercer County, Monmouth County, Northeast, Upper Delaware and Upper Raritan Water Quality Management Plans

Total Maximum Daily Load Report For the Non-Tidal Raritan River Basin Addressing Total Phosphorus, Dissolved Oxygen, pH and Total Suspended Solids Impairments

Watershed Management Areas 8, 9 and 10

Proposed: June 16, 2014
Established:
Approved:
Adopted:

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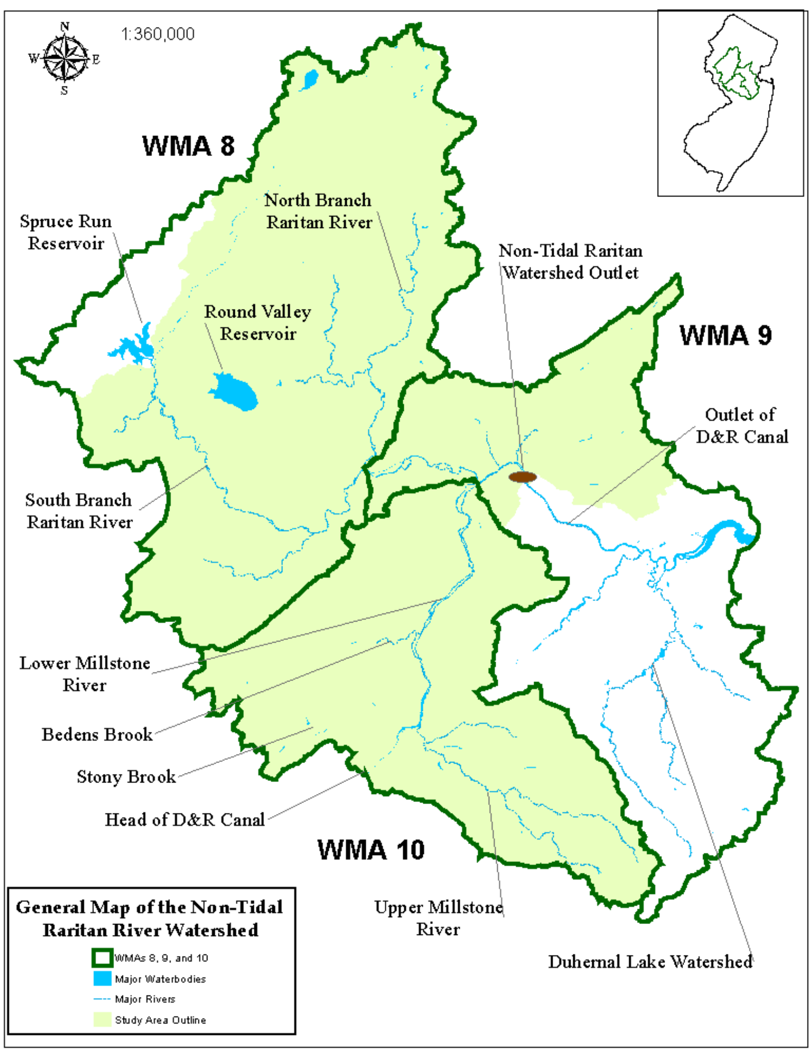
1.0 Executive Summary

This Total Maximum Daily Load (TMDL) document addresses 33 total phosphorus (TP), 3 pH, 1 dissolved oxygen (DO), and 15 total suspended solids (TSS) impairments in the streams and lakes within the non-tidal Raritan River basin. The TMDL study area encompasses portions of Watershed Management Areas 8, 9 and 10 and includes the North and South Branch Raritan River, Upper Millstone River, Stony Brook, Lower Millstone River, Bedens Brook, and the Mainstem Raritan River to Fieldville Dam. The watersheds of the Spruce Run Reservoir, Round Valley Reservoir, and the Delaware and Raritan Canal were not modeled as part of this study, but were included as boundary inputs. The TMDL study area is shaded in Figure 1. Upon completion of the study, it was determined that for TP the mainstem Lower Millstone River and the mainstem Raritan River between the Millstone River confluence and Fieldville Dam must be deferred pending further study. In addition, the Duhernal Lake watershed will be covered in a separate report because the TMDL will be calculated based on a different method than was used for the remainder of the study area.

Figure 1. Raritan River Watershed Overview



In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (Department) is required to assess the overall water quality of the State's waters and identify those waterbodies with water quality impairments for which TMDLs may be necessary. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. The Department fulfills its assessment obligation under the CWA through the Integrated List of Waterbodies, issued biennially. The *2010 Integrated List of Waterbodies* was adopted by the Department and published in the March 5, 2012 New Jersey Register as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a).

The *2010 Integrated List of Waterbodies* and supplemental data gathered to develop this TMDL identified 92 assessment unit/pollutant combinations in the Raritan River basin as impaired with respect to total phosphorus (TP), pH, dissolved oxygen (DO), and total suspended solids (TSS). The Department funded a basin-wide study to identify in-stream critical locations and determine the pollutant load reductions needed to attain the TP, DO, pH, and TSS criteria specified in the Surface Water Quality Standards for the multiple stream classifications present in the non-tidal Raritan River basin. The TMDL study was conducted by Kleinfelder/Omni and resulted in two reports, one summarizing the monitoring work that served as the foundation for the modeling and the other presenting the model development and outcomes. The first report is entitled "The Raritan River Basin TMDL Phase I Data Summary and Analysis Report" (December, 2005). The second report is entitled "The Raritan River Basin Nutrient TMDL Study – Phase II Watershed Model and TMDL Calculations" (August, 2013). Both the Phase I and II Reports can be found within the spreadsheet connected to the "New Jersey TMDLs" link on the Department's website at: http://www.nj.gov/dep/wms/bear/tmdls.html.

These studies were reviewed by the Rutgers New Jersey EcoComplex TMDL review panel and found to be appropriate for use in developing the proposed TMDLs. Using these studies, the Department will address 52 impairments, as described in this TMDL document, as set forth in Table 1.

Table 1. Assessment units addressed by the TMDL report

TMDL	Watershed (HUC 14)	Name of Watershed	Parameter	Priority Ranking from 2010 List
1	NJ02030105010060-01	Raritan R SB(Califon br to Long Valley)	pH	NA**
2	NJ02030105010080-01	Raritan R SB(Spruce Run-StoneMill gage)	TP	NA**
3	NJ02030105020050-01	Beaver Brook (Clinton)	TP	H
4	NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	TP	H
5	NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	TSS	H
6	NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	TSS	H
7	NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	TP	H
8	NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	TSS	H
9	NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	TP	H
10	NJ02030105030070-01	Neshanic River (below Black Brk)	TP	H
11	NJ02030105040010-01	Raritan R SB(Pleasant Run-Three Bridges)	TP	H
12	NJ02030105040030-01	Holland Brook	TP	NA**
13	NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	pH	H
14	NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	TP	H
15	NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	TSS	H
16	NJ02030105050020-01	Lamington R (Hillside Rd to Rt 10)	TP	H
17	NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	TP	H
18	NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	TSS	M
19	NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	pH	M
20	NJ02030105050090-01	Rockaway Ck (below McCrea Mills)	TP	H
21	NJ02030105050100-01	Rockaway Ck SB	TP	H
22	NJ02030105050100-01	Rockaway Ck SB	TSS	H
23	NJ02030105060040-01	Raritan R NB (Peapack Bk to McVickers Bk)	TP	NA**
24	NJ02030105060040-01	Raritan R NB(Peapack Bk to McVickers Bk)	TSS	M
25	NJ02030105070030-01	Raritan R NB (below Rt 28)	TP	H
26	NJ02030105070030-01	Raritan R NB (below Rt 28)	TSS	H
27	NJ02030105080020-01	Raritan R Lwr (Rt 206 to NB / SB)	TP	H
28	NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	TP	NA**
29	NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	TSS	H
30	NJ02030105090050-01	Stony Bk(Province Line Rd to 74d46m dam)	TP	H
31	NJ02030105090060-01	Stony Bk (Rt 206 to Province Line Rd)	TP	H
32	NJ02030105090070-01	Stony Bk (Harrison St to Rt 206)	TP	H
33	NJ02030105090090-01	Stony Bk- Princeton drainage	TP	M
34	NJ02030105100010-01	Millstone River (above Rt 33)	TP	H
35	NJ02030105100010-01	Millstone River (above Rt 33)	TSS	H
36	NJ02030105100020-01	Millstone R (Applegarth road to Rt 33)	TP	H
37	NJ02030105100020-01	Millstone R (Applegarth road to Rt 33)	TSS	H
38	NJ02030105100030-01	Millstone R (RockyBk to Applegarth road)	TP	H
39	NJ02030105100050-01	Rocky Brook (below Monmouth Co line)	TP	H
40	NJ02030105100060-01	Millstone R (Cranbury Bk to Rocky Bk)	DO	NA**

TMDL	Watershed (HUC 14)	Name of Watershed	Parameter	Priority Ranking from 2010 List
41	NJ02030105100060-01	Millstone R (Cranbury Bk to Rocky Bk)	TP	H
42	NJ02030105100090-01	Cranbury Brook (below NJ Turnpike)	TP	NA**
43	NJ02030105100110-01	Devils Brook	TP	NA**
44	NJ02030105100130-01	Bear Brook (below Trenton Road)	TP	NA**
45	NJ02030105100140-01	Millstone R (Rt 1 to Cranbury Bk)	TP	M
46	NJ02030105110010-01	Heathcote Brook	TSS	H
47	NJ02030105110020-01	Millstone R (Heathcote Bk to Harrison St)	TP	NA**
48	NJ02030105110050-01	Beden Brook (below Province Line Rd)	TP	M
49	NJ02030105110100-01	Pike Run (below Cruser Brook)	TP	H
50	NJ02030105120130-01	Green Brook (below Bound Brook)	TSS	M
51	NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	TSS	M
52	NJ02030105120180-01	Middle Brook	TSS	M

Footnote: * The 303(d) List includes the priority ranking ("high", "medium", or "low") of these waters for TMDL development. A detailed explanation of the priority ranking process can be found in Section 8 of the 2010 Methods Document. ** Impairment identified through supplemental data review as part of the TMDL study; these did not have a 2010 303(d) List assigned priority ranking and therefore are marked as Not Applicable (NA) in the table.

The Kleinfelder/Omni reports (2005, 2013) describe the development of integrated hydrodynamic and water quality models used to develop the TMDLs. The water quality model used was Water Quality Analysis Simulation Program 7.1 (WASP 7.1), and the hydrologic model used was named HydroWAMIT. The latter component provides hydrodynamic and nonpoint source inputs to WASP 7.1. The study area was divided into five subbasins for which models were constructed and calibrated for nutrients, DO and TSS. The linked models were used to simulate water quality and flow in the non-tidal Raritan River under various scenarios and to calculate the pollutant load reductions needed to meet the critical water quality end point that would ensure attainment of SWQS for the subject parameters throughout the study area.

The total allowable load was disaggregated among wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources, along with a required margin of safety (MOS), while providing for reserve capacity (RC) for future loads. The WLAs and LAs, MOS and RC are summarized in Tables 5 through 11 in Section 5.0 of this TMDL report. The details on how these values were calculated can be found in the Kleinfelder/Omni report (Kleinfelder, 2013).

The TMDL document shall be proposed and made available for public comment. Upon satisfactory completion of the public review process and upon approval by EPA, the TMDL document will be adopted by the Department as an amendment to the Lower Raritan/Middlesex, Mercer County, Monmouth County, Northeast, Upper Delaware and Upper Raritan Water Quality Management Plans (WQMPs) in accordance with N.J.A.C. 7:15-6.

This TMDL report was prepared in accordance with the following USEPA guidance documents: *Revisions to the November 22, 2002 Memorandum Establishing Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs; EPA Review of 2002 Section 303(d) List and Guidelines for Reviewing TMDLs under Existing Regulations Issues in 1992; Establishing Total Maximum Daily Load (TMDL) Wasteland Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on those WLAs;* and *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. V. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits*.

2.0 Introduction

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the EPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The Integrated Water Quality Monitoring and Assessment Report combines these two assessments and assigns waterbodies to one of five sublists on the Integrated List of Waterbodies.

The *New Jersey 2010 Integrated Water Quality Monitoring and Assessment Report* identified impairments based on designated use attainment and then listed the parameters responsible for the non-attainment of the designated use. The assessments were conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublists 1 and 2), have limited assessment or data availability (Sublist 3), or are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required. For the Raritan River basin, the *2010 Integrated List of Waterbodies* identified 75 assessment units as impaired for total phosphorus, pH, dissolved oxygen, and/or total suspended solids based on in-stream concentrations not meeting the applicable SWQS for the pollutant. An additional 17 impairments were found based on the data gathered during the TMDL study, resulting in a total of 92 impairments that would be considered under the TMDL study. At the conclusion of the study, it was determined that TMDLs were not warranted or could not be prepared at this time for all of the identified impairments. The basis for these determinations is discussed more fully under "Pollutants of Concern" in section 3.0 below. Through this TMDL document, the Department is proposing TMDLs for 52 water quality impairments.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background, and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating the state's water quality standard, allocates that load capacity to known point and nonpoint sources, and is expressed as the sum of Waste Load Allocations for point sources, Load Allocations for nonpoint sources, a required Margin of Safety, and an optional Reserve Capacity.

EPA guidance entitled, *EPA Review of 2002 Section 303(d) Lists and Guidelines for Reviewing TMDLs under Existing Regulations Issues in 1992* (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that the TMDLs in this report address the following items in the May 20, 2002 guideline document:

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

In addition to Sutfin 2002, this TMDL report was prepared in accordance with the USEPA guidance documents; *Revisions to the November 22, 2002 Memorandum Establishing Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs; Establishing Total Maximum Daily Load (TMDL) Wasteland Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on those WLAs;* and *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. V. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits*.

3.0 Pollutants of Concern and Area of Interest

3.1 Pollutants of Concern

The pollutants of concern for this TMDL study are phosphorus (including associated oxygen and pH effects due to primary productivity), ammonia, and total suspended solids. Each of these parameters can have detrimental effects with regard to supporting designated uses of waters. This section describes the water quality standards and the concerns associated with each pollutant.

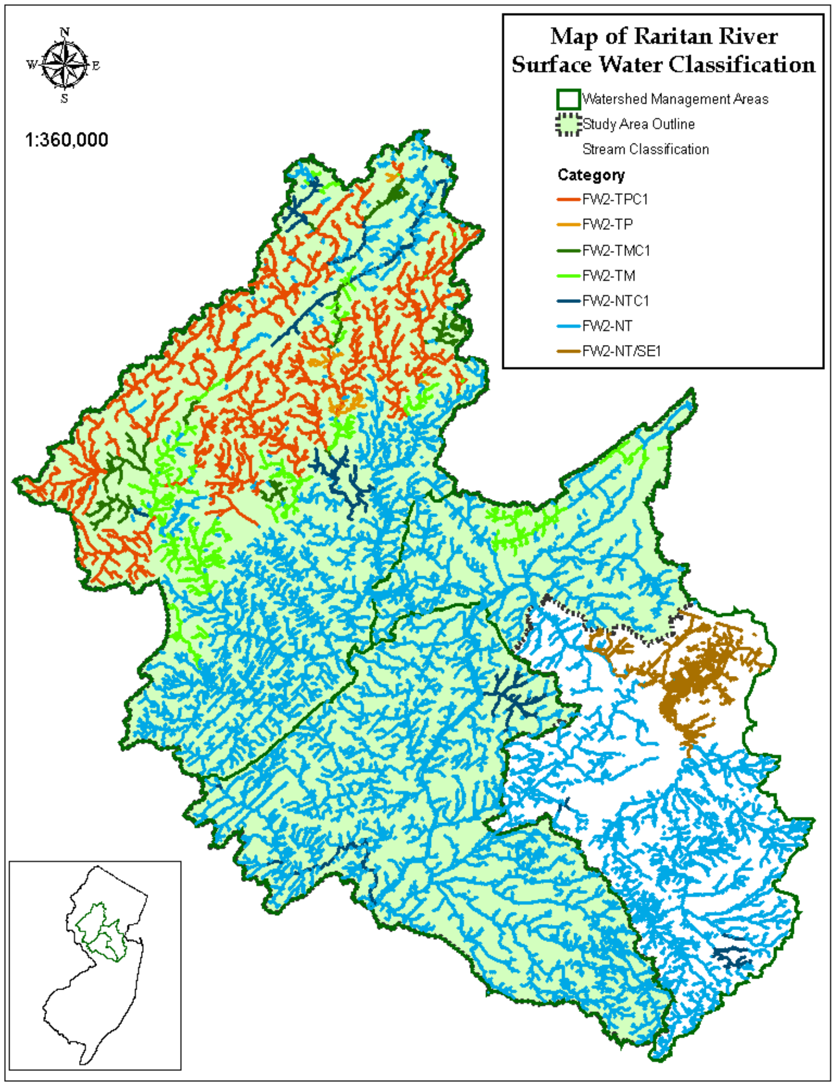
Monitoring data and/or model simulations indicate that the TP, DO, pH, and TSS criteria were not met during critical conditions in various assessment units. The focus of this study was to define the pollutant responsible, either directly or indirectly, for non-attainment of applicable criteria and the designated uses they were established to support.

All of the impaired assessment units addressed in this report are classified as Fresh Water 2 (FW2). In all FW2 waters, the designated uses are set forth in N.J.A.C. 7:9B-1.12 c:

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

FW2 waters receive an additional designation related to status with respect to support of trout species. Within the study area, waters are designated Non-Trout (NT), Trout Maintenance (TM), or Trout Production (TP). The Raritan River basin includes both Category 1 (C1) and Category 2 (C2) designated waters, a designation relevant to anti-degradation status. C1 streams are designated through rulemaking for protection from measurable changes in water quality because of their exceptional ecological significance, exceptional water supply, exceptional recreation, and exceptional fisheries to protect and maintain their water quality, aesthetic value, and ecological integrity. In C2 waters, similar to C1 waters, existing water quality is to be maintained where it is better than standards; however, lowering of water quality can be allowed to accommodate necessary and important social and economic development, provided standards are attained. This information important for determining the applicable SWQS and is presented in Figure 2. The applicable SWQS for the parameters of concern are provided below.

Figure 2. Raritan Watershed Surface Water Classification



Phosphorus:

The first parameter of concern in this TMDL report is total phosphorus. Plant growth is a necessary element in a healthy aquatic community, with one key role being to serve as the foundation of the food web. Phosphorus is a key nutrient for plant growth and is often the limiting nutrient in a freshwater setting. Therefore, the amount of phosphorus is a key factor in the extent of productivity and, when present in excessive amounts, phosphorus can lead to excessive primary productivity, in the form of algal and/or macrophyte growth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. The narrative nutrient criteria reference this issue. There are also implications that result from excessive algae with respect to the drinking water use. Algal blooms in raw drinking water sources can cause taste and odor problems and have a negative impact on conventional treatment efficiency at a drinking water system. When algae are present in large amounts, purveyors must increase the use of disinfectants and oxidants to treat the algae, which can lead to an increase in disinfection byproducts such as trihalomethanes, listed as likely carcinogens by EPA. In addition, the respiration cycle in the presence of excessive plant biomass can cause significant swings in pH and dissolved oxygen, which can result in the violation of criteria for these parameters and adversely affect the aquatic community.

There are numeric criteria with respect to phosphorus, as well as, narrative nutrient criteria and nutrient policies. As stated in N.J.A.C. 7:9B-1.14(d) of the SWQS for all waters, the narrative criteria for nutrients are as follows:

> Nutrients
> 4.i. Except as due to natural conditions, nutrients shall not be allowed in concentrations that render the waters unsuitable for the existing or designated uses due to objectionable algal densities, nuisance aquatic vegetation, diurnal fluctuations in dissolved oxygen or pH indicative of excessive photosynthetic activity, detrimental changes to the composition of aquatic ecosystems, or other indicators of use impairment caused by nutrients.

As stated in N.J.A.C. 7:9B-1.14(d) of the SWQS for FW2 waters, the numeric criteria for phosphorus are as follows:

> 4.ii. Phosphorus, Total (mg/l):
> (1) Non Tidal Streams: Concentrations of total P shall not exceed 0.1 in any stream, unless watershed-specific translators are established pursuant to N.J.A.C. 7:9B-1.5(g)2 or if the Department determines that concentrations do not render the waters unsuitable in accordance with (d)4i. above
>
> (2) Lakes: Concentrations of total P shall not exceed 0.05 in any lake, pond or reservoir, or in a tributary at the point where it enters such bodies of water, unless watershed-specific translators are developed pursuant to N.J.A.C. 7:9B-1.5(g)2 or if the Department determines that concentrations do not render the waters unsuitable in accordance with (d)4i. above

As stated in N.J.A.C. 7:9B-1.5(g), the nutrient policies are as follows:

1. These policies apply to all waters of the State.
2. The Department may develop watershed-specific translators or site-specific criteria through a Total Maximum Daily Load (TMDL). Site specific criteria shall be incorporated at N.J.A.C. 7:9B-1.14(g).
3. The Department shall establish water quality-based effluent limits for nutrients, in addition to or more stringent than the effluent standard in N.J.A.C. 7:14A-12.7, as necessary to meet a wasteload allocation established through a TMDL, or to meet the criteria at N.J.A.C. 7:9B-1.14(d)4.
4. Activities resulting in the nonpoint discharge of nutrients shall implement the best management practices determined by the Department to be necessary to protect the existing or designated uses.

Numerous waterbodies within the Raritan River basin were placed on Sublist 5 in the 2010 *Integrated List* (see Table 2), based on data showing phosphorus in excess of the numeric in-stream criterion of 0.1 mg/l. However, data are not generally available to assess waterbodies relative to the narrative nutrient criteria during the assessment process. Therefore, the numeric criterion is often the sole basis for listing of a waterbody with respect to phosphorus. One of the objectives of the monitoring program conducted for this TMDL report was to determine if phosphorus was causing non-attainment of any of the narrative criteria. Within the non-tidal Raritan River study area, relevant parameters were monitored under a range of flow conditions at representative locations. The details of the monitoring program and data generated are provided in the support materials for this TMDL document (Kleinfelder/Omni, 2005). Diurnal dissolved oxygen and pH are two parameters that are illustrative of the eutrophication effects of phosphorus in the waterbodies. Excessive primary productivity is indicated by high swings in pH and dissolved oxygen concentrations and may result in a pH maxima and dissolved oxygen minima in violation of the SWQS. Based on careful evaluation of the data, the Department has determined that phosphorus is responsible for causing excessive primary productivity at many locations in the Raritan River basin, and in some locations, this excessive productivity was resulting in non-attainment of DO and pH. Because of the relationship between productivity and DO and pH, several of the DO and pH impairments will be addressed by way of controlling excessive productivity. DO is directly modeled and allowed this determination directly. By determining site specific relationships between DO-pH, several pH problems in the basin can be demonstrated to be addressed by controlling productivity. It is expected that most if not all of the other pH impairments will be addressed by controlling productivity, but this cannot be demonstrated at this time. These locations will be monitored to determine if implementing these TMDLs has been effective in addressing the remaining pH impairments in the Raritan Watershed. More detail on the site locations for TMDL development based on pH and dissolved oxygen endpoints is found below and also later in report section "5.0 Analytical Approach and TMDL Calculation".

Unless attainment of another SWQS required a greater reduction, meeting the numeric criterion at the outlet of the applicable HUC14 assessment unit was set as the TMDL endpoint. Where the narrative criteria are met, the numeric criterion of 0.1 mg/L TP was not set as a target, but attainment of SWQS at other locations did drive pollutant load reductions in some upstream areas.

The SWQS allow for natural conditions to supersede the numeric criteria where natural conditions would not result in attainment of the established criteria. For the natural condition, it was assumed that all land uses were undisturbed. Natural conditions were found to apply in lieu of the default criterion in the 4 small lakes in the Upper Millstone basin as well as in Carnegie Lake. The natural condition determined for Carnegie Lake was the critical driver for reductions in the Upper Millstone watershed.

Dissolved Oxygen:

The second parameter of concern is Dissolved Oxygen (DO). The value given for DO is the amount of oxygen that is in solution. Having the right amount of DO is essential for aquatic organism survival. Dissolved oxygen is introduced and lost in the waterbody through a number of cyclical processes. These include the flux of oxygen into and out of the atmosphere, photosynthesis, respiration and decomposition. Dissolved oxygen circulates through a waterbody via turbulence and currents and is affected by a number of physical factors, such as wind, wave action, altitude, salinity and temperature. For example, warm water holds less DO; low and slow moving water from low volume and/or channel geometry may increase localized effects of oxygen demand from decomposition. It is because of the photosynthesis/respiration cycle that issues with levels of DO may be connected to levels of phosphorus in a waterbody. During daylight periods, aquatic plants and algae produce oxygen through photosynthesis, with a net positive increase when balanced with daytime respiration. At night, both plants and animals consume oxygen through respiration and there is no photosynthesis, so there is a net loss of DO. In highly productive waterbodies, DO consumed by night-time respiration may so far exceed influx from the atmosphere that there is a decline below levels needed to support aquatic life.

Low dissolved oxygen can result from factors besides the respiration side of the diurnal swing associated with the excessive primary productivity. For example, biochemical oxygen demand and nitrification of ammonia from wastewater treatment discharges consume dissolved oxygen. Besides anthropogenic sources, the natural process of breaking down plant and animal materials that have settled to the stream bed also consumes oxygen and is known as sediment oxygen demand (SOD). While some SOD is normal, it can be greater than under natural conditions if productivity is excessive. It should be noted that dissolved oxygen can be naturally low in some areas, such as headwaters, where surface water is derived directly from ground water sources, which are low in dissolved oxygen, and have not had time to oxygenate from exposure to the atmosphere.

The Department has surface water quality standards for DO, based on variable surface water classifications to protect aquatic life (general and trout). Those that apply in the study area include:

Dissolved Oxygen (mg/L)		
i.	Not less than 7.0 at any time;	FW2 – TP
ii.	24 hour average not less than 6.0. Not less than 5.0 at any time (see paragraph viii below);	FW2 - TM
iii.	24 hour average not less than 5.0, but not less than 4.0 at any time (see paragraph viii below);	FW2-NT
viii.	Supersaturated dissolved oxygen values shall be expressed as their corresponding 100 percent saturation values for purposes of calculating 24 hour averages.	FW2 TM, NT

pH:

The third parameter of concern is pH. The pH of a solution is a measure of the molar concentration of hydrogen ions in the solution and as such is a measure of the acidity or basicity of the solution. Most lakes and streams have a pH between 6 and 8. Fluctuations of pH seen in the Raritan follow a diurnal cycle and are positively correlated to dissolved oxygen. The SWQS defined pH range protects aquatic life (general and trout), drinking water supply, and industrial water supply designated uses. The Department has surface water quality standards for pH evaluated based on surface water classification. Criteria applicable in the Raritan study area are presented below.

pH (standard units)

i.	6.5 - 8.5	FW2 waters listed at 1.15(d), (f), (g) and (i),
ii.	4.5 – 7.5	FW2 waters listed at 1.15(c), (e) and (h)

Ammonia:

The fourth parameter of concern is Ammonia. Un-ionized ammonia is typically an aquatic life (general and trout) designated use concern from a toxicity perspective. However, monitoring and modeling determined ammonia to be the cause of an existing minimum dissolved oxygen violation in the Upper Millstone River. This was confirmed through the water quality study through monitoring at UMR3. The DO violation is proposed to be addressed by reducing the nitrogenous oxygen demand caused by ammonia in effluent discharged from Princeton Meadows WWTP.

Total Suspended Solids:

The fifth parameter of concern in this TMDL report is Total Suspended Solids (TSS). High concentrations of suspended solids can cause problems for stream health and aquatic life. Excessive TSS can bury benthic organisms and can affect the viability of organisms that reside in the water column. The SWQS defined TSS levels protect aquatic life (general and trout) and industrial water supply designated uses.

Solids, Suspended (mg/L) (Non-filterable residue)

i.	25.0	FW2-TP, FW2-TM
ii.	40.0	FW2-NT

3.2 Area of Interest

The spatial focus of this TMDL study is the non-tidal Raritan River basin. Figure 1 shows the study area and depicts the limits of the model domain, wherein a series of dynamic models were constructed to simulate the water quality response to pollutant loading. Drainage areas to Spruce Run Reservoir, Round Valley Reservoir, and Delaware and Raritan Canal were not within the model domain. The loadings from these drainage areas were introduced to the model as boundary inputs. There are 106 HUC-14s assessment units within the model domain. Based on the 2010 303(d) list, there are 92 combinations of pollutants/assessment units that are identified as impairments within the model domain and considered in this TMDL study, as outlined in Table 2.

Some areas within the area of interest will not be addressed in this TMDL document.
The TP impairment in the mainstem Raritan River between the Millstone River confluence and Fieldville Dam stream segment is deferred at this time. While there is evidence of excessive primary productivity and associated non-attainment of pH, the water quality response in this stretch could not be reliably predicted due to some unknown variable that is not captured by the model. Therefore, additional study will be needed in order to determine the appropriate management response.

This TMDL report does not address impaired assessment units contributing to Spruce Run Reservoir, Round Valley Reservoir, and Delaware and Raritan Canal. These areas were not included in the dynamic model because they are managed as part of the water supply system. It was determined that the effort that would be required to include these areas as part of the dynamic model was not warranted because they could be efficiently and effectively included as boundary inputs to the dynamically modeled area.

Further, the Duhernal Lake watershed impairments will be addressed in a separate TMDL report. A separate report is appropriate as a different approach is taken for Duhernal Lake TMDL development and is not yet complete.

The total number of impairments that will be addressed was also reduced because, under the TMDL simulation, attaining standards could not be definitively demonstrated for 23 DO and pH impairments. However, there is a reasonable expectation that many if not all of these impairments will be addressed by implementing the TMDLs calculated for the remainder of the study area. These areas will continue to be monitored following TMDL implementation to determine if SWQS are attained. These impairments will remain on the 303(d) list, but will receive a low priority for TMDL development, pending the results of further monitoring.

As a result of these refinements to the spatial extent of the study, the Department proposes to address 52 impairments that are associated with 39 assessment units (HUC14s), including 33 TP, 1 DO, 3 pH and 15 TSS impairments. The assessed HUCs and proposed TMDLs are presented below in Table 2. The complete assessment status of the assessment units within the study area, are identified in Appendix C. Assessment unit/pollutant combinations for which TMDLs have already been established and approved are provided in Appendix D. Separate TMDL evaluations will be developed to address other pollutants of concern as appropriate and as resources allow. Therefore, these waterbodies will remain on Sublist 5 with respect to these pollutants until such time that a TMDL has been completed and approved by EPA. With respect to the impairments listed as addressed in Table 2, these waterbodies will be moved to Sublist 4 following approval of these TMDLs by EPA Region 2. Impairments assessed and addressed by the TMDL are also mapped in Figures 3, 4, 5, and 6.

Table 2. HUC 14 watersheds assessed by this TMDL study

Watershed (HUC 14)	Name of Watershed	Parameter	Basis of Impairment *	TMDL #/Other Outcome
NJ02030105010050-01	Raritan R SB(LongValley br to 74d44m15s)	pH	SDR	Unaddressed
NJ02030105010060-01	Raritan R SB(Califon br to Long Valley)	DO	2010	Unaddressed
NJ02030105010060-01	Raritan R SB(Califon br to Long Valley)	pH	SDR	1
NJ02030105010080-01	Raritan R SB(Spruce Run-StoneMill gage)	TP	SDR	2
NJ02030105020050-01	Beaver Brook (Clinton)	pH	2010	Unaddressed
NJ02030105020050-01	Beaver Brook (Clinton)	TP	2010	3
NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	pH	2010	Unaddressed
NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	TP	2010	4
NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	TSS	2010	5
NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	pH	SDR	Unaddressed
NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	TSS	2010	6
NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	pH	SDR	Unaddressed
NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	TP	2010	7
NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	TSS	2010	8
NJ02030105030030-01	Headquarters trib (Third Neshanic River)	DO	2010	Unaddressed
NJ02030105030040-01	Third Neshanic River	DO	2010	Unaddressed
NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	DO	2010	Unaddressed
NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	pH	2010	Unaddressed
NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	TP	2010	9
NJ02030105030070-01	Neshanic River (below Black Brk)	pH	2010	Unaddressed
NJ02030105030070-01	Neshanic River (below Black Brk)	TP	2010	10
NJ02030105040010-01	Raritan R SB(Pleasant Run-Three Bridges)	TP	2010	11
NJ02030105040030-01	Holland Brook	pH	SDR	Unaddressed
NJ02030105040030-01	Holland Brook	TP	SDR	12
NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	pH	2010	13
NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	TP	2010	14
NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	TSS	2010	15
NJ02030105050020-01	Lamington R (Hillside Rd to Rt 10)	DO	SDR	Unaddressed
NJ02030105050020-01	Lamington R (Hillside Rd to Rt 10)	TP	2010	16
NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	TP	2010	17
NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	TSS	2010	18
NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	pH	2010	19
NJ02030105050090-01	Rockaway Ck (below McCrea Mills)	pH	2010	Unaddressed
NJ02030105050090-01	Rockaway Ck (below McCrea Mills)	TP	2010	20
NJ02030105050100-01	Rockaway Ck SB	TP	2010	21
NJ02030105050100-01	Rockaway Ck SB	TSS	2010	22
NJ02030105060040-01	Raritan R NB(Peapack Bk to McVickers Bk)	DO	2010	Unaddressed
NJ02030105060040-01	Raritan R NB (Peapack Bk to McVickers Bk)	TP	SDR	23
NJ02030105060040-01	Raritan R NB(Peapack Bk to McVickers Bk)	TSS	2010	24
NJ02030105060090-01	Raritan R NB (Lamington R to Mine Bk)	pH	SDR	Unaddressed
NJ02030105070030-01	Raritan R NB (below Rt 28)	pH	SDR	Unaddressed
NJ02030105070030-01	Raritan R NB (below Rt 28)	TP	2010	25

Watershed (HUC 14)	Name of Watershed	Parameter	Basis of Impairment *	TMDL #/Other Outcome
NJ02030105070030-01	Raritan R NB (below Rt 28)	TSS	2010	26
NJ02030105080020-01	Raritan R Lwr (Rt 206 to NB / SB)	TP	2010	27
NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	pH	2010	Unaddressed
NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	TP	SDR	28
NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	TSS	2010	29
NJ02030105090050-01	Stony Bk(Province Line Rd to 74d46m dam)	TP	2010	30
NJ02030105090060-01	Stony Bk (Rt 206 to Province Line Rd)	TP	2010	31
NJ02030105090070-01	Stony Bk (Harrison St to Rt 206)	TP	2010	32
NJ02030105090090-01	Stony Bk- Princeton drainage	TP	2010	33
NJ02030105100010-01	Millstone River (above Rt 33)	TP	2010	34
NJ02030105100010-01	Millstone River (above Rt 33)	TSS	2010	35
NJ02030105100020-01	Millstone R (Applegarth road to Rt 33)	TP	2010	36
NJ02030105100020-01	Millstone R (Applegarth road to Rt 33)	TSS	2010	37
NJ02030105100030-01	Millstone R (RockyBk to Applegarth road)	DO	2010	Unaddressed
NJ02030105100030-01	Millstone R (RockyBk to Applegarth road)	TP	2010	38
NJ02030105100050-01	Rocky Brook (below Monmouth Co line)	DO	2010	Unaddressed
NJ02030105100050-01	Rocky Brook (below Monmouth Co line)	TP	2010	39
NJ02030105100060-01	Millstone R (Cranbury Bk to Rocky Bk)	DO	SDR	40
NJ02030105100060-01	Millstone R (Cranbury Bk to Rocky Bk)	TP	2010	41
NJ02030105100090-01	Cranbury Brook (below NJ Turnpike)	TP	SDR	42
NJ02030105100110-01	Devils Brook	DO	2010	Unaddressed
NJ02030105100110-01	Devils Brook	TP	SDR	43
NJ02030105100130-01	Bear Brook (below Trenton Road)	DO	2010	Unaddressed
NJ02030105100130-01	Bear Brook (below Trenton Road)	TP	SDR	44
NJ02030105100140-01	Millstone R (Rt 1 to Cranbury Bk)	DO	2010	Unaddressed
NJ02030105100140-01	Millstone R (Rt 1 to Cranbury Bk)	TP	2010	45
NJ02030105110010-01	Heathcote Brook	pH	2010	Deferred
NJ02030105110010-01	Heathcote Brook	TSS	2010	46
NJ02030105110020-01	Millstone R (Heathcote Bk to Harrison St)	TP	SDR	47
NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	DO	2010	Deferred
NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	pH	2010	Deferred
NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	TP	2010	Deferred
NJ02030105110050-01	Beden Brook (below Province Line Rd)	TP	2010	48
NJ02030105110100-01	Pike Run (below Cruser Brook)	TP	2010	49
NJ02030105110110-01	Millstone R (BlackwellsMills to BedenBk)	TP	2010	Deferred
NJ02030105110120-01	Sixmile Run (above Middlebush Rd)	TP	2010	Deferred
NJ02030105110130-01	Sixmile Run (below Middlebush Rd)	TP	2010	Deferred
NJ02030105110140-01	Millstone R(AmwellRd to BlackwellsMills)	TP	2010	Deferred
NJ02030105110170-01	Millstone River (below Amwell Rd)	pH	2010	Deferred
NJ02030105110170-01	Millstone River (below Amwell Rd)	TP	2010	Deferred
NJ02030105120020-01	Green Bk (N Plainfield gage to Blue Bk)	pH	2010	Deferred
NJ02030105120080-01	South Fork of Bound Brook	TP	2010	Deferred
NJ02030105120090-01	Spring Lake Fork of Bound Brook	TP	2010	Deferred

Watershed (HUC 14)	Name of Watershed	Parameter	Basis of Impairment *	TMDL #/Other Outcome
NJ02030105120100-01	Bound Brook (below fork at 74d 25m 15s)	TP	2010	Deferred
NJ02030105120130-01	Green Brook (below Bound Brook)	TP	2010	Deferred
NJ02030105120130-01	Green Brook (below Bound Brook)	TSS	2010	50
NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	TP	2010	Deferred
NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	TSS	2010	51
NJ02030105120180-01	Middle Brook	TP	2010	Deferred
NJ02030105120180-01	Middle Brook	TSS	2010	52

Footnotes: * 2010 Assessment or Supplemental Data Review (SDR).

Figure 3. Raritan River 2010 *Integrated List* Total Phosphorus Assessments

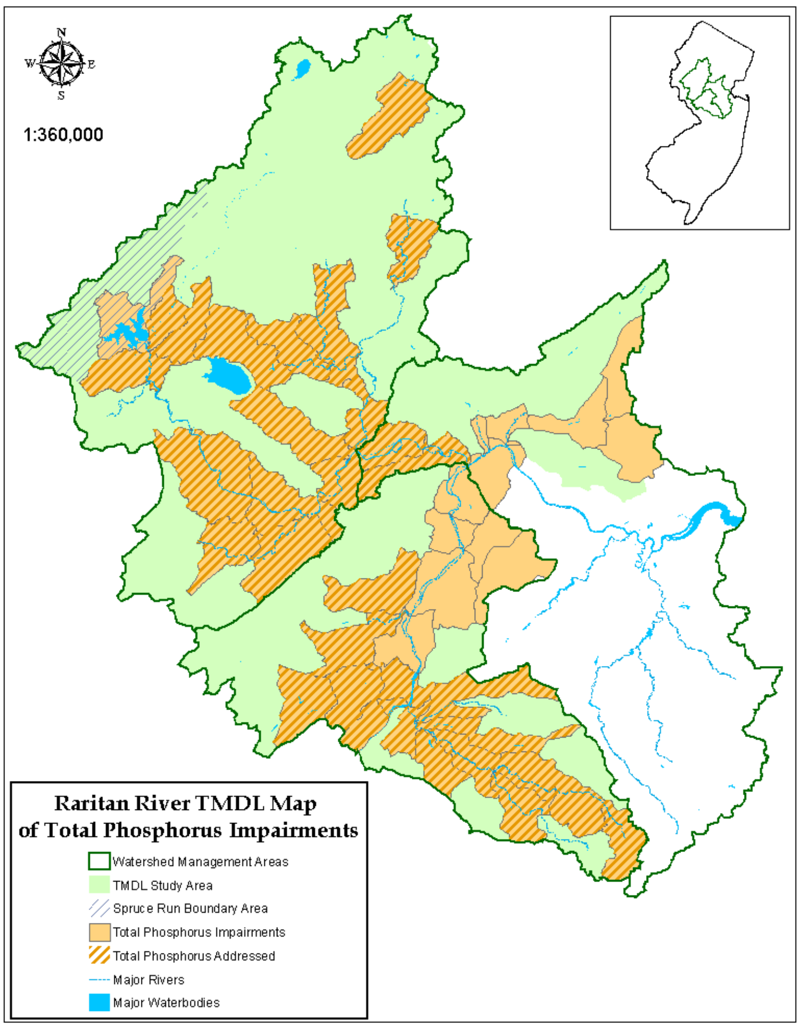


Figure 4. Raritan River 2010 *Integrated List* Dissolved Oxygen Assessments

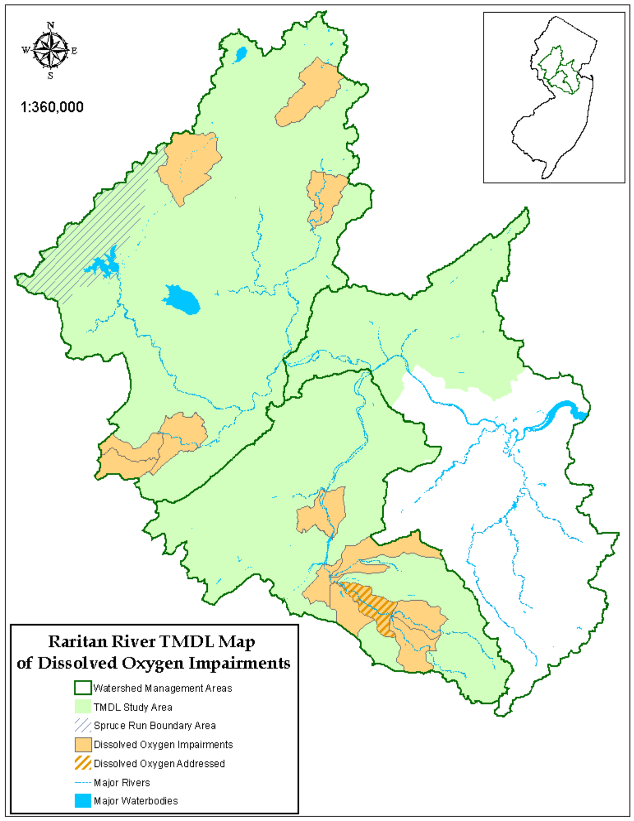


Figure 5. Raritan River 2010 *Integrated List* pH Assessments

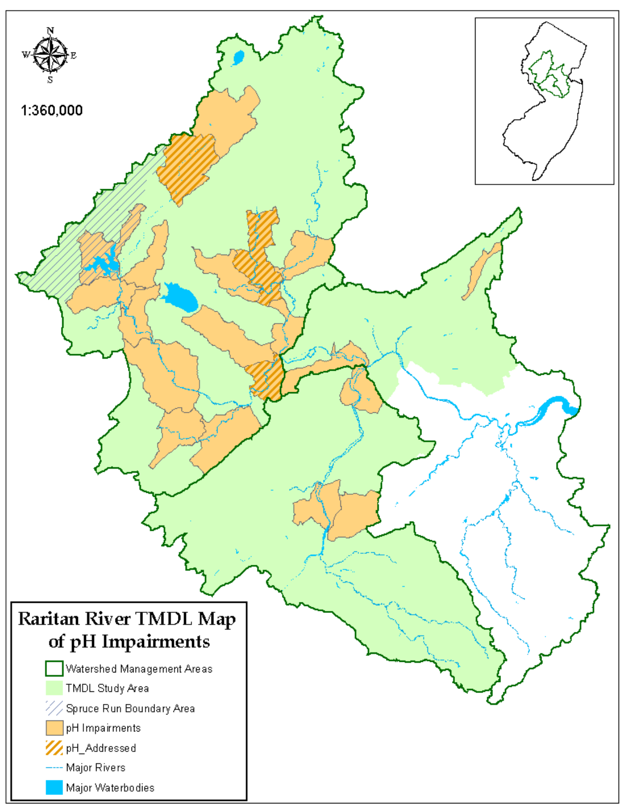
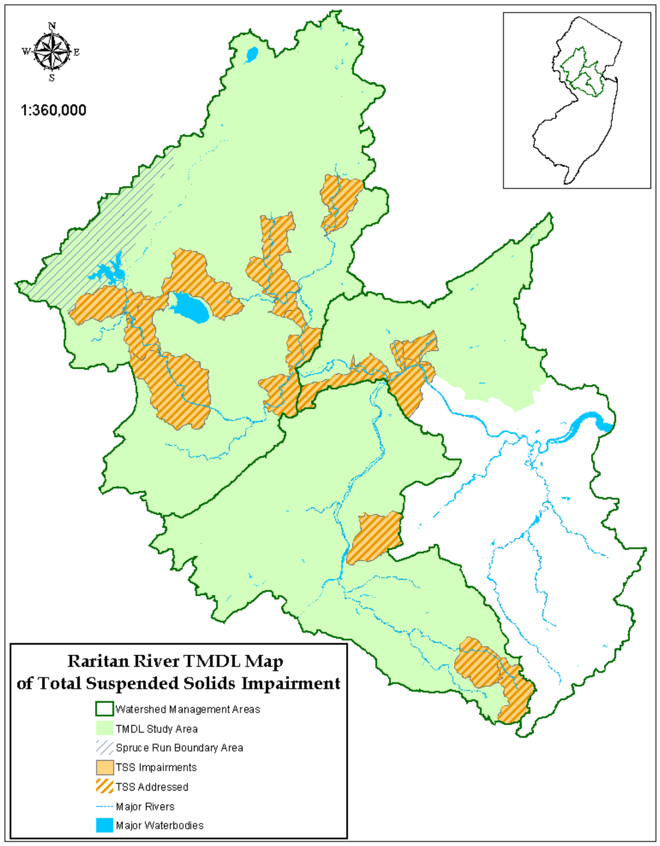


Figure 6. Raritan River 2010 *Integrated List* Total Suspended Solids Assessments



General information about the area of interest, which includes the non-tidal Raritan River basin within Watershed Management Areas 8, 9, and 10, is provided below:

<u>Watershed Management Area 8 - North and South Branch Raritan</u>

Watershed Management Area 8 includes the North and South Branches of the Raritan River and their tributaries. Large portions of Somerset, Hunterdon, and Morris Counties are included in this land area.

The South Branch of the Raritan River, beginning in the most northern part of the watershed at the outlet of Budd Lake and flowing to the southwest, southeast, and then northeast, is 51 miles long and flows from western Morris County through central Hunterdon County into western Somerset County before joining the North Branch near the confluence with the mainstem Raritan River. Major tributaries include the Neshanic River, Spruce Run Creek, Mulhockaway Creek and Cakepoulin Creek and major impoundments are the Spruce Run and Round Valley Reservoirs. Land use in the South Branch Raritan River Watershed is mostly agricultural, but suburban-industrial development is increasing at a rapid rate. Near Neshanic Station, the South Branch is joined by the Neshanic River which, from its confluence the river turns and flows north to its confluence with the North Branch, forming the Raritan River.

The North Branch of the Raritan River is 23 miles long and flows from northwestern Morris County through Somerset County to the confluence with the South Branch between the towns of Branchburg and Raritan. Major tributaries include the Peapack Brook, Rockaway Creek and Lamington River and the only major impoundment is Ravine Lake. Land use in the North Branch Raritan River Watershed is primarily rural, woodland and agricultural with scattered areas of commercial and residential but there is intense development along the major road corridors.

Watershed Management Area 9 - Lower Raritan, South River, Lawrence

Watershed Management Area 9 includes the mainstem of the Raritan River, the South River and Lawrence Brook. Middlesex, Somerset and Monmouth Counties make up most of the political geography of this WMA.

The mainstem of the Raritan River spans from the confluence of the North and South Branches to the Raritan Bay. For the most part, this drainage area is densely populated. Until recently, there were two low dams in this river, Fieldsville Dam and Calco Dam. Among the many small recreational lakes and ponds in this area are Watchung Lake, Surprise Lake, Spring Lake and Green Brook Pond (all manmade). Land use in the mainstem Raritan River Watershed is primarily urban/suburban, with industrial and commercial centers throughout.

The drainage area of Duhernal Lake constitutes a large portion of WMA 9. As mentioned earlier, the TMDL development for Duhernal Lake will be covered in a separate report.

Watershed Management Area 10 – Millstone

Watershed Management Area 10 includes the Millstone River and its tributaries. The Millstone River itself is a tributary to the Raritan River. This watershed lies in parts of Hunterdon, Somerset, Middlesex, Mercer and Monmouth Counties.

The Millstone River is 38 miles long and flows from Millstone Township in Monmouth County to the Raritan River near Manville and Bound Brook. Major tributaries include the Stony Brook, Cranbury Brook, Bear Brook, Ten Mile Run, Six Mile Run and Bedens Brook and the largest impoundment is Carnegie Lake. Land use in the Millstone Watershed is primarily suburban development with scattered agricultural areas although there is extensive, recent development present in the upper portion.

Land use in the non-tidal Raritan River basin within the model domain is depicted in Figure 7 and summarized in Table 3. In general, agricultural and forested land uses are more prevalent in the northern, upstream portions of the study area, wetland areas are more prevalent in the south, and urban areas increase towards the downstream parts of the basin.

Figure 7. 2007 Land Use in the Raritan River Basin Covered by this TMDL

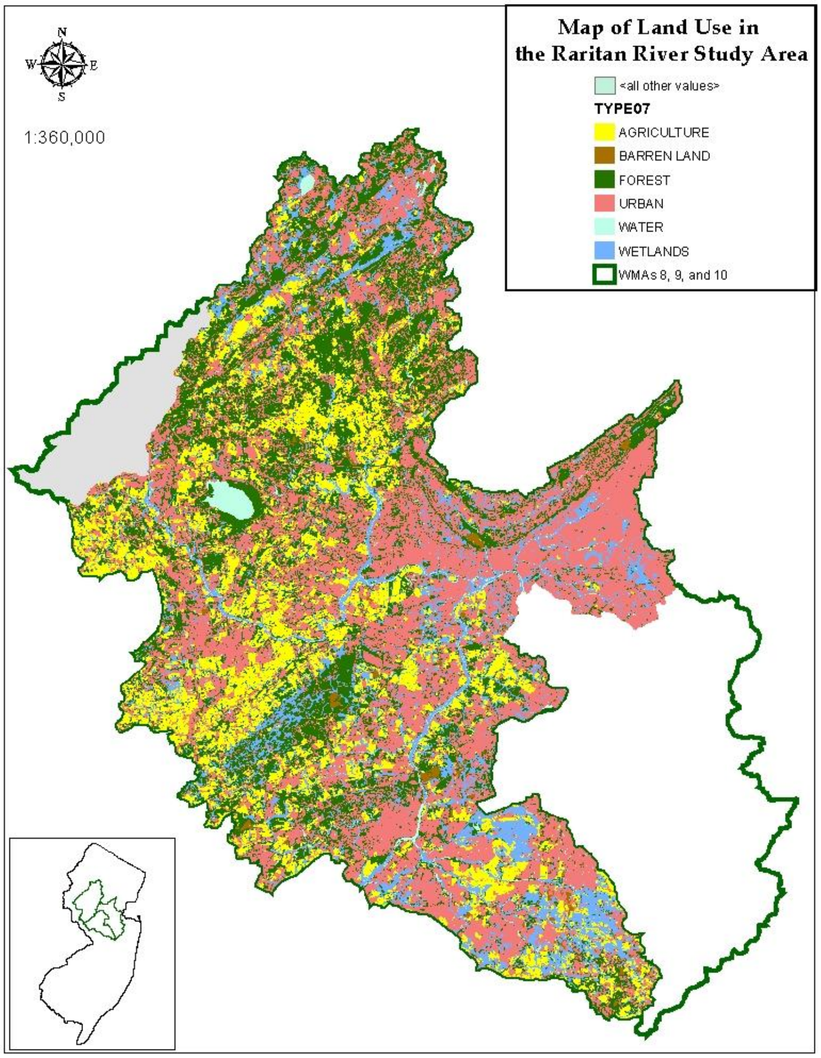


Table 3. 2007 Land Use in the Raritan River Basin Covered by this TMDL

Landuse Classification (TYPE07)	Acres	Percent
Agriculture	95,835	17.8%
Barren Land	4,943	0.9%
Forest	146,810	27.2%
Urban	215,555	40.0%
Water	9,095	1.7%
Wetlands	67,173	12.5%
TOTAL	539,411	

For purposes of TMDL modeling conducted by Kleinfelder/Omni, the study area was divided into five subbasins and a model was developed for each subbasin: North and South Branch Raritan River (NSBranch), Upper Millstone River (UpperMills), Stony Brook (Stony), Beden Brook/Lower Millstone River (BBLowerMills), and Mainstem Raritan (Mainstem). Each model area is described in greater detail in the technical report (Kleinfelder/Omni, 2013)). This subdivision was necessary due to the large size of the Raritan River Basin. The separation into five watershed area models provides a flexible structure and allows the kinetic coefficients for the water quality parameters to be better represented during the water quality simulations.

4.0 Source Assessment

Point Sources

For the purposes of TMDL development, point sources (PS) include domestic and industrial wastewater treatment plants that discharge to surface water, combined sewer overflows (CSOs), as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the NJPDES municipal stormwater permitting program. Point sources contributing phosphorus loads within the affected drainage area include the wastewater treatment facilities listed in Table 4 as well as stormwater point sources, including the Tier A municipalities listed in Appendix B. There are no CSOs in the study area. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through best management practices (BMPs). The distinction is that stormwater point sources are regulated under the Clean Water Act.

A total of 47 point sources, shown in Figure 8 and Table 4, were identified for individual WLA development. Refer to Figure 8 for the location of municipal wastewater treatment plant point sources. The stormwater point sources are quantified through the watershed nonpoint sources simulation, as described below, but will be assigned a WLA expressed as a percent reduction of the load associated with land use categories used as a surrogate to represent the areas subject to the WLA (see Tables 5 thru 11).

Figure 8. NJPDES Permitted Discharges within TMDL Study Area

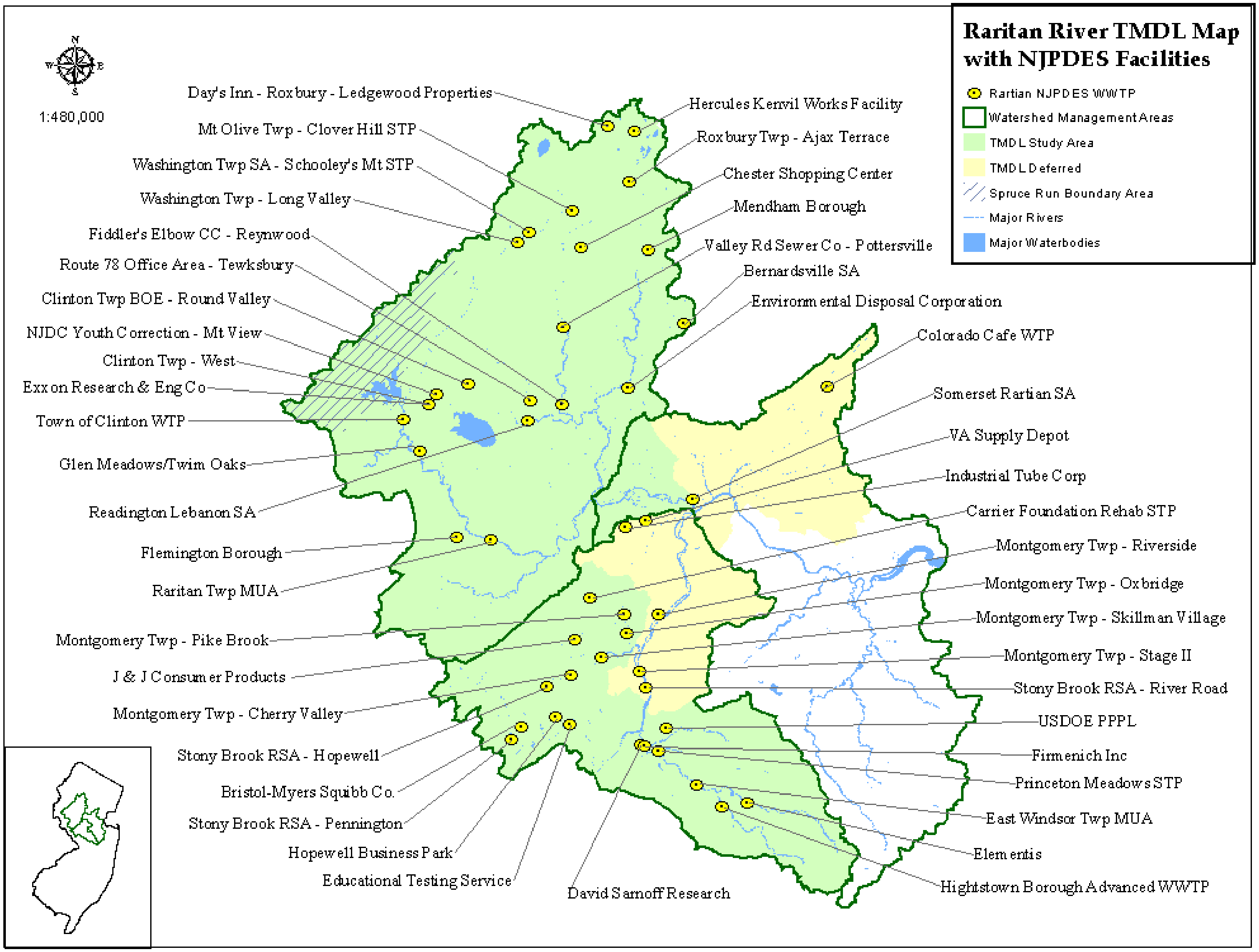


Table 4. Permitted Point Sources within the Non-Tidal Raritan River TMDL Study Area

NJPDES #	Facility Name	Permitted Flow (mgd)	Current Flow (mgd)	Existing Permit TP Conc. (mg/l)	Existing Permit TSS Conc. (mg/l)
NJ0028304	Day's Inn - Roxbury - Ledgewood Propty.	0.04	.0085	0.5 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0021954	Mt Olive Twp - Clover Hill STP	0.5	.3027	1.0 mg/l TP as MOAV	17 mg/l as a MOAV
NJ0023493	Washington Twp-Schooley's Mt	0.5	.4067	No Limit	10 mg/l as a MOAV
NJ0109061	Washington Twp-Long Valley	0.244	.1017	No Limit	30 mg/l as a MOAV
NJ0028487	NJDC Youth Correct-Mt view	0.26	.2202	0.4 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0078018	Clinton West (1)	0.25	NODI	2.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0035084	Exxon Research & Eng Co	0.22	.0372	0.5 mg/l TP as MOAV	5 mg/l as a MOAV
NJ0020389	Town of Clinton WTP	2.03	1.204	2.0 mg/l TP as MOAV (S)	30 mg/l as a MOAV
NJ0100528	Glen Meadows/Twin Oaks	0.025	.0089	No Limit	30 mg/l as a MOAV
NJ0028436	Flemington Boro (wet Wx only)	3.85	(wet Wx)	No Limit	Report Only
NJ0022047	Raritan Twp MUA	3.8	2.5317	No Limit	30 mg/l as a MOAV
NJ0000876	Hercules Kenvil Works Facility (1)	0.135	NODI	1.0 mg/l TP as MOAV	No Limit
NJ0022675	Roxbury Twp-Ajax Terrace	2.0	1.5619	No Limit	16 mg/l as a MOAV
NJ0026824	Chester Shopping Center	0.011	.0091	No Limit	30 mg/l as a MOAV
NJ0022781	Valley Rd Sewer Co - Pottersville STP	0.048	.0163	No Limit	30 mg/l as a MOAV
NJ0021865	Fiddler's Elbow CC - Reynwood Inc	0.03	.0044	No Limit	30 mg/l as a MOAV
NJ0102563	Route 78 Office Area - Tewkbury (1)	0.09653	NODI	New Discharge - Antideg.	No Limit
NJ0023175	Clinton BOE - Rnd Valley	0.009	0.0015	No Limit	30 mg/l as a MOAV
NJ0098922	Readington-Lebanon SA	1.45	.6331	No Limit	22 mg/l as a MOAV
NJ0021334	Mendham Boro	0.45	.3475	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0026387	Bernardsville	0.8	.5208	0.12 mg/l TP as MOAV	15 mg/l as a MOAV
NJ0033995	Environmental Disposal Corporation	2.1	1.2618	0.5 mg/l TP as MOAV	20 mg/l as a MOAV
NJ0004243	Elementis (2)	0.036	0.0096	No Limit	30 mg/l as a MOAV
NJ0029475	Hightstown Boro Advanced WWTP	1.0	0.64	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0023787	East Windsor Twp MUA	4.5	2.68	1.0 mg/l TP as MOAV	30 mg/l as a MOAV

NJPDES #	Facility Name	Permitted Flow (mgd	Current Flow (mgd)	Existing Permit TP Conc. (mg/l)	Existing Permit TSS Conc. (mg/l)
NJ0024104	Princeton Meadows STP	1.64	1.19	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0023922	USDOE PPPL	0.637	0.19	No Limit	Report Only
NJ0000272	David Sarnoff Research	0.096	0.06	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0031445	Firmenich Inc	0.036	0.05	1.0 mg/l TP as MOAV	Report Only
NJ0000795	Bristol-Myers Squibb Co	0.172	0.05	No Limit	Report Only
NJ0035319	Stony Brook RSA Pennington	0.445	0.22	No Limit	5-10 mg/l as a MOAV
NJ0000809	Hopewell Business Park	0.128	0.14	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0022110	Educational Testing Service	0.08	0.03	1.0 mg/l TP as MOAV	20 mg/l as a MOAV
NJ0035301	Stony Brook RSA - Hopewell	0.3	0.233	No Limit	5-10 mg/l as a MOAV
NJ0069523	Cherry Valley STP	0.29	0.16	0.5 mg/l TP as MOAV (S)	4 mg/l as a MOAV
NJ0022390	NJDHS - N Princeton Dev Center	0.5	0.031	1.0 mg/l TP as MOAV	20 mg/l as a MOAV
NJ0023663	Carrier Foundation Rehab STP	0.04	0.03	1.0 mg/l TP as MOAV	30 mg/l as a MOAV
NJ0060038	Montgomery Twp-Pike Brook	0.67	.4260	0.3 mg/l TP as MOAV	20 mg/l as a MOAV
NJ0026140	J & J Consumer Products	0.063	.09125	1.0 mg/l TP as MOAV	20 mg/l as a MOAV
NJ0067733	Montgomery Twp - Oxbridge	0.088	.0341	0.2 mg/l TP as MOAV (S)	5 mg/l as a MOAV
NJ0031119	Stony Brook RSA-River Road (3)	13.06	8.52	No Limit	30 mg/l as a MOAV
NJ0026905	Montgomery Twp-Stage II (3)	0.48	0.41	No Limit	30 mg/l as a MOAV
NJ0023019	Industrial Tube Corp (3)	0.012	0.0062	No Limit	20 mg/l as a MOAV
NJ0020036	VA Supply Depot (2), (3)	0.08	0.03	No Limit	30 mg/l as a MOAV
NJ0050130	Montgomery Twp – Riverside (3)	0.145	.0745	No Limit	30 mg/l as a MOAV
NJ0024864	Somerset Raritan SA (3)	24.3	14.6583	No Limit	30 mg/l as a MOAV
NJ0026727	Colorado Café (3)	0.018	.004	No Limit	30 mg/l as a MOAV

Footnotes: (S) – Summer applied existing total phosphorus permit limit.
(1) Inactive discharge
(2) Facility modeled and permit revoked after TMDL was developed. Reserve capacity adjusted in Table 6.
(3) Facility discharges to the deferred TP TMDL area.
MOAV – Monthly Average .
NODI – No Discharge.

As shown in Figure 8 and noted in Table 4, there are 7 facilities discharging to the TMDL deferred area along the Lower Millstone River and the mainstem Raritan. Permit limits for these facilities will remain pending the deferred TP TMDL outcome.

Nonpoint Sources (NPS)

For the purposes of TMDL development, the definition of nonpoint sources (NPS) includes stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. Tier B municipalities in the spatial extent are identified in Appendix B.

Nonpoint sources are a major component of the loading that enters into the waterbodies within the spatial extent of the study. NPS loads were derived by multiplying the Event Mean Concentrations (EMCs) and Base Flow Concentrations (BFCs) by the surface flow from each respective land use source area and baseflow from each subwatershed. Technical details on how the EMCs and BFCs were derived and how the NPS loadings were calculated and adjusted to match the observed values can be found at Kleinfelder/Omni's report (2013, Volume 1, p. 56). Nonpoint sources receive a load allocation, also expressed as a percent load reduction related to land uses that are designated as a surrogate for this type of pollutant loading.

5.0 Analytical Approach and TMDL Calculation

The non-tidal Raritan River basin TMDLs are based on the integration of HydroWAMIT and the Water Quality Analysis Simulation Program 7.1 (WASP7.1). HydroWAMIT, the hydrologic model, provides hydrodynamic and nonpoint source inputs to WASP7.1. WASP7.1 simulates the fate and transport of conventional water quality constituents required for the TMDL analyses.

HydroWAMIT consists of two independent routines. The first routine is responsible for the simulation of the land phase of the hydrologic cycle for each land use type defined within the subwatersheds, the second routine is responsible for streamflow routing to generate the hydrodynamic input file for WASP. HydroWAMIT also includes algorithms to calculate nonpoint source loads as a function of tributary baseflow and surface waters given by a hydrograph separation scheme, sub-basin characteristics and EMCs/BFCs for different land use types. In addition, the loadings of some small WWTPs were included by adding their loading into the system through HydroWAMIT.

Basic inputs to HydroWAMIT are point source flows, cross section geometry of streams, land use distribution within contributing subwatersheds, weather data, hydrologic parameters and the concentration of pollutants associated with surface runoff and baseflow.

The WASP7.1 model is a dynamic compartment model that can predict a variety of water quality responses due to natural phenomena and man-made pollution for diverse aquatic systems. The submodel PERIPHYTON was used in this application. The PERIPHYTON sub-model is an enhancement of the original EUTRO sub-model and simulates the phenomenon of nutrient luxury uptake. Nutrient luxury uptake is a phenomenon in which extra levels of nutrients, beyond the immediate needs for growth, are taken up by the plants when they are available and are later used to sustain growth of algae and aquatic plants when the levels of nutrients in the water column are lower, as occurs in the Raritan River.

Besides the hydrodynamic file and nonpoint source files provided by HydroWAMIT, kinetic parameters and descriptive parameters must be specified in WASP. Kinetic parameters are global, affecting all compartments of the system and not changing in space and time unless they are adjusted based on the assigned temperature correction coefficients. As each watershed area model has an independent WASP7.1 model setup, the kinetic parameters change according to the particular characteristics of a watershed area model. In general, most parameters are the same across all watershed area models. However, more sensitive parameters such as nitrification rate, growth rate of phytoplankton and benthic algae, respiration and death rates were assigned different values in the various models. Some of the descriptive parameters include stream water temperature, solar radiation, and ammonia and phosphorus sediment flux. Descriptive parameters in WASP7.1 are assigned for each model segment, which can be a time series function, such as temperature; or a specific local constant, such as SOD and the fraction of segment bottom covered with benthic algae (or aquatic plants).

The simulation period for the Raritan Basin hydrologic and water quality model is from January 2002 through August 2005. This time frame provides a wide variety of flow conditions, which is important for calibrating the water quality model and for performing the TMDL analyses. Years 2002 and 2005 are considered dry, 2003 is wet and 2004 is typical. Besides the flow conditions, the availability of data for model inputs and calibration also influences the selection of the simulation period. For the TMDL calculation, the required load reductions were determined to assure that water quality targets are met at the critical flow conditions at which the SWQS still apply.

A systematic approach was used to calibrate this large and diverse modeling system. Details regarding the model development process can be found in the Kleinfelder/Omni report (2013). This report was reviewed by the Department as well as by an independent, academic peer review panel. The modeling tools developed were determined to be appropriate for developing these TMDLs in the Raritan River (Obropta).

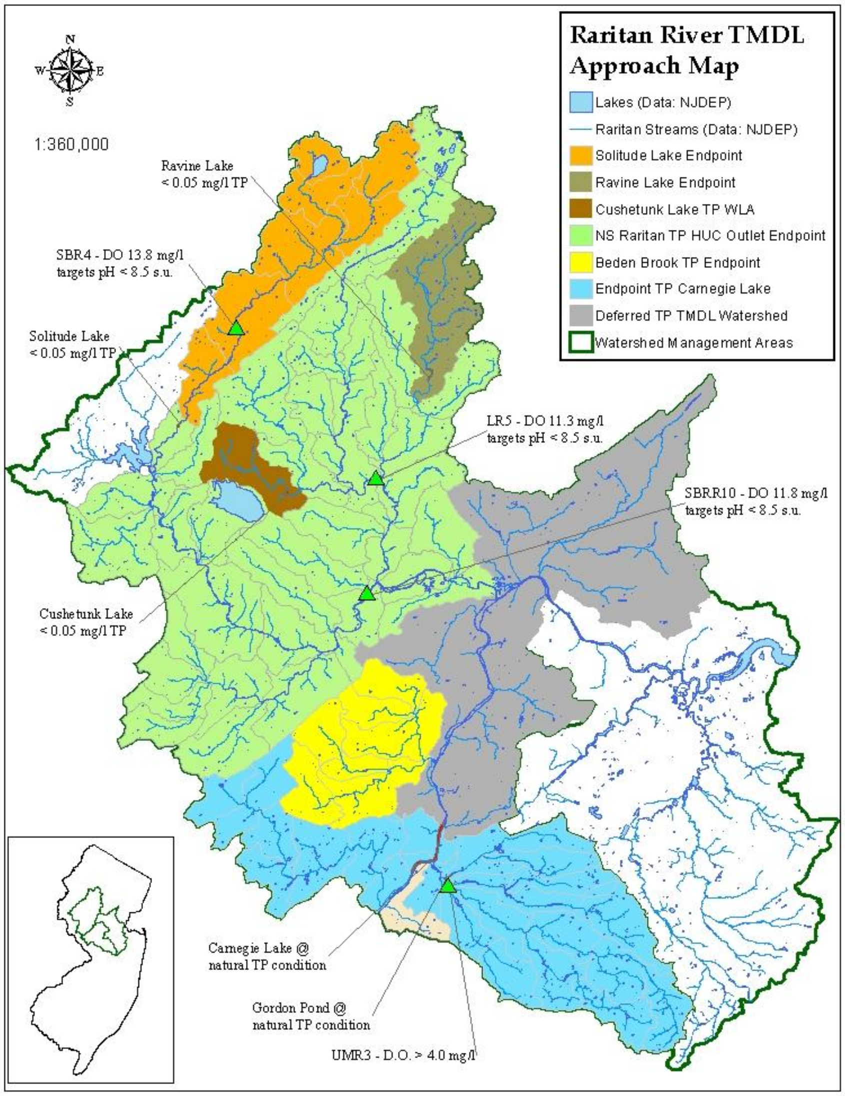
Using the calibrated and validated modeling tool, iterative model simulations were performed to determine the combination of load reductions needed to ensure SWQS compliance at the various endpoints within the study area. The assumptions and findings are set forth in detail in the Kleinfelder/Omni report (2013).

Figure 9 summarizes the endpoints that were the drivers for the TMDL and assigned allocations/reductions to address the impairments in the watershed. The TMDL critical endpoints included:

- Three locations (SBR4, LR5 and SBRR10) where a DO-pH site specific relationship allowed the calculation of a TMDL for TP to resolve pH impairment. This was done through determining a site-specific DO threshold corresponding to the maximum pH of 8.5 per the SWQS. This approach was necessary because WASP 7.1 doesn't simulate pH but does simulate DO. Converting the pH criteria to a DO threshold enables the model to address some pH impairments within the basin. The DO-pH site specific relationships developed by Kleinfelder/Omni are presented in Table 2 and Figure 5 of the Kleinfelder/Omni Report (2013, Volume 1, p. 17-18);
- Minimum DO violation at UMR3 will be resolved by implementing the drafted ammonia limitation reflected in the factsheet (p. 8) for NJPDES permit NJ0024104. TMDL model input values for ammonia were 6.64 mg/l (summer) and 10.33 mg/l (winter);
- Stream TP numeric criteria 0.1 mg/L at HUC14 outlets;
- Lake TP criteria 0.05 mg/l or natural conditions at various lakes.

Total phosphorus reductions based on the endpoints described above were shown to satisfy the total suspended solids impairments. This is due to TP removal practices, which when implemented, will remove TSS to an even greater extent than needed to meet SWQS for TSS where there are TSS impairments. Kleinfelder/Omni calculated the appropriate TSS load reduction in the TP deferred TMDL part of the watershed (gray area in Figure 9) and these will be expressed as a TMDL. Additional information on the approach to addressing TSS impairments can be found in the Kleinfelder/Omni report (2013, Volume 1, p. 188).

Figure 9. Non-Tidal Raritan River Approach Map for TMDL Development



An iterative approach was used to derive the required reductions on PS and NPS to achieve the SWQS at the critical locations. Details can be found in Kleinfelder/Omni's report (2013). Below are a few highlights the Department wants to emphasize:

- Both PS and NPS reductions are required to achieve all the water quality endpoints. Reducing the PS or NPS alone will not address the water quality impairment targeted in this TMDL. PS contributions are dominant during base flow conditions, including the design flow for the SWQS. Regulated stormwater, technically a PS, and NPS are more important during periods of high flow.
- Management measures will be used to achieve reductions from urban and agricultural land uses, which contribute to the regulated stormwater PS and the NPS allocations. Forested and wetland uses are assigned a load allocation which remains the same from the existing to the TMDL scenario, as reductions from these land uses are not practical.
- For PS, TMDL simulations are based on the facility's permitted/design flow.

- For any facility with existing effluent limits for a parameter of concern, the effective effluent limits on TP and TSS were used as the initial input value in the process for determining the allowable load.
- The input values of the contributing sources were lowered as necessary to achieve the SWQS at the critical locations in streams or lakes.
- Reducing the ortho-phosphorus component of the TP load was critical to achieve pH compliance at the three locations where the DO/pH relationship was established.
- The violation of the DO minimum in the Upper Millstone will be addressed by requiring ammonia reduction at the Princeton Meadows STP.
- Except where there were downstream impoundments, higher inputs from PS were allowed during the winter season because of the greater stream flow and resultant dilution available.
- Where there were multiple PS contributing to the same critical endpoint, the smaller facilities were reduced less than larger facilities because of the difference in relative impact of the effluent loads.

Seasonal Variation, Critical Conditions, MOS and Reserve Capacity

A TMDL must account for critical conditions and seasonal variations. The summer season is the critical period for biological activity. It is during this time that primary productivity peaks and can result in associated oxygen and pH effects (excessive swings and excursion from the criteria). Wet seasons and dry seasons have different effects on water quality with wet seasons having higher dilution but producing more runoff and dry seasons allowing for a concentrating of pollutants and more extreme localized effects. Seasonal flow effects are also apparent, with the summer design low flow (7Q10) being lower than the winter 7Q10. A wide range of conditions was captured in the monitoring period that was used to develop the model, including wet, dry and average hydrologic conditions. As the 2013 Kleinfelder/Omni's report describes, a demonstration of compliance with the water quality standards under various critical conditions was accomplished through continuous simulation over 44 months, from January 2002 through August 2005, with Years 2002 and 2005 being considered as dry, 2003 as wet and 2004 as typical. These 3.7 years include a range of hydrologic conditions, both seasonal and year-to-year. The impact of typical spring rains, summer thunderstorms, summer dry periods, and low flows are all represented during continuous simulation of pollutants over several seasons. The TMDL condition used to derive the WLAs and LAs was selected to ensure attainment t of water targets under all of these critical conditions. The critical conditions for any given location could occur in any given year; therefore, the WLAs will need to be achieved on an annual basis.

In the development of a TMDL, Section 303(d) of Clean Water Act requires specification of a Margin of Safety (MOS) – an unallocated portion of the assimilative capacity. MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). In particular, a MOS accounts for uncertainties in the loading estimates, physical parameters and the linked models themselves. The MOS, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). In this TMDL, 10% of the point source loading that was input into the model to determine the allowable loadings without violating the water quality standard was assigned as the MOS. Therefore, the remaining 90% of the simulated PS loading is assigned as the Waste Load Allocation. For the NPS, 20% of the simulated loading was assigned as the MOS so only 80% of the simulated NPS loading was assigned as the Load Allocation. Details on the MOS used can be found in Kleinfelder/Omni's report (2013).

Reserve capacity is an optional means of setting aside in the TMDL a portion of the loading capacity to allow for new or expanded STPs. This component of the loading capacity provides a measure of long term certainty to regulated sources that their permits will not need to be adjusted each time there is a need to provide additional wastewater capacity. The Department has incorporated the reserve capacity component in prior TMDLs that covered large areas in order to provide that certainty. This decision was validated in that, relative to the 2007 Passaic River TMDL, there have already been two occasions where the reserve capacity has been accessed.

In the Raritan study area, there are both C1 and C2 streams. C1 streams receive a high level of protection under the anti-degradation policies; nevertheless, a small measure of reserve capacity has been provided in these areas. This is because treatment and dilution may allow for some measure of additional loading and still have no measureable change in water quality. Reserve capacity was provided through the HydroWAMIT NPS inputs so as to maximize flexibility in locating the additional loads. Details on the reserve capacity component set for each modeled subwatershed are provided in the Kleinfelder/Omni Report (2013, Volume 1, p. 155).

Allocation of Loading Capacity to Sources

WLAs are established for all point sources, while LAs are established for nonpoint sources, as these sources are defined in the CWA and as required for each TMDL.

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

Loads from some land uses, specifically forest, wetland, water and barren land are not readily adjustable. As a result, existing loads from these sources have been set equal to the future loads. The NPS load reduction is only required from urban or agricultural land use where the expected reduction is practicable.

Allocation of the loading capacity for the TMDL critical locations is presented in Table 5 through Table 11. In accordance with EPA's requirements, WLAs must be expressed as a daily loads. The assignment of WLAs to each WWTP is based on model inputs set at permitted flows and the constant effluent concentrations found to result in attainment of the SWQS. Individual WLAs are set forth in Table 12. EPA does afford flexibility in expressing the WLAs as effluent limits, provided they are consistent with achieving the TMDL. The considerations important in achieving this objective are discussed further in the TMDL Implementation Plan section.

Table 5. Distribution of TP WLAs and LAs among source categories for the North & South Branch Raritan River Watershed

Long Term Average Daily Load (kg/d TP)	South Branch Raritan River Watershed			North Branch Raritan River Watershed*			Raritan River Basin Upstream of Millstone River Confluence**		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	106.4	65.0	39.0%	78.2	30.5	60.9%	184.6	95.5	48.3%
Treated Effluent from WWTP Dischargers	72.4	54.5***	24.8%	44.2	17.7***	60.0%	116.6	72.2***	38.1%
Stormwater from Residential Land Cover Areas	25.8	7.9	69.4%	23.1	8.7	62.3%	48.8	16.6	66.1%
Stormwater from Other Urban Land Cover Areas	8.2	2.6	68.5%	10.9	4.2	61.8%	19.1	6.7	64.7%
Sum of Load Allocations (LAs)	85.2	44.3	48.0%	62.6	29.7	52.6%	147.8	74.0	49.9%
Boundary Inputs	11.8	11.8	0.0%	0.9	0.9	0.0%	12.7	12.7	0.0%
Tributary Baseflow	32.9	14.8	54.9%	28.3	13.1	53.8%	61.2	27.9	54.4%
Stormwater from Agricultural Land Cover Areas	31.9	9.1	71.5%	25.6	7.9	69.0%	57.5	17.0	70.4%
Stormwater from Forest and Barren Land Cover Areas	2.4	2.4	0.0%	3.3	3.3	0.0%	5.7	5.7	0.0%
Stormwater from Wetlands Land Cover Areas	6.2	6.2	0.0%	4.4	4.4	0.0%	10.5	10.5	0.0%
Air Deposition onto Water Land Cover Areas	0.06	0.06	0.0%	0.06	0.06	0.0%	0.12	0.12	0.0%
Total Margin of Safety (% of LC)	n/a	11.8	9.6%	n/a	9.0	12.8%	n/a	20.8	10.8%
STP MOS		4.8	3.9%		2.0	2.8%		6.8	3.5%
Stormwater and NPS MOS		7.0	5.7%		7.1	10.0%		14.0	7.3%
Reserve Capacity (% of WWTP load)	n/a	1.3	2.3%	n/a	1.3	7.3%	n/a	2.6	3.5%
Loading Capacity (LC)	191.6	122.3	36.2%	140.7	70.5	49.9%	332.3	192.8	42.0%

* Includes the portion of the mainstem Raritan River upstream of the Millstone River confluence

** Equal to South Branch Raritan River Watershed plus North Branch Raritan River Watershed

*** Average of seasonal TMDL loading.

n/a - not applicable

Table 6. Distribution of TP WLAs and LAs among source categories for parts of the Carnegie Lake Watershed

Long Term Average Daily Load (kg/d TP)	Upper Millstone River Watershed			Stony Brook Watershed			Carnegie Lake Direct Watershed		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	27.8	5.5	80.2%	20.9	2.3	89.0%	2.7	0.4	84.0%
Treated Effluent from WWTP Dischargers	15.9	3.6	77.4%	10.1	0.6	94.4%	0.0	0.0	0.0%
Stormwater from Residential Land Cover Areas	6.6	1.1	84.0%	8.1	1.3	84.0%	1.4	0.2	84.0%
Stormwater from Other Urban Land Cover Areas	5.2	0.8	84.0%	2.7	0.4	84.0%	1.2	0.2	84.0%
Sum of Load Allocations (LAs)	22.9	16.1	29.8%	14.8	6.1	58.9%	0.5	0.3	45.7%
Boundary Inputs	0.0	0.0	0.0%	0.0	0.0	0.0%	0.0	0.0	0.0%
Tributary Baseflow	14.9	11.0	25.9%	3.2	1.0	69.2%	0.3	0.1	62.1%
Stormwater from Agricultural Land Cover Areas	3.5	0.6	84.0%	7.7	1.2	84.0%	0.1	0.0	84.0%
Stormwater from Forest and Barren Land Cover Areas	0.1	0.1	0.0%	1.5	1.5	0.0%	0.0	0.0	0.0%
Stormwater from Wetlands Land Cover Areas	4.3	4.3	0.0%	2.4	2.4	0.0%	0.1	0.1	0.0%
Air Deposition onto Water Land Cover Areas	0.02	0.02	0.0%	0.02	0.02	0.0%	0.02	0.02	0.0%
Total Margin of Safety (% of LC)	n/a	1.0	4.4%	n/a	1.0	10.2%	n/a	0.1	13.6%
WWTP MOS		0.4	1.7%		0.1	0.7%		0.0	0.0%
Stormwater and NPS MOS		0.6	2.7%		0.9	9.5%		0.1	13.6%
Reserve Capacity (% of WWTP load)	n/a	0.5*	14.2%	n/a	0.05	8.8%	n/a	n/a	n/a
Loading Capacity (LC)	50.6	23.1	54.4%	35.7	9.4	73.8%	3.2	0.8	74.5%

* NJDPES facility NJ004243 in the Kleinfelder/Omni report and this TMDL report was recently revoked. The TMDL allocated load of 0.05 kg/d TP for this facility has been included in the applicable modeled subbasin as reserve capacity. Per Kleinfelder/Omni Appendix R (page R-8), the reserve capacity total for the subwatershed of 0.51 has changed to 0.56 kg/d TP.

n/a - not applicable

Table 7. Distribution of TP WLAs and LAs among source categories for Carnegie Lake and Beden Brook Watersheds

Long Term Average Daily Load (kg/d TP)	Total Carnegie Lake Basin*			Beden Brook Watershed		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	51.3	8.2	84.0%	17.4	6.0	65.7%
Treated Effluent from WWTP Dischargers	26.0	4.2	84.0%	7.4	2.8 **	62.6%
Stormwater from Residential Land Cover Areas	16.1	2.6	84.0%	6.7	2.1	68.0%
Stormwater from Other Urban Land Cover Areas	9.2	1.5	84.0%	3.3	1.1	68.0%
Sum of Load Allocations (LAs)	38.1	22.4	41.3%	17.8	9.3	47.8%
Boundary Inputs	0.0	0.0	0.0%	0.0	0.0	0.0%
Tributary Baseflow	18.4	12.1	34.1%	3.6	1.6	56.2%
Stormwater from Agricultural Land Cover Areas	11.3	1.8	84.0%	9.5	3.0	68.0%
Stormwater from Forest and Barren Land Cover Areas	1.6	1.6	0.0%	1.8	1.8	0.0%
Stormwater from Wetlands Land Cover Areas	6.8	6.8	0.0%	2.8	2.8	0.0%
Air Deposition onto Water Land Cover Areas	0.05	0.05	0.0%	0.01	0.01	0.0%
Total Margin of Safety (% of LC)	n/a	2.1	6.2%	n/a	2.1	12.1%
STP MOS		0.5	1.4%		0.3	1.8%
Stormwater and NPS MOS		1.6	4.9%		1.8	10.3%
Reserve Capacity (% of WWTP load)	n/a	0.6	13.4%	n/a	0.1	3.7%
Loading Capacity (LC)	89.5	33.2	62.8%	35.1	17.4	50.4%

* Total Carnegie Lake Basin is the sum of the Upper Millstone River Watershed, the Stony Brook Watershed, and the Carnegie Lake Direct Watershed above.

** Average of seasonal TMDL loading.

n/a - not applicable

Table 8. Distribution of TSS WLAs and LAs among source categories for the North & South Branch Raritan River Watershed

Long Term Average Daily Load (kg/d TSS)	South Branch Raritan River Watershed			North Branch Raritan River Watershed*			Raritan River Basin Upstream of Millstone River Confluence**		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	8,094	3,582	55.7%	7,748	3,346	56.8%	15,843	6,927	56.3%
Treated Effluent from WWTP Dischargers	998	1,390	-39.4%	281	532	-89.6%	1,278	1,923	-50.4
Stormwater from Residential Land Cover Areas	4,879	1,492	69.4%	4,408	1,657	62.4%	9,286	3,150	66.1%
Stormwater from Other Urban Land Cover Areas	2,218	699	68.5%	3,060	1,156	62.2%	5,278	1,855	64.8%
Sum of Load Allocations (LAs)	9,723	5,150	47.0%	8,036	4,405	45.2%	17,760	9,555	46.2%
Boundary Inputs	592	592	0.0%	70	70	0.0%	662	662	0.0%
Tributary Baseflow	1,201	1,201	0.0%	1,011	1,011	0.0%	2,211	2,211	0.0%
Stormwater from Agricultural Land Cover Areas	6,393	1,819	71.5%	5,257	1,625	69.1%	11,649	3,444	70.4%
Stormwater from Forest and Barren Land Cover Areas	864	864	0.0%	1,214	1,214	0.0%	2,078	2,078	0.0%
Stormwater from Wetlands Land Cover Areas	674	674	0.0%	485	485	0.0%	1,160	1,160	0.0%
Total Margin of Safety (% of LC)	n/a	1,003	10.2%	n/a	1,110	12.4%	n/a	2,112	11.3%
Reserve Capacity (% of WWTP load)	n/a	82	5.9%	n/a	57	10.7%	n/a	139	7.2%
Loading Capacity (LC)	17,817	9,816	44.9%	15,785	8,917	43.5%	33,602	18,733	44.3%

* Includes the portion of the mainstem Raritan River upstream of the Millstone River confluence

** Equal to South Branch Raritan River Watershed plus North Branch Raritan River Watershed

n/a - not applicable

Table 9. Distribution of TSS WLAs and LAs among source categories for parts of the Carnegie Lake Watershed

Long Term Average Daily Load (kg/d TSS)	Upper Millstone River Watershed			Stony Brook Watershed			Carnegie Lake Direct Watershed		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	3,961	1,506	62.0%	2,286	401	82.5%	602	96	84.0%
Treated Effluent from WWTP Dischargers	502	953	-89.6%	20	38	-89.6%	0	0	0%
Stormwater from Residential Land Cover Areas	1,615	258	84.0%	1,529	245	84.0%	272	44	84.0%
Stormwater from Other Urban Land Cover Areas	1,843	295	84.0%	737	118	84.0%	329	53	84.0%
Sum of Load Allocations (LAs)	2,775	2,060	25.8%	2,624	1,328	49.4%	58	49	14.9%
Boundary Inputs	0	0	0.0%	0	0	0.0%	0	0	0.0%
Tributary Baseflow	1,267	1,267	0.0%	297	297	0.0%	29	29	0.0%
Stormwater from Agricultural Land Cover Areas	851	136	84.0%	1,543	247	84.0%	10	2	84.0%
Stormwater from Forest and Barren Land Cover Areas	51	51	0.0%	525	525	0.0%	6	6	0.0%
Stormwater from Wetlands Land Cover Areas	605	605	0.0%	260	260	0.0%	13	13	0.0%
Total Margin of Safety (% of LC)	n/a	172	4.5%	n/a	152	8.0%	n/a	24	14.4%
Reserve Capacity (% of WWTP load)	n/a	103	10.8%	n/a	25	66.5%	n/a	0	n/a
Loading Capacity (LC)	6,735	3,841	43.0%	4,909	1,906	61.2%	660	170	74.2%

n/a - not applicable

Table 10. Distribution of TSS WLAs and LAs among source categories for Carnegie Lake and Beden Brook Watersheds

Long Term Average Daily Load (kg/d TSS)	Total Carnegie Lake Basin*			Beden Brook Watershed		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	6,848	2,003	70.8%	2,220	806	63.7%
Treated Effluent from WWTP Dischargers	522	991	-89.6%	60	115	-89.6%
Stormwater from Residential Land Cover Areas	3,416	547	84.0%	1,269	406	68.0%
Stormwater from Other Urban Land Cover Areas	2,909	465	84.0%	891	285	68.0%
Sum of Load Allocations (LAs)	5,457	3,437	37.0%	3,085	1,789	42.0%
Boundary Inputs	0	0	0.0%	0	0	0.0%
Tributary Baseflow	1,593	1,593	0.0%	205	205	0.0%
Stormwater from Agricultural Land Cover Areas	2,405	385	84.0%	1,905	610	68.0%
Stormwater from Forest and Barren Land Cover Areas	582	582	0.0%	668	668	0.0%
Stormwater from Wetlands Land Cover Areas	877	877	0.0%	306	306	0.0%
Total Margin of Safety (% of LC)	n/a	349	5.9%	n/a	325	11.1%
Reserve Capacity (% of WWTP load)	n/a	128	12.9%	n/a	14	12.2%
Loading Capacity (LC)	12,305	5,917	51.9%	5,305	2,934	44.7%

* Total Carnegie Lake Basin is the sum of the Upper Millstone River Watershed, the Stony Brook Watershed, and the Carnegie Lake Direct Watershed on previous table.

n/a - not applicable

Table 11. Distribution of TSS WLAs and LAs among source categories for the Lower Millstone River and Total Raritan River Watershed

Long Term Average Daily Load (kg/d TSS)	Lower Millstone/Raritan River (except Beden)*			Total Lower Millstone/ Raritan River Watershed*		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Sum of Wasteload Allocations (WLAs)	13,791	8,590	37.7%	16,011	9,396	41.3%
Treated Effluent from WWTP Dischargers	3,127	4,325	-38.3%	3,187	4,439	-39.3%
Stormwater from Residential Land Cover Areas	5,835	2,334	60.0%	7,103	2,740	61.4%
Stormwater from Other Urban Land Cover Areas	4,829	1,932	60.0%	5,720	2,217	61.2%
Sum of Load Allocations (LAs)	42,171	25,741	39.0%	45,255	27,531	39.2%
Boundary Inputs**	39,091	23,575	39.7%	39,091	23,575	39.7%
Tributary Baseflow	460	460	0.0%	665	665	0.0%
Stormwater from Agricultural Land Cover Areas	1,523	609	60.0%	3,428	1,219	64.4%
Stormwater from Forest and Barren Land Cover Areas	399	399	0.0%	1,067	1,067	0.0%
Stormwater from Wetlands Land Cover Areas	698	698	0.0%	1,004	1,004	0.0%
Total Margin of Safety (% of LC)	n/a	1,219	3.4%	n/a	1,544	4.0%
Reserve Capacity (% of WWTP load)	n/a	156	3.6%	n/a	171	3.8%
Loading Capacity (LC)	55,961	35,707	36.2%	61,266	38,641	36.9%

* Lower Millstone/Raritan River Watershed includes the Millstone River watershed downstream of Carnegie Lake and the portion of the non-tidal mainstem Raritan River watershed downstream of the Millstone confluence.

** Boundary inputs to Lower Millstone/Raritan River Watershed include the Raritan River upstream of the Millstone River confluence and Carnegie Lake.

n/a - not applicable

Table 12: TMDL Condition for Waste Water Treatment Plants

NJPDES #	Facility Name	Permitted Flow	Effluent Concentrations and Loads Associated with TMDL Condition							
			May October				November April			
			OrthoP (mg/L)	TP (mg/L)	TP (kg/d)	TSS (mg/L)	OrthoP (mg/L)	TP (mg/L)	TP (kg/d)	TSS (mg/L)
NJ0028304	Day's Inn - Roxbury - Ledgewood Property (1)	0.04	0.08	0.50	0.08	n/a	0.11	0.50	0.08	n/a
NJ0021954	Mt Olive Twp - Clover Hill STP (1)	0.5	0.08	0.62	1.18	17.0	0.11	1.00	1.89	17.0
NJ0023493	Washington Twp-Schooley's Mt (1)	0.5	0.08	0.68	1.29	10.0	0.11	0.71	1.35	10.0
NJ0109061	Washington Twp-Long Valley (1)	0.244	0.08	1.34	1.24	30.0	0.11	1.37	1.27	30.0
NJ0028487	NJDC Youth Correct-Mt View	0.26	0.09	0.18	0.18	30.0	0.13	0.25	0.25	30.0
NJ0078018	Clinton West	0.25	0.09	0.18	0.17	30.0	0.13	0.25	0.24	30.0
NJ0035084	Exxon Research & Eng Co	0.22	0.09	0.18	0.15	30.0	0.13	0.25	0.21	30.0
NJ0020389	Town of Clinton WTP (1)	2.03	0.14	2.00	15.37	30.0	0.20	2.00	15.37	30.0
NJ0100528	Glen Meadows/Twin Oaks (1)	0.025	0.43	2.23	0.21	n/a	0.61	2.41	0.23	n/a
NJ0028436	Flemington Boro (wet weather only) (2)	3.85	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NJ0022047	Raritan Twp MUA (1)	3.8	0.14	1.31	18.90	30.0	0.20	1.86	26.75	30.0
NJ0000876	Hercules Kenvil Works Facility	0.135	0.30	0.59	0.30	n/a	0.50	1.00	0.51	n/a
NJ0022675	Roxbury Twp-Ajax Terrace	2.0	0.10	0.20	1.50	16.0	0.18	0.36	2.73	16.0
NJ0026824	Chester Shopping Center (1)	0.011	0.41	2.21	0.09	n/a	0.54	2.34	0.10	n/a
NJ0022781	Valley Rd Sewer Co - Pottersville STP (1)	0.048	0.41	2.21	0.40	n/a	0.54	2.34	0.43	n/a
NJ0021865	Fiddler's Elbow CC - Reynwood Inc (1)	0.03	0.41	2.21	0.25	n/a	0.54	2.34	0.27	n/a
NJ0102563	Route 78 Office Area – Tewksbury	0.09653	0.07	0.13	0.05	n/a	0.12	0.23	0.08	n/a
NJ0023175	Clinton BOE - Round Valley	0.009	1.25	2.50	0.09	n/a	1.25	2.50	0.09	n/a
NJ0098922	Readington-Lebanon SA (1)	1.45	0.14	1.40	7.66	22.0	0.18	1.44	7.90	22.0
NJ0021334	Mendham Boro	0.45	0.27	0.54	0.92	30.0	0.36	0.72	1.23	30.0
NJ0026387	Bernardsville	0.8	0.20	0.41	1.23	15.0	0.27	0.54	1.64	15.0
NJ0033995	Environmental Disposal Corporation	2.1	0.25	0.50	3.97	20.0	0.25	0.50	3.97	20.0
NJ0029475	Hightstown Boro Advanced WWTP	1.0	..	0.12	0.44	30.0	..	0.12	0.44	30.0
NJ0023787	East Windsor Twp MUA	4.5	..	0.12	1.99	30.0	..	0.12	1.99	30.0
NJ0024104	Princeton Meadows STP (3)	1.64	..	0.12	0.73	30.0	..	0.12	0.73	30.0

NJPDES #	Facility Name	Permitted Flow	Effluent Concentrations and Loads Associated with TMDL Condition							
			May October				November April			
			OrthoP (mg/L)	TP (mg/L)	TP (kg/d)	TSS (mg/L)	OrthoP (mg/L)	TP (mg/L)	TP (kg/d)	TSS (mg/L)
NJ0023922	USDOE PPPL	0.637	..	0.09	0.22	n/a	..	0.09	0.22	n/a
NJ0000272	David Sarnoff Research	0.096	..	0.35	0.13	n/a	..	0.35	0.13	n/a
NJ0031445	Firmenich Inc	0.036	..	0.35	0.05	n/a	..	0.35	0.05	n/a
NJ0000795	Bristol-Myers Squibb Co	0.172	..	0.18	0.12	5.0	..	0.18	0.12	10.0
NJ0035319	Stony Brook RSA Pennington	0.445	..	0.18	0.30	5.0	..	0.18	0.30	10.0
NJ0000809	Hopewell Business Park	0.128	..	0.18	0.09	30.0	..	0.18	0.09	30.0
NJ0022110	Educational Testing Service	0.08	..	0.18	0.05	20.0	..	0.18	0.05	20.0
NJ0035301	Stony Brook RSA - Hopewell	0.3	..	0.22	0.25	5.0	..	0.54	0.61	10.0
NJ0069523	Cherry Valley STP	0.29	..	0.22	0.23	4.0	..	0.54	0.58	4.0
NJ0022390	NJDHS - N Princeton Dev Center	0.5	..	0.22	0.41	n/a	..	0.54	1.02	n/a
NJ0023663	Carrier Foundation Rehab STP	0.04	..	0.70	0.11	n/a	..	1.00	0.15	n/a
NJ0060038	Montgomery Twp-Pike Brook	0.67	..	0.23	0.59	20.0	..	0.30	0.76	20.0
NJ0026140	J & J Consumer Products	0.063	..	0.70	0.17	n/a	..	1.00	0.24	n/a
NJ0067733	Montgomery Twp - Oxbridge	0.088	..	0.20	0.07	n/a	..	1.00	0.33	n/a
NJ0031119	Stony Brook RSA-River Road	13.06	..	..	..	30.0	..	..	..	30.0
NJ0026905	Montgomery Twp-Stage II	0.48	..	..	..	30.0	..	..	..	30.0
NJ0023019	Industrial Tube Corp	0.012	..	..	..	n/a	..	..	..	n/a
NJ0050130	Montgomery Twp - Riverside	0.145	..	..	..	n/a	..	..	..	n/a
NJ0024864	Somerset Raritan SA	24.3	..	..	..	30.0	..	..	..	30.0
NJ0026727	Colorado Café	0.018	..	..	..	n/a	..	..	..	n/a

Footnotes:

1) Eleven (11) WWTPs where Ortho P input concentration reductions were needed to meet the TMDL DO-pH endpoints.
2) The actual intermittent flow reported in Discharge Monitoring Report (DMR) was used to characterize the wet weather load contributions from Flemington Boro WWTP for both existing and TMDL conditions. Effluent quality was modeled at the 90th percentile of DMR data and a permit change is not proposed.
3) The TMDL condition for Princeton Meadows WWTP included model inputs for ammonia of 6.64 mg/l in summer and 10.33 mg/l in winter.

n/a - not applicable

6.0 Follow-up Monitoring

The Water Resources Division of the U.S. Geological Survey and the Department have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. A second ambient monitoring network, DEP's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from this these networks and from stakeholder data meeting quality and submission requirements have been used to assess the quality of the State's waters relative to compliance with SWQS. These same monitoring programs will continue and will be the primary basis to determine effectiveness in achieving the objectives of the TMDLs in attaining the SWQS following implementation. In addition, a component of some of the implementation projects includes effectiveness monitoring. This information will help determine localized effectiveness of specific practices put in place to reduce pollutant loads. Further, monthly discharge monitoring data submitted to the Department from regulated treatment facilities will provide information regarding attainment of the WLAs assigned to these sources.

7.0 Implementation Plan

The Department recognizes that TMDLs alone are not sufficient to restore impaired waters. The TMDL establishes the required pollutant reductions needed to attain SWQS. An implementation plan goes on to identify the regulatory and non-regulatory tools intended to be used to achieve the reductions. Some management measures are regulatory and will be effectuated by ensuring compliance with existing regulations regarding stormwater or with the revisions that will be made to NJPDES wastewater treatment permits consistent with the WLAs. Where management measures rely upon non-regulatory action, such as by further reducing regulated stormwater and/or nonpoint sources (NPS) by implementing best practices, an implementation plan provides a basis for aligning available funding and stewardship building resources to assist with implementation activities. As previously discussed, wetlands and forest land uses contribute some of the NPS load, but loads from these land uses are not readily adjustable. Urban and agricultural land uses contribute loads that are storm-driven including regulated stormwater and non-regulated stormwater, which is considered a nonpoint source in accordance with the CWA, as well as other nonpoint sources. These latter land uses are the focus for implementing best practices using available funding programs and targeted efforts to promote stewardship. Projects that would implement measures that will reduce pollutants of concern in the study area are a priority for available funds, such as 319(h) and Farm Bill programs. In some areas, Watershed Restoration Plans have already been developed. Such plans elaborate on TMDL implementation plans by identifying the specific measures that would be needed to achieve the NPS load reduction assigned to a subwatershed, as well as the suggested responsible entities, funding sources and schedules for implementing the specific measures. Raritan River Basin Watershed Based Plans meeting EPA's 9 minimum components of a watershed plan as specified in *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEAP, 2005) are identified in Table 13.

7.1 Waste Water Treatment Facilities

The Department will work with affected dischargers to modify effluent limits in the identified NJPDES permits. When modified, effluent concentrations and loads expressed in NJPDES permits must be consistent with the basis for calculating the WLAs to ensure that SWQS and the designated uses they protect are attained. NJPDES permits typically express effluent limits as an average monthly limit (AML). USEPA's *Technical Support Document for Water Quality-Based Toxics Control* (TSD) (USEPA, 1991) provides a methodology to calculate an AML from a long term average (LTA), which would be the target over a time frame longer than one month, in order to allow short term flexibility in treatment plant performance while meeting the longer term objective. In the TSD, the LTA is the central tendency of varying values over a long term that can be expressed as the short term AML based on the equations in the TSD that consider sample size and the degree of variation around the central tendency of the LTA. In this TMDL study, the model inputs for WWTPs were fed in at a constant concentration and at the permitted flow. There was no variability included in the inputs to the model that were used to calculate the WLAs that will achieve the SWQS, leaving great uncertainty as to the appropriate inputs for calculating an AML using the statistical methods of the TSD. While this TMDL study does not make or apply assumptions about the degree of variability of effluent quality in calculating the WLAs, it is important to allow some flexibility in expressing the effluent limits, recognizing that the reality is that effluent quality will vary. In fact, there is precedent for setting the WLA equal to the LTA factor in USEPA's TSD methodology in order to derive a shorter term average monthly limit (AML), provided there is a backstop to the WLA. The Department consulted the USEPA Region 10 NPDES permit unit response to comments on NPDES Permit #ID002422 in Idaho and the Wisconsin Department of Natural Resources guidance document in this regard. Citations for these materials are included in Appendix A Therefore, because variability was not assumed in the model and the actual degree of variability upon implementation cannot be known, in order to ensure that the effluent quality that will attain SWQS is actually achieved, a longer term component equal to the WLA will be needed in the NJPDES permits implementing this TMDL.

Controlling ortho-phosphorus at eleven waste water treatment facilities that discharge to three DO/pH endpoint locations is important to achieve the targeted water quality there, as previously discussed. An assumption regarding the relative distribution between ortho-phosphorus and organic phosphorus was made for the TMDL scenario. Monitoring the level of ortho-phosphorus discharged from these facilities following implementation of the TMDL-driven effluent limits will be a necessary component of the NJPDES permits issued to these facilities in order to verify that the TMDL assumption was correct and that the required level of ortho-phosphorus is attained. Adjustment of permit limits may be necessary if discharge monitoring and in-stream ambient water quality demonstrate this to be needed.

In the Raritan study, the system was modeled under a variety of conditions, but the critical conditions could occur in any given year. Therefore, the objective of the goal component in the NJPDES permits implementing the TMDL will be to achieve the WLA on an annual basis, since it cannot be known in advance if the critical conditions will occur in any given year. Where concentrations were specified to allow for seasonal flow conditions, the permit will need to include seasonal (summer/winter) goals to determine compliance with the model input values.

7.2 Regulated Stormwater Measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction of existing load and are applied to the land use categories that approximate the areas regulated under industrial and municipal stormwater programs. The minimum required elements under the municipal stormwater program, are generally expected to achieve a substantial portion of the required load reductions assigned to the associated urban land uses. The Department also has rules in place that will minimize the generation of stormwater-related nonpoint sources from future development. Both rules are described in greater detail below.

The NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" that operate "municipal separate storm sewer systems" (MS4s) to develop stormwater management programs for those MS4s consistent with the NJPDES permit requirements. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, street sweeping, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development. The Department is currently engaged in a number of efforts aimed at gauging the effectiveness of the existing MS4 program and identifying areas that could be improved through the annual report audit and in the process of renewing permits. In addition, the success of these measures will be assessed through follow up monitoring. As needed through adaptive management, other additional measures may need to be identified and included in stormwater permits. Additional measures that may be considered in the future include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to include nutrient removal.

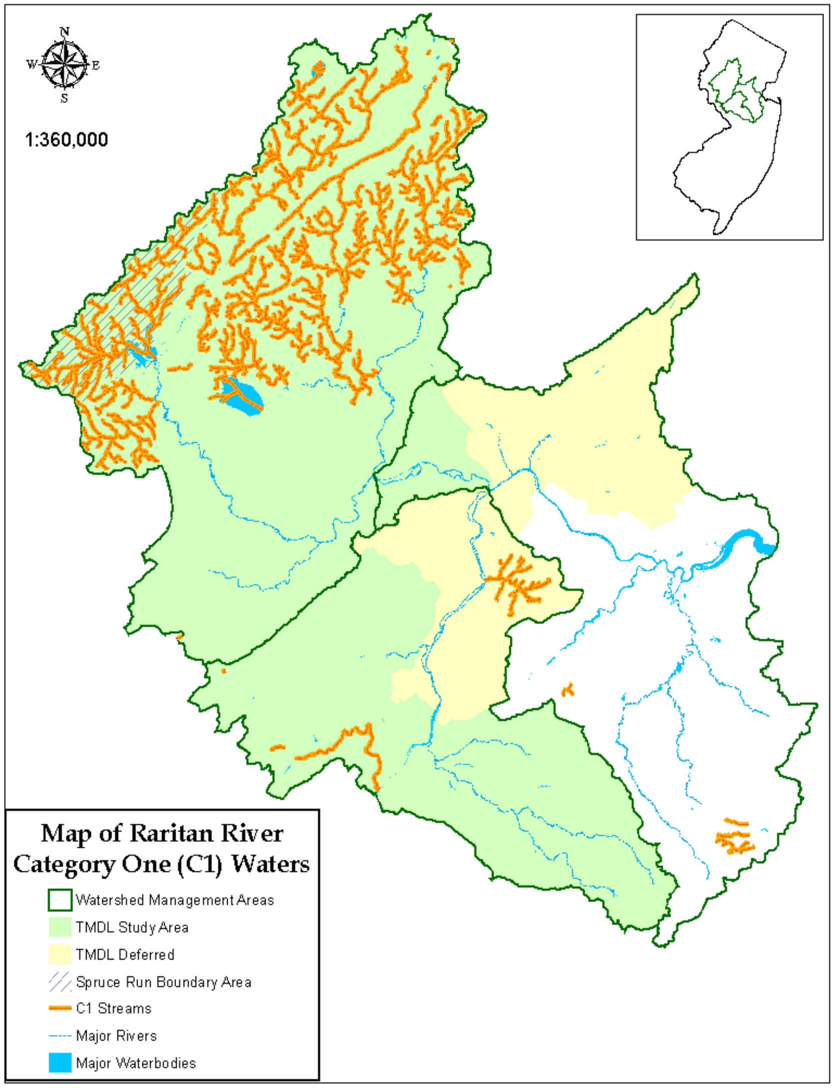
The NJDEP adopted the Stormwater Management Rules N.J.A.C 7:8, which minimizes the impact of stormwater run-off from new development. The Stormwater Management Rules, N.J.A.C. 7:8, establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department's Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, Waterfront Development, and through the NJPDES rules for the Municipal Stormwater Regulation Program.

The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients.

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities will also be updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules.

Moreover, the New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13 require a 300 foot buffer or riparian zone for all "regulated activities" within the 300 foot riparian zone that is adjacent to designated C1 waters and upstream tributaries within the same HUC 14. The Flood Hazard Area Control Act Rules encapsulate the New Jersey Stormwater Management Rule's special water resource protection area (SWRPA) requirement around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. C1 waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at http://www.state.nj.us/dep/wms/bwqsa/swqs.htm. A map of the C1 designations within the pertinent portion of the Raritan River basin are depicted on Figure 10.

Figure 10. C1 waterways adopted December 21, 2009 in WMAs 8, 9, and 10



7.3 Nonpoint Source Implementation

Green Infrastructure

EPA strongly promotes the use of green infrastructure methods as management practices that address stormwater runoff through soils, or reuse. An October 2011 memo from EPA entitled, *Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans* directs EPA regions and states to work with local partners to engage in implementing all NPDES related obligations in an orderly manner. The purpose is to promote integrated planning that is the most cost-effective and protective of clean water. Integrated planning promotes efficiencies in implementing overlapping and competing requirements that may arise from separate waste and storm water programs, capital investments and operation and maintenance requirements. Green infrastructure is a means to achieve integrated planning and cost savings to municipalities.

Likewise, the Department supports green infrastructure as a preferred method of stormwater management that reduces wet weather/stormwater volume, flow, or changes the characteristics of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing the stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse. The use of green infrastructure encourages the idea that stormwater is a resource that can be reused, rather than simply conveyed elsewhere. For a comprehensive list of the Department's recommended green stormwater practices and completed projects, go to http://www.nj.gov/dep/gi/. Several projects and initiatives discussed below and listed in Table 13 already embody this concept, e.g. rain barrels and riparian buffers.

The approved Federal Budget beginning with FFY 10 Clean Water State Revolving Fund (CWSRF or SRF) program includes provisions to promote 'green' technologies and requires States to establish a Green Project Reserve (GPR). The GPR provision generally requires States to reserve not less than 20% of the annual federal allocation for CWSRF capitalization grants to address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. Projects meeting GPR criteria are subject to all SRF program requirements. As New Jersey continues to recover from Superstorm Sandy, strong efforts are being made to implement resiliency practices to help handle the effects of similar future events. Green infrastructure is one of these key practices, and it is essential that these methods be utilized as frequently as possible to promote sound stormwater management.

New Jersey Fertilizer Law

In 2007 the Department began working with the lawn care industry to voluntarily reduce the content of phosphorus in fertilizer by 50%. For FFY 2008, New Jersey reported in its 2009-2010 Annual Nonpoint Source Report, a statewide phosphorus reduction of 172,000 lbs/yr, which in addition to 319(h) nonpoint source restoration efforts is mainly attributed to New Jersey's fertilizer initiative as part of the Department's Health Lawns Healthy Water campaign. Also, the New Jersey Department of Agriculture reports a general reduction trend in tons of fertilizer use from 2008 – 2012 based on fertilizer sales in New Jersey.

On January 5, 2011 the fertilizer reduction initiative was taken to a new level when Governor Christie signed into law the most restrictive fertilizer content standards in the nation for nitrogen and phosphorus. The law was implemented in three phases. **Phase I** went into effect when the law was signed and requires the use of best management practices to reduce the impacts of fertilizers on waterways, and public education regarding correct fertilizer use. **Phase II** initiated in 2012, resulted in the creation of a certification program for professional fertilizer applicators and lawn care providers. To date, over 1,500 professionals have been tested and are certified through the New Jersey Agricultural Experiment Station at Rutgers University and an additional 700 staff and seasonal employees have been trained by a certified professional. **Phase III** enacted in 2013, requires manufacturers to reformulate fertilizers with reduced nitrogen and zero phosphorus content, with a few exceptions such as when establishing a lawn if a soil test indicates the need for phosphorus. This requirement is not applicable to home gardens. Details of the law and its implementation may be found on the Department's Healthy Lawns Healthy Water website at http://www.nj.gov/dep/healthylawnshealthywater.

AmeriCorps NJ Watershed Ambassadors Program

The Department is actively engaged in stewardship building activities aimed at reducing NPS through the AmeriCorps New Jersey Watershed Ambassadors Program. This program is an environmental community service program administered by the Department to raise public awareness about water and watershed issues and to promote watershed stewardship through direct community involvement. AmeriCorps members are assigned to different watersheds throughout the State to serve as "Watershed Ambassadors" to their watershed communities. The Watershed Ambassadors train and work with community volunteers to monitor the waters in their community using New Jersey's protocols for visual and biological monitoring techniques. They also visit schools and community organizations to share information and educate the community about water and watershed issues in New Jersey and to encourage students and residents to become involved in protecting their watershed. The program works to improve water quality by exploring relationships between people and the environment, nurturing community-based environmental activities, and empowering residents to make responsible and informed decisions regarding their watershed.

Watershed Ambassadors complete several partnership projects with community partners throughout their one-year term of service. In support of green infrastructure initiatives, they have conducted several Rain Barrel Workshops within the Raritan River basin over the past two years. Attendees leave the workshop with a completed rain barrel and instructions on installation.

In support of stormwater management, during 2013 Americorps Watershed Ambassadors conducted five Rain Barrel Workshops through community partnerships. Over 100 members of the public were engaged in building and installing home rain barrels, resulting in the prevention of an estimated 142,800 gallons of water from entering the stormwater system (1400 gallons per year X's 102 barrels= 142,800) in the Raritan River Basin.

WMA 8	2 Rain Barrel Workshops	32 Rain Barrels Built
WMA 9	1 Rain Barrel Workshop	20 Rain Barrels Built
WMA 10	2 Rain Barrel Workshops	50 Rain Barrels Built

Although outside the purview of the AmeriCorps NJ Watershed Ambassadors Program to track the installation and maintenance of the rain barrels, many agencies such as the Stony Brook Millstone Watershed Association, New Jersey Water Supply Authority and Rutgers have such programs in place. Within the Raritan River basin, the Stony Brook Millstone Watershed Association runs a "Retain the Rain" rain barrel management program initiated in the Harry's Brook subwatershed and Rutgers Cooperative Extension Water Resources Program conducts a "Stormwater Management in Your Backyard" program with a focus on rain barrel and rain garden installation and maintenance. The New Jersey Water Supply Authority offers a homeowner Rain Garden Rebate Program in Somerville, Bridgewater and Raritan townships http://www.raritanbasin.org/rain_barrel.html to spearhead implementation through requiring homeowner's pledge to operate and maintain their rain barrel upon its installation.

The Department plans to work with Rutgers University as a follow-up to confirm installation of the rain barrel and/or provide support on its implementation to attendants of workshops conducted by a watershed ambassador.

Agricultural

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

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

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

Conservation Reserve Enhancement Program (CREP) The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, signed a $100 million CREP agreement in 2004. Through this program, $23 million of State money was matched with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP is part of the USDA's Conservation Reserve Program (CRP). There will be a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

The goal is to enroll 30,000 acres of eligible farmland into CREP for the planning of grass waterways, contour grass strips, filter strips and riparian buffers. Results will address nonpoint source pollution from agricultural runoff by reducing 26,000 pounds of phosphorus and 7 million pounds of total suspended solids annually. As of June 19, 2013, there are 192 New Jersey CREP contracts, totaling 703.8 acres. Only about 2% of this area is within the Raritan watershed, but there is significant potential for future enrollment to achieve nutrient and TSS reductions.

Regional and local initiatives:

Numerous partnerships already exist in the Raritan watershed which have been and will continue to assist in TMDL implementation. The partners for TMDL implementation include but are not limited to: the NJ Water Supply Authority, Raritan River Basin Alliance, Sustainable Raritan River Initiative, NY/NJ Baykeeper/Raritan Riverkeeper, Stony Brook Millstone Watershed Association, Upper Raritan Headwaters Association, engaged municipalities, county government and Rutgers University.

EPA has identified land stewardship practices as key in alleviating the amount of nitrogen and phosphorus loadings to our nation's waterways. Based on findings from August 2009 Task Group of state and EPA water quality and drinking water officials and managers, a follow-up March 2011 memorandum from EPA entitled, *Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions* promotes nonpoint reductions to be achieved through proven land stewardship practices that improve water quality. Stating that states, federal agencies, conservation districts and private land owners need to work collaboratively to develop watershed-scale plans that target the most effective agricultural practices to the acres most in need.

An example of an existing collaboration is that between the Department and the New Jersey Water Supply Authority (NJWSA). The NJWSA implements a host of programs to engage landowners to improve water resources through: water quality and NPS management; water conservation; native habitat and wildlife enhancement; land preservation and education and outreach. NJWSA implements a suite of River-Friendly programs in WMAs 8 and 9 geared towards, golf courses, businesses, schools and residents. These programs were originally based on those implemented by Stony Brook Millstone Watershed Association and are designed to be a voluntary cooperative effort between the participants and NJWSA. These and other programs led by the NJWSA are highlighted on the NJWSA web page at http://raritanbasin.org/riverfriendly.html and described in detail in Appendix E.

Some specific nutrient reduction projects implemented by NJWSA include in 2003, the Stony Brook-Millstone Watershed Association (SBMWA) and the NJWSA received a $1 million Targeted Watershed Initiative Grant from the USEPA, toward a $2.1 million project that focuses on three types of strategies: restoration at locations with existing problems, protection and preservation of high quality resources and pollution prevention focused on ongoing nonpoint source discharges. The project was targeted to three areas: the upper portion of the South Branch Raritan River, a semi-rural area; the Millstone River, a rapidly developing area; and a portion of the Lower or Mainstem Raritan River, a core urban/industrial area that is just upstream of the Basins largest water supply intake. Additional partners included the South Branch Watershed Association (SBWA) and the NJDEP.

The Peters Brook Stormwater Reduction Project focuses on implementing small, low-cost best management practices (BMPs), such as rain gardens and rain barrels, that will reduce the amount of stormwater, which carries pollutants including fecal coliform, that reaches the Peters Brook. In the summer of 2010, NJWSA worked with Rutgers Cooperative Extension to host four "Build a Rain Barrel" workshops in targeted neighborhoods in Somerville, Bridgewater, and Raritan. The kick-off project was the installation of two 500 square foot rain gardens planted at Van Derveer School in Somerville in June 2010 designed by Rutgers Water Resources program.

Current Implementation Projects

The following projects are either ongoing or are anticipated to be implemented in the TMDL study area. These projects were either funded by the 319(h) grants and/or funding was provided by the Corporate Business Tax and each is expected to have an immediate and positive effect on water quality. Those projects that have been implemented since 2005, the date the water quality characterization was completed, accrue toward achieving the reductions needed and reflected in the load allocation component of the TMDL and the portion of the wasteload allocation assigned to regulated stormwater, where these actions affect areas that drain to regulated stormwater systems.

Table 13. Implementation Projects in the TMDL Study Area

	Grant Number	Cost	Grantee	Project Name	Outcome/Outputs	Completed Pre-2005	Completed Post-2005
North & South Branch Raritan River	RP00-095	$100,000	South Branch Watershed Association	Action Plan Presentation to Communities to Address Nonpoint Source Pollution	NPS Education Program	Yes	--
	RP00-062	$153,000	Ken Lockwood Chapter Trout Unlimited	Restoring our Rivers	Stream Restoration	Yes	--
	RP01-114	$83,919	Upper Raritan Watershed Association	Design and Implementation of NPS Pollution Control measures in the Peapack Brook Subwatershed	Implement BMPS	Yes	--
	RP02-084	$235,000	NJWSA	Mulhockaway Creek Watershed Study	Stormwater Mgt and Watershed Restoration Plan		Yes
	RP04-088	$52,560	Readington Twp	Regional Stormwater Mgt Plan for Pleasant Run and Holland Brook Watershed	Stormwater Mgt Plan Watershed Restoration Plan	--	Yes
	RP04-084	$92,470	East Amwell Twp	Regional Stormwater Management Plan Sourland Mountain	Stormwater Mgt Plan Watershed Restoration Plan	--	Yes
	RP05-081	$393,944	Mount Olive Twp	Budd Lake Watershed Restoration, Protection and Regional Stormwater Mgt Plan	Address Fecal TMDL/Stormwater Mgt Plan	--	Yes
	RP06-068	$435,715	NJIT	Developing a Watershed Restoration Plan for the Neshanic River Watershed	Approved Watershed Based Plan	--	Yes
	RP07-003	$237,362	Union Twp Env Comm	Development of a Watershed Protection Plan for Sidney Brook	Approved Watershed Based Plan	--	Yes
			NJRC&D	Walnut Brook Riparian Restoration Project (implementation of Neshanic Watershed Based plan)	800 ft restored, 3 acres wetlands created		YES
	CBT Grant	$300,000	NJWSA	Addressing Agriculture NPS in Priority Watershed	Ag mini-grant program Develop Nutrient Mgt Plans	--	Ongoing
Upp. Millstone	RP04-085	$286,200	Middlesex County Planning Board	Regional Stormwater Management Plan for the Devils, Shallow, Cedar and Cranbury Brooks	Approved Watershed Based Plan for Manalapan Brook (TSS Source ID)	--	Yes

	Grant Number	Cost	Grantee	Project Name	Outcome/Outputs	Completed Pre-2005	Completed Post-2005
Upp. Millstone, Stony Brk., Beden Brk.	RP98-086	*$132,000	Stony Brook Millstone WA	NPS Control and Mgt for Stony Brook-Millstone Watershed	Restoration projects	Yes	
	RP00-043	$300,000		Streambank Restoration on the Millstone River and Stony Brook	Restoration projects		
Stony Brk., Beden Brk.	RP04-084 & RP06-065	$92,470 & $18,102	East Amwell Twp	Regional Stormwater Management Plan Sourland Mountain	Approved Watershed Based Plan	--	Yes
L. Mills & Raritan R.	RP98-086	*$132,000	Stony Brook Millstone WA	NPS Control and Mgt for Stony Brook-Millstone Watershed	Restoration projects		

* Project covers multiple subwatersheds in the table.

8.0 Reasonable Assurance

There is reasonable assurance that the TMDL will result in attainment of the SWQS based on the suite of regulatory and non-regulatory actions that are ongoing and/or planned to reduce pollutant loads in the Raritan River basin. The above implementation plan describes these various management measures. Follow up monitoring will identify the degree to which the strategies implemented are successful. It will then be determined if other management measures can be implemented to fully attain the surface water quality standards or if it is necessary to consider other approaches, such as use attainability.

9.0 Public Participation

In accordance with the Water Quality Management Planning Rules each TMDL shall be proposed by the Department as an amendment to the appropriate area-wide water quality management plan(s) in accordance with N.J.A.C. 7:15-6. This subchapter provides that there may be one or more opportunities for public involvement prior to proposing the TMDL.

The Department has maintained a long term commitment to the stakeholder process and public participation in the development of this TMDL for the Raritan River basin. The TMDL was developed with assistance and direct input from stakeholders in Watershed Management Areas 8, 9 and 10.

The stakeholder process in the Raritan River basin has been continuous for the past nine years, beginning with the collaborative process associated with the Department's watershed initiative that began in the fall of 2000. Several workgroups were created and the Raritan Basin Watershed Alliance, an offshoot of that process and has been instrumental in facilitating and maintaining a stakeholder process in the Raritan Basin.

There have been a series of public presentations at key points in the development of the monitoring and modeling that have led to this TMDL report, including:

- June 2, 2004; the Department and TRC Omni presented the Raritan River Nutrient TMDL Study and sampling plan to the dischargers in the Basin.
- August 17, 2004; the scope of work for the Raritan Basin Nutrient TMDLs was presented to Raritan Basin Watershed Alliance by the Department.
- September 13, 2004; representatives from the Department and TRC Omni attended a Carnegie Lake Interagency Workgroup Meeting to discuss the TMDL under development.
- February 9, 2005; "Raritan TMDL – Solving In-Stream Nutrient Impairments," presented at the NJWEA, Central Section by TRC Omni.
- June 22, 2005; in coordination with the Department, TRC Omni presented "What is the Raritan Basin TMDL Study; Sampling Approach and Progress; Sampling Results and Overview of Modeling Approach" to the Raritan Basin Watershed Alliance.
- October 2006; "Development of Nutrient TMDLs for the Raritan River Basin," Proceedings of WEFTEC 2006, Dallas, TX, presentation by TRC Omni.

- May 2007; "Water Quality Objectives: What Will the Passaic and Raritan Phosphorus TMDLs Achieve?" NJWEA 92nd Annual Conference & Exhibition, Atlantic City, NJ, presentation by TRC Omni.
- August 20, 2007; Omni, in conjunction with the Department, presented the water quality data and preliminary assessment from the Raritan Basin Nutrient TMDL Study to the stakeholders for informal discussion and review by the Raritan Basin Watershed Alliance's Technical Advisory Committee.
- September 17, 2007; Omni, in conjunction with the Department, presented the Raritan Basin Nutrient TMDL Study model calibration and validation to the Raritan Basin Watershed Alliance's Technical Advisory Committee.
- September 26, 2007; Department presented "Partnerships for Implementation of the Raritan Total Nutrients TMDL" to the Raritan Basin Watershed Alliance.
- December 17, 2007; Omni and the Department presented and discussed Water Quality Targets and Results of Future Simulations for the Raritan Basin Nutrient TMDL Study to the Raritan Basin Watershed Alliance's Technical Advisory Committee.
- May 1, 2008; Omni presented "Raritan River Basin TMDL: Phosphorus and Nitrogen Impacts" at the 93rd NJWEA Annual Conference
- May 7, 2008; Omni and the Department summarized the current status of the Raritan River Basin Nutrient TMDL Study and presented the tentatively limits developed to address DO and/or pH water quality targets to the Raritan Technical Advisory Committee.
- October 9, 2008; a Department representative attended the Raritan Basin Watershed Alliance Steering Committee and provided a status update on the Raritan TMDL.
- March 25, 2009; a Department representative attended the Raritan Basin Watershed Alliance Steering Committee and provided a status update on the Raritan TMDL.
- June 16, 2011; Department presented "NJDEP's Forthcoming Raritan Nutrient TMDL - What does it Mean to the Local Municipality" at the 3rd Annual Sustainable Raritan River Conference.
- May 17, 2012; "Raritan TMDL Update: Is there a Phosphorus Limit in Your Future?" presented at NJWEA Annual Meeting, Atlantic City, NJ by Omni.
- May 16, 2013; "Raritan River Basin Nutrient TMDL: Status and Outcomes," NJWEA 98th Annual Conference and Exhibition, Atlantic City, Kleinfelder/Omni.
- June 5, 2013; Department reviewed past TMDL work and presented the draft TMDL outcomes for nonpoint and point sources to the Raritan River stakeholders for informal public input prior to formal proposal.
- June 11, 2013; Department alerted participants about the forthcoming Raritan TMDL at the 5th Annual Sustainable Raritan River Conference.
- June 18, 2012; Department presented the draft TMDL outcomes to the Raritan River Discharges for informal public input prior to formal proposal.

Throughout the development of the TMDLs for the Raritan River Basin, progress was reported to and reviewed by the Rutgers New Jersey EcoComplex (NJEC) TMDL review panel. The Department contracted with the NJEC in August 2001. The NJEC consists of a review panel of New Jersey university professors whose role is to provide comments on the Department's technical approaches and tools for the development of TMDLs and other management strategies. Their comments on the TMDL study have resulted in refinements to the modeling work upon which this TMDL document is based. Specific milestones for presentation/review included:

April 13, 2004	Proposed Scope of Work
February 17, 2005	Presentation of Phase I Results; Presentation of Proposed Phase II Study
September 20, 2006	Raritan TMDL Phase II Study Results
December 10, 2007	Raritan River Basin TMDL Study End Points and Outcomes
October 1, 2010	Raritan River Basin TMDL Study: TMDL Targets and Approaches

Following these various opportunities, along with additional dialogue to refine the modeling tools, the TMDL review panel determined that the model developed was appropriate for use in developing the proposed TMDLs.

Notice proposing the Raritan River basin phosphorus TMDL was published on June 16, 2014 in the New Jersey Register and in newspapers of general circulation in the affected area in order to provide the public an opportunity to review the TMDL and submit comments. In addition, a public hearing will be held on July 16, 2014, 3:00 – 5:00 p.m. at the Somerset County Administration Building, 20 Grove Street, Somerville, NJ 08876-2312. Notice of the proposal and hearing was provided to affected municipalities, dischargers, and purveyors in the watershed. The comment period will remain open until August 15, 2014.

All comments received during the public notice period for this TMDL study and at the public hearing will become part of the record for this TMDL and will be considered in the Department's decision regarding establishment of this TMDL. If the Department determines to establish the TMDL, it will be submitted to EPA Region 2 for consideration. If approved by EPA, the TMDL would be adopted as an amendment to the Lower Raritan/Middlesex, Mercer County, Monmouth, Northeast, Upper Delaware and Upper Raritan WQMPs.

Appendix A. Cited References

Grumbles, Benjamin H., November 15, 2006, "Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. V. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits"

Hanlon, James A. and Denise Keehner, November 12, 2010 Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" Office of Wastewater Management and Office of Wetlands, Oceans and Watersheds

New Jersey Department of Environmental Protection, "Integrated Water Quality Monitoring and Assessments Methods", 2008

New Jersey Department of Environmental Protection, New Jersey 2010 Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)

NJDEP Surface Water Quality Standards of New Jersey published January 18, 2011 (43 N.J.R. 174(b)) by NJDEP, Division of Water Monitoring and Standards, Bureau of Water Quality Standards and Assessment Online at: http://www.nj.gov/dep/rules/rules/njac7_9b.pdf

New Jersey Department of Environmental Protection, DWQ, August 2008, "Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits". http://www.nj.gov/dep/dwq/pdf/p-manual-07-30-08.pdf

Obropta, Christopher C., Ph.D., P.E., Chair TMDL Advisory Panel. Letter to Barbara Hirst. June 4, 2012.

Omni Environmental, December 2005, "The Raritan River Basin TMDL Phase I Data Summary and Analysis Report", Prepared for Rutgers University New Jersey EcoComplex and New Jersey Department of Environmental Protection Division of Watershed Management.

Kleinfelder/Omni Environmental LLC, August 2013, Final Report "The Raritan River Basin Nutrient TMDL Study Phase II Watershed Model and TMDL Calculations" Prepared for Rutgers University New Jersey EcoComplex and New Jersey Department of Environmental Protection Division of Water Monitoring and Standards.

Spitz, F.J., 2007, Simulation of Surface-Water Conditions in the Non-Tidal Passaic River Basin, New Jersey: U.S. Geological Survey, Scientific Investigations Report 2007-5052

Stoner, Nancy K. March 16, 2011. Memorandum: "Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions". Office of Water, U.S. EPA.

Stoner, Nancy and Giles, Cynthia. October 27, 2011. Memorandum: "Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans". Office of Water and Office of Enforcement and Compliance Assurance, U.S. EPA.

Sutfin, C.H. May 2002. Memorandum: EPA Review of 2002 Section 303(d) Lists and Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992. Office of Wetlands, Oceans and Watersheds, U.S. EPA.

University of Rhode Island College of Resource Development of Natural Sciences, Cooperative extension Fact Sheet No. 96-3 March, 1997 Dissolved Oxygen and Temperature

USEPA November 1999, "Protocols for Developing Nutrient TMDLs" First Edition USEPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-92-002. Washington, DC.

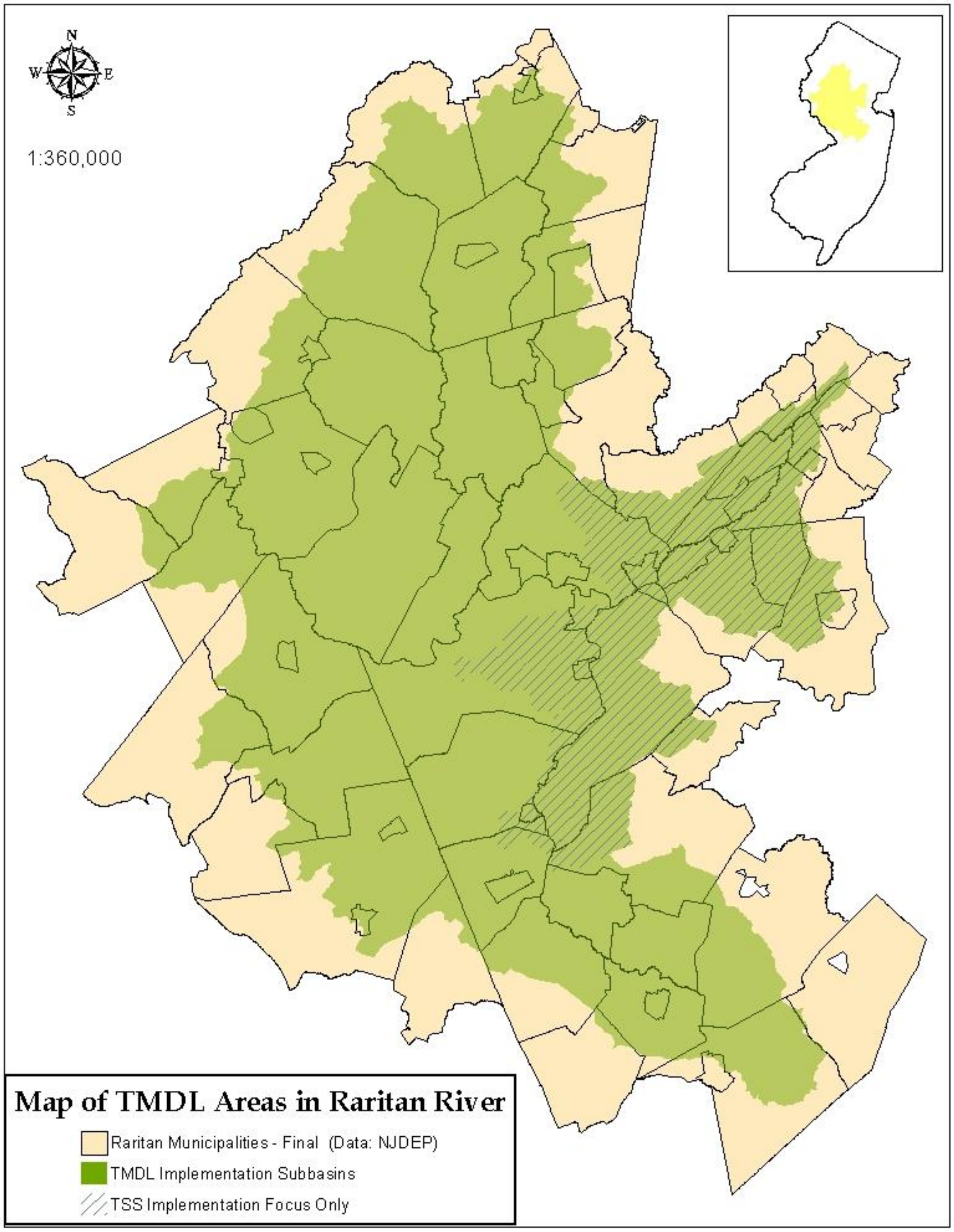
USEPA 1991, "Technical Support Document for Water Quality-Based Toxics Control" EPA-505/2-90-001, Washington, D.C.

USEPA, Region 10, NPDES Permits Unit, June 2012, "Response to Comments on the Draft NPDES Permit for The Meadows, LLC: Permit # ID0024422"
http://www.epa.gov/region10/pdf/permits/npdes/id/the_meadows_rtc_id0024422_2012.pdf

Wayland, R.H. III. November 22, 2002. Memo: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. Office of Wetlands, Oceans and Watersheds, U.S. EPA.

Wisconsin Department of Natural Resources, February 12, 2013, "TMDL Development and Implementation Guidance: Integrating the WPDES and Impaired Waters Programs, Edition No. 2" Guidance Number: 3400-2013-02

Appendix B Municipalities Located in the Raritan River Basin, NJPDES Permit Number and their MS4 Designation



Municipal Name	County	WMA(s)	Tier A or B	NJPDES Permit No.
Alexandria Township	Hunterdon	8	Tier B	NJG0149659
Califon Borough	Hunterdon	8	Tier B	NJG0149641
Clinton Town	Hunterdon	8	Tier A	NJG0148237
Clinton Township	Hunterdon	8	Tier A	NJG0151475
Delaware Township	Hunterdon	8	Tier B	NJG0150673
East Amwell Township	Hunterdon	8,10	Tier B	NJG0151581
Flemington Borough	Hunterdon	8	Tier A	NJG0150908
Franklin Township	Hunterdon	8	Tier B	NJG0149501
High Bridge Borough	Hunterdon	8	Tier A	NJG0153656
Lebanon Borough	Hunterdon	8	Tier A	NJG0151050
Lebanon Township	Hunterdon	8	Tier B	NJG0148041
Raritan Township	Hunterdon	8	Tier A	NJG0149241
Readington Township	Hunterdon	8	Tier A	NJG0149942
Tewksbury Township	Hunterdon	8	Tier B	NJG0154890
Union Township	Hunterdon	8	Tier B	NJG0152978
West Amwell Township	Hunterdon	8,10	Tier B	NJG0150703
East Windsor Township	Mercer	10	Tier A	NJG0150461
Hightstown Borough	Mercer	10	Tier A	NJG0152889
Hopewell Borough	Mercer	10	Tier B	NJG0152986
Hopewell Township	Mercer	10	Tier A	NJG0150622
Lawrence Township	Mercer	10	Tier A	NJG0149560
Pennington Borough	Mercer	10	Tier A	NJG0153141
Princeton	Mercer	10	Tier A	NJG0152064
Robbinsville Twp	Mercer	10	Tier A	NJG0149004
West Windsor Township	Mercer	10	Tier A	NJG0149977
Cranbury Township	Middlesex	10	Tier A	NJG0148482
Dunellen Borough	Middlesex	9	Tier A	NJG0152480
Edison Township	Middlesex	9	Tier A	NJG0155063
Metuchen Borough	Middlesex	9	Tier A	NJG0153389
Middlesex Borough	Middlesex	9	Tier A	NJG0150444
Monroe Township	Middlesex	9,10	Tier A	NJG0148318
North Brunswick Township	Middlesex	10	Tier A	NJG0153117
Piscataway Township	Middlesex	9	Tier A	NJG0149934
Plainsboro Township	Middlesex	10	Tier A	NJG0152391
South Brunswick Township	Middlesex	9,10	Tier A	NJG0154636
South Plainfield Borough	Middlesex	9	Tier A	NJG0153966
Manalapan Township	Monmouth	9,10	Tier A	NJG0150886
Millstone Township	Monmouth	9,10	Tier A	NJG0153532
Roosevelt Borough	Monmouth	10	Tier B	NJG0149713
Chester Borough	Morris	8	Tier A	NJG0151467
Chester Township	Morris	8	Tier A	NJG0151238
Mendham Borough	Morris	8	Tier A	NJG0151483

Municipal Name	County	WMA(s)	Tier A or B	NJPDES Permit No.
Mendham Township	Morris	8	Tier A	NJG0150819
Mine Hill Township	Morris	8	Tier A	NJG0153133
Mount Arlington Borough	Morris	8	Tier A	NJG0153265
Mount Olive Township	Morris	8	Tier A	NJG0148326
Randolph Township	Morris	8	Tier A	NJG0152501
Roxbury Township	Morris	8	Tier A	NJG0152641
Washington Township	Morris	8	Tier A	NJG0152471
Bedminster Township	Somerset	8	Tier A	NJG0151459
Bernards Township	Somerset	8,9	Tier A	NJG0148661
Bernardsville Borough	Somerset	8	Tier A	NJG0151068
Bound Brook Borough	Somerset	9	Tier A	NJG0148725
Branchburg Township	Somerset	8	Tier A	NJG0148539
Bridgewater Township	Somerset	8,9	Tier A	NJG0147893
Far Hills Borough	Somerset	8	Tier B	NJG0151599
Franklin Township	Somerset	9,10	Tier A	NJG0147869
Green Brook Township	Somerset	9	Tier A	NJG0149276
Hillsborough Township	Somerset	8,9,10	Tier A	NJG0153231
Manville Borough	Somerset	9,10	Tier A	NJG0150347
Millstone Borough	Somerset	10	Tier B	NJG0154806
Montgomery Township	Somerset	10	Tier A	NJG0148261
North Plainfield Borough	Somerset	9	Tier A	NJG0149586
Peapack-Gladstone Borough	Somerset	8	Tier A	NJG0153711
Raritan Borough	Somerset	8,9	Tier A	NJG0153427
Rocky Hill Borough	Somerset	10	Tier B	NJG0149705
Somerville Borough	Somerset	9	Tier A	NJG0150941
South Bound Brook Borough	Somerset	9	Tier A	NJG0152404
Warren Township	Somerset	9	Tier A	NJG0154202
Watchung Borough	Somerset	9	Tier A	NJG0149993
Berkeley Heights Township	Union	9	Tier A	NJG0147923
Fanwood Borough	Union	9	Tier A	NJG0154415
Mountainside Borough	Union	9	Tier A	NJG0154946
New Providence Borough	Union	9	Tier A	NJG0153494
Plainfield City	Union	9	Tier A	NJG0151271
Scotch Plains Township	Union	9	Tier A	NJG0149985
Springfield Township	Union	9	Tier A	NJG0153885
Summit City	Union	9	Tier A	NJG0153613
Westfield Town	Union	9	Tier A	NJG0150100

Appendix C Additional Impairments within TMDL Area

The table below identifies the assessment units within the TMDL area of interest which have impairments not being addressed in the scope of this TMDL based on the *2010 Integrated Water Quality Monitoring and Assessment Report* and the TMDL supplemental data review.

WMA	Watershed (HUC 14)	Name of Watershed	Parameter
8	NJ02030105010020-01	Drakes Brook (below Eyland Ave)	Cause Unknown
8	NJ02030105010050-01	Raritan R SB(LongValley br to 74d44m15s)	Cause Unknown
8	NJ02030105010050-01	Raritan R SB(LongValley br to 74d44m15s)	pH
8	NJ02030105010050-01	Raritan R SB(LongValley br to 74d44m15s)	Temperature, water
8	NJ02030105010060-01	Raritan R SB(Califon br to Long Valley)	Oxygen, Dissolved
8	NJ02030105010060-01	Raritan R SB(Califon br to Long Valley)	Temperature, water
8	NJ02030105010070-01	Raritan R SB(StoneMill gage to Califon)	Temperature, water
8	NJ02030105010080-01	Raritan R SB(Spruce Run-StoneMill gage)	Temperature, water
8	NJ02030105020010-01	Spruce Run (above Glen Gardner)	Temperature, water (#)
8	NJ02030105020020-01	Spruce Run (Reservior to Glen Gardner)	Temperature, water (#)
8	NJ02030105020030-01	Mulhockaway Creek	Temperature, water (#)
8	NJ02030105020040-01	Spruce Run Reservoir / Willoughby Brook	pH (#)
8	NJ02030105020040-01	Spruce Run Reservoir / Willoughby Brook	Phosphorus (Total) (#)
8	NJ02030105020040-01	Spruce Run Reservoir / Willoughby Brook	Temperature, water (#)
8	NJ02030105020050-01	Beaver Brook (Clinton)	pH
8	NJ02030105020050-01	Beaver Brook (Clinton)	Temperature, water
8	NJ02030105020060-01	Cakepoulin Creek	DDD
8	NJ02030105020060-01	Cakepoulin Creek	DDE
8	NJ02030105020060-01	Cakepoulin Creek	DDT
8	NJ02030105020060-01	Cakepoulin Creek	Temperature, water
8	NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	pH
8	NJ02030105020070-01	Raritan R SB(River Rd to Spruce Run)	Temperature, water
8	NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	Arsenic
8	NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	pH
8	NJ02030105020080-01	Raritan R SB(Prescott Bk to River Rd)	Temperature, water
8	NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	Arsenic
8	NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	pH
8	NJ02030105020100-01	Raritan R SB(Three Bridges-Prescott Bk)	Temperature, water
8	NJ02030105030010-01	First Neshanic River	Cause Unknown
8	NJ02030105030030-01	Headquarters trib (Third Neshanic River)	Oxygen, Dissolved
8	NJ02030105030040-01	Third Neshanic River	Oxygen, Dissolved
8	NJ02030105030050-01	Back Brook	Cause Unknown
8	NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	Arsenic
8	NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	Oxygen, Dissolved
8	NJ02030105030060-01	Neshanic River (below FNR / SNR confl)	pH
8	NJ02030105030070-01	Neshanic River (below Black Brk)	Arsenic
8	NJ02030105030070-01	Neshanic River (below Black Brk)	pH
8	NJ02030105040010-01	Raritan R SB(Pleasant Run-Three Bridges)	Arsenic
8	NJ02030105040020-01	Pleasant Run	Cause Unknown
8	NJ02030105040020-01	Pleasant Run	Escherichia coli
8	NJ02030105040030-01	Holland Brook	Cause Unknown
8	NJ02030105040030-01	Holland Brook	pH
8	NJ02030105040040-01	Raritan R SB(NB to Pleasant Run)	Arsenic
8	NJ02030105050020-01	Lamington R (Hillside Rd to Rt 10)	Oxygen, Dissolved

WMA	Watershed (HUC 14)	Name of Watershed	Parameter
8	NJ02030105050030-01	Lamington R (Furnace Rd to Hillside Rd)	Temperature, water
8	NJ02030105050040-01	Lamington R(Pottersville gage-FurnaceRd)	Cause Unknown
8	NJ02030105050040-01	Lamington R(Pottersville gage-FurnaceRd)	Temperature, water
8	NJ02030105050070-01	Lamington R(HallsBrRd-HerzogBrk)	Temperature, water
8	NJ02030105050090-01	Rockaway Ck (below McCrea Mills)	pH
8	NJ02030105050100-01	Rockaway Ck SB	Temperature, water
8	NJ02030105050130-01	Lamington R(Hertzog Brk to Pottersville gage)	Temperature, water
8	NJ02030105060030-01	Raritan R NB(incl McVickers to India Bk)	Temperature, water
8	NJ02030105060040-01	Raritan R NB(Peapack Bk to McVickers Bk)	Oxygen, Dissolved
8	NJ02030105060040-01	Raritan R NB(Peapack Bk to McVickers Bk)	Temperature, water
8	NJ02030105060070-01	Raritan R NB(incl Mine Bk to Peapack Bk)	Cause Unknown
8	NJ02030105060080-01	Middle Brook (NB Raritan River)	Cause Unknown
8	NJ02030105060080-01	Middle Brook (NB Raritan River)	Escherichia coli
8	NJ02030105060090-01	Raritan R NB (Lamington R to Mine Bk)	pH
8	NJ02030105070010-01	Raritan R NB (Rt 28 to Lamington R)	Cause Unknown
8	NJ02030105070020-01	Chambers Brook	Cause Unknown
8	NJ02030105070030-01	Raritan R NB (below Rt 28)	pH
9	NJ02030105080010-01	Peters Brook	Cause Unknown
9	NJ02030105080030-01	Raritan R Lwr (Millstone to Rt 206)	pH
10	NJ02030105090020-01	Stony Bk (74d 48m 10s to 74d 49m 15s)	Escherichia coli
10	NJ02030105090050-01	Stony Bk(Province Line Rd to 74d46m dam)	Arsenic
10	NJ02030105090060-01	Stony Bk (Rt 206 to Province Line Rd)	Arsenic
10	NJ02030105090070-01	Stony Bk (Harrison St to Rt 206)	Arsenic
10	NJ02030105090080-01	Duck Pond Run	Cause Unknown
10	NJ02030105090090-01	Stony Bk- Princeton drainage	Arsenic
10	NJ02030105100010-01	Millstone River (above Rt 33)	Arsenic
10	NJ02030105100020-01	Millstone R (Applegarth road to Rt 33)	Arsenic
10	NJ02030105100030-01	Millstone R (RockyBk to Applegarth road)	Oxygen, Dissolved
10	NJ02030105100040-01	Rocky Brook (above Monmouth Co line)	Arsenic
10	NJ02030105100050-01	Rocky Brook (below Monmouth Co line)	Arsenic
10	NJ02030105100050-01	Rocky Brook (below Monmouth Co line)	Oxygen, Dissolved
10	NJ02030105100060-01	Millstone R (Cranbury Bk to Rocky Bk)	Arsenic
10	NJ02030105100070-01	Cranbury Brook (above NJ Turnpike)	Cause Unknown
10	NJ02030105100090-01	Cranbury Brook (below NJ Turnpike)	Cause Unknown
10	NJ02030105100100-01	Shallow Brook (Devils Brook)	Cause Unknown
10	NJ02030105100110-01	Devils Brook	Escherichia coli
10	NJ02030105100110-01	Devils Brook	Oxygen, Dissolved
10	NJ02030105100120-01	Bear Brook (above Trenton Road)	Arsenic
10	NJ02030105100120-01	Bear Brook (above Trenton Road)	Cause Unknown
10	NJ02030105100120-01	Bear Brook (above Trenton Road)	Escherichia coli
10	NJ02030105100130-01	Bear Brook (below Trenton Road)	Arsenic
10	NJ02030105100130-01	Bear Brook (below Trenton Road)	Escherichia coli
10	NJ02030105100130-01	Bear Brook (below Trenton Road)	Oxygen, Dissolved
10	NJ02030105100140-01	Millstone R (Rt 1 to Cranbury Bk)	Arsenic
10	NJ02030105100140-01	Millstone R (Rt 1 to Cranbury Bk)	Oxygen, Dissolved
10	NJ02030105110010-01	Heathcote Brook	pH
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	Oxygen, Dissolved
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	pH
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	Phosphorus (Total)
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	Arsenic
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	Escherichia coli

WMA	Watershed (HUC 14)	Name of Watershed	Parameter
10	NJ02030105110030-01	Millstone R (Beden Bk to Heathcote Bk)	Temperature, water
10	NJ02030105110040-01	Beden Brook (above Province Line Rd)	Cause Unknown
10	NJ02030105110040-01	Beden Brook (above Province Line Rd)	Escherichia coli
10	NJ02030105110050-01	Beden Brook (below Province Line Rd)	Arsenic
10	NJ02030105110080-01	Pike Run (above Cruser Brook)	Cause Unknown
10	NJ02030105110110-01	Millstone R (BlackwellsMills to BedenBk)	Phosphorus (Total)
10	NJ02030105110110-01	Millstone R (BlackwellsMills to BedenBk)	Arsenic
10	NJ02030105110120-01	Sixmile Run (above Middlebush Rd)	Phosphorus (Total)
10	NJ02030105110130-01	Sixmile Run (below Middlebush Rd)	Phosphorus (Total)
10	NJ02030105110140-01	Millstone R(AmwellRd to BlackwellsMills)	Phosphorus (Total)
10	NJ02030105110140-01	Millstone R(AmwellRd to BlackwellsMills)	Arsenic
10	NJ02030105110150-01	Royce Brook (above Branch Royce Brook)	Cause Unknown
10	NJ02030105110160-01	Royce Brook (below/incl Branch Royce Bk)	Cause Unknown
10	NJ02030105110170-01	Millstone River (below Amwell Rd)	pH
10	NJ02030105110170-01	Millstone River (below Amwell Rd)	Phosphorus (Total)
9	NJ02030105120020-01	Green Bk (N Plainfield gage to Blue Bk)	pH
9	NJ02030105120020-01	Green Bk (N Plainfield gage to Blue Bk)	Total Dissolved Solids
9	NJ02030105120020-01	Green Bk (N Plainfield gage to Blue Bk)	Chloride
9	NJ02030105120030-01	Stony Brook (North Plainfield)	Total Dissolved Solids
9	NJ02030105120030-01	Stony Brook (North Plainfield)	Cause Unknown
9	NJ02030105120040-01	Green Bk (Bound Bk to N Plainfield gage)	Cause Unknown
9	NJ02030105120050-01	Middle Brook EB	Total Dissolved Solids
9	NJ02030105120050-01	Middle Brook EB	Chloride
9	nJ02030105120050-01	Middle Brook EB	Cause Unknown
9	NJ02030105120060-01	Middle Brook WB	Cause Unknown
9	NJ02030105120070-01	Cuckels Brook	Cause Unknown
9	NJ02030105120080-01	South Fork of Bound Brook	Phosphorus (Total)
9	NJ02030105120080-01	South Fork of Bound Brook	Polychlorinated biphenyls
9	NJ02030105120090-01	Spring Lake Fork of Bound Brook	Phosphorus (Total)
9	NJ02030105120090-01	Spring Lake Fork of Bound Brook	Polychlorinated biphenyls
9	NJ02030105120100-01	Bound Brook (below fork at 74d 25m 15s)	Phosphorus (Total)
9	NJ02030105120100-01	Bound Brook (below fork at 74d 25m 15s)	Dioxin (including 2,3,7,8-TCDD)
9	NJ02030105120100-01	Bound Brook (below fork at 74d 25m 15s)	Polychlorinated biphenyls
9	NJ02030105120120-01	Ambrose Brook (below Lake Nelson)	Cause Unknown
9	NJ02030105120130-01	Green Brook (below Bound Brook)	Phosphorus (Total)
9	NJ02030105120130-01	Green Brook (below Bound Brook)	Polychlorinated biphenyls
9	NJ02030105120130-01	Green Brook (below Bound Brook)	Sulfates
9	NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	Phosphorus (Total)
9	NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	Arsenic
9	NJ02030105120140-01	Raritan R Lwr(I-287 Piscatway-Millstone)	Benzene
9	NJ02030105120180-01	Middle Brook	Arsenic
9	NJ02030105120180-01	Middle Brook	Benzene
9	NJ02030105120180-01	Middle Brook	Phosphorus (Total)

Footnote – (#) Above TMDL model area; Spruce Run Reservoir watershed.

Appendix D TMDLs approved by USEPA in the Raritan River Basin

WMA	Monitoring Site Name	TMDL Parameter	TMDL Year	Monitoring Site(s)/Location	Included HUC14(s)
8	Lamington River	Fecal Coliform	2003	1399200, 1399500, 1399700, 1399780	02030105050020, 30, 40, 50, 60, 70, 110
8	N Br Raritan River	Fecal Coliform	2003	1398260	02030105060010, 30
8	N Br Raritan River, Chambers Brook	Fecal Coliform	2003	1399120, 1399900, 1400000	02030105070020, 30, 10, 02030105060090
8	Neshanic River	Fecal Coliform	2003	1398000	02030105030010, 20, 30, 40, 60
8	S Br Raritan River, Assiscong Ck,	Fecal Coliform	2003	1397000, 1397400, 1398102	02030105020080, 100, 5040010, 0040
8	S Br Raritan River, Stony Brook	Fecal Coliform	2003	1396219, 1396280, 1396535	02030105010050, 60, 70, 80
9	Green Brook, Bound Brook	Fecal Coliform	2003	1403385, 1403470	02030105120010, 20, 30, 40, 80, 90, 100
9	Middle Brook W Br	Fecal Coliform	2003	01403171	02030105120060
9	Peters Brook	Fecal Coliform	2003	1400395	02030105080010
9	Raritan R downstream of Green Bk/Bound Bk, includes Cuckels Bk, Dukes Bk, Middle Bk	Fecal Coliform	2003	1400500, 1403300, 1403900	02030105080020, 30, 02030105120070, 120130, 40, 60
10	Back Brook, Pike Run, Bedens Brook	Fecal Coliform	2003	1401600, 1401700	02030105110100, 02030105110050
10	Cranbury Brook	Fecal Coliform	2003	1400690	02030105100070, 90
10	Duck Pond Run	Fecal Coliform	2003	1401200	02030105090080
10	Heathcote Bk, Carters Bk	Fecal Coliform	2003	1401400	02030105110010
10	Millstone R, Rocky Brook	Fecal Coliform	2003	1400540, 1400650	02030105100010, 20, 30, 50, 60
10	Millstone R, Simonson Bk, Ten Mile Run	Fecal Coliform	2003	1402000, 1402540	02030105110110, 02030105110140, 170
10	Rock Brook	Fecal Coliform	2003	01401560	02030105110060, 70
10	Stony Brook	Fecal Coliform	2003	1401000	02030105090050, 60, 70
8	Budd Lake	Fecal Coliform	2007	Mount Olive Twp, Morris County	02030105010030
8	Randolph Park Lake	Fecal Coliform	2007	Randolph Twp, Morris County	02030105050010

WMA	Monitoring Site Name	TMDL Parameter	TMDL Year	Monitoring Site(s)/Location	Included HUC14(s)
8	Ravine Lake	Fecal Coliform	2007	Peapack-Gladstone Boro & Far Hills Boro, Somerset County	02030105060010, 20, 30, 40
8	Round Valley Recreation Area	TP	2003	Clinton Twp, Hunterdon County	02030105020090
8	Sunset Lake	Fecal Coliform	2007	Bridgewater Twp, Somerset County	02030105070010

Appendix E New Jersey Water Supply Authority Nonpoint Source Implementation Activities

I. Addressing Agricultural Nonpoint Sources in Priority Watersheds of the Raritan Basin (Ag Mini Grants)

The goal of this project is to increase the amount of agricultural conservation practice implementation in four priority watersheds of the Raritan Basin: Spruce Run, Mulhockaway Creek, Neshanic River, and South Branch/Long Valley. The priority watersheds were selected due to their importance to water supply in the Raritan Basin, the existence of watershed restoration plan recommendations, the known impairments and the presence of a significant amount of agriculture in each watershed. A portion of these watersheds is in the TMDL implementation area.

NJWSA will implement an agricultural mini-grant program to provide cost-share funding to agricultural producers in order to increase conservation practice implementation. The program is intended to expand the ability of farmers to implement conservation practices by providing a funding source to either serve as a complement to United State Department of Agriculture (USDA) Farm Bill programs or be a sole-source of funding. NJWSA will also provide containers to be used for equine manure collection and storage at individual farms prior to transport to a regional manure composting facility.

In the Mulhockaway Creek watershed, Hunterdon County Soil Conservation District (HCSCD) developed nutrient management plans and provided integrated crop management services. Riparian buffers will be established in the Mulhockaway and Spruce Run watersheds.

The EPA STEP-L (Spreadsheet Tool for Estimating Pollutant Load) model will be used to establish baseline pollutant load levels and to document reductions accomplished through the project.

The practices implemented through this project will reduce nutrient, sediment and bacteria loads in the target watersheds.

Accomplishments to date:

- Development of the agricultural minigrant program guidance.
- Received seven applications during the first round of mini-grants; recommended five for funding.
- Development of 32 nutrient management plans in the Mulhockaway Creek watershed.
- Implementation of integrated crop management on more than 1,400 acres in the Mulhockaway Creek watershed.

Future objectives:

- Implementation of conservation practices.
- Establishment of riparian buffers.

II. Delaware & Raritan Canal Restoration Plan and Implementation Projects

a. Restoration Plan

The Delaware & Raritan Canal is a 60-mile long water transmission facility with its Delaware River intake at Bulls Island in Hunterdon County (north of Stockton Borough) and its outlet at the Raritan River in the City of New Brunswick. The Canal travels through WMA 10 and into WMA 9. Several streams and stormwater systems are tributary to the Canal and contribute water.

Since 1997, several of the Canal's water purveyors reported increased concentrations of total suspended solids in the raw water during and immediately after precipitation events, requiring increased chemical use for treatment and increasing residual sludge generation. A 1999 study by the United States Geological Survey (USGS) reported that the turbidity does not decrease in the Canal reach between Ten Mile Lock and the Route 18 spillway as would be expected due to low water velocities in this reach, indicating that settling solids are replaced by particulates from influent streams and stormwater discharges to the Canal. Field observations downstream of the Canal's confluence with Cedar Grove Brook confirm this, noting the formation of a sand bar indicating that Cedar Grove Brook contributes sediment-laden stormwater to the Canal.

The Delaware & Raritan Canal Nonpoint Source Tributary Assessment and Restoration Plan identified the streams and stormwater outfalls that contribute the greatest pollutant loadings in the last 11 miles of the Canal, and recommended remedial projects for the top 15 drainage areas in the project area from the Amwell Road Bridge to the Landing Lane Bridge. Some of these drainage areas are within the TMDL area.

b. Implementation Plan

In 2006, NJWSA received funding from NJDEP to implement stormwater improvement projects in the top 15 drainage areas that were identified in the Delaware & Raritan Canal Tributary Assessment and Nonpoint Source Assessment Project. This project focuses on the goal of reducing the amount of particulate solids entering the Delaware & Raritan Canal by installing stormwater best management practices.

c. Implementation Project: Infall 38

Infall 38 was ranked thirteenth in the original Canal restoration plan prioritization. This drainage area, which contributes approximately 3% of the total particulate solids load to the Canal from the project area, contains most of the Rutgers Preparatory School property. A dry basin on the school property received the runoff from the entire 53-acre drainage area. The basin was retrofitted to a wet pond in 2009 to improve sediment removal.

d. Implementation Project: Infall 21

Infall 21, ranked second in the priority ranking performed as part of the D&R Canal project, is primarily comprised of residential land uses (66%). This infall contributes approximately 9% of the total particulate solids load from the project area to the Canal for a load of more than 3 million pounds. The residential land uses and the other urban (open space) land uses contributed 54% and 41% of the solids load to the infall.

In 2012, NJWSA worked with South Bound Brook Borough to install five Filterra vegetated stormdrain inlet boxes and a baffle box to remove sediment and other pollutants from stormwater runoff. The five Filterra units were installed adjacent to five existing stormdrains. As stormwater flows along the curb, it enters the Filterra unit and flows through a filter media. A plant in the Filterra unit increases the amount of nutrient uptake and evapotranspiration. If flow exceeds the Filterra capacity, it goes into the existing storm drain. The Suntree Technologies nutrient-separating baffle box is installed at the Abraham Staats House where the stormwater system discharges into the Canal. The baffle box removes sediments and trash via settling and use of a filter media. The BMPs will remove approximately 65% of the TSS load from the drainage area.

e. Implementation Projects: Additional Infalls

NJWSA is working with Franklin Township, the New Jersey Department of Transportation and private landowners to install BMPs in Infalls 5, 28 and 60/62. Conceptual designs were developed for each of these infalls to increase sediment removal from the drainage areas.

f. Rain Barrel Workshops

As part of NJWSA's work in the D&R Canal watersheds, four rain barrel workshops were held in 2012 and 2013 with South Bound Brook Borough and Franklin Township. A fifth workshop is scheduled for 2014. A total of 59 barrels were built at the first four workshops.

Accomplishments to date:

- Retrofit of existing detention basin in Infall 38 drainage area.

- Installation of nutrient separating baffle box in Infall 21 drainage area.
- Installation of five Filterra vegetated inlets in Infall 21 drainage area.
- Completion of four rain barrel workshops with 59 barrels constructed.

Future objectives:

- Installation of BMPs in Infalls 5, 28 and 60/62.
- Identification and implementation of projects in additional drainage areas.
- Additional rain barrel workshops.

III. Land Preservation

In 2001, NJWSA launched the Spruce Run Initiative (SRI) to preserve critical watershed properties in the vicinity of the Spruce Run Reservoir. The SRI involved outreach to landowners within the Spruce Run watershed, exploring the possibilities of Authority-led acquisition of critical parcels. This outreach was guided by the Watershed Protection Programs' report, Preservation of Critical Areas in the Spruce Run Reservoir Watersheds, as well as GIS-based critical area mapping provided by the Watershed Protection Programs. Since that time, the Authority expanded its land preservation efforts to include lands within the watersheds of the North and South Branches of the Raritan River as well as the Lockatong and Wickecheoke watersheds, utilizing the WPP's critical area mapping as a tool for identifying target properties.

NJWSA formed partnerships with non-profit, municipal, County, State, and Federal entities to maximize its watershed acquisitions. NJWSA, along with its partners, has taken a strategic approach at preservation with the intention of creating contiguous areas of preserved open space. In addition, these partnerships have allowed NJWSA to cost-share, and to designate management of properties to other entities who wish to utilize the properties for mutually acceptable purposes.

NJWSA instituted a Source Water Protection (SWP) rate component on July 1, 2002 to fund the SWP program. This ongoing source of dedicated funds allows the Authority to finance land acquisitions through the New Jersey Environmental Infrastructure Trust (NJEIT) at very favorable interest rates. The NJEIT is a low interest loan program available to public entities for, among other things, the acquisition of properties benefiting drinking water quality.

To date, NJWSA and its partners have participated in the preservation of nearly 4,000 acres of critical watershed property, valued at more than $77,000,000. Of those acres, 316 acres are held as conservation easements on agricultural lands. NJWSA has forged successful partnerships with 36 different entities, both for cost sharing and management responsibilities on preserved parcels.

While land preservation is not an "active" best management practice to reduce pollutant loads, it is effective in preventing future pollutant loads.

Accomplishments to date:

- Preservation of nearly 4,000 acres of critical watershed properties with 36 partners.

Future objectives:

- Management and restoration activities on preserved properties.

IV. Residential Rain Barrel Workshops

The installation of rain barrels on residential properties can help reduce the volume of runoff, promote infiltration of runoff and reduce the pollutant load entering the stormwater system; however, a significant benefit is the opportunity to educate residents about how their actions affect the watershed. The Residential Rain Barrel Program complements the River-Friendly Resident program.

Workshop participants are introduced to the connection among stormwater runoff, their local stream and their drinking water and homeowner solutions such as rain barrels, rain gardens and other River-Friendly activities. Participants build their own rain barrel and are provided with information regarding proper installation and maintenance.

a. Peters Brook Watershed

Since 2010, NJWSA has held ten (10) Build-a-Rain-Barrel workshops in the three Peters Brook Watershed communities of Bridgewater, Somerville and Raritan Borough. More than 225 participants attended the workshops and built 183 barrels. For the first four workshops, barrels were offered at a subsidized rate of $20 per barrel, and the workshops were a neighborhood-based approach. In 2011, when the Peters Brook Rain Barrel Rebate Program began, barrels were offered at the rate which they were purchased from Rutgers of $38-$40. Initial workshops were held within walking distance of these neighborhoods, and within viewing distance of the Peters Brook or tributaries.

b. Delaware & Raritan Canal Watersheds

See Delaware & Raritan Canal Implementation Projects.

c. Neshanic River Watershed

See Neshanic River Watershed Implementation Projects.

d. Raritan River Rain Barrel Rebate Program

In 2011, the Regional Center Partnership and NJWSA initiated a rain barrel rebate program for residents of the Peters Brook Watershed. Rebates of up to $200 have been available to provide incentive for residents to install rain barrels. The rebate amount is based upon the storage capacity of the barrels, and a maximum of two rebates per property is in effect. Rain barrels that hold 40-70 gallons are eligible for rebates of up to $50 (not to exceed the purchase price), and barrels that hold more than 70 gallons are eligible for rebates up to $100 (not to exceed the purchase price). In 2014 the program expanded to include all residents of Bridgewater Township, Somerville Borough and Raritan Borough. To date (4/24/14), rebates have been issued for 31 rain barrels, with the capacity of 1822 gallons of roof runoff combined. The objective is to achieve 150 rain barrels installed through this program.

Accomplishments to date:

- Peters Brook Watershed – 183 rain barrels at ten workshops
- Delaware & Raritan Canal – 59 barrels at four workshops
- Neshanic River – 17 barrels at two workshops

Future objectives:

- Additional rain barrel workshops. Three additional workshops are scheduled for 2014 in the Neshanic watershed, and one additional workshop is scheduled in the Delaware & Raritan Canal watershed.
- 150 rain barrels (total) installed through the rebate program.

V. Rain Garden Rebate Program

Rutgers Cooperative Extension Water Resources Program and NJWSA piloted the New Jersey Rain Garden Rebate Program in fall 2013 in Somerville Borough. The Rain Garden Rebate Program is a two-part educational program, where participants receive a rebate once they have installed a rain garden. The first part of the program is a two-hour educational workshop where participants learn about rain gardens, rain garden maintenance, and how to determine the best location for a rain garden. Participants leave the workshop with an assignment to measure their property, take photographs, and complete a percolation test. Approximately two weeks later, participants return for one-on-one design consultations with Rutgers engineers and landscape architects. Participants leave their session with a custom design for their property with all material quantities listed. Once the garden is installed, participants will receive $3 per square foot of rain garden installed (based on the Rutgers design), up to $450.

The fall 2013 workshops had 45 participants, and 21 rain gardens were designed for 15 properties within Somerville Borough. More than 25 participants are expected for the spring 2014 program, which has expanded to include Bridgewater Township and Raritan Borough. The objective is to have 80 rain gardens in up to 4 communities.

Accomplishments to date:

- 45 workshop participants.
- 21 designed gardens.

Future objectives:

- Spring 2014 workshops.
- Total of 80 rain gardens installed in up to four communities.

VI. River-Friendly Programs:

NJWSA implements a suite of River-Friendly programs in WMA 8 and WMA 9, including those for Golf Courses, Businesses, Schools and Residents. These programs were originally based on those implemented by the Stony Brook Millstone Watershed Association. Through these programs, NJWSA works with landowners and land managers to improve water quality by implementing actions in four categories:

- Water Quality Management & Nonpoint Source Pollution Management,
- Water Conservation,
- Native Habitat & Wildlife Enhancement, and
- Education & Outreach.

The voluntary River-Friendly Golf Course, Business and School programs are a cooperative effort between the participants and NJWSA. They provide an opportunity for landowners and land managers to become local stewards, to showcase positive environmental actions they have already taken and to work with NJWSA to implement new practices. Participating landowners receive ongoing technical information, support and guidance for implementing environmental actions tailored to their unique location, resources and needs.

a. River-Friendly Business Certification Program

The River-Friendly Business Certification Program is designed to help businesses take a leading role in preserving their community's environmental health. This program allows a business to demonstrate a commitment to the environment and the local economy.

Each business is required to meet a set of baseline standards and complete site-specific actions that are designed to address water quality issues or issues that may be unique to a business's campus or facility. By participating in the River-Friendly Program, businesses become an environmental steward and a model for others by enhancing water quality, protecting open space, and promoting wildlife habitat.

Certification benefits:

- Protects natural resources and preserves New Jersey's native landscapes.
- Provides public recognition for achievements
- Reduces costs by decreasing use of fertilizers, pesticides and herbicides.
- Creates healthier landscaping.
- Maintains campus aesthetics and creates a positive working environment.
- Decreases water use.
- Increases natural habitat and attracts beneficial wildlife.
- Reduces employee exposure to pesticides and other chemicals.
- Promotes a positive relationship between the community and the business.

Accomplishments to date:

- Nine Business participants
- 68 new acres of no mow or reduced mow (several sites had many acres of no mow before)
- 34 new acres of no spray or reduced irrigation
- 13 acres wildflower/native grasses planted
- 15 native/butterfly gardens planted
- 3 rain gardens planted

- 800 trees planted
- 78 bluebird/kestrel/owl/duck boxes installed
- 6 bat boxes installed

Future objectives:

- Continued increments of improvement by each participating business.
- Continued involvement in the Business program.

b. River-Friendly Golf Course Certification Program

The River-Friendly Golf Course Certification Program is designed to help golf course superintendents and staff implement proactive environmental stewardship strategies that benefit the environment and the golf course. This program also publicly recognizes participating courses. Certified golf courses help create challenging playing conditions, while at the same time preserving and enhancing the local environment.

Through the River-Friendly Golf Course Certification Program, golf courses implement actions that help reduce nonpoint source pollution. Each participating golf course is required to meet a set of baseline standards and to complete site specific actions. Site specific actions are unique to each course and are designed to either address water quality issues or support the four core areas of the River-Friendly program.

Example actions include:

- Implementing an integrated pest management program
- Expanding vegetative buffers along waterways.
- Assessing streams and other waterways.
- Reviewing chemical use to identify potential reductions.
- Expanding no– and reduced-mow areas to increase wildlife habitat, protect water quality and reduce operations costs.
- Educating staff and golfers about how the actions taken at the course protect drinking water quality.

Participating golf courses receive ongoing technical information, support and guidance for implementing environmental projects tailored to the golf course's unique location, resources and needs.

Accomplishments to date:

- Six participating golf courses (1,575 acres of land)
- Five certified golf courses.
- Approximately 290 acres designated reduced or low mow.
- Installation of 70+ bird and bat houses.
- Installation of rain garden at Quail Brook Golf Course.
- Installation of bioswale at Heron Glen Golf Course.
- Installation of rain barrels.

Future objectives:

- Continued increments of improvement by participating golf courses.
- Addition of new golf courses to the program.

c. River-Friendly School Certification Program

River-Friendly schools are those seeking to have a leading role in conserving their community's environmental resources. Benefits for participating schools include assistance with the incorporation of water-related lessons for any grade level, public recognition of their achievements, healthier landscaping, lowered operating costs, and the opportunity to be a leader in environmental stewardship.

The River-Friendly School Program takes a tiered approach to certification. For Participant status, each school is required to implement at least one lesson on each of the following topics: water quality, water conservation and wildlife habitat. The Education and Outreach component can be satisfied through a presentation to school officials, parents, and/or the community on the school's River-Friendly progress. Schools can work towards an advanced stewardship level by completing additional actions and receiving points. The advanced stewardship levels are Stream (Bronze), River (Silver), and Watershed (Gold). The Stream level focuses on classroom and hands-on education, while the River and Watershed levels require on-campus and community stewardship projects.

River-Friendly Schools that achieve Participant status receive a sign for the exterior for their school. NJWSA provides support and technical guidance throughout the program. After schools achieve certification, they may continue to work towards the desired highest level of stewardship. NJWSA will continue to provide guidance for water-resource related projects and suggest place-based and service-learning lessons that may fit within the school's curriculum.

Accomplishments to date:

- Two schools participating in the program.

Future objectives:

- Certified schools.
- Additional schools participating in the program.
- Documented increments of improvement by participating schools.

d. River-Friendly Resident Certification Program

NJWSA began implementing the River-Friendly Resident certification program in 2004. The program originally was modeled after the Golf Course and Business programs, and staff worked with individual property owners to identify specific actions for improvement. The program is now a self-certification program. Residents fill out a questionnaire to receive recognition. The questionnaire includes questions about lawn management practices, water conservation and septic system management, and represents a resident's pledge to manage their property in a responsible manner to help protect drinking water resources and the environment. The questionnaire has been provided at numerous community events, such as the Hunterdon and Somerset County 4H Fairs, Hunterdon County Earth Day and other municipal events. In addition, it is available on the NJWSA website. The questionnaire is a gateway to discussions with property owners about their management techniques.

Accomplishments to date:

- Outreach to numerous residents at community events.

Future objectives:

- Continue to utilize the River-Friendly Resident questionnaire as a gateway to educating homeowners about the importance of their land management decisions.

e. River-Friendly Farm Certification Program

The River-Friendly Farm Program promotes agricultural best management practices by recognizing farms that, through good management, help to protect water resources within the watershed. Farms are evaluated based on five main criteria:

- Soil Loss Management
- Nutrient Management
- Pest Management
- Riparian Buffers
- Irrigation Water Management

Technical assistance is offered to those farms that do not meet the certifying criteria, but would like to install or adapt the necessary components to become certified as River-Friendly.

Accomplishments to date:

- Approximately 50 farms participating in the program.

Future objectives:

- Modification of the program to focus on water quality improvements.
- Tracking of water quality improvements accomplished by participants.

VII. Municipal Assessment

The Municipal Assessment program documents a community's current goals by way of a survey questionnaire administered through a locally established project committee. The community's master plan, land use regulations and local management practices are then evaluated against the survey responses and a series of recommendations are developed to help the municipality meet their stated goals.

Participating municipalities:

Hunterdon County

- Bethlehem Township
- Califon Borough
- Clinton Township
- Lebanon Township
- Union Township

Morris County

- Chester Township
- Mendham Township
- Washington Township

Somerset County

- Bedminster Township
- Peapack-Gladstone Borough

Accomplishments to date:

Master Plan and ordinance assessments resulted in the following municipal actions:

- 24 (municipalities) adopted stormwater plans/ordinances
- 2 adopted wellhead protection ordinances
- 15 adopted stream corridor protection ordinances
- 4 adopted soil erosion and sediment control ordinances
- 5 adopted zoning amendments to reduce development impacts
- 18 adopted master plan revisions
- 11 adopted steep slope ordinances
- 5 adopted woodlands conservation ordinances
- 6 adopted limitations on impervious surfaces
- 8 initiated wastewater management plans

- 8 adopted septic management strategies

Future objectives:

- Municipal assessments will be incorporated into future planning projects where appropriate.

VIII. Raritan Highlands Wastewater Management Planning Project

In 2003 NJWSA was awarded a Section 604b grant to improve Area-wide Water Quality Management Plans and wastewater management plans (WMPs) in the Highlands region of New Jersey. The scope of work focused on the Raritan River basin portion of the Highlands, in an area primarily affecting the Upper Raritan Water Quality Management Plan.

Accomplishments:

- Checklist – an annotated outline for WMP Development.
- Municipal Assessment reports on local regulatory efforts to protect water resources for the following six communities:
    - Califon Borough, Hunterdon County
    - Clinton Township, Hunterdon County
    - Mendham Township, Morris County
    - Washington Township, Morris County
    - Bedminster Township, Somerset County
    - Peapack-Gladstone Borough, Somerset County
- Model Master Plan and Ordinance Guidance on steep slope development and net density zoning.
- Technical Analysis and Tools – resource documents on the preparation of water budgets and an assessment of water resource sustainability in the Highlands.
- Guidance System – county WMP guidance template. The template is designed to be used state-wide and is available on the DEP web site at http://www.nj.gov/dep/wqmp/guidance.html
- WMP Development: Case Examples – draft wastewater management plans for Clinton Township, Hunterdon County and Washington Township, Morris County.
- Water Use and Conservation guidance documents for water conservation in the Highlands region. The Water Conservation Web Links resource is available to communities as an upload which can be added to their municipal web-page. A Water Conservation Brochure and model water conservation ordinance were also prepared.

IX. EPA Targeted Watershed Initiative Grant for the Raritan Basin

This project was a four-year effort, completed in 2007, with $1,060,000 for NJWSA project areas. A portion of the NJWSA project areas were within the TMDL area. In the South Branch Raritan Area (upstream of NJWSA's South Branch Pumping Station), the project focused on stream restoration, municipal planning and ordinances, and riparian area management. In the Mainstem Raritan Area (between the North & South Branch Raritan Confluence and the Millstone/Raritan Confluence), the project focused on improved municipal planning and ordinances, and riparian area management.

Accomplishments (NJWSA project area:

- Establishment of River-Friendly programs in WMA 8 and WMA 9.
- Municipal Assessments (see Section XIII).
- Hoffman Park Stream Restoration Project (Mulhockaway Creek Watershed).
- Old Farm Road Riparian Buffer Project (Mulhockaway Creek Watershed).
- Crystal Springs Stream Restoration Project (Spruce Run Watershed).

Future objectives:

- Project completed in 2007; however, several components, such as River-Friendly programs, were continued through other efforts.

f. Raritan Basin Watershed Alliance Riparian Health Analysis

X. NJWSA Projects outside the TMDL area

a. Mulhockaway Creek Watershed Restoration Plan

In 2002, NJDEP provided funding through the Section 319(h) Nonpoint Source Grant program for the Mulhockaway Creek Stormwater Management and Watershed Restoration Plan to address the non-attainment listings and the TMDL. As part of the plan, which was completed in 2007, the following activities were conducted:

- Review of historical water quality monitoring data – Data from one USGS cooperative monitoring station on the Creek indicated that the Creek does not meet water quality standards for temperature and fecal coliform.
- Inventory of stormwater infrastructure – More than 2600 features were located, including 460 outfall pipes, 1,072 catch basins and 24 detention basins. 52 areas of concern were identified.
- Stream assessment – 20 locations were assessed. Many sites received low riparian zone scores due to the presence of invasive species and the lack of an adequate riparian buffer. Severe bank erosion due to high flow events was observed at many sites. Bank stability and canopy cover scores varied throughout the sites.
- Trackdown water quality monitoring – Conducted at ten locations during low flow conditions, ambient conditions and during storm events. Approximately 46 percent of all samples under all conditions (low flow, ambient conditions and wet weather) exceeded the single sample criterion for bacteria; the majority of the samples exceeding the criteria were collected under wet weather conditions.

The watershed restoration plan identified four watershed-wide projects and fourteen site-specific projects for implementation. The intent of the projects is to address the water quality impairments in the watershed, in particular fecal coliform and temperature.

Comprehensive Agricultural Management Program: The watershed has a large amount of agricultural land (17% of the watershed, or approximately 1,500 acres), including cropland, pastureland and livestock properties. The objective of this program is to reduce the amount of nutrients, sediment and bacteria that have the potential to enter the Mulhockaway through the preparation and implementation of nutrient management plans and provision of integrated crop management services.

Sanitary Survey & Illicit Discharge Removal Program: The stormwater infrastructure survey identified several potential illicit connections. In addition, local representatives indicated throughout the planning process that they believed there to be a high incidence of failing septic systems in the watershed. The survey would specifically identify areas of human pathogen contribution and provide recommendations for remediation.

Municipal Ordinance Improvement: The municipal assessment resulted in recommendations to improve the regulatory framework for protecting riparian areas and to ensure ongoing maintenance of detention basins and other stormwater infrastructure.

Stormwater Infrastructure Improvements: Much of the stormwater infrastructure in the watershed is older and poorly maintained. Several projects to improve existing infrastructure were identified in the plan. For instance, existing ditches could be converted to vegetated swales to increase infiltration and reduce runoff velocities. A detention basin in an older residential development was identified for retrofit, for instance conversion into a wetland or bioretention basin and a project at the Union Township Middle School would involve retrofitting a grass swale and stormwater outlet to a vegetated swale and rain garden.

Accomplishments to date:

- Implementation of the Comprehensive Agricultural Management Program

Future objectives:

- Implementation of stormwater retrofit projects.
- Implementation of riparian buffer improvement projects.

b. Cedar Grove Brook Watershed Restoration Plan

The project focus was to identify management measures to address impacts from existing nonpoint source pollution problems concentrating on stormwater issues. The work included inventorying stream conditions, evaluating existing management practices and determining retrofit opportunities and remedial actions. In addition, a monitoring program was implemented to track down sources of turbidity and identify best management practices (BMPs) to address likely sources of sediment. Several potential structural and non-structural nonpoint source management measures were evaluated for the Cedar Grove Brook watershed. The recommended measures include:

Structural Management Measures:

- Quail Brook Golf Course Pond – Outlet structure modification and addition of flow-path baffles
- Ukrainian Village Pond – Outlet structure modification
- Lower Pond – weir modification
- Riparian Restoration (multiple locations)
- Stormwater Basin Retrofits (multiple locations)
- Residential Stormwater Management – Rain barrels and rain gardens

Non-structural Management Measures

- River-Friendly Programs – Golf courses, businesses, schools and residents

- River-Friendly Communities

Accomplishments to date:

- Completion and approval of watershed restoration plan.

Future objectives:

- Implementation of the Quail Brook Golf Course Pond and Lower Pond projects.

c. Manalapan Brook Watershed Restoration Plan

In response to a total phosphorus TMDL established by the New Jersey Department of Environmental Protection for Manalapan Lake (Monroe Township, Middlesex County, New Jersey) the New Jersey Water Supply Authority contracted Princeton Hydro, LLC to develop a restoration plan for the lake to comply with the existing TMDL. As part of this project two years of water quality and watershed monitoring was conducted. The result of this monitoring, as well as the application of several lake-based water quality models, revealed that it would be more appropriate, in terms of improving overall water quality in the watershed, to identify total suspended solids (TSS) as the primary pollutant of concern, instead of TP. Therefore, the focus of the project was modified and the scope of the project broadened to include the entire Manalapan Brook watershed instead of just the contributory drainage area to Manalapan Lake.

A number of tasks were conducted to develop a site-specific, yet comprehensive protection and restoration plan. The following tasks were conducted:

- develop a GIS-based characterization and assessment of the watershed;
- conduct a stream visual assessment of stations throughout the watershed;
- collect additional water quality and ecological data of Manalapan Lake;
- apply the ArcView Generalized Watershed Loading Function (AVGWLF) model to quantify TSS loads on a municipal and sub-watershed basis.

The watershed restoration and protection plan included watershed initiatives and specific restoration projects that should be implemented to reduce the existing TSS loads. The plan is specifically geared towards decreasing TSS loads to levels that would result in compliance with the state's Surface Water Quality Standards for a FW2-NT water.

Specific best management practices or other watershed restoration activities were described for each site assessed throughout the watershed. This included an approximate cost for their implementation and a prioritization of these projects. Two of these projects, a demonstration rain garden and shoreline buffer planting, were designed and installed in 2010 at Thompson Park in Middlesex County immediately adjacent to Manalapan Lake.

Accomplishments:

- Completed watershed restoration plan.
- Installation of rain garden and shoreline buffer planting.

Future objectives:

- This project area is outside the TMDL area and NJWSA's source water area. Other entities are focusing on implementation.

XI. Additional Raritan Basin Projects

a. Black River Watershed Restoration and Protection Plan (Raritan Highlands Compact lead, NJWSA partner)

The Raritan Highlands Compact, in conjunction with the Association of New Jersey Environmental Commissions (ANJEC), the municipalities in the watershed, and other stakeholders worked with Rutgers Cooperative Extension Water Resources Program to develop this plan. Six watershed-wide strategies were identified:

- Septic Management Program (Onsite Wastewater Treatment Systems)
- Dumpster Leachate Management Program
- Equine Operations Technical Assistance Program
- Goose Management Programs
- The Disconnection of Stormwater Runoff from Impervious Surfaces
- Microbial Source Tracking Study

In addition, several site-specific recommendations were developed. The plan has not yet been approved by NJDEP. No implementation actions have occurred as of 2014.

Accomplishments to date:

Completion of watershed restoration plan.

Future objectives:

TBD.

b. **Americorps Watershed Ambassador Rain Barrel Workshops (NJDEP lead)**

c. **Morris County River-Friendly Business (Rutgers Cooperative Extension Water Resources Program lead)**

d. **Rain Barrel Workshops (Rutgers Cooperative Extension Water Resources Program lead)**

e. **Stony Brook Millstone Watershed Association Characterization & Assessment Reports (SBMWA lead)**

- Beden Brook
- Cranbury Brook
- Duck pond Run
- Heathcote Brook
- Rocky Brook
- Royce Brook

f. **Stony Brook Millstone Watershed Association River-Friendly Programs (SBMWA lead)**
g. **Pleasant Run & Holland Brook Watershed Restoration Plan (Readington Township lead)**
h. **Sourland Mountain Watershed Protection Plan (East Amwell Township lead)**
i. **Sidney Brook Watershed Protection Plan (Union Township lead, NJWSA partner)**

The Sidney Brook Watershed Protection Plan was completed in 2010 by Union Township. The plan recommended several land management and stormwater improvement projects in the watershed to protect the stream's water quality. A riparian buffer improvement project was completed on a preserved property as part of the development of the watershed protection plan.

Accomplishments:
- Completion of watershed protection plan.

- Installation of riparian buffer at Milligan Farms.

Future objectives:
- Seek funding for implementation of stormwater and ecological improvement projects.

j. Protection of Critical Source Areas for Achieving Long Term Sustainability of Water Resources (New Jersey Institute of Technology lead, NJWSA partner)

This project focused on the Rockaway Creek watershed. Variable Source Hydrology (VSA) states that the runoff that carries pollutants is primarily generated in relatively small but predictable hydrologically sensitive areas. The hydrologically sensitive areas that generate runoff and pollutants are called critical source areas. By protecting and preserving the critical source areas that generate the most runoff and pollutants, municipalities can achieve long-term water quality goals. Existing land use policies typically do not protect these critical source areas (CSA).

As part of this project, NJIT, NJWSA, North Jersey RC&D and the Municipal Land Use Center identified the critical source areas for the municipalities in the Rockaway Creek watershed and then overlaid state, regional and municipal land use protections to see where the CSAs were not protected. The project team made recommendations for the municipalities in order to better protect the CSAs.

k. Riparian Restoration Plan for Agricultural Lands in the Raritan Basin (North Jersey Resource Conservation & Development Council lead, NJWSA partner)

In 2006, North Jersey Resource Conservation & Development Council, NJWSA and the New Jersey Institute of Technology (NJIT) received a Cooperative Conservation Partnership Initiative (CCPI) grant from the Natural Resources Conservation Service (NRCS) to develop a riparian restoration plan for agricultural lands in the Raritan Basin. Agricultural use comprises approximately 19% of the Basin. Riparian area analyses indicate a conversion of approximately 30% of the Basin's historical riparian areas to urban and agricultural land uses. This indicated a need for better protection of stream corridors to prevent future degradation of the Basin's surface waters and continued loss of habitat.

As part of the Raritan Basin Watershed Management Plan, NJWSA delineated riparian areas. Through the CCPI project, NJIT mapped Critical Source Areas (CSA), the intersection of hydrologically sensitive areas (those that actively contribute to runoff) and pollutant source areas. Restoring buffers within CSAs is both environmentally effective and cost-effective.

Utilizing the baseline riparian area and CSA mapping with GIS layers for wildlife habitat, impervious surface, and an erodibility index, the project team developed a multi-criteria decision making framework to identify priority restoration areas.

High priority areas for riparian restoration were identified during the planning process. The plan provides a clear road map to achieve restoration of these critical areas, thus maximizing the environmental benefit of conservation funding.

Accomplishments:

- Development of multi-criteria database.
- Identification of high priority areas for riparian restoration.
- Use of the CCPI results in other projects, including Sidney Brook Watershed Restoration Plan, Addressing Agricultural Nonpoint Source Pollution and other riparian buffer identification efforts.
- Use of the CCPI model by the Natural Resources Conservation Service to rank applications to the Agricultural Water Enhancement Program.

Future objectives:

- Continued use of the CCPI model to identify the best sites for riparian buffer restoration and agricultural practice implementation.

l. Neshanic River Watershed Restoration Plan (New Jersey Institute of Technology lead, NJWSA partner) and Implementation Projects (North Jersey RC&D lead, NJWSA partner)

The Neshanic River Watershed Restoration Plan details the management measures needed to achieve the desired reduction in bacteria and attain water quality standards for total phosphorus (TP) and total suspended solids (TSS), and to reduce aquatic life impairments to a non-impaired level and outline the actions needed to restore the base flow of the Neshanic River. Because a similar effort was conducted in the lower part of the Neshanic River Watershed, including the Back Brook and its drainage area, the Neshanic River Watershed Restoration Plan focuses on the 31 square mile upper part of the Neshanic River Watershed, which includes Walnut Brook, First, Second and Third Neshanic Rivers and the Neshanic River main branch immediately above the Back Brook confluence with the Neshanic River.

Several management measures were recommended as a result of the water quality monitoring and modeling that were done during the planning process. These measures include agricultural best management practices, stormwater retrofit actions and new small-scale stormwater measures.

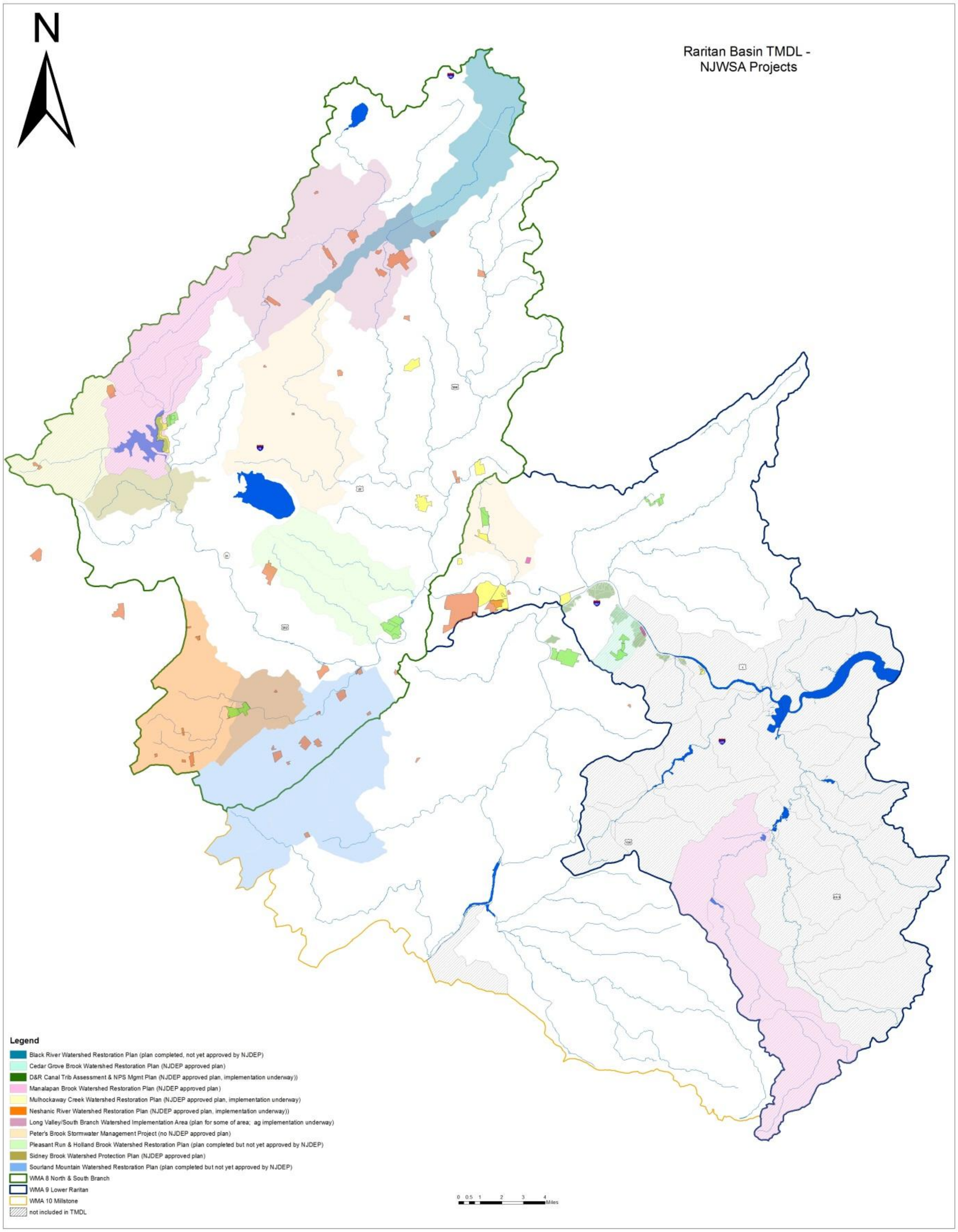
North Jersey RC&D received implementation funding from NJDEP to implement the watershed restoration plan.

Accomplishments:

- Completion of the watershed restoration plan.
- Streambank restoration and wetland mitigation at the Walnut Brook site.
- Installation of rain garden at Raritan Township municipal building.
- Two rain barrel workshops.

Future objectives:

- Additional rain barrel workshops.
- Residential rain garden projects.
- Stormwater retrofit projects.
- Agricultural conservation practice implementation.
- Riparian buffer improvement projects.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Raritan Basin TMDL -
NJWSA Projects
Legend
Black River Watershed Restoration Plan (plan completed, not yet approved by NJDEP)
Cedar Grove Brook Watershed Restoration Plan (NJDEP approved plan)
D&R Canal Trib Assessment & NPS Mgmt Plan (NJDEP approved plan, implementation underway))
Manalapan Brook Watershed Restoration Plan (NJDEP approved plan)
Mulhockaway Creek Watershed Restoration Plan (NJDEP approved plan, implementation underway)
Neshanic River Watershed Restoration Plan (NJDEP approved plan, implementation underway))
Long Valley/South Branch Watershed Implementation Area (plan for some of area; ag implementation underway)
Peter's Brook Stormwater Management Project (no NJDEP approved plan)
Pleasant Run & Holland Brook Watershed Restoration Plan (plan completed but not yet approved by NJDEP)
Sidney Brook Watershed Protection Plan (NJDEP approved plan)
Sourland Mountain Watershed Restoration Plan (plan completed but not yet approved by NJDEP)
WMA 8 North & South Branch
WMA 9 Lower Raritan
WMA 10 Millstone
not included in TMDL
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Miles