Amendment to the
Lower Delaware Water Quality Management Plan,
Tri-County Water Quality Management Plan

Total Maximum Daily Loads for
Fecal Coliform to Address 3 Streams in the
Lower Delaware Water Region

Watershed Management Area 17
(Major Run)
Watershed Management Area 18
(Edwards Run)
Watershed Management Area 20
(North Run)

Proposed:	May 2, 2005
Established:	August 19, 2005
Approved:	September 15, 2005
Adopted:	

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1.0 Executive Summary

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) developed the *2004 Integrated List of Waterbodies* addressing the overall water quality of the State's waters and, in Sublist 5, identifying impaired waterbodies for which Total Maximum Daily Loads (TMDLs) may be necessary. On August 9, 2004, the Department adopted the *2004 Integrated List of Waterbodies* as an amendment to the Statewide Water Quality Management Plan, 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). In the Lower Delaware Water Region, the *2004 Integrated List of Waterbodies* Sublist 5 identifies 9 impairments with respect to pathogens, as indicated by the presence of fecal coliform concentrations in excess of standards. TMDLs have been developed addressing fecal coliform impairment in the waterbodies identified in Table 1. More data is needed to develop TMDLs for Buckshutem Creek, Mount Misery Brook, and the North Branch of the Rancocas Creek. TMDLs for these stream segments will be developed at a later date after the collection of additional data. The TMDL for Crosswicks Creek at Extonville has already been completed as part of a larger stream segment. The TMDL including this segment was approved September 29, 2003.

Table 1 Stream segments in the Lower Delaware Water Region identified on the *2004 Integrated List of Waterbodies.*

TMDL Number	WMA	Station Name/Waterbody	Site ID	Sublist	Proposed Action
1	17	Major Run at Sharptown	01482530	5	TMDL
2	18	Edwards Run at Jefferson	01475090	5	TMDL
3	20	North Run at Cookstown	01464380	5	TMDL
4	20	Crosswicks Creek at Extonville	01464500	5	TMDL Completed
5	17	Buckshutem Creek near Laurel Lake	01411950	5	Deferred
6	19	Little Creek at Chairville	01465893	5	Deferred
7	19	Mount Misery Brook	01466100	5	Deferred
8		Rancocas North Branch at Browns Mills	01465970	5	Deferred
9	19	Rancocas Creek S Br at Hainesport	EWQ0176S, 19-RA-1S	5	Deferred

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey Surface Water Quality Standards (SWQS), "Fecal coliform levels shall not exceed a geometric average of 200 CFU/100 ml nor should more than 10 percent of the total sample taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters." Using ambient water quality data monitoring conducted by USGS/NJDEP during water years 1998-2002, summer and all season geometric means were determined for each Category 5 listed waterbody. Given the two surface water quality criteria of 200 CFU/100 ml and 400 CFU/100 ml in FW2 waters, computations were necessary for both criteria and resulted in two values for percent reduction for each waterbody. The higher (more stringent) percent reduction value was selected as the TMDL, which was then allocated among the sources. Nonpoint and stormwater point sources are the primary contributors to

fecal coliform loads in these waterbodies and can include storm-driven loads transporting fecal coliform from sources such as geese, farm operations, and domestic pets to the receiving water. Nonpoint sources can also include steady-state inputs from sources such as failing sewage conveyance systems and failing or inappropriately located septic systems.

This TMDL report includes implementation strategies to achieve SWQS for fecal coliform. The TMDLs in this report have been proposed and will be adopted by the Department as amendments to the appropriate areawide water quality management plan in accordance with N.J.A.C. 7:15-3.4(g). This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA's) May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs.

2.0 Introduction

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The *Integrated List of Waterbodies* combines these two assessments and assigns waterbodies to one of five sublists. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), 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. In the Lower Delaware Water Region, the *2004 Integrated List of Waterbodies* currently identifies 9 impaired segments.

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

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

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.

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

This report establishes 3 TMDLs that address fecal coliform impairment in waterbodies identified in Table 2. These TMDLs include management approaches to reduce loadings of fecal coliform from various sources in order to attain applicable surface water quality standards for fecal coliform. In addition to the above mentioned fecal coliform impairments, Edwards Run at Jefferson (01475090) and Major Run at Sharptown (01482530) are also listed for phosphorus. These waterbodies will remain on Sublist 5 with respect to these pollutants and will be addressed in future TMDLs. With respect to the fecal coliform impairment, the waterbodies will be moved to Sublist 4 following approval of the TMDLs by USEPA.

3.0 Pollutant of Concern and Area of Interest

The pollutant of concern for these TMDLs is pathogens, the presence of which is indicated by elevated concentrations of fecal coliform bacteria. Fecal coliform concentrations were found to exceed New Jersey's SWQS, published at N.J.A.C. 7-9B et seq., for the segments in the Lower Delaware Region identified in Table 2. These segments have been identified in the 2004 Integrated Water Quality Monitoring and Assessment Report as a high priority for establishing a fecal coliform TMDL.

Table 2 Waterbodies listed for fecal coliform impairment in the Lower Delaware Water Region for which TMDLs are required.

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	17	Major run at Sharptown	01482530	Salem	3.68
2	18	Edwards Run at Jefferson	01475090	Gloucester	6.60
3	20	North Run at Cookstown	01464380	Burlington	2.15
Total River Miles:					**23.56**

Applicable Surface Water Quality Standards

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

> "Fecal coliform levels shall not exceed a geometric average of 200 CFU/100 ml nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters".

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

In all FW2 waters, the designated uses are:

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

Description of the Lower Delaware Region

The Lower Delaware Region includes the Delaware River, Delaware Bay and numerous tributaries from Trenton to southern Cumberland County. The Lower Delaware Region is one of diversity, comprised of a mixture of suburban areas, urban centers, agricultural land, rural towns, forests, and the protected Pinelands ecosystem.

Included in the Lower Delaware Region are large portions of Burlington, Camden, Cumberland, Gloucester, and Salem Counties, as well as parts of Mercer, Monmouth, Ocean and Atlantic Counties. These counties are divided into Watershed Management Area (WMA) 17 (Maurice, Salem, Cohansey), WMA 18 (Lower Delaware Tributaries), WMA 19 (Rancocas Creek) and WMA 20 (Assiscunk, Crosswicks, Doctors Creeks).

Watershed Management Area 17

WMA 17 includes the Cohansey River, Maurice River, Salem River and Alloway, Dividing, Manantico, Manumuskin, Miles, Mill, Stow and Whooping Creeks. This area includes portions of Atlantic, Cumberland, Gloucester, and Salem counties, over 39 municipalities and encompasses 885 square miles.

The Cohansey River, which drains 105 square miles of eastern Salem County, is nearly 30 miles long from its headwaters to Delaware Bay. From the headwaters in Salem County, through Bridgeton, an urban center in Cumberland County, to its mouth in Delaware Bay, it is the second largest river in Cumberland County. The Cohansey River watershed is an area of very low relief, which results in numerous small tributaries. Sunset Lake and Mary Elmer Lake are among 20 major impoundments in this drainage basin. The majority of the land use in this watershed is agriculture, while much of the undeveloped area remains forested.

The Maurice River has a drainage area of 386 square miles and meanders south for 50 miles through Cumberland County to the Delaware Bay. The major tributaries of this river are Scotland Run, Manantico Creek, Muskee Creek, Muddy Run, and the Manumuskin River. Agriculture is also the principal land use in this watershed. Land use in the upper portion of the basin is 48% forested, 27% agricultural, and 25% developed or barren. Portions of the river have been nationally designated as Wild and Scenic. The main stem and tributaries flow through Vineland and Millville, which are local centers of development.

The Salem River drains an area of 114 square miles and flows 32 miles from Upper Pittsgrove Township west to Deepwater, then south to the Delaware River. Much of the lower portions of the river are tidal. Major tributaries of the Salem River include Mannington Creek, Game Creek, Majors Run, and Fenwick Creek. Land use is 43% agricultural, 10% forested and 33% wetlands, and 13% urban/suburban. The major urban center is Salem City.

Figure 1 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 17 and 18

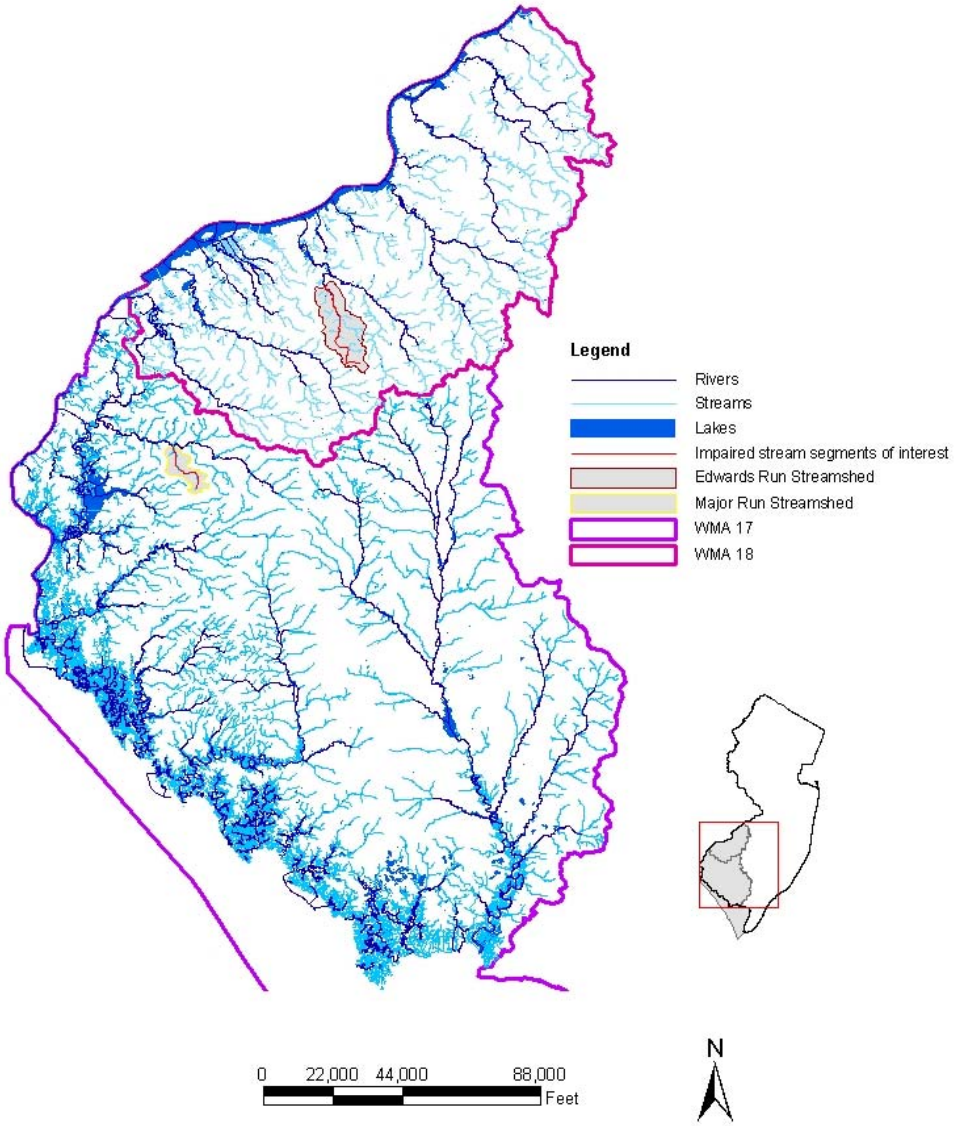
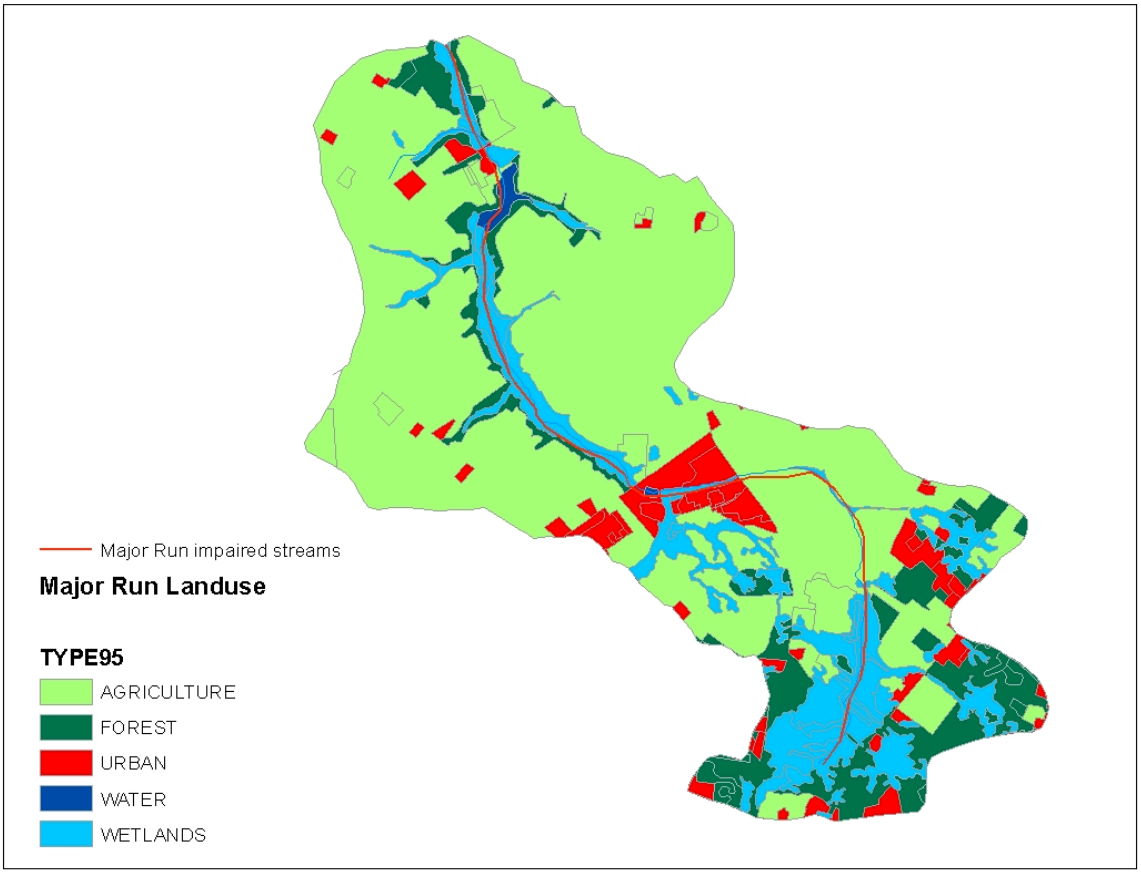


Table 3 River miles, Watershed size, and Anderson Land Use classification for Sublist 5 segments, listed for fecal coliform, in WMA 17

Major Run at Sharptown Segment ID 01482530	
Sublist 5 Impaired river miles (Miles)	**3.68**
Total river miles within watershed and included in the implementation plan (miles)	**4.19**
Watershed size (acres)	**2152**
Landuse/Landcover	
Agriculture	66.1%
Barren Land	0.0%
Forest	12.2%
Urban	6.8%
Water	0.5%
Wetlands	14.4%

Figure 2 Land Use of Major Run Watershed



Watershed Management Area 18

WMA 18 includes the Cooper River, Big Timber, Mantua, Newton, Oldmans, Pennsauken, Pompeston, Raccoon, Repaupo, and Woodbury Creeks, as well as Baldwin Run, Swede Run and Maple Swamp. WMA 18 covers all or parts of Burlington, Camden and Gloucester counties, including 68 municipalities covering 391 square miles.

The Cooper River is 16 miles long, and its watershed encompasses an area of 40 square miles. The river flows through Camden County to the Delaware River at Camden City. The largest tributaries are the North Branch Cooper River and Tindale Run. Extensive development exists along the main stem and areas adjacent to the North Branch. Major impoundments are present such as Cooper River Lake, Kirkwood Lake, Evans Pond, Linden Lake, Hopkins Pond, and Square Circle Lake. The land use within the Cooper River watershed is primarily urban and suburban.

Big Timber Creek drains an area of 63 square miles. The main stem and most of the South Branch divide Gloucester and Camden counties before flowing into the Delaware River near Brooklawn, south of Camden City. Major tributaries include Otter Creek, Beaver Brook, and Almonesson Creek. Major impoundments are Blackwood Lake, Grenloch Lake, Hirsch Pond, and Nash's Lake. This watershed is primarily urban/suburban with forested areas at the headwaters and urban areas at the mouth of Big Timber Creek.

Mantua Creek drains an area of 50.9 square miles of land. From its headwaters in Glassboro, Mantua Creek flows 18.6 miles northwest to the Delaware River at Paulsboro. Major tributaries include the Chestnut Branch (7 miles long), Edwards Run (6.9 miles long) and Duffield Run which drains 2.3 square miles (Information provided by the Federation of Gloucester County Watersheds). Land use is urban/suburban along the main branch and most of Chestnut Branch, and agriculture along Edwards Run.

Oldmans Creek drains an area of 44 square miles and flows to the Delaware River. This creek is 20 miles long and marks the boundary between Gloucester and Salem counties. Tidal marshes exist at the mouth of this creek, while the western third of Oldmans Creek is tidal. Major tributaries include Kettle Run and Beaver Creek. For the most part, Oldmans Creek watershed is agricultural and forested, with some residential and industrial development.

The Pennsauken Creek drains 33 square miles of southwestern Burlington County and northern Camden County. This creek flows into the Delaware River near Palmyra. The North Branch of the Pennsauken is in Burlington County, while the South Branch is the boundary between Burlington and Camden Counties. Industry is concentrated at the mouth of the Pennsauken Creek. Much of the watershed is developed as urban/suburban development, with the remainder divided between agricultural and forested land.

The Raccoon Creek watershed is approximately 40 square miles and drains central Gloucester County. The creek itself is 19 miles long and flows from Elk Township to the Delaware River. While there are several minor tributaries, the most significant of these is the South Branch of

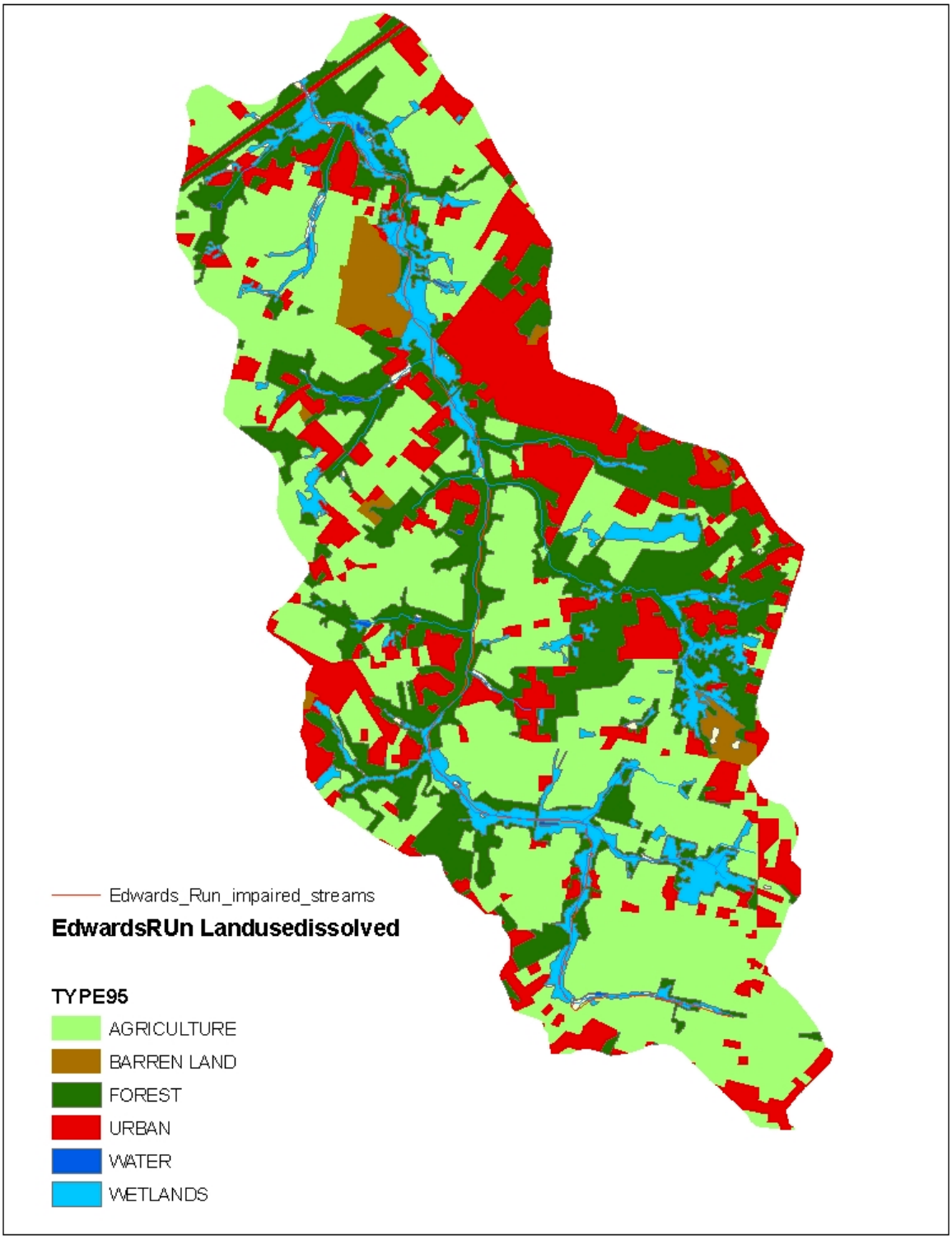
the Raccoon Creek. Much of the lower half of Raccoon Creek is tidal, and at the mouth are a number of tidal marshes. Evan Lake, Mullica Hill Pond, and Swedesboro Lake are among the many small lakes and ponds in this area. The land use is primarily agricultural, with industrial areas located along the creek's tidal sections.

Woodbury Creek is approximately five miles in length and drains an area of 18 square miles. Woodbury Creek contains two major tributaries: Hessian Run and Matthews Branch. Land use in the Woodbury Creek watershed is characterized by commercial, urban and suburban development. Woodbury Creek is the most densely developed watershed in Gloucester County. Much of the land along the main stem is publicly owned and is used for parks, lakes, active recreation, and conservation areas.

Table 4 River miles, Watershed size, and Anderson Land Use classification for three Sublist 5 segments, listed for fecal coliform, in WMA 18

Edwards Run Segment ID 01475090	
Sublist 5 Impaired river miles (Miles)	**6.60**
Total river miles within watershed and included in the implementation plan (miles)	**16.73**
Watershed size (acres)	**6036**
Landuse/Landcover	
Agriculture	45.3%
Barren Land	2.3%
Forest	24.2%
Urban	19.9%
Water	0.4%
Wetlands	7.8%

Figure 3 Land Use in the Edwards Run Watershed



Watershed Management Area 20

WMA 20 includes the Assiscunk, Blacks, Crafts, Crosswicks, Doctors, Duck and Mill Creeks. This watershed management area is comprised of 26 municipalities spanning four counties: Burlington, Mercer, Monmouth and Ocean encompassing 253 square miles. Crosswicks Creek, entering the Delaware River at Bordentown, is 25 miles long and drains an area of 146 square miles. Major tributaries include Jumping Brook, Lahaway Creek, North Run and Doctors Creek. Tides affect this stream up to the Crosswicks Mill Dam. Allentown Lake, Oxford Lake, Prospertown Lake, and Imlaystown Lake are major impoundments in the Crosswicks Creek Watershed. Important land uses in this watershed include agriculture, residential/commercial development and military installations, with the remainder covered by woodland areas.

Figure 4 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 20

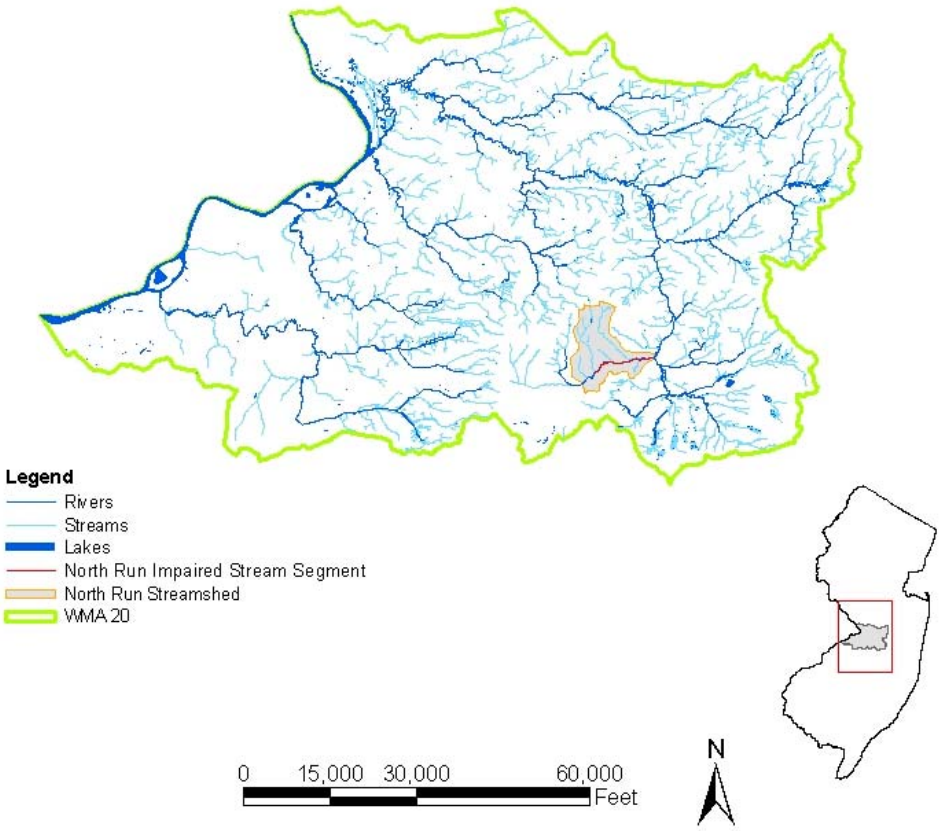
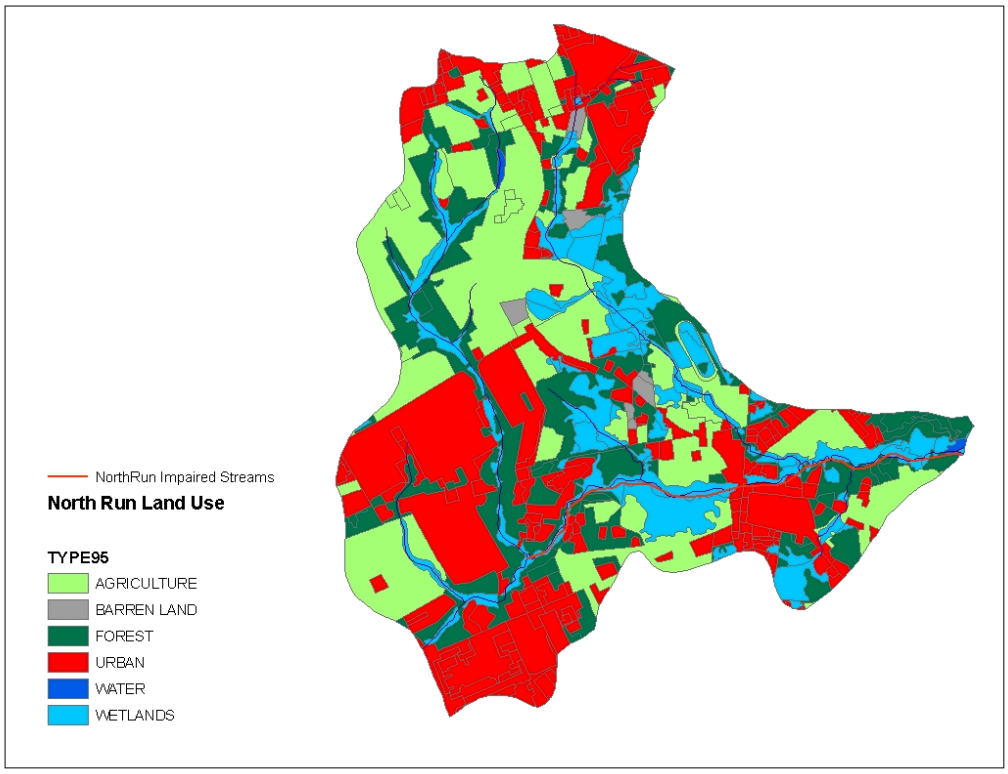


Table 5 River miles, Watershed size, and Anderson Land Use classification for Sublist 5 segments, listed for fecal coliform, in WMA 20

North Run at Cookstown Segment ID 01464380	
Sublist 5 Impaired river miles (Miles)	**2.15**
Total river miles within watershed and included in the implementation plan (miles)	**11.47**
Watershed size (acres)	**2604**
Landuse/Landcover	
Agriculture	29.0%
Barren Land	1.0%
Forest	20.6%
Urban	34.1%
Water	0.2%
Wetlands	15.3%

Figure 5 Land Use in North Run Watershed



Data Sources

The Department's Geographic Information System (GIS) was used extensively to describe the Lower Delaware watershed characteristics. The following is general information regarding the data used to describe the watershed management area:

- Land use/Land cover was taken from: "NJDEP 1995/97 Land use/Land cover Update for New Jersey (by WMA)", published 12/01/2000 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), and delineated by watershed management area.

- "NJDEP 2004 Integrated Report Results for Non-Tidal Rivers", published 6/2004 by NJDEP, Watershed Assessment Group (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_river_conventionals2004.gif

- County Boundaries: Published 01/23/2003 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), "NJDEP County Boundaries for the State of New Jersey." Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip

- Detailed stream coverage of New Jersey: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). "NJDEP Streams of New Jersey (1:24000)." Online at: http://www.state.nj.us/dep/gis/strmshp.html

- NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC14), published 4/5/2000 by Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

    - NJDEP Digital Elevation Grid for New Jersey (10 meter) published 10/01/2004 by NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/wmalattice.html

    - "NJPDES Surface Water Discharges in New Jersey, (1:12,000)", published 09/12/2002 by NJDEP, Environmental Regulation (ER), Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1). Online at: http://depnet/gis/digidownload/images/statewide/njpdesswd.gif

- "NJDEP 2004 Integrated Report Stations on Non-Tidal Rivers (Conventionals and Toxics)", published 6/2004 by NJDEP, Water Assessment Team (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_stations_river2004.gif

- New Jersey Environmental Management System (NJEMS)

4.0 Source Assessment

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

Assessment of Point Sources other than Stormwater

There are no wastewater treatment discharges or other point sources within the spatial extent for these TMDLs.

Assessment of Nonpoint and Stormwater Point Sources

Nonpoint and stormwater point sources include runoff from various land uses that transport fecal coliform from sources such as geese, farms, and domestic pets to the receiving water. Nonpoint sources also include inputs that do not depend on precipitation events such as failing sewage conveyance systems, and failing or inappropriately located septic systems. Stormwater point sources are distinguished from nonpoint sources that derive from stormwater in that they are regulated under the NJPDES program.

5.0 Water Quality Analysis

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

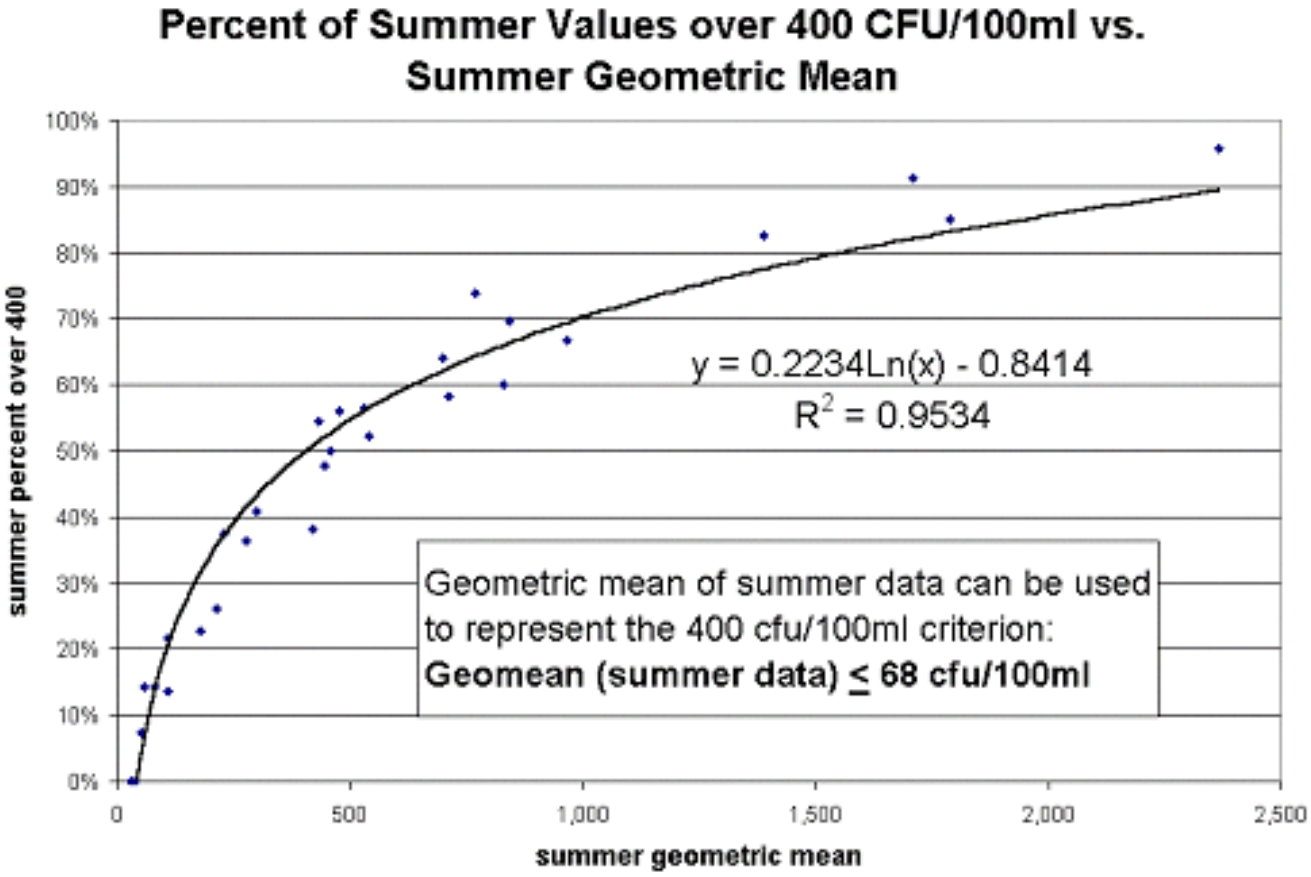
As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 C.F.R. 130.2). The loadings are required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

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

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

To satisfy the 200 CFU/100ml criteria, the geometric mean of all available data between water years 1994-2002 was compared to an adjusted target concentration. The adjusted target accounts for an explicit margin of safety and is equal to 200 minus the margin of safety. A calculation incorporating all available data is generally conservative since most samples are taken during the summer when fecal coliform is generally higher. A geometric mean of summer data was used to develop a percent reduction to satisfy the 400 CFU/100 ml criteria. A summer geometric mean can be used to represent the 400 criteria by regressing the percent over 400 CFU/100 ml against the geometric mean (Figure 6). Thus, each datapoint on Figure 6 represents all the data from one individual monitoring station. Sites with 20 or more summer data points were used to develop this regression, in order to make use of more significant values for percent exceedance. A statewide regression was used rather than regional regressions because the regression shape was not region-specific and the strength of the correlation was highest when all statewide data were included. The resulting regression has an r-squared value of 0.9534. Solving for X when Y is equal to 10% yields a geometric mean threshold of 68 CFU/100ml. This means that, using summer data, a geometric mean of 68 can be used to represent the 400 CFU/100ml criterion. Since the geometric mean is a more reliable statistic than percentile when limited data are available, 68 CFU/100ml was used to represent the 400 CFU/100ml criterion for all sites. The inclusion of all data from summer months (May through September) to compare with the 30-day criterion is justified because summer represents the critical period when primary and secondary contact with water bodies is most prevalent. A more detailed justification for using summer data can be found in the discussion of seasonal variation and critical conditions.

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


Percent of Summer Values over 400 CFU/100ml vs. Summer Geometric Mean
summer percent over 400
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
500
1,000
1,500
2,000
2,500
summer geometric mean
y = 0.2234Ln(x) - 0.8414
R2 = 0.9534
Geometric mean of summer data can be used to represent the 400 cfu/100ml criterion:
Geomean (summer data) ≤ 68 cfu/100ml

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

$R^2 = 0.9534$

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

$$Geometric\ Mean\ for\ 200 CFU\ criteria = \sqrt[n]{y_1 y_2 y_3 y_4 .... y_n} \quad \text{Equation 2}$$

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

$$200\ CFU\ criteria\ Percent\ \text{Re}duction = \frac{(Geometric\ mean - (200 - e))}{Geometric\ mean} \times 100\ \% \quad \text{Equation 3}$$

$$400\ CFU\ criteria\ Percent\ \text{Re}duction = \frac{(SummerGeometric\ mean - (68 - e))}{SummerGeometric\ mean} \times 100\ \% \quad \text{Equation 4}$$

where:
e = (margin of safety)

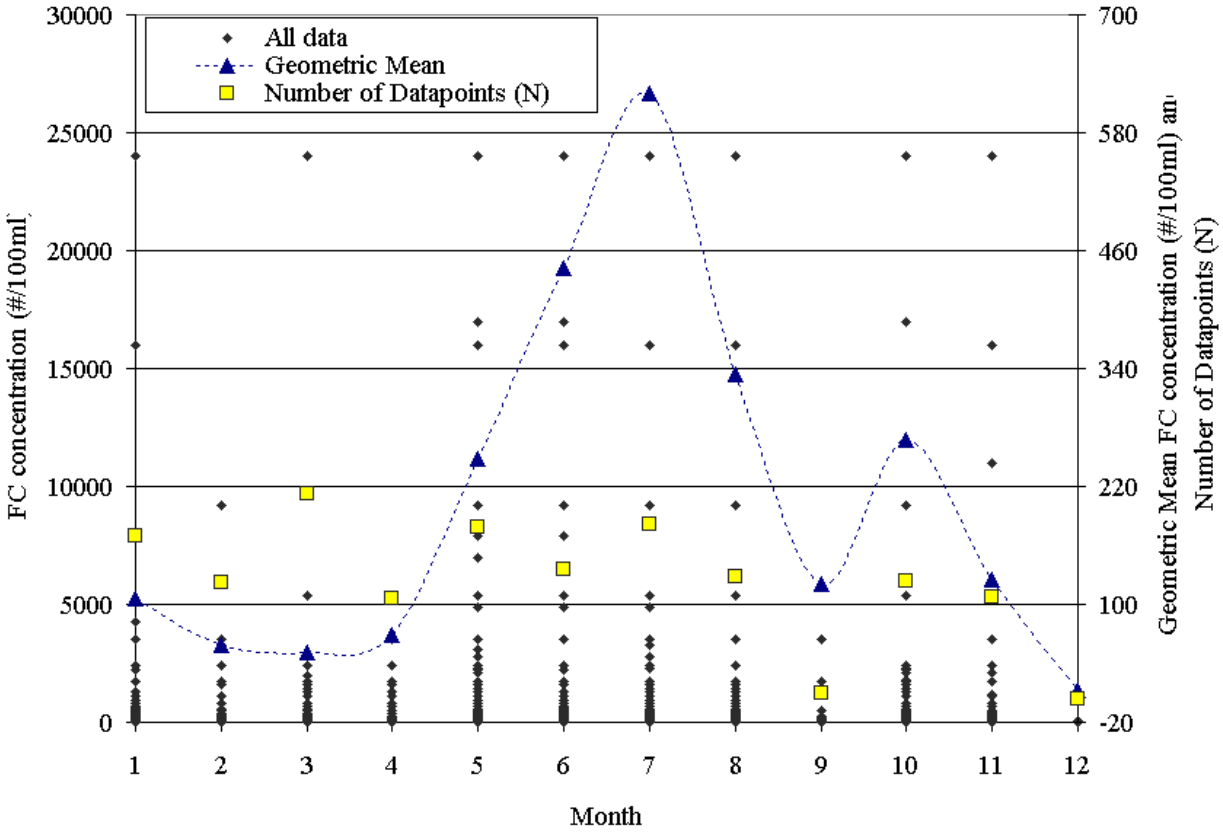
This percent reduction can be applied to nonpoint and stormwater point sources as a whole or be apportioned to categories of nonpoint and stormwater point sources within the study area. The extent to which nonpoint and stormwater point sources have been identified or need to be identified varies by study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

Seasonal Variation/Critical Conditions

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

or datasets from individual water years. Given this relationship, summer is considered the critical period for violating fecal coliform SWQS and, as such, sampling during this period is considered adequate for meeting year round protections and designated uses.

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



Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). For these TMDLs calculations, both an implicit and explicit Margin of Safety (MOS) are incorporated. Implicitly, a MOS is inherent in the estimates of current pollutant loadings, the targeted water quality goals (New Jersey's SWQS) and the allocations of loading. This was accomplished by taking conservative assumptions throughout the TMDL evaluation and development. Examples of some of the conservative assumptions include treating fecal coliform as a conservative substance, applying the fecal coliform criteria to stormwater point sources, and applying the fecal coliform criteria to the stream during all weather conditions. Fecal coliforms decay in the environment (i.e. outside the fecal tract) relatively rapidly, yet this analysis assumes a linear relationship between fecal load and instream concentration.

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

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

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

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

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

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

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

6.0 TMDL Calculations

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

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

LC = loading capacity for a particular stream;
PR = percent reduction as specified in Table 7;
L_o = current load.

Wasteload Allocations and Load Allocations

There are no wastewater dischargers in the segments for which TMDLs are being established. WLAs are established for NJPDES-regulated stormwater, while LAs are established for all stormwater sources that are not subject to NJPDES regulation, and for all nonpoint sources. Both WLAs and LAs are expressed as percentage reductions for particular stream segments. Stormwater point sources receiving a WLA are distinguished from 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 as shown in Table 6. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the residential, commercial, industrial and mixed urban runoff source 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.

Table 6 Distribution of WLAs and LAs among source categories

Source category	**TMDL allocation**
Nonpoint and Stormwater Sources	
medium / high density residential	WLA
low density / rural residential	WLA
commercial	WLA
industrial	WLA
Mixed urban / other urban	WLA
agricultural	LA
forest, wetland, water	LA
barren land	LA

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

Table 7 TMDLs for fecal coliform-impaired stream segments in the Lower Delaware Water Region as identified in Sublist 5 of the 2004 Integrated List of Waterbodies. The reductions reported in this table represent the higher, or more stringent, percent reduction required of the two fecal coliform criteria.

TMDL Number	WMA	303(d) Category 5 Segments	Water Quality Stations	Station Names	Wasteload Allocations (WLA)Load Allocation (LA) and Margin of Safety (MOS)				
					Summer N	Summer Geometric Mean (CFU/ 100ml)	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS
1	17	01411950	01411950	Major Run at Sharptown	10	1705	44%	96%	98%
2	18	01475090	01475090	Edwards Run at Jefferson	10	1835	54%	96%	98%
3	20	01464380	01464380	North Run at Cookstown	13	242	28%	72%	80%

[1] MOS as a percent of target is equal to: $\frac{e}{200\ CFU/100ml}$ or $\frac{e}{68\ CFU/100ml}$ where "e" is defined as the term in Section 5.0

Reserve Capacity

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

7.0 Follow - up Monitoring

In association with the Water Resources Division of the U.S. Geological Survey, the NJDEP has cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. Bacteria monitoring, as part of the ASMN network, is conducted five times during a consecutive 30-day summer period each year. The data from this network has been used to assess the quality of freshwater streams and percent load reductions. The ASMN will remain a principal source of fecal coliform monitoring to determine the effectiveness of implementing these TMDLs. In addition the Department will undertake a Microbial Source Trackdown program where needed, as discussed under Implementation.

8.0 Implementation

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

Development of effective management measures depends on accurate source assessment. Fecal coliform is contributed to the environment from a number of categories of sources including human, domestic or captive animals, agricultural practices, and wildlife. Fecal coliform from these sources can reach waterbodies directly, through overland runoff, or through sewage or stormwater conveyance facilities. Each potential source will respond to one or more management strategies designed to eliminate or reduce that source of fecal coliform. Each management strategy has one or more entities that can take lead responsibility to effect the strategy. Various funding sources are available to assist in accomplishing the management strategies. The Department will address the sources of impairment through systematic source trackdown, matching strategies with sources, selecting responsible entities and aligning available resources to effect implementation.

For example, the stormwater discharged to the impaired segments through "small municipal separate storm sewer systems" (MS4s) are regulated under the Department's Phase II NJPDES stormwater rules for the Municipal Stormwater Regulation Program. Under those rules and associated general permits, many municipalities (and various county, State, and other agencies) in the Lower Delaware Region are required to implement various control measures that should substantially reduce bacteria loadings, including measures to eliminate "illicit connections" of domestic sewage and other waste to the MS4, adopt and enforce a pet waste ordinance, prohibit feeding of unconfined wildlife on public property, clean catch basins, perform good housekeeping at maintenance yards, and provide related public education and employee training. For Major Run and North Run, the Phase II MS4 program is currently limited to public education and control of stormwater from new development and redevelopment.

Sewage conveyance facilities are potential sources of fecal coliform in that equipment failure or operational problems may result in the release of untreated sewage. These sources, once identified, can be eliminated through appropriate corrective measures that can be effected through the Department's enforcement authority.

Inadequate on-site sewage disposal can also be a source of fecal coliform. Systems that were improperly designed, located or maintained may result in surfacing of effluent and illicit remedies such as connections to storm sewers or streams add human waste directly to waterbodies. Once these problems have been identified through local health departments, sanitary surveys or other means, alternatives to address the problems can be evaluated and the best solution implemented.

The Department has committed grant funds to assist municipalities in meeting Phase II requirements. In addition, The New Jersey Environmental Infrastructure Financing Program, which includes New Jersey's State Revolving Fund, provides low interest loans to assist in correction of water quality problems related to stormwater and wastewater management.

Other wildlife contributions include significant deer populations that have been identified as a potential fecal coliform source in the impaired watersheds. The forested and low-density residential areas that provide deer habitat can be found in close proximity to the impaired stream segments. Deer have been evaluated in fecal coliform TMDLs by other States (e.g. Alabama and South Carolina) and could be a fecal coliform source in New Jersey.

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

- **The Conservation Reserve Enhancement Program** 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 dollar CREP agreement. The program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP will be 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 thereby making 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.

Management strategies are summarized as follows:

Source Category	Responses	Potential Responsible Entity	Funding options
Human Sources			
Inadequate (per design, operation, maintenance, location, density) on-site disposal systems	Confirm inadequate condition; evaluate and select cost effective alternative, such as rehabilitation or replacement of systems, or connection to centralized treatment system	Municipality, MUA, RSA	CWA 604(b) for confirmation of inadequate condition; Environmental Infrastructure Financing Program for construction of selected option
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Phase II Stormwater permitting program including any additional measures determined in the future to be needed through TMDL process	Municipality, State and County regulated entities, stormwater utilities	CWA 319(h)
Malfunctioning sewage conveyance facilities	Identify through source trackdown	Owner of malfunctioning facility— compliance issue	User fees

Domestic/captive animal sources			
Pets	Pet waste ordinances	Municipalities for ordinance adoption and compliance	
Horses, livestock, zoos	Confirm through source trackdown: SCD/NRCS develop conservation management plans	Property owner	EQIP, CRP, CREP
Agricultural practices	Confirm through source trackdown; SCD/NRCS develop conservation management plans	Property owner	EQIP, CRP, CREP
Wildlife			
Nuisance concentrations, e.g. resident Canada geese	Feeding ordinances; Goose Management BMPs	Municipalities for ordinance; Community Plans for BMPs	CBT, CWA 319(h)
Indigenous wildlife	Confirm through trackdown; consider revising designated uses	State	NA

Source Trackdown

Efforts to identify sources include visual assessments and planned track-down monitoring, where appropriate.

Pathogen Indicators and Microbial Source Tracking:

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

Tests for fecal organisms are conducted at an elevated temperature (44.5°C), where the growth of bacteria of non-fecal origin is suppressed. While correlation between indicator

organisms and diseases can vary greatly, as seen in several studies performed by the EPA and others, two indicator organisms *Esherichia coli* (*E. coli*) and enterococci species showed stronger correlation with incidence of disease than fecal coliform (USEPA, 2001). Recent advances have allowed for more accurate identification of pathogen sources. A few of these methods, including, molecular, biochemical, and chemical are briefly described in the following paragraph.

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

MST methods have already been successfully employed at the Department in the past decade. Since 1988, the Department has worked cooperatively with the University of North Carolina in developing and determining the application of RNA coliphage as a pathogen indicator. This research was funded through USEPA and Hudson River Foundation grants. These studies showed that the RNA coliphages are useful as an indicator of fecal contamination, particularly in chlorinated effluents and that they can be serotyped to distinguish human and animal fecal contamination. Through these studies, the Department has developed an extensive database of the presence of coliphages in defined contaminated areas (point human, non-point human, point animal, and non-point animal).

More recently, the Department has established a MST methodolgy that utilizes both genotype (genotyping of F+RNA coliphages) and phenotype (MAR testing) tests. The results of these tests are collectively evaluated to best determine sources of fecal contamination. The Bureau's methodology includes evaluation of long-term microbial results as well as data (GIS Land use coverage, aerial photographs, visual assesments) of actual and potential sources, stormwater monitoring to deliantae location of major sources and the use of MAR and F+ coliphage in conjunction with conventional microbial indicators. This methodology has been successfully applied in several areas including; Seaside Park, Long Swamp, Atlantic City, and Parvin State Park. This methodology will be utilized on select TMDL segments as indicated.

<u>Visual Assessment:</u>

Through the watershed management process and the New Jersey Watershed Ambassadors Program, visual surveys of the impaired segment watersheds were conducted to identify potential sources of fecal coliform. Watershed partners, who are intimately familiar with local land use practices, were able to share information relative to potential fecal coliform sources. The New Jersey Watershed Ambassadors Program is a community-oriented AmeriCorps environmental program designed to raise awareness about watershed issues in New Jersey. Through this program, AmeriCorps members are placed in watershed management areas across the state to serve their local communities. Watershed Ambassadors monitor the rivers of New Jersey through visual assessments and biological assessment volunteer monitoring programs. Supplemental training is provided to prepare the members to perform river assessments on the fecal impaired segments. Each member is provided with detailed maps of the impaired segments within their watershed management area. The Department worked with and through watershed partners and AmeriCorps members to conduct visual assessments in March/April 2005.

The Department reviewed monitoring data, visual assessments, other information supplied by watershed partners, load duration curves, and aerial photography of the impaired segments to formulate segment specific strategies. Segment specific monitoring strategies in combination with generic strategies appropriate to the sources in each segment will lead to reductions in fecal coliform loads in order to attain SWQS.

Segment Specific Recommendations

Watershed Management Area 17

Major Run At Sharptown (Site ID# 01482530)
The watershed that drains this segment is largely agricultural. It is possible that manure application for fertilizer and livestock may be of concern. Small pockets of residences are present. Much of the segment has a wooded buffer. A lake is present above the sampling site. Monitoring: Additional fecal coliform monitoring is suggested in order to locate potential sources. Strategies: The lake area should be investigated for presence of excessive numbers and geese and if needed a goose management program should be implemented; prioritize for EQIP funds to install agricultural BMPs; Phase II stormwater program.

Watershed Management Area 18

Edwards Run Branch of Mantua Creek (Site ID #01475090)
The watershed that drains this segment is largely residential with a few farms. Application of manure may be of concern in the agricultural areas. There are horse farms and farms with cows, goats and chickens located in the segment and residences with pets along the stream. Buffers are generally less than fifty feet, although direct access is generally limited by thick undergrowth. Monitoring: fecal coliform and MST sampling to locate and identify significant sources of pathogens. Strategies: prioritize for EQIP funds to install agricultural BMPs; phase II stormwater program.

Watershed Management Area 20

North Run at Cookstown (Site ID# 01464380)
The watershed is a mix of agriculture (including livestock) and residential development. Wooded buffers are present in much of the watershed, but there are areas were buffers are absent. Application of manure may be of concern in the agricultural areas. Monitoring: fecal coliform monitoring to narrow the scope of the impairment. Strategies: prioritize for EQIP funds to install agricultural BMPs; phase II stormwater program

Short Term Management Strategies

Short term management measures include projects recently completed, underway or planned that are designed to address the targeted impairment. Pertinent projects in the Lower Delaware are as follows:

WMA 18
Mantua Township has an ongoing Greenway project for Mantua creek that includes Edwards Run. They are in the processes of establishing a Greenway along the creek in their Township. There is also an active watershed association, the Mantua Creek Watershed Association, that supports efforts to protect the creek.

9.0 Reasonable Assurance

With the implementation of follow-up monitoring, source identification and source reduction as described for each segment, the Department has reasonable assurance that New Jersey's Surface Water Quality Standards will be attained for fecal coliform. The Department proposes to undertake the identified monitoring responses beginning in 2003-2004.

The Department's ambient monitoring network will be the means to determine if the strategies identified have been effective. Where trackdown monitoring has been recommended, the results of this monitoring as well as ambient monitoring will be evaluated to determine if additional strategies for source reduction are needed.

10.0 Public Participation

The Water Quality Management Planning Rules NJAC 7:15-7.2 require the Department to initiate a public process prior to the development of each TMDL and to allow public input to the Department on policy issues affecting the development of the TMDL. Further, the Department shall propose each TMDL as an amendment to the appropriate areawide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g). As part of the public participation process for the development and implementation of the TMDLs for fecal coliform in the Lower Delaware Water Region, the Department worked collaboratively

with a series of stakeholder groups throughout New Jersey as part of the Department's ongoing watershed management efforts.

Through a series of presentations and discussions the Department engaged the WMA 17, 18, 19 and 20 PACs and TACs in the development of the these TMDLs. Meetings were held, as specified below, in each WMA. At the PAC meetings, the expedited fecal coliform TMDL protocols and the executed Memorandum of Agreement between the Department and EPA Region 2 were described, including the associated schedule for completing TMDLs.

WMA	PAC Meeting
17	December 10, 2002
18	December 3, 2002
19	November 13, 2002
20	November 13, 2002

Additionally, beginning in March of 2005, GIS maps, including aerial photographs as well as USGS topographical maps of each segment were made available on the Department's website for review and comment. Interested parties had the opportunity to supply the Department with information about each TMDL segment via e-mail. The Department specifically solicited information regarding potential sources and/or current non point sources of pollution reduction projects within the impaired streamsheds.

Additional input was received through the NJ EcoComplex (NJEC). The Department contracted with NJEC in July 2001. The NJEC consists of a review panel of New Jersey University professors whose role is to provide comments on the Department's technical approaches for development of TMDLs and management strategies. The New Jersey Statewide Protocol for Developing Fecal TMDLs was presented to NJEC on August 7, 2002 and was subsequently reviewed and approved. The protocol was also presented at the SETAC Fall Workshop on September 13, 2002 and met with approval.

Amendment Process

In accordance with N.J.A.C. 7:15–7.2(g), these TMDLs were proposed by the Department as amendments to the Lower Delaware Water Quality Management Plan (WQMP), and Tri-County WQMP.

The notice proposing the TMDLs was published on May 2, 2005 in the New Jersey Register and the Star Ledger. The TMDL documents were made available at the Department, upon request by mail, and on the Department's website. The Department conducted non-adversarial publics hearing on June 7, 2005 and June 8, 2005. The public comment period ended on June 22, 2005.

Department initiated changes include the following:

1. The New Jersey Environmental Management System (NJEMS), which contains NJPDES permitted facility information evaluated during TMDL development, has been listed under "Data Sources". This has been added to the document.
2. Typographical errors in table references were corrected.
3. The priority ranking and a notation on the other impairments that have not yet been addressed were added.

Three people attended the public hearing held on June 7, 2005, no one testified. Thirteen (13) people attended the public hearing held on June 8, 2005 and two testified (Nancy Merritt and Nick Mesogianes). One letter commenting on the proposed TMDLs was received by the Department.

The following people submitted written and/or oral comments on the proposal:

1. Nancy Merrit, Salem County Watershed Association (Oral comments)
2. Nicholas Mesogianes, Pennsville resident (Oral commets)
3. Jennifer A. Murphy and David J. Jablonski, Mid Atlantic Environmental Law Center (Written Comment)

A summary of comments to the proposal, and the Department's Responses to those comments follow. The numbers(s) in brackets at the end of each comment corresponds to the commenters(s) listed above

Comment 1.
The Department does not indicate that it developed the Lower Delaware Water Region TMDL (LDWR) with the USEPA's guidance document, "Protocol for Developing Pathogen TMDLs", First Edition, January 2001, USEPA Document Number EPA 841-R-00-002, ("Pathogen Protocol"). The Department does not express a rationale for not using the Pathogen Protocol. The Pathogen Protocol is the more specific guidance document, and should have been utilized in the development of the LDWR TMDL. (3)

Response 1.
The USEPA guidance document "Protocol for Developing Pathogen TMDLs" establishes an organizational framework for states to utilize in the development of pathogen TMDLs. The Department did utilize this guidance in the development of New Jersey's statewide protocol for fecal coliform TMDLs. This document is included as a reference in Section 10.0 of the LDWR TMDL.

Comment 2.
The LDWR TMDL does not contain an analysis of the sampling data used to construct the LDWR TMDL. The proposed TMDL does not distinguish between the two stream segments in any manner regarding sampling data and the SWQS exceedances evidenced by that sampling data. At the least, the LDWR TMDL should be more specific as to; the date and time of

sampling events, the location of sampling events, (including which stream segment and the sample location in that stream segment), the type of samples collected for each sampling; date, the sampling methods employed, the method(s) of analysis and the detected concentration of the sample. (3)

Response 2.
All data used in the TMDL process is publicly accessible through the internet at http://waterdata.usgs.gov/nj/nwis/qw. All water quality data for each stream segment was fully assembled prior to performing the calculations found in Section 5.0 Water Quality Analysis of the TMDL document. This analysis was done for each segment separately. The sampling information has been added to the document as an appendix for added convenience. The Department performs an analysis of all available water quality data for assessed waters statewide to determine compliance with the Surface Water Quality Standards biennially to compile the Integrated Water Quality Monitoring and Assessment Report. The methods the Department used to develop the 2004 Integrated List of Water Bodies are described in detail in the 2004 Integrated Water Quality Monitoring and Assessment Methods Document. All water bodies that appear on Sublist 5 of the Integrated List have been assessed relative to the New Jersey Surface Water Quality Standards and found to be in non-attainment of the standards.

Comment 3.
The LDWR TMDL does not contain a rationale as to why the Department decided to group the Major Run, Edwards Run and North Run stream segments under the same TMDL. Each of these waterbodies is in a different County, and both are in different watershed management areas (LDWR TMDL, p. 6-10). The Department has not addressed the relevant and pertinent issues within each of these impaired Watersheds, which would support the Department's decision to propose one TMDL for both stream segments. (3)

Response 3.
To clarify, the Department is proposing separate TMDLs for each of the impaired segments, based on the water quality data relevant to each. For convenience of review and to avoid unnecessary duplication, considering the application of the same approved TMDL method on multiple streams, the Department has grouped the impaired segments by water region in a single document. Tailoring of strategies for addressing each of the impaired segments, taking into account unique characteristics of each segment, is reflected in the section "Segment Specific Recommendations".

Comment 4.
The Department contends there are no wastewater treatment discharges or other point sources within the impaired watersheds (LDWR TMDL, p. 12). The Department does not provide any information regarding the location of these facilities, sewage conveyances, or sanitary sewers. The Department does not consider the possibility that conveyances, sanitary sewers, and septic systems are discharging directly to one of the streams. If point source discharges are present they should be assigned a WLA. Further, the Department does not address the permitting and inspection process for the installation and maintenance of septic systems. In addition, the Department is required to investigate complaints from citizens

about water quality. The Department does not provide this information, and therefore, the LDWR TMDL is inadequate because it does not contain a fully developed assessment of point sources within the impaired watersheds. (3)

Response 4

In Section 6.0 TMDL Calculations of the LDWR TMDL, the Department states that there are no wastewater treatment plants within the impaired watersheds. The statement regarding wastewater treatment discharges refers only to this subset of point sources. As there are no wastewater treatment discharges, as stated, no map of locations is provided and there are no numeric WLAs to be assigned. The Department states in Section 4.0 Source Assessment that "There are no point sources, other than stormwater, that discharge to the impaired segments…". These are the only point sources, as this term is applied in TMDL development, in the impaired segments. WLAs are established for stormwater discharges subject to regulation under the Clean Water Act. In accordance with EPA guidance discussed in the document, stormwater point sources receive a WLA expressed as a percentage reduction for particular stream segments on the basis of land use. The Department recognizes sewage conveyances and septic malfunctions as potential sources of fecal coliform in Section 4.0 Source Assessment and in Section 8.0 Implementation, but is not aware of any current or ongoing malfunctions. For this potential source to be an actual source would be as the result of a malfunction, not by design. The Department investigates reports of noncompliance with NJPDES permits, illegal point and nonpoint discharges, and accidental discharges. These discharges are not considered ongoing point sources that warrant a WLA other than zero; rather, they are ephemeral events that are promptly addressed through compliance and enforcement measures as they occur. Segment specific recommendations include track down monitoring, as appropriate, to identify if any human sources, eg, malfunctioning conveyance systems or septic systems, are actually present. If such sources are found to exist, they will be referred for appropriate compliance measures and/or management measures. With regard to permitting of septic systems, Chapter 199 establishes requirements for septic system design and installation. Permitting for these systems is a local function, except that the Department certifies designs for development that includes 50 or more reality improvements.

Comment 5.

The Department mischaracterizes nonpoint sources of pathogen impairment by including sanitary sewer overflows (SSOs) as a nonpoint source of pathogen impairment. The Department contends that nonpoint sources include "inputs" that are not dependent on precipitation events including Sanitary Sewer Overflows (SSOs), (LDWR TMDL, p. 12). (3)

Response 5.

The commenter is correct that sanitary sewer overflows are point sources. However, there are no legally existing SSOs in New Jersey. Any discharge from a sanitary sewer line would be an event that is subject to compliance and enforcement action, and is, therefore, not characterized as an on-going point source. To avoid any confusion, the Department has revised the language in the TMDL document.

Comment 6.

The LDWR TMDL does not provide any location-specific sources of pathogen impairment in the two waterbodies, nor does the LDWR TMDL provide a sufficient level of detail of the specific land uses and land cover present within the impaired stream watersheds. The Department has identified the following possible sources of pathogen impairment; failing sewage conveyances systems, SSOs, failing or inappropriately located septic systems, geese, wildlife, farms and domestic pets (LDWR TMDL, p. 11-13). The Department does not discuss where or to what extent these sources are located within the impaired watersheds or spatially related to the rivers themselves. The Department should use a more detailed land use breakdown in the TMDL. (3)

Response 6.
The Department disagrees. Location specific information regarding sources is provided in the Segment Specific Recommendations section of the TMDL document. Further, the implementation plan describes the process by which, through the watershed restoration plans for priority segments, more detailed work plans for restoration will be developed. The land use classification system used in the TMDL document contains the most current land use information to assess sources. Land use is not used in these TMDLs to extrapolate pollutant loadings and, therefore, a more detailed analysis is not warranted.

Comment 7.
The Department does not discuss whether domestic or industrial wastewater sludge or other solid wastes are being land applied within the impaired watersheds. (3)

Response 7.
There are no dedicated sludge or solid waste land application sites within the studied areas.

Comment 8.
The Department defines stormwater point sources, and distinguishes NJPDES permitted stormwater discharges from nonpoint sources, but does not indicate if any NJPDES stormwater point sources are within either of the two stream segments. The Department states, "stormwater discharged to the impaired segments through 'small municipal separate storm sewer systems' (MS4s) are regulated under the Department's Phase II Municipal Stormwater Regulation Program" (LDWR TMDL, p. 24). The Department has failed to identify the location of these MS4s within the impaired watersheds. In addition, the Department indicates, "these measures are to be phased in over a timeframe specified in the Department's Phase II permitting program", but does not specify when this will occur (LDWR TMDL, p. 24). The MS4 program should be fast tracked for these two areas in order to actually implement the reductions through MS4 permits. In addition the programs for the Major Run and North Run are “limited to public education and control of stormwater from new development and redevelopment”, which is not implementing a reduction to the current discharges. There is no mention of the MS4 program in Edwards Run. (3)

Response 8.
With regard to MS4s, the Department has supplied the Tier A and Tier B classifications for the municipalities within the areas affected by the TMDLs as an appendix. All 566 municipalities within the State are assigned regulated as either Tier A or Tier B. Tier A municipalities are

located within the more densely populated regions of the state or have drainage to the coast. Tier B municipalities are more rural and in non-coastal regions. Both Tier A and Tier B municipalities have NJPDES permits, but only Tier A municipalities are considered point sources under the Clean Water Act. This is explained in the TMDL report. Also explained are Statewide Basic Requirements (SBRs) applicable to each tier. More detail regarding the municipal stormwater permitting program can be found at the Department's website at stormwater.org. The TMDL report explains that stormwater point sources are addressed by assigning a percent reduction as a WLA to land uses that are deemed equivalent to the areas regulated as point sources. Therefore, the location of these point sources is the urban land use area given in Figures 2, 3 and 5. The implementation schedule for the municipal stormwater permitting program has already been set forth in rules and can be found at www.njstormwater.org. The Department believes that this schedule is sufficiently aggressive and would note that the requirements, such as street sweeping and inlet cleanout, are now operative. In segments where the municipalities are subject only to Tier B requirements, the expectation is that the collected stormwater source is de minimus and the reduction that must be obtained from the urban land use will be achieved by addressing septic system sources and/or through goose management, as applicable.

Comment 9.

The Department contends, "[r]elating pathogen sources to in-stream concentrations is distinguished from quantifying that relationship for other pollutants given the inherent variability in population size and dependence not only on physical factors such as temperature and soil characteristics, but also on less predictable factors such as re-growth media" (LDWR TMDL, p. 14). The Department further contends the above facts warrant using "a concentration set to meet the state water quality standard" to express load capacity (LDWR TMDL, p. 14-15). The Department is essentially proposing to establish the loading capacity for the two streams as the SWQS. This is inadequate because the purpose of the TMDL is to ensure compliance with the SWQS. In addition, this method requires a less detailed analysis of the sources of pathogen impairment, and broader, less specific, decision-making regarding reductions in the identified sources of pathogen impairment. This is evidenced by the broad, generalized nature of the LDWR TMDL as a whole. The Department should allocate more resources to the source assessment portion of the TMDL. (3)

Response 9.

While the purpose of a TMDL is to identify the load of a pollutant that can be assimilated by a waterbody and still attain surface water quality standards and support designated uses, allocate that loading capacity to point sources, nonpoint sources and a margin of safety, the means to achieve the standards is through implementation of management measures that will result in the necessary load reductions. The Department believes that the technical approach used to establish the loading capacity should consider the uncertainties (gaps and variability) in the data, the ability to model and predict concentration response relative to loadings, and the predictability of achieving a load reduction from applying a given management measure. The approach used in these TMDLs is appropriate to the parameter being addressed, including the variability and unpredictability of sources and effectiveness of management measures. The inclusion of both an implicit and explicit Margin of Safety (MOS) as part of the TMDL calculation is a reflection of the uncertainties and provides for reasonable assurance

that the standard will be met. EPA has accepted this TMDL approach in over 170 previously approved TMDLs. With regard to identification and implementation of management measures, the Department has gathered information on the impaired segments. Detailed stream characterization information has been gathered from many useful sources including: solicited public input, stream-walks conducted by Department-trained AmeriCorps members, and field visits. This information, as well as the generic approaches that apply to source types wherever they are found to exist, is the basis for the preliminary implementation plan, which includes a plan for source trackdown and identification, as needed. Through its watershed management initiative, the Department is developing detailed watershed restoration workplans for each stream segment with a TMDL, on a priority basis. These workplans take the preliminary implementation plan to the next level and are the basis for targeting available funds, as discussed in the TMDL report, to effect specific projects to achieve load reductions. The Department believes it is more effective in achieving water quality improvement to devote resources to implementation measures than to attempt to precisely quantify and model fecal coliform loads.

Comment 10.
The Department does not provide a discussion regarding why it chose to focus solely on bacteria when discussing the load capacity being expressed as a concentration (LDWR TMDL, p. 14-15). The Department does not discuss viruses or protozoa, generally grouped under the pathogen heading. (3)

Response 10.
Waterbodies are listed as impaired when a water quality standard or designated use is not attained. TMDLs are then prepared to determine the load reductions of a pollutant necessary to attain the standard/designated use. The TMDL for fecal coliform does not discuss other pathogens, such as viruses or protozoa, because the SWQS are expressed in terms of fecal coliform and there are no standards for specific pathogens, such as viruses or protozoa. The Department assesses streams for sanitary quality by using fecal coliform because it is a widely accepted indicator of the sanitary quality of the water. As stated in EPA Protocol for Developing Pathogen TMDLs, pathogenic organisms present in polluted water are few and difficult to isolate; therefore, an indicator organism is chosen because it is more easily sampled and measured. Indicator organisms are assumed to indicate the presence of all human pathogenic organisms.

Comment 11.
The Department does not provide sufficient detail on the relationship between the proposed percent reductions, the assigned WLAs and LAs and the eight source categories listed in Table 5 (LDWR TMDL, p. 22). In addition, the Department does not adequately explain how the percent reductions, the assigned WLAs and LAs and the calculated MOS will result in the two stream segments meeting the SWQS in the future. The implementation plan proposed by the Department for the LDWR TMDL is insufficient because it lacks the specificity required to implement the purpose of the TMDL process, which is to ensure the attainment of the established water quality standards. (3)

Response 11.

The TMDL approach employed here does not attempt to model the relationship between load and concentration as previously explained. The Department's strategy is to reduce the nonpoint and stormwater point sources to the extent practicable using BMPs, based on the reasonable initial assumption that, if sources are controlled, SWQS will be attained. If, through follow up monitoring, it is determined that SWQS are not met, then, in accordance with the adaptive management paradigm, the Department will identify additional measures, such as stormwater management retrofits, that will be implemented in order to attain SWQS.

Comment 12.
There is no information provided regarding where the 115 monitoring stations in the Ambient Stream Monitoring Network (ASMN) program are in relation to the impaired stream segments. In addition, the Department does not provide a link between the follow-up monitoring and the verification of attainment of the established percent reductions for the identified sources of pathogen impairment. (3)

Response 12.
Figures 1 and 2 in the TMDL report identify the locations of the monitoring stations within the impaired segments that were used to assess the segments, resulting in placement on Sublist 5 of the Integrated List. The ASMN program was used to compile the list of impaired waterbodies and will be used to evaluate SWQS attainment in the future. If the ASMN monitoring data demonstrates compliance with the SWQS, then TMDL implementation will be deemed successful and the waterbody will be place on Sublist 1. The follow-up monitoring discussed in the implementation section is intended for relative source identification to inform targeting management measures, not for effectiveness evaluation.

Comment 13.
The Department does not indicate why it has not been identifying and preventing unauthorized discharges from the wastewater collection systems in the impaired watersheds prior to the proposal of this TMDL. (3)

Response 13.
While the Department does not explicitly state it in the document, the Department and the entities maintaining the wastewater collection systems routinely respond to unauthorized discharges as they are identified.

Comment 14.
The Department offers no timeframe when they intend to implement the proposed management strategies in the impaired watersheds or when the fecal coliform SWQS for the impaired streams will be attained. (3)

Response 14.
The elements of the plan for attaining the SWQS will proceed over time and may be adjusted, as needed, through adaptive management, to respond to results of the ambient monitoring program, which will be assessed at least every two years, until attainment of SWQS is demonstrated. The Department is currently engaged in source track down efforts for the fecal coliform TMDLs established in 2003. Plans are being developed to expand this project to

carry out the track down monitoring for the current suite of proposed fecal coliform TMDLs. Once the data are available from the current and expanded monitoring projects they will be assessed and will inform further development and/or refinement of management measures to implement the TMDLs. In addition, it should be noted that the measures required under the municipal stormwater permitting program are currently operative. Further, the Department is continually working through its watershed management initiative to implement nonpoint source reduction strategies within the 20 watershed management areas, consistent with established TMDLs, using available resources. The TMDL documents provide the basis upon which regulatory action can be taken to implement management strategies. The Department has been and continues to target available resources, like the 319(h) grant program, Corporate Business Tax (CBT) revenues, and allied grant programs for agricultural areas (EQIP, CRP and CREP) to address fecal coliform sources in the impaired segments for which TMDLs were completed. Follow up monitoring will determine where efforts need to be stepped up or redirected to attain SWQS. For example, if it is determined that additional measures are needed to address stormwater sources subject to the municipal stormwater permitting rules, these measures will become requirements under the general permits issued by the Department. Finally, the TMDL process and adoption of the TMDLs as amendments to the applicable area-wide Water Quality Management Plans (WQMPs) is significant because it assures that plan amendments and permitting throughout the Department are consistent with the TMDLs. For example, implementation of septic management districts may be required through wastewater management plan updates where septic system sources are identified.

Comment 15.
The Department states, "[e]fforts to identify sources include visual assessments and planned track-down monitoring, where appropriate" (LDWR TMDL, p. 28). The Department does not provide an explanation as to its rationale for not conducting these activities prior to proposing the LDWR TMDL. In addition, the Department will need to elaborate on its course of action, if the source track-down efforts result in findings contrary to the LDWR TMDL or shows the LDWR TMDL is inadequate. (3)

Response 15.
Detailed stream characterization information was gathered from many useful sources including: solicited public input, stream-walks conducted by Department-trained AmeriCorps members, and field visits. The Department relied on these information resources to tailor the segment specific recommendations in the implementation section. The data collected through track-down monitoring is intended and will be evaluated and used to inform implementation decisions. The Department's ambient monitoring network will be an on-going means to determine if SWQS have been and continue to be maintained or if adaptive management will direct refinement/enhancement of management measures.

Comment 16.
The total river miles for the proposed LDWR TMDLs are calculated incorrectly in Table 2. on page 5 of the document. The total river miles should be listed as 12.43 not 23.56 miles. (3)

Response 16.
The error has been corrected.

Comment 17.
Table 2 in Section 3.0"pollutant of Concern and Area of Interest", (page 5), and Table 4, (page 9), indicate Edwards Run's impaired river miles are 6.6 miles while under the description of Watershed Management Area 18, Edwards Run is described as 6.9 miles long (page 8). The document is unclear as to whether the Department is proposing the TMDL for the entire segment of Edwards Run or only a 6.6 mile stretch of the stream, the Department should explain is rational for excluding the 0.3 miles. (3)

Response 17
The TMDLs developed with this methodology were intended to apply only to the non-tidal portions of the segments in question. Tidal segments that are impaired will be addressed in separate TMDLs.

Comment 18
The LDWR TMDL states "[t]herefore allocations are established according to source categories as shown in Table 5". This is an error. The reference should be to Table 6. (3)

Response18
This error has been corrected.

Comment 19
There is an error on the bottom of page 22. Table 6 is referenced when the correct reference is Table 7. (3)

Response 19
This error has been corrected.

Comment 20.
The Department should provide more detail on why strategies for source reduction will apply equally well to new development as to existing development. (3)

Response 20.
New development is expected to contribute a de minimus load relative to the existing land use it replaces. This is because stormwater associated with newly developed areas will be controlled by the new stormwater management control requirements, and, in MS4 regulated areas, by the requirements in the municipal stormwater permitting rules. This is expected to effectively avoid increases in storm driven sources, thereby preventing the water quality problems that are attributed to the existing development.

Comment 21.
Commenter expressed support for the Department addressing nonpoint source pollution; however, believes that more focus needs to be placed on larger issues, including the Lower Delaware Water Quality Management Plan as it applies to Salem County. Regionalization of sewers and impacts of sewage treatment plants on the Salem River are of greater concern. There needs to be an accurate, up to date sewer service area map for the area. While Major

Run should be addressed, other, larger, waterways that have more significant pollution problems should be the focus of the Department's efforts. (1)

Response 21.
The Department appreciates the support for addressing nonpoint source pollution. The Department is aware that the WMPs in Salem County are out-of-date. This is true in much of the State. The Department continues to consider options and strategies for dealing with these deficiencies Statewide. In the mean time, the Department is triggering new and updated WMPs under the existing rules when amendments are filed. The Department is seeking funding opportunities to update the WMPs in a comprehensive fashion. Addressing Major Run does not prevent the Department from focusing on Water Quality Management Plans or on other waterways. In fact, aTMDL for fecal coliform on the Salem River has already been completed. The TMDL for phosphorus on the Salem River is currently being developed. It should be noted that 319 grant funds have been committed to develop a detailed watershed restoration and protection plan for portions of the Salem River watershed.

Comment 22.
The commenter would like to know how the permit by rule provision of Fast Track is going to affect Water Quality Management Plans. (1)

Response 22.
There has been an executive order postponing Fast Track until certain requirements are met. At this time there is no effect on the Water Quality Management Plans.

Comment 23.

The commenter expressed concern about the amount of new and proposed development occurring while the county has an interim sewer plan. The commenter is concerned that sewer line extensions have been put in to provide service to new development without approval and in violation of the plan, that development may be occurring in environmentally sensitive areas, and that the sewage treatment plant may not be able to properly treat the added sewage. (2)

Response 23.
Issues regarding violations of Water Quality Management plans are beyond the scope of this public notice. For information about or to discuss issues regarding the Water Quality Management Plans, please contact the Bureau of Watershed Regulation at (609) 984-6888.

Comment 24.
The Department should work with the Department of Agriculture where agriculture may be impacted by regulations. The Department should not make things more difficult for the farmers. (1)

Response 24.
Strategies to obtain fecal coliform reductions from agricultural land uses are coordinated with the New Jersey Department of Agriculture and the NRCS, agencies that are available to

provide advice, assistance and funding for TMDL implementation strategies related to agriculture.

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Appendix A: TMDL Calculations

Load Allocation (LA) and Margin of Safety (MOS)															
				200 FC/100ml Standard					400 FC/400ml Standard						
WMA	**303(d) Category 5 Segments**	**Water Quality Stations**	**Station Names**	N (# of values)	Geometric mean CFU/100ml	MOS as a percentage of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Summer N	Summer geometric mean CFU/100 ml	MOS as a percentage of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Wasteload Allocation (WLA)	**Period of records used in analysis**
17	01482530	01482530	Major Run	10	1705	44	88	93	10	1705	44	96	98	98	6/14/01 – 7/2/02
18	01475090	01475090	Edwards Run	10	1835	54	89	95	10	1835	54	96	98	98	7/10/01 – 6/26/02
20	01454380	01454380	North Run	13	242	28	17	41	13	242	28	72	80	80	5/23/01 – 7/15/02

Appendix B: Sampling Data

Major Run Fecal Coliform Data

	Sampling station	Date	Time	Results (CFU/100ml)
USGS	1482530	6/14/2001	9:30	2200
USGS	1482530	6/21/2001	10:15	490
USGS	1482530	6/28/2001	10:30	790
USGS	1482530	7/5/2001	9:20	330
USGS	1482530	7/12/2001	9:45	3840
USGS	1482530	6/5/2002	9:15	3000
USGS	1482530	6/12/2002	9:30	1300
USGS	1482530	6/19/2002	9:30	1400
USGS	1482530	6/26/2002	9:15	16000
USGS	1482530	7/2/2002	8:15	2200

Edwards Run

USGS	1475090	7/10/2001	9:40	940
USGS	1475090	7/17/2001	9:40	1100
USGS	1475090	7/24/2001	9:40	16000
USGS	1475090	7/31/2001	9:50	940
USGS	1475090	8/7/2001	9:30	24000
USGS	1475090	5/29/2002	9:30	1100
USGS	1475090	6/5/2002	9:30	500
USGS	1475090	6/12/2002	9:50	5000
USGS	1475090	6/26/2002	10:25	230

North Run

USGS	1464380	5/23/2001	10:15	700
USGS	1464380	5/30/2001	11:15	110
USGS	1464380	6/6/2001	10:50	110
USGS	1464380	6/13/2001	11:05	460
USGS	1464380	6/19/2001	11:10	630
USGS	1464380	5/1/2002	10:50	170
USGS	1464380	5/8/2002	10:45	130
USGS	1464380	5/15/2002	11:00	110
USGS	1464380	5/23/2002	12:15	220
USGS	1464380	5/30/2002	12:08	230
USGS	1464380	7/1/2002	10:45	500
USGS	1464380	7/8/2002	10:50	500
USGS	1464380	7/15/2002	10:35	130

Appendix C

WMA	Segment	NJPDES Permit Number	Municipality	Discharge Type	Additional Measures
17	Major Run at Sharptown	NJG0151173	Mannington Twp		None
		NJG0152714	Pilesgrove Twp	Tier B	None
18	Edwards Run at Jefferson	NJG0154075	East Greenwich	Tier A	None
		NJG0150169	Harrison Twp	Tier A	None
		NJG0152846	Mantua Twp	Tier A	None
20	North Run at Cookstown	NJG0148156	North Hanover		None
		NJG0152722	New Hanover	Tier B	None