STORMWATER POLLUTION PREVENTION PLAN

FOR

The City of Gloucester City

Camden County, New Jersey

CES# 3676-05

Prepared: February 2005
Revised: January 2019

Marie Baaden, PE, CME
N.J.P.E. License No. 50849

Jarod Thomas, PE
N.J.P.E. License No. 54029

Prepared by:
Remington and Vernick, Engineers Inc.
232 Kings Highway East
Haddonfield, NJ 08033

Revised by:

CONSULTING ENGINEER SERVICES
Professional Engineers, Planners, and Land Surveyors
645 Berlin-Cross Keys Road, Suite 1 Sicklerville, NJ 08081
(856) 228-2200 Fax (856) 232-2346

Table of Contents

II. Appendices

- SPPP Signature Certification Page
- SPPP Form 1 – Stormwater Pollution Prevention Team Members
- SPPP Form 2 – Public Notice
- SPPP Form 3 – New Development and Redevelopment Program
- SPPP Form 4 – Local Public Education Program
    - Long-Term Control Plan
    - Recent Projects
- SPPP Form 5 – Storm Drain Inlet Labeling
- SPPP Form 6 – MS4 Outfall Pipe Mapping
    - Outfall Map
    - Outfall Inspection Form

- SPPP Form 7 – Illicit Connection Elimination Program
    - Illicit Connection Report Form
    - Illicit Connection Closeout Form
- SPPP Form 8 – Illicit Connection Records
- SPPP Form 9 – Yard Waste Collection/Ordinance Program
- SPPP Form 10 – Ordinances
    - Enforcement Log
    - Copies of Ordinance
- SPPP Form 11 – Storm Drain Inlet Retrofitting
- SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance
    - Sample Street Sweeping Log
- SPPP Form 13 – Stormwater Facility Maintenance
    - Sample Stormwater Maintenance Log
- SPPP Form 14 – Outfall Pipe Stream Scouring Remediation
- SPPP Form 15 – De-Icing Material Storage
- SPPP Form 16 – Standard Operating Procedures
    - City Specific Operating Procedures
    - Attachment E
- SPPP Form 17 – Employee Training
    - Municipal Employee Training Log
    - Review Staff Training Log
    - Governing Body Members Training Log
- TMDL Reports
- Employee Training Videos

I Executive Summary

Remington & Vernick, Engineers was authorized by the City of Gloucester City (City) to provide Year 1 services for the City's compliance with the New Jersey Municipal Separate Storm Sewer System (MS4) regulations in 2004. As part of those services, an audit of the Department of Public Works (DPW) facility was performed, including site inspection and interviews with City personnel. Using this information, and data obtained from the facility, the initial Stormwater Pollution Prevention Plan (SPPP) was prepared using forms provide by the New Jersey Department of Environmental Protection (NJDEP) and contained in the Tier A Stormwater Guidance Document published April 2004. The SPPP consisted of 17 forms, sample maintenance logs, and standard operating procedures. These forms were subject to periodic updates as the City achieved compliance with various MS4 obligations.

In 2014, the City was audited by the Environmental Protection Agency (EPA) for permit compliance. Deficiencies in the City's stormwater program identified in the audit were reviewed and addressed by 2015.

The City was issued a new MS4 permit on November 9, 2017 with an effective date of permit approval (EDPA) of January 1, 2018. The City has authorized Consulting Engineer Services (CES) to revise the SPPP to meet the requirements of the new permit as well as review stormwater components of applications submitted for approval to the City's Planning and Zoning Boards. The new MS4 permit contains additional requirements beyond those obligated by the 2004 permit. Where feasible, the original 17 forms have been updated and kept in the SPPP. Where it was not feasible to continue using those forms, the SPPP has been updated to address the required information without relying upon the form.

Table 1 is a summary of the City's MS4 permit obligations and associated timetables taken from Attachment A of the permit. The City's Stormwater Program Coordinator is responsible for ensuring implementation of the SPPP. Tasks have been grouped in a manner to delegate responsibility based on the designated Stormwater Pollution Team Members indicated in SPPP Form 1.

Table 1: MS4 Permit Obligations and Time Tables

Task	Regulatory Timetable	Location in SPPP	New Req't?
II. Public Notice Requirements (Public Notice Coordinator)			
Comply with public notice requirements.	January 1, 2018 + Annual certification	Form 2	No
Provide the current SPPP to the public upon request	January 1, 2018	Form 4	No
Post the current SPPP on the municipality's website	April 1, 2018	Form 4	Yes
Post the current Municipal Stormwater Management Plan (MSWMP) and related ordinances to the municipality's website	April 1, 2018	Form 2	Yes
III. Local Public Education and Outreach (Local Public Education Coordinator)			
Implement a public education and outreach program that totals at least 12 points across 3 categories in Attachment B.	January 1, 2018 + Annual certification	Form 4	Modified
Label storm drain inlets and maintain those labels.	January 1, 2018 + Annual certification	Form 5	No
Advertise public involvement programs pertaining to education and outreach.	January 1, 2019 + Annual certification	Forms 4	Yes
IV. Post Construction Stormwater Management (Stormwater Program Coordinator)			
Develop, update, implement, and enforce post-construction stormwater management program	January 1, 2018 + Annual certification	Form 3	No
Require Major Development Stormwater Summary for all new BMPs	January 1, 2018 + Annual certification	Form 3	Yes
V. Pollution Prevention/Good Housekeeping – Community Wide Ordinances (Ordinance Coordinator)			
Adopt and enforce ordinances for pet	January 1, 2018 + Annual	Form 10	No

waste, wildlife feeding, litter control, improper disposal of waste, yard waste collection program, and stormdrain retrofitting	certification		
VI. Pollution Prevention/Good Housekeeping – Community Wide Measures (Public Works Coordinator)			
Perform monthly street sweeping	January 1, 2018 + Annual certification	Form 12	No
Perform inlet inspections and cleanings at least once every 5 years	January 1, 2018 + Annual certification	Form 13	Modified
Continue to implement storm drain retrofit program	January 1, 2018 + Annual certification	Form 11	No
VII. Municipal Maintenance Yards (Public Works Coordinator)			
Attachment E BMPS:			
-Inventory of Materials and Machinery	January 1, 2018 + Annual certification	Form 16	No
-Inspections and Good Housekeeping	January 1, 2018 + Annual certification	Form 16	No
-Fueling operations	January 1, 2018 + Annual certification	Form 16	No
-Vehicle maintenance	January 1, 2018 + Annual certification	Form 16	No
-Salt and de-icing materials	January 1, 2018 + Annual certification	Form 15	No
-Aggregate and construction debris	January 1, 2019 + Annual certification	Form 16	Yes
-Street sweepings and catch basin material	January 1, 2019 + Annual certification	Form 16	Yes
-Roadside vegetation management	January 1, 2019 + Annual certification		Yes
VIII. Training Program (Employee Training Coordinator)			

Training Requirements:			
-Municipal Employee training at least every 2 years	January 1, 2019 + Annual certification	Form 17 and Training Log	Yes
-Review Staff training at least every 5 years	January 1, 2019 + Annual certification	Form 17 and Training Log	Yes
-Municipal Board member training at least once per service term	July 1, 2018 + Annual certification	Form 17 and Training Log	Yes
IX. MS4 Outfall Pipe Mapping and Illicit Connection Detection (Public Works Coordinator)			
Develop, update, and maintain outfall pipe map in SPPP	January 1, 2019 + Annual certification	Form 6	No
Submit outfall pipe map to NJDEP electronically	December 21, 2020		Yes
Develop program for outfall scouring	January 1, 2019 + Annual certification	Form 14	Modified
Adopt and enforce an ordinance prohibiting illicit connections	January 1, 2018 + Annual certification	Form 10	No
X. Stormwater Facilities Maintenance (Post-Construction Stormwater Management Coordinator)			
Develop and implement program to maintain stormwater facilities in municipality	January 1, 2018 + Annual certification	Form 13	Modified
Develop and implement program to ensure proper maintenance of privately owned stormwater facilities in municipality	January 1, 2019 + Annual certification	Form 13	Yes

Maintain copies of all stormwater facility maintenance plans approved by the municipality	January 1, 2019 + Annual certification	Form 13	Yes
XI. TMDLs (Stormwater Program Coordinator)			
Annually review approved or adopted TMDL reports	January 1, 2019 + Annual certification	Section XI	Yes
Update SPPP per TMDL reports	January 1, 2019 + Annual certification	Section XI	Yes
Incorporate strategies to mitigate TMDLs per annual reports	January 1, 2019 + Annual certification	Section XI	Yes

II. Public Notice Requirements (Public Notice Coordinator)

Public Meetings and Ordinances (Public Notice Coordinator)

Public notice requirements must comply with the Open Public Meetings Act (NJSA 10:4-6) and the procedure for passage of ordinances (NJSA 40:49-2). In addition, applicable sections of the Municipal Land Use Law shall be complied with for public notice relating to the Master Plan (NJSA 40:55D-13, 28, & 94).

Records shall be maintained necessary to verify compliance with public participation and notice.

SPPP Access to Public (Public Notice Coordinator)

The City must make the current SPPP available to public inspection upon request during normal business hours.

Website Updates (Public Notice Coordinator)

The current SPPP and MSWMP must be posted to the City's web site. The version posted to the web site does not need to include inspection logs and other recordkeeping nor does it need to include the names of the SPPP Team Members, however, the Stormwater Program Coordinator must be included.

See SPPP Form 2 – Public Notice

III. Local Public Education and Outreach (Local Public Education Coordinator)

Public Education (Local Public Education Coordinator)

The City shall implement a public education that provides at least 12 points of public education across a minimum of 3 categories as described in Attachment B of the permit. Records and dates of these activities shall be maintained by the City.

Public education activities are most commonly completed by the City's Green Team. Green Team meetings are announced annually and minutes are provided on the City's web site.

See SPPP Form 4 – Local Public Education Program, Long-Term Control Plan, Example Projects

Inlet Labeling (Public Works Coordinator, Local Public Education Coordinator)

The City has labeled all storm drains in the MS4 system and currently maintains them as necessary. Labels that are missing or illegible shall be replaced by either the Coordinator for Public Works or Local Public Education.

Upon completion of capital projects, the Local Public Education Coordinator and the City's Green Team shall work with City youth groups to perform new inlet labelings.

See SPPP Form 5 – Storm Drain Inlet Labeling

Advertisement of Public Involvement (Local Public Education Coordinator, Public Notice Coordinator)

Public education activities shall be advertised in a manner suitable to generate adequate attention for the activity.

See SPPP Form 4 – Local Public Education Program

IV. Post Construction Stormwater in New Development and Redevelopment (Stormwater Program Coordinator)

Stormwater Management Ordinances (Ordinance Coordinator)

The City has passed ordinance #O2-2006 establishing rules that meet the requirements of NJAC 7:8 for Major Developments exempting those projects subject to the Residential Site Improvement Standards. The City shall continue to review development applications and enforce the requirements of this ordinance on all new development and redevelopment projects that disturb one acre or more or any project that creates more than 10,000 square feet of new impervious coverage.

See SPPP Form 3 – New Development and Redevelopment

Municipal Stormwater Management Plan (Stormwater Program Coordinator)

The City last submitted the MSWMP to the County for review in 2006 when it was approved. When the City updates its Master Plan, the City shall review and revise the MSWMP, if necessary, as part of that update.

Variances from Design Standards (Stormwater Program Coordinator)

Variances from the design standards shall only be issued if they can be mitigated as part of the MSWMP. To date, no variances to the design standards have been granted. If any variance is granted, a written report shall be submitted to the Department and county review agency within 30 days.

Design Standards for Storm Drain Inlets (Post-Construction Stormwater Management Coordinator)

All inlets within the MS4 area of the City have been replaced with inlet grates that comply with Attachment C of the permit.

See SPPP Form 11 – Storm Drain Inlet Retrofitting

Operation and Maintenance of Stormwater Measures (Public Works Coordinator / Post-Construction Stormwater Management Coordinator)

Stormwater measures owned and operated by the City are inspected and maintained annually, unless more frequent activities are necessitated.

Stormwater measures not owned and operated by the City are inspected annually for signs of insufficient maintenance activities. Sites that are insufficiently maintained shall be cited for non-compliance.

<u>Major Development Stormwater Summary (Post-Construction Stormwater Management Coordinator)</u>

The Major Development Stormwater Summary, Attachment D of the permit, shall be completed for all development applications. The Major Development Stormwater Summary shall be completed, updated, finalized, and maintained by the City going forward.

V. Pollution Prevention/Good Housekeeping – Community Wide Ordinances (Ordinance Coordinator)

<u>Community Wide Ordinances (Ordinance Coordinator)</u>

The City has passed ordinance #O09-2005 establishing rules to address the following requirements within the MS4 permit:

- Pet Waste
- Wildlife Feeding
- Litter Control
- Improper Waste Disposal
- Yard Waste Collection Program
- Illicit Connect

The City has passed ordinance #O07-2009 establishing rules to address the following requirements within the MS4 permit:

- Private stormwater drain inlet retrofitting

A log of enforcement actions shall document violations of these ordinances.

See SPPP Form 10, copy of ordinances, and associated enforcement log.

VI. Pollution Prevention/Good Housekeeping – Community Wide Measures (Public Works Coordinator)

Community Wide Measures (Public Works Coordinator)

The City public works department is responsible for performing community wide pollution prevention measures, which shall include:

- Monthly street sweeping activities
- Catch basin and inlet inspection and cleaning at least every 5 years or as necessary to mitigate potential issues
- Retrofit and maintain existing inlets to comply with the requirements of Attachment C of the permit.

See SPPP Forms 11, 12, & 13 and sample logs for community-wide measures.

VII. Municipal Maintenance Yards (Public Works Coordinator)

Municipal Maintenance Yard (Public Works Coordinator)

The City public works department operates a municipal maintenance yard for the purposes of conducting the following activities. These activities shall comply to the BMP of Attachment E of the permit:

- Fueling operations
- Vehicle maintenance
- Salt and de-icing material storage and handling
- Aggregate material and construction debris storage
- Street sweepings, catch basin cleanout, and other material storage

The City's maintenance yard is in the process of constructing a salt barn to store salt under roof and is also updating signage at the fueling facility to comply with Attachment E.

Water Works (Public Works Coordinator)

The following activities occur at the City's water works yard. These activities shall comply to the applicable BMP of Attachment E of the permit:

- Fueling operations
- Salt and de-icing material storage and handling
- Aggregate material and construction debris storage

The City's water works yard is in the process of relocating the outdoor brine storage tanks to the maintenance yard, moving storage of the sodium hypochlorite tank under roof, and updating the signage and equipment at the fueling facility to comply with Attachment E.

See SPPP Forms 15 & 16 and Standard Operating Procedures.

VIII. Training Program (Employee Training Coordinator)

Employee Training – Municipal Employees

All municipal employees involved in maintenance activities for the MS4 system shall receive training on the following topics within 3 months of commencement of their duties and at least every 2 years thereafter:

- Yard waste collection program
- Monthly street sweeping program
- Illicit connection elimination
- Outfall pipe mapping
- Outfall pipe stream scouring detection and control
- Waste disposal education
- Municipal ordinances

- Construction activity/post-construction stormwater management in new development and redevelopment
- Additional training topics related to stormwater.

Employees shall be trained on the following topics within 3 months of commencement of their duties and at least annually thereafter:

- Maintenance yard operations
- Stormwater facility maintenance
- SPPP
- Recordkeeping
- Items applicable to employee's title and duties

Compliance with this training shall be achieved by having employees watch the Municipal Excess Liability webinar series on Environmental Liability (included herein on DVD). Alternately, the City shall offer other training sufficient to meet these requirements at the discretion of the Employee Training Coordinator.

Logs documenting status of municipal employees' training shall be maintained.

See SPPP Form 17 and training logs.

Employee Training – Review Staff

All City employees involved in the review of stormwater for development and redevelopment projects shall be trained by completing NJDEP's approved Stormwater Management Design Review Course at least once every 5 years.

Logs documenting status of review staff's training shall be maintained.

See SPPP Form 17 and training logs.

Employee Training – Municipal Board and Governing Body Member

All municipal board and governing body members that review and approve applications for development and redevelopment projects shall complete the "Asking the Right Questions in Stormwater Review Training Tool" provided by NJDEP within 6 months of commencement of duties and once per term of service thereafter.

Logs documenting status of municipal board and governing body member's training shall be maintained.

See SPPP Form 17 and training logs.

IX. MS4 Outfall Pipe Mapping and Illicit Connection Detection (Public Works Coordinator)

Outfall Pipe Mapping (Public Works Coordinator)

All outfall pipe locations shall be mapped by the City and the map updated annually. The map shall show the location of all outfalls and receiving waterbodies.

The outfall map was last updated in 2015 and 23 publicly-owned outfalls were identified. No new outfalls have been constructed since then. The map shall be updated annually when new outfalls are constructed.

See SPPP Form 6, Outfall Pipe Map, and Outfall Inspection Form.

Stream Scouring (Public Works Coordinator)

All outfall pipes shall be inspected at least once every 5 years for scouring. Any required remediation efforts shall be documented and prioritized as necessary.

Remediation of locations with localized stream scouring shall include identifying contributing sources to the outfall and efforts made to reduce rate or volume from those sources as appropriate as well as proper function of existing stormwater facilities.

See SPPP Form 14.

Illicit Discharge Detection and Elimination

No illicit detections have been detected since the City began efforts to detect them. Illicit detections shall as part of routine inspections and outfall stream scourings inspections that occur during dry weather. If flows are detected during dry weather, the City shall trace the source to the location and attempt to eliminate it. Investigations shall be documented throughout the process.

All illicit connection enforcement activities shall be performed in accordance with City ordinances prohibiting them.

If the City receives a report regarding potential illicit connections, it shall be investigated within 3 months of receipt.

See SPPP Form 8, Illicit Connection Report Form, and Closeout Investigation Form.

X. Stormwater Facilities Maintenance (Post-Construction Stormwater Management Coordinator)

Develop Program to Maintain Stormwater Facilities (Public Works Coordinator)

All outfall pipes shall be inspected for illicit connections every 5 years. The Post-Construction Stormwater Management Coordinator and Pubic Works Coordinator shall work together to implement maintenance activities associated with elements of the stormwater system owned by the City.

Logs of maintenance activities and inspections shall be maintained to document completion of maintenance activities and identify areas in need of remediation.

Private Stormwater Systems (Post-Construction Stormwater Management Coordinator)

Owners of private stormwater systems shall be responsible for performing maintenance on those systems in accordance with their site's approved maintenance plan. In the event that privately owned stormwater BMPs are not being maintained, the City shall conduct enforcement actions in accordance with Section 27A of the ordinance.

The City shall maintain copies of the approved maintenance plans as well as the Major Development Stormwater Summary, Attachment D, required by the permit.

See SPPP Form 13 and maintenance logs.

XI. TMDLs (Stormwater Program Coordinator)

Incorporate TMDL Information Into SPPP (Stormwater Program Coordinator)

The City's Stormwater Program Coordinator shall review approved or adopted TMDL reports to identify stormwater related pollutants listed therein and associated with any segment of surface water bordering or within the City. The maintenance program shall be modified, as appropriate, to identify and address those specific sources of stormwater related pollutants and strive to eliminate their discharge to surrounding water bodies wherever practicable to do so.

The following pollutants of concern were identified based on the most recent approved or adopted TMDL reports:

- Mercury – Newton Creek – Amendment to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware, and Upper Raritan Water Quality Management Plans, Adopted June 2010.
    - Recommendations:
        - Point Sources:
            - Maintain NJ mercury emission standards for mercury per the Control and Prohibition of Mercury Emission act implemented 1996 and revised in 2004.
            - Maintain the Dry Cell Battery Management Act of 1992.
            - Maintain requirements for all dental facilities to implements BMPs for the handling of dental amalgam waste as required by the Dental Amalgam Rule implemented in 2007.
        - Non-Point Sources:

            - Continue to support and participate in regional, national, and global efforts to reduce mercury use, releases, and exposures.
            - Provide education and information to commercial and industrial entities who regularly work with mercury and mercury-containing products.
            - Monitor and report mercury levels detected in sewage sludge for peaks.
                - Identify potential sources of peaks and control their releases.
            - Promote household hazardous waste collection events.
            - Maintain bans on mercury in thermometers, auto switches, and other items per the Mercury Switch Removal Act of 2005.
        - Other Sources:
            - Coordinate and work with other states and regions to reduce their own mercury air deposition levels.

The City shall continue to assist in mercury reduction efforts by advising residents to direct household hazardous wastes to Camden County Recycling Center or the Pennsauken Landfill. Either disposal site permits disposal to residents for household hazardous waste free of charge.

The City will work with CCMUA when notified that spikes in mercury are detected in sewer sludge to help identify the source and control it.

- PCBs – Big Timber Creek, Little Timber Creek, Newton Creek, Woodbury Creek – Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River, Adopted December 2003.
    - Recommendations:
        - Point Sources:
            - Require entities with NPDES permits to comply with applicable water quality based effluent limits consistent with individual permittee's Stage 1 WLA.
            - Increase monitoring using Method 1668A.
            - Zone 3 WLA for MS4 is 0.1847 mg/day
        - Non-Point Sources:
            - Review and implement recommendations and strategies provided by the Implementation Advisory Committee.

The City shall continue periodic outfall inspections for potential illicit connections. If physical observations indicate the potential for illicit PCB discharges in the MS4 flows, water samples shall be collected to determine the presence of PCBs, the source will be identified, and the illicit connection eliminated.

See attached TMDL Reports.

SPPP Signature Certification Page

SPPP Signature Page

Municipality Information	
	Municipality: City of Gloucester City County: Camden
	NJPDES # : NJG NJ0141852 PI ID #: 50577
	Team Member/Title: Eric G. Fooder, Stormwater Program Coordinator
	Effective Date of Permit Authorization (EDPA): 01/01/2018
	Date of Completion: 10/16/2018 Date of most recent update:

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

(Signature) 10/16/2018 (Date)

Eric G. Fooder
(Print Name)

Stormwater Program Coordinator
(Title)

(NOTE: A new SPPP signature page should be attached each time the SPPP is updated or modified, excluding data entries. Previous SPPP signature pages shall be retained as part of the SPPP.)

SPPP Form 1 – Stormwater Pollution Prevention Team Members

Tier A Municipal Stormwater Regulation Program

Stormwater Pollution Prevention Team Members

Number of team members may vary.

Completed by: Marie Baaden, PE, CME
Title: Consulting Engineer, CES
Date: 10/16/2018
Municipality: City of Gloucester City
County: Camden
NJPDES #: NJ0141852
PI ID #: 50577

Stormwater Program Coordinator: Eric G. Fooder
Title: Director, Department of Utilities
Office Phone #: 856-456-0169
Emergency Phone #: 856-456-0169

Public Notice Coordinator: Jack Lipsett
Title: Administrator, City of Gloucester
Office Phone #: 856-456-0205
Emergency Phone #: 856-456-0205

Post-Construction Stormwater Management Coordinator: Eric G. Fooder
Title: Director, Department of Utilities
Office Phone #: 856-456-0169
Emergency Phone #: 856-456-0169

Local Public Education Coordinator: Eric G. Fooder
Title: Director, Department of Utilities
Office Phone #: 856-456-0169
Emergency Phone #: 856-456-0169

Ordinance Coordinator: Jack Lipsett
Title: Administrator, City of Gloucester
Office Phone #: 856-456-0205
Emergency Phone #: 856-456-0205

Public Works Coordinator: Eric G. Fooder
Title: Director, Department of Utilities
Office Phone #: 856-456-0169
Emergency Phone #: 856-456-0169

Employee Training Coordinator: Eric G. Fooder
Title: Director, Department of Utilities
Office Phone #: 856-456-0169
Emergency Phone #: 856-456-0169

Other: Marie Baaden, PE, CME
Title: Consulting Engineer
Office Phone #: 856-228-2200
Emergency Phone #: 856-228-2200

SPPP Form 2 – Public Notice

SPPP Form 2 - Public Notice

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJG 0141852 PI ID #: 50577

Team Member/Title: Jack Lipsett, Administrator

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Briefly outline the principal ways in which you comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of your stormwater program.

For meetings where public notice is required under the Open Public Meetings Act ("Sunshine Law," NJSA 10:4-6), Gloucester City provides public notice in a manner that complies with the Act. Also, in regard to the passage of ordinances, Gloucester City provides public notice in a manner that complies with the requirements of NJSA 40:49-2. For municipal actions subject to the public notice requirements of the Municipal Land Use Law (NJSA 40:55D-J), Gloucester City complies with those requirements.

The City posts the current SPPP and MSWMP to its website.

The City shall re-certify compliance with these requirements annually.

SPPP Form 3 – New Development and Redevelopment Program

SPPP Form 3 – New Development and Redevelopment Program

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJG 01441852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Describe in general terms your post-construction stormwater management in new development and redevelopment program (post-construction program), and how it complies with the Tier A Permit minimum standard. This description must address compliance with the Residential Site Improvement Standards for stormwater management; ensuring adequate long-term operation and maintenance of BMPs (including BMPs on property that you own or operate); design of storm drain inlets (including inlets that you install); and preparation, adoption, approval, and implementation of a municipal stormwater management plan and municipal stormwater control ordinance(s). Attach additional pages as necessary. Some additional specific information (mainly about that plan and ordinance(s)) will be provided in your annual reports.

To control stormwater from new development and redevelopment projects throughout Gloucester City (including City projects), the City does the following:

-Ensures that all new residential development and redevelopment projects, that are subject to the Residential Site Improvement Standards for stormwater management, are in compliance with those standards. The City Planning and Zoning Boards ensure such compliance prior to issuing preliminary or final subdivision or site plan approvals under the Municipal Land Use Law.

-The City ensures adequate long-term operation and maintenance of BMPs for a project by requiring a project maintenance plan and by requiring funding of implementation of the plan. Furthermore, all proposed inlets must comply with Attachment C of the permit.

-The City's governing bodies will administer the stormwater ordinance for all development and redevelopment projects in accordance with the requirements of the permit.

-For any BMP that is installed with the requirements of our post-construction program, Gloucester City will ensure adequate long-term operation, as well as preventative and corrective maintenance (including replacement) of BMPs. For BMPs on private property, the City shall enforce provisions in the municipal ordinances to provide necessary operations and maintenance.

-The City will also enforce, through the municipal stormwater control ordinance, compliance with the design standard in Attachment C of our permit to control passage of solid and floatable materials through storm drain inlets.

-All structural and non-structural BMPs shall be documented with a Major Development Stormwater Summary per Attachment D of the permit.

SPPP Form 4 – Local Public Education Program

SPPP Form 4 - Local Public Education Program

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Local Public Education Program

Describe your Local Public Education Program. Be specific on how you will distribute your educational information, and how you will conduct your annual event. Attach additional pages with the date(s) of your annual mailing and the date and location of your annual event.

The City complies by providing at least 12 points of public education activities across 3 categories in compliance with Attachment B of the permit.

Category 1:
-The City maintains a stormwater related page on the municipal website. The website shall include posting a copy of the current SPPP as required by the MS4.

Category 2:
-The City distributes mailings to both residents and owners of stormwater facilities not owned by the City to notify them of the importance of stormwater measures and maintenance.

Category 3:
-The City's Green Team coordinates with local youth groups to perform storm drain labeling following the completion of capital projects within the City.

Category 4:
-The City is participating in a regional stormwater collaboration with Rutgers University, CCMUA, NJ Arbor Group, NJDEP, and members of the public to establish a long-term control plan to address TMDLs and regional watershed issues.
-The City organizes green infrastructure workshops in parallel with a program to construct green infrastructure BMPs around the City.

Category 5:
-The City's Green Team organizes and presents a rain barrel workshop at least annually.
-The City's Green Teem organizes and presents a rain garden installation workshop at least annually.

Records of education materials and activities as well as dates shall be maintained by the Local Public Education Coordinator.

Department of Utilities
512 Monmouth Street
Gloucester City, NJ 08039
ericfooder@cityofgloucester.org

June 26, 2018

Long Term Control Plan

Public Participation Process Report, Final Revisions

The City of Gloucester, as a component of the Joint Project for the control and remediation of Flooding issues associated with the Combined Sewer System is hereby presenting our portion of the LTCP concerning inclusion of the public in the review and decision making process.

It is our goal to actively involve the affected public. Monthly, there is a public meeting of the Supplemental CSO Team (Gloucester City Green Team). Members of this team include Gloucester City Dept. of Utilities, the Gloucester City Business Administrator, Rutgers University, CCMUA, NJ Arbor Group, NJDEP and 3 other members of the public. In addition, all members of the public are invited to attend as well.

Another goal of this team is to actively involve the public with CSO concerns and in recommending Public Policy regarding CSS issues to the Governing Body. The City updates its website to include various public meetings including Green Team meetings, Council Meetings and Various public meetings to discuss specific topics. As an example, Green Team Meeting Minutes, Council minutes that include the public participation section as well as participation in public events (Earth Day) that may impact residents as well as commercial users located within the municipal limits of the City of Gloucester, Camden County, NJ. All other members of the public, please refer to CCMUA Public Participation Process Report.

In addition to these outreach methods, the City is also involved with:

- Participation in Classroom events at the local schools
- Participation in events hosted by the local business association

These additional methods, upon discussion, advice and consent of the Green Team group were used to broaden the area of outreach to include the youth of the City and the various businesses. The public engagement activities provide opportunities for the public to be engaged throughout all three stages of the LTCP development process which include but are not limited to System Characterization, Development and evaluation of Alternatives and Selection of Alternatives and Implementation as appropriate.

The City of Gloucester achieves these goals via the following process: two-way feedback starting with comments from the public, discussion with the Green Team, monthly discussion of Green Team recommendations with members of Council, bringing these comments and recommendation to meetings with CCMUA and CDM for discussion and inclusion in the LTCP. Then providing feedback and comment to members of Council and ultimately back to the Green Team and the public for further discussion. All public feedback is evaluated and discussed by the appropriate parties and taken into account for inclusion in the LTPC. The only exception would be a recommendation that would result in a regulatory violation.

Supplemental CSO Team:

The Supplemental CSO Team (Green Team) was established by Ordinance. Please review the attached copy to review Council Action in this matter. The current membership of the Green Teem includes the following

- Chair, Director of Department of Utilities / Stormwater Coordinator
- Member, Rutgers University, Water Resources Program
- Member, NJ DEP
- Member, CCMUA
- Member, CDM Smith
- Member, NJ Tree Foundation
- 3 members of the public
-

It is the opinion of the Governing Body that the makeup of the Green team is consistent with the NJDEP requirements for the formation and administration of the Supplemental CSO Team as well as the requirements for dissemination of information and receiving feedback.

- How the Supplemental CSO Team is provided an opportunity to review key draft submittals such as the Characterization Report, the Public Participation Process Plan, the Consideration of Sensetive areas and the Development and Evaluation of Alternatives and the Selection of Alternatives? This is accomplished by two-way feedback starting with comments from the public, discussion with the Green Team, monthly discussion of Green Team recommendations with members of Council, bringing these comments and recommendation to meetings with CCMUA and CDM for discussion and inclusion in the LTCP. Then providing feedback and comment to members of Council and ultimately back to the Green Team and the public for further discussion.

This concludes our presentation of the means and methods used to generate a report for each meeting of the Green Team. The attached meeting agendas and minutes are our documentation (Report) of compliance.

ORDINANCE OF THE CITY OF GLOUCESTER CITY
County of Camden, State of New Jersey
#O20-2016

AN ORDINANCE CREATING THE CITY OF GLOUCESTER CITY'S STORMWATER PROGRAM COORDINATER

Whereas, The Mayor and Council of the City of Gloucester City desire to create the Stormwater Program Coordinator for the City of Gloucester City; and

Whereas, the creation of the Stormwater Program Coordinator is in the best interest of the City of Gloucester City; and

NOW, THEREFORE BE IT ORDAINED, by the Mayor and Council of the City of Gloucester City, County of Camden, State of New Jersey:

RESPONSIBILITIES:

1. Manage, produce and complete the written storm water management plans; including public education and outreach, public involvement, illicit discharge detection and elimination; construction site storm water runoff, post-construction storm water management and pollution prevention and good housekeeping.
2. Prepare a tracking/scheduling process/system to track the information required for the completion and implementation of the above plans and required reports.
3. Attends and participate in local and regional meetings of municipal groups and cogs dealing with storm water management, MS4 activates and related topics, provide Mayor and Board with timely meeting and information updates.
4. Research the full range of funding opportunities available to support these activities, prepare grant applications and manage grants and other funding sources.
5. Continually communicate with NJDEP and EPA to ensure Gloucester City is in full regulatory compliance and prepared for any future requirements.
6. Monitor and maintain a working knowledge of state and federal laws pertaining to MS4s and court case decisions that may have a potential impact on municipal storm water ordinance administration.

REQUIREMENTS:

1. Bachelor Degree or minimum ten (10) years experience in related field
2. MS4 Certification is required
3. A minimum of two (2) years of previous MS4 experience

JOB LOCATION: Gloucester City, New Jersey, United States

POSITION TYPE: Full-Time/Regular

William P. James, Mayor
Passed on First Reading: 7-21-16

Adopted by the Mayor and Common Council of the City of Gloucester City this 18th day of Aug, 2016.

Kathleen M. Jentsch, City Clerk

PUBLIC MEETING

NOTICE is hereby given that the foregoing ORDINANCE was introduced and passed at a meeting of the Common Council of the City of Gloucester City, County of Camden, New Jersey, held on the 21st day of July, 2016, and will be considered for final passage after a public hearing at a meeting of the Common Council of the City of Gloucester City to be held on the 18th day of August, 2016 at 7:00 pm in the evening prevailing time at 512 Monmouth Street, Gloucester City, New Jersey.

Kathleen M. Jentsch

Kathleen M. Jentsch, City Clerk

I hereby certify that the foregoing ORDINANCE was approved for final adoption by the Mayor and Common Council of the City of Gloucester City, County of Camden, State of New Jersey at a regularly scheduled meeting held on the 18th day of Aug, 2016.

Kathleen M. Jentsch

Kathleen M. Jentsch, City Clerk

ORDINANCE OF THE CITY OF GLOUCESTER CITY
County of Camden, State of New Jersey
#O21-2016

AN ORDINANCE CREATING A CITIZEN ADVISORY PROGRAM OR GREEN TEAM TO BE CONSISTENT WITH THE CITY'S STORMWATER PERMIT

Whereas, The Mayor and Council of the City of Gloucester City desire to create a Citizen Advisory Program or Green Team to be consistent with the City's stormwater permit; and

Whereas, the creation of the Citizen Advisory Program or Green Team is in the best interest of the City of Gloucester City; and

NOW, THEREFORE BE IT ORDAINED, by the Mayor and Council of the City of Gloucester City, County of Camden, State of New Jersey:

1. In accordance with Section G.2. of the Combined Sewer Management subsection of New Jersey Pollutant Discharge Elimination System (NJPDES) Permit No.: NJ0108847, Gloucester City hereby establishes the creation of a Green Team that shall comprise of both staff members and members of the public in order to develop and maintain a Long Term Control Plan (LTCP) in accordance with the NJPDES Permit.

2. The public member shall effectively be known as the Combined Sewer Overflow (SCO) Team and will be given equal voice amongst the staff members of the Green Team. The City's Stormwater Program Coordinator will be the head of the Green Team and will have final say in all matters related to the development and maintenance of the LTCP.

3. The Green Team shall meet periodically, review the proposed nature and extent of data and information collected during the LTCP development, provide input for consideration in the evaluation of CSO control alternatives, and provide input for consideration in the selection of those CSO controls that will cost effectively meet the Clean Water Act requirements.

____
William P. James, Mayor

Passed on First Reading: 7-21-16

Adopted by the Mayor and Common Council of the City of Gloucester City this 18th day of Aug, 2016.

____
Kathleen M. Jentsch, City Clerk

PUBLIC MEETING

NOTICE is hereby given that the foregoing ORDINANCE was introduced and passed at a meeting of the Common Council of the City of Gloucester City, County of Camden, New Jersey, held on the 21st day of July, 2016, and will be considered for final passage after a public hearing at a meeting of the Common Council of the City of Gloucester City to be held on the 18th day of August, 2016 at 7:00 pm in the evening prevailing time at 512 Monmouth Street, Gloucester City, New Jersey.

Kathleen M. Jentsch
Kathleen M. Jentsch, City Clerk

I hereby certify that the foregoing ORDINANCE was approved for final adoption by the Mayor and Common Council of the City of Gloucester City, County of Camden, State of New Jersey at a regularly scheduled meeting held on the 18th day of Aug, 2016.

Kathleen M. Jentsch
Kathleen M. Jentsch, City Clerk

Gloucester City Environmental Partners

Gloucester City Green Team Agenda
June 13, 2018 at 1:00 PM
Municipal Building – 512 Monmouth Street, Gloucester City, NJ 08030

Green Team Business (Mike Duffy)

- Sustainable Jersey Updates
- EDA Grant

CCMUA & CDM Smith & DEP Updates (Eric/Armando)

- Update from Gloucester City & DPW/Sewer Director
- Update from CCMUA
- Update from NJDEP
- Status of Long-Term Control Plan

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
- Demonstration Projects
- Community Partners
- Schedule of upcoming milestones

NJ Tree Foundation (Meredith Brown)

- 2018 Tree Planting Program

Other Business

- Next Meeting: July 11th, 2018

Gloucester City Environmental Partners

Gloucester City Green Team Minutes
March 14, 2018 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- Camden County Sustainability Champion
  - Joyce Calzonetti will be recognized by county freeholders as Sustainable Champion
- EDA Grant
  - Application broken into two phases
    - Phase I: general application, 30 day review period
    - Phase II: detailed full application, 60 day review period
  - Still need employment numbers
  - Updated budget
- Sustainable Jersey
  - Initial deadline: June 2, 2018
  - Revisions deadline: September 9th, 2018
  - Final deadline: November 18, 2017

Green Infrastructure Municipal Action Team Business (Jeremiah, Craig, Meredith)

- 319(h) Grant Update
  - Still awaiting DEP approval
  - If native plants are ordered from the Pinelands, they need to be planted soon
    - Ex. Purple Clump Flowers
    - Need to put an order in by the end of March
    - Would need to be planted within days after receiving
    - Pinelands supplying, minimum of 100 plants per species per order
    - Craig to coordinate with Eric and will find volunteers
- Demonstration Projects
  - Washington Playlot
    - New Map
    - 1st week of April for asphalt removal
      - Will need to look into underground piping and wiring
      - 511 and look for overhead wires
      - Planting to follow soon after
    - Tree planting April 21st
  - 3 species of trees to be planted: hornbeam, serviceberry, and cherry
  - PAL building/school is city owned

            - Two open tree pits
            - Howard to verify with Alex from public works
            - Updated 3/27: to plant 2 redbuds in tree pits on Somerset St
    - Two more projects: Water plant and Rain Garden at Cherry Street/Division
    - Rain garden: first week of May for prep work for top soil and mulch
        - Can order plants for this site
        - Will reach out to Mark from schools to student volunteers
    - Division/Cherry Street
        - Revisit site to determine redesign of rain garden and additions
        - Possible additions: tree planting, sidewalk improvements, water inlet
        - No strict timeline and can visit other potential sites
- Community Partners
    - Mark and students from Gloucester High School
- Schedule of upcoming milestones
    - Washington Playlot: First week of April for asphalt/April 21st tree planting
    - Rain garden: first week of May for prep work

CCMUA & CDM Smith & DEP Updates (Eric Fooder)

- Status of Long-Term Control Plan
    - LTCP has been updated
    - 3 major milestones, first of which is July 1st
    - Public participation and training: will need another public CSO meeting
- Update for CCMUA
    - CCMUA plans to increase capacity and design for interceptors
    - Gloucester City to join county system, while Camden City will be separate
- Update from Gloucester City & DPW/Sewer Director
    - CSO mainline to be replaced along Burlington St (3rd) during the summer with DCA funds
    - Hope to do from Broad to Water street, then work on Main street
    - Larger collection storage will allow larger lead time in case tidal gates are closed during high tide
    - Next June will require alternative's analysis which CCMUA's engineer will work on
- Update from NJDEP

NJ Tree Foundation (Meredith Brown)

- New website: njtreefoundation.org
- 2018 Tree Planting Program
    - About 15 trees and 37 potential tree locations: may go door to door again
    - AC Moore volunteers and possibly MOMs Organic as well
    - May advertise in Gloucester City paper on April 12th or earlier
    - 9am-12pm, DPW will help unload trees
- TD Bank Tree Planting

Other Business

- Next Meeting: April 11th, 2018
    - Possible CSO meeting at courthouse, confirm with Jack
    - Contact local organizations: Democrats Club, Lions Club, Business Association etc.

Gloucester City Environmental Partners

Gloucester City Green Team Minutes
April 11, 2018 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

CSO CCMUA & CDM Smith & DEP Updates (Eric Fooder)

- Status of Long-Term Control Plan
  - Plan is to be summited July 1st of this year
  - Following submissions are July 2019 and the final submission 2020
  - CDM to forward characterization report
  - All aspects have been satisfied except local engineer review and sign off
  - Will tie in next CSO meeting with Brown St tree meeting
- CSO
  - 6 CSO regulator testing
  - G5 & G6 on Holt property
    - Worked on contamination, now working on flooding and drainage
  - Due for annual inspection from DEP
    - Usually in May
    - No issues last year

Green Team Business (Mike Duffy)

- EDA Grant
  - Working to get employment numbers
- Sustainable Jersey
  - Currently working on submission
  - Initial deadline: June 2, 2018
  - Revisions deadline: September 9th, 2018
  - Final deadline: November 18, 2017

Green Infrastructure Municipal Action Team Business (Jeremiah, Craig, Meredith)

- 319(h) Grant Update
  - First quarter finished as of March 31st
  - Purchased wild tuber flowers, purple clump, and golden rod
    - No mow signage will be needed
- Demonstration Projects
  - May close streets, left message for Captain Morrell
  - Prep work on Friday the 20th, then volunteer planning on Saturday, 21st 9am
  - 16 trees to be planted: 9 at Washington Playlot, 2 at PAL building, 5 at Martin Lake

    - Asphalt to be pulled along with old poles and swings
    - AC Moore and Girl Scouts to volunteer, and other volunteers welcomed
- Other projects: Water Treatment Plant Cherry Street/Division
    - Rain garden at Water Treatment
        - first week of May
        - Utility to mark out then have a team to level out and grade area
        - Use DPW backhoe to dig out for top soil and mulch
        - Have students plant in June
    - Other sites: Division/Cherry Street, Firehouse, Middle school lot, and High school
- Funding comes from DEP through Camden County Soil Conservation with help from Rutgers and NJ Tree Foundation
- Demonstration project will have course tie-in

NJ Tree Foundation (Meredith Brown)

- New website: njtreefoundation.org
- Spring Schule is up
    - Camden has upcoming events
    - Saturday, June 2nd 9am-12pm Farnham Park event needs volunteers
- TD Bank Tree Planting possibly at Brown and Paul Streets
- Monmouth St pruning from last year's planting successful
- Future rail work near water and other potential sites for trees
- Tree Committee had first meeting and will publicize future meetings
- Brown Street meeting will be held at night and could satisfy education requirement
- Swamp maple tree caused problems, while the public liked Monmouth Street's Cherry trees
- NJ Tree Foundation promotes the proper tree in the proper place
- Will also do sign ups and canvassing for future plantings

Other Business

- Next Meeting: May 9th, 2018
    - Location to be determined

Gloucester City Environmental Partners

Gloucester City Green Team Minutes
May 9, 2018 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
  - Still gathering numbers and data
- Sustainable Jersey
  - Working on June 3rd submission deadline

CCMUA & CDM Smith & DEP Updates (Eric & Armando)

- Permittees deciding on certification and each parties role (i.e. Camden, Gloucester City, CCMUA, etc.)
- Gloucester City will need to submit progress report
- CDM Smith has questions on Gloucester sewer system
- Flooding on Water Street and CCMUA's issues
  - Flood control plan
  - DEP requires any issue to be in writing
- Other parts such as system characterization and public participation are coming along
  - CCMUA is taking lead

Green Infrastructure Municipal Action Team Business (Jeremiah & Craig)

- 319(h) Grant Update
- Demonstration Projects
- Community Partners
- Schedule of upcoming milestones

NJ Tree Foundation (Meredith Brown)

- 2018 Tree Planting Program

Other Business

- Next Meeting: June 13th, 2018

Gloucester City Green Team Agenda
February 8, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Doug Burns, Adriana Caldarelli, Eliot Nagele, Mark Lattanzio, Armando Alfonso, Jessica Franzini, Mickie Glassman, Joyce Calzonetti, Howard Clark, Jeff Dey, Rocco D'Antonio, Eric Fooder, Michael Duffy

Discussion:

Green Team Business (Jack Lipsett/Mike Duffy)

- Sustainable Jersey Certification
  - Actions
    - See attached list
- Supplemental CSO Team
  - Mickie and community garden people would be interesting in CSO issues
  - Jersey Water Works is a great resource and group for CSO issues
  - DEP is accepting comments for guidance documents for CSO communities
  - The town is looking at different options for storage
  - CSO public participant report is due in July 2017
  - CCMUA will include CSO material with bills
- BIG Competition
  - Presentation regarding BIG competition at New Jersey Future Redevelopment Forum; March 10
  - Grant from Federal EDA to research flooding impact

Green Infrastructure Municipal Action Team Business (Rutgers Water Resources Program)

- Status of 319(h) Grant
  - Signing documents soon
  - Work to begin in the fall
  - Application documents to be distributed
  - Seeking suggestions for demonstration projects
  - $200,000 to be split between Camden and Gloucester City
  - Possible locations and community partners: High School and American Legion building
  - Eliot to receive contacts from Mark and Jessica

CCMUA & CDM Smith updates (Adriana)

- Plan will be submitted this summer
  - DEP will review

- An alternative plan will be developed after the review
- Eric to provide flooding information to modelers on system characteristics
- Eric has questions for CCMUA on flow control relating to bypass and upgrading pumps
    - As of now, no plan on expansion

NJ Tree Foundation (Jess Franzini)

- 2017 Tree Planting Program
- Requirements for Urban Tree planting
    - Wanted by the area
    - Permission to plant trees at location
    - Will have someone to take care of planted trees
    - Long term management in place
- Mickie and Joyce looking to restart tree committee
- Tree Foundation is seeking to have an event, more information to follow
    - Johnson Boulevard and the nearby park
    - 900 block of Monmouth Street as second location
- Key is having the right tree for the right place: larger trees for Johnson Blvd and smaller trees elsewhere
- Proprietors Park and jogging path are successful prior projects
- Gloucester City has a forestry management plan
    - Requires updates in order to qualify for tree funding
    - CSP grants are available
    - Tree Committee will manage grants
- Existing issues with tree stumps and older trees
    - Programs to help with maintenance
    - Can hire an arborist to access trees of hazard or at risk
- Gloucester City can provide assistance with tree events
    - Last two project corporate sponsors provided tables, tents, water, prep work, and staffing
    - Eric to offer up services

Other Business

- Community Day, June 3rd
- Next Meeting: Wednesday, March 8, 1pm

Gloucester City Environmental Partners

Gloucester City Green Team Agenda
February 14, 2018 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
  - In progress
  - Still need job numbers
- Sustainable Jersey
  - Working on 2018 submission
  - Possible grant in March, looking for ideas
    - Possibly tree planting

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
  - 3 plans submitted to DEP
  - Will reach out to Armando to check status
- Demonstration Projects
  - Checking for projects near the new school
  - Asphalt removing should only take one day
- Schedule of upcoming milestones

CCMUA & CDM Smith & DEP/Water & Sewer Updates (Eric Fooder)

- Had medium level water event last week
- No flood events reported
- Long term control plan: Next meeting next week with state, Camden, and CCMUA
- To perform flow testing in sewer system
- 2 ACOs on last items requirements

NJ Tree Foundation (Meredith Brown)

- Potential for tree planting on and around Washington play lot
- Potential site at PAL building
- 37 trees estimated to be planted

- Still scheduling future events
- 18 planting this season
- April planting in Gloucester City: 4/21

Other Business

- Next Meeting: March 14th at 1pm

Gloucester City Meeting Minutes
May 2, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- Yashar Ebady has join the group from the Clean Energy Program: focuses on new construction, energy star, audit, et. Al.
- Community Stewardship Incentive Program (CSIP) Grant
    - Joyce will help with apply next year
    - NJ Urban and Community Forestry Program: Approved status as 2016

Supplemental CSO Team Business (Jack Lipsett/Mike Duffy/Eric Fooder)

- Next community meeting
    - Held meetings at Democrats Club, Business Association, and Lions Club
    - Possibly the Rotary
    - June 3rd Community Day
        - Jack to look into getting a table/spot
        - 10AM-3PM
        - Rutgers to bring rain barrels and such
- Eric: CSO compliance going forward
    - Site visit on May 11th
    - Recently sent update to DEP
    - ACO has been reduced
- Next Supplemental CSO meeting: Next meeting to be S-CSO meeting

Green Infrastructure Municipal Action Team Business (Rutgers Water Resources Program)

- Status of 319(h) Grant
    - Rutgers has reached out to Craig McGee
    - Grant is moving along
    - Follow-up meeting to be scheduled
- Demonstration Projects
    - Mark and Jeremiah will contact each other
    - A list to be developed and pared down
- No match is needed from city, but maybe services in kind

NJ Tree Foundation

- No new contact yet
- 30+ trees were planted
- Neighboring blocks interested
- Joyce well take lead as tree liaison

Other Business

- Community Day, June 3rd
- Next Meeting
  - June 21, 1PM for Green Team and S-CSO
  - Following S-CSO will be at night

Gloucester City Green Team Minutes

Monday June 13, 2016 at 1:00 PM

Water Department building

Attendees: Fred Schindler, Jessica Franzini, Jack Lipsett, Jeremiah Bergstrom, Adriana Caldarelli, Michael Duffy

Agenda:

1) Introductions and opening
2) Level of involvement and recommended members
    a. How often do we want to meet?
3) Future Projects
    a. NJ Future BIG Competition
    b. Sustainable Jersey & other grants
    c. Supplemental CSO Team

Dicussion:

- Mostly everyone is available once a month
- Jess and the tree foundation are looking to establish community based tree planting
    - Knows a few friends within Gloucester City to ask to help
- DEP team will present on Supplemental CSO Teams
    - Would like to have one member of council attend
- Maybe have Mickey Glassman and a representative from the business association join
- Tuesday and Thursdays work best for the meetings, during the day
- Possibly divide into work groups that can meet separately or at different times
- Tree planting in October in Proprietors Park
- Gloucester City does have a Community Forestry Management Plan
    - Would need to see what it currently looks like
- Gloucester City's 319(h) application was combined with Camden and still is awaiting
- Would like to get Southport involved with Supplemental CSO
- Other possible team members
    - Craig McGee – Camden County
    - Chris Waldron – Sustainable Camden County; can help with Sustainable Jersey applications
    - Doug Burns – CCMUA
    - Bob Agnor (sp?)
- Other suggestions from community: team rotary, lions, utility, pw, schools, scouts, senior citizens

Next Steps:

- Next meeting: August 2nd, 1pm at the municipal building
  - 1st hour: presentation on Supplement CSO Team
  - 2nd hour: Community involvement with Green Team

Gloucester City Meeting Minutes
June 21, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- Sustainable Jersey Certification
  - Application was submitted awaiting feedback
- EDA Grant Review

Supplemental CSO Team Business (Jack Lipsett/Eric Fooder)

- July 31st is the ACO
- Pre-construction meeting will take place regarding new piping, upgrades, but no separation
- CSO inspection was done by DEP
  - 16 page report
  - A on report
- DEP would like asset management plan

Green Infrastructure Municipal Action Team Business (Rutgers Water Resources Program)

- Status of 319(h) Grant
  - Still open to recommended locations
    - Needs to be on public land
  - Purpose is to educate the public
  - Will provide signage
  - Will be presented to Mayor and council
  - Note: Cherry Street rain garden not working correctly and is flooding
  - Great for potential for municipal partnership and add-on existing projects, e.g. pervious paving
- Demonstration Projects
  - American Legion and Costello school taken off the list
  - Open reign for Washington playlot
  - Examples seen in Camden

NJ Tree Foundation

- Meredith Brown taking over for Jess and will be the Program Coordinator in South Jersey

Other Business

- Next Meeting 8/9 @ 1pm

Gloucester City Green Team Minutes

August 2, 2016 at 1:00 PM

Water Department building

Attendees: Jack Lipsett, Michael Duffy, Howard Clark, Jessica Franzini, Rachel Pepe, Julie Krause, Craig McGee, Eliot Nagele, Jeremiah Bergstrom, Armando Alfonso, Adriana Caldarelli, Jeff Dey

Agenda:

1) Supplemental CSO Team
2) Green Team

Dicussion:

1) Supplemental CSO Team
    - Goal: Public participation
    - Informal team to work with permittee for the life of the permit: 4 ½ years
    - No expertise needed
    - Possible joint team with Camden
    - No minimal meeting times or size
    - Must ask key stakeholder to key (see DEP handout)
    - Andy from CCMUA is aiming to complete permit within 2 years
    - Must keep track of which meetings are Supp. CSO and just Green Team
    - A public participation plan will need to be submitted
    - Progress report to be done by Fred
    - Rutgers' is involved through their Municipal Action Green Team
    - Possible events and groups for outreach
        - Water body users
        - Rate payers
    - Will require a website or hotline
2) Green Team
    - Bring in Doug Burns from CCMUA
    - Adriana will reach out to Andy about CDM Smith and their involvement
    - Big competition
        - NJ Futures and Refocus will develop concept plan and funding opportunities
        - March 2017 end date
        - Will keep in mind the NJ Tree Foundation as project moves along
    - New members
        - Supp. CSO Team meetings
            - 1st meeting introductions in October
            - 2nd meeting near report

        - Future meetings as needed
    - Nikki Glassman and Bob Angor: Jack will reach out
    - Chris Waldron: Mike will reach out
    - Camden County Improvement Authority: Howard and Jack
    - Public Works
    - St. Mary's Church
    - Delaware Riverkeeper: Mike
    - Marina
    - Sports Teams
    - Business Association: Jeff will reach out with Rocco
    - Schools: Howard
- Jeremiah and Craig's project
    - Green infrastructure outside of typical zoning area
    - Includes an education component
    - Focuses on small scale, area wide, rain management
    - Will include demonstration projects

Next Steps:

- Next meeting: September 7th, 1pm at the municipal building
- Develop list for Supplemental CSO Team for October meeting
- Mike to draft letter for outreach

Gloucester City Environmental Partners

Gloucester City Meeting Minutes
August 9, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
  - Letters coming in
  - Will update letter chart
- Sustainable Jersey Certification
  - Reviewing comments

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
  - Last meeting reviewed list of demonstration projects
    - Johnson Park, Schools, etc.
    - Still need to visit fire station
  - Rutgers team surveyed sites in Gloucester City
  - GC recent approved a project for Fort Nassau for flood control and green infrastructure
    - May be included for the grant
- Community Partners
  - Potential projects for Meredith and NJ Tree Foundation
    - Would like to do rain barrel project
    - Eric and Micki will look into obtaining barrels
    - Meredith will look into farms near Millville/Bridgeton
    - Possible demonstration project at municipal building

NJ Tree Foundation (Meredith)

- Meredith is work with a 2 year William Penn Foundation grant
- Multiple events in Camden and will forward along any information
- Micki would like to organize a pruning classes

DEP (Armando)

- ACO is near completion from 2 years ago, especially thanks to Eric
- MS4 permit is looking good

- System characterization is moving along – working with CCMUA and CDM Smith for data and collaboration
    - Part of CCMUA's Long Term Control Plan in conjunction with Camden and the county
- EIT wants to know if GC is still coming in
    - yes for asset management plan and Southport

Other Business

- Joyce has question regarding cleaning sewer grates
    - City cleans them twice a year
    - Cleaning sewer grates as a safety concern – public should not be cleaning sewer grates, especially to avoid needles
- Next Meeting 9/13 @ 1pm

Gloucester City Green Team Minutes

September 7, 2016 at 1:00 PM

Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendees: Howard Clark, Sean Gorman, Jeremiah Bergstrom, Jack Lipsett, Michael Duffy, Adriana Caldarelli, Armando Alfonso, Douglas Burns, Rachel Pepe, Jennifer Feltis Cortese, Jack Zuccarelli, Jeff Dey, Fred Schindler

Agenda:

1) BIG Competition
2) Letter and New Members
3) Supplemental CSO Team
4) Other Items

Dicussion:

1) Build It Green Competition
    a. Had a conference call on 8/29
    b. Refocus team seeking additional information on NJDEP Landscape Project Forest, Priority species area
2) Letter and New Members
    a. Fred Stine from Delaware Riverkeeper
    b. Carey Surgeon?
    c. Mikki Glassman and Bob Angor
    d. Invite planning board and Economic board members
3) Supplemental CSO Team
    a. Agenda to include: Characterization of CSO area, Goals for the Team, Development of Alternatives, Choosing of Plan, additional ideas from new members
    b. Meeting in Municipal meeting room
    c. Time/date: TBD
4) Other Items
    - Adriana will provide monthly updates on CDM Smith and other issues
    - Jeremiah:
        - 319(h) grant application still in on-going
        - Will include educational projects and demonstrations
        - Will likely start next year
        - May fulfill CSO public participation requirement
    - Tree Foundation
        - Seeking Forestry Plan and possible update/review of current status
        - Requires two members for continued education courses
        - Possibly connect Mikki with Jessica Franzini

Next Steps:

- Next meeting: October 5th, 1pm at the municipal building
- Send invites for Supplemental CSO Team
- Set an evening for Supplemental CSO meeting

Gloucester City Green Team Minutes

October 5, 2016 at 1:00 PM

Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendees: Howard Clark, Eliot Nagele, Doug Burns, Joan Chalmers, Adriana Caldarelli, Armando Alfonso, Jeff Dey, Rocco D'Antonio, Jack Lipsett, Fred Schindler, Jess Franzini, Michael Duffy

Agenda:

1) BIG Competition Updates (Jack/Howard)
2) Supplemental CSO Team
3) Other Items
   a. CCMUA & CDM Smith updates (Adriana)
   b. 319(h) Grant (Jeremiah/Eliot)
   c. Tree Foundation
   d. Student Visitors & possible project

Discussion:

1) BIG Competition Updates
   a. Ellory has been working with Jack and Howard
   b. Created a design and looking for future challenges
   c. Sent surveys to businesses through the Business Association regarding flooding impact
   d. Setting up plan for economic grant
2) Supplemental CSO Team
   a. October 26th, 6:30pm at Municipal Building
   b. CSO workshop: Communicate on Water Issues to Engage Stakeholders
      i. October 25 @ 1:30 pm - 3:30 pm
      ii. North Jersey Transportation Planning Authority
      iii. Hosted by Jersey Water Works
3) Other Items
   a. CCMUA & CDM Smith updates (Adriana)
      i. Progress Reporting starting November 1st
      ii. 2-year plan
   b. Tree Foundation
      i. Jess meeting with Mikki on Octover 12th
      ii. Going over the current status of the Urban Forestry Plan and other major issues
      iii. Planting day coming up
      iv. Foundation to receive $20,000 grant
         1. Looking to take applications from local neighborhoods and the right trees for the right neighbors
         2. Application takes 3-4 months

3. Homeowner is responsible for 2 years plus requires training
4. Could canvas flood prone areas, but application need to come from citizens unless the area is city owned property
5. Adriana and Fred to send maps

c. 319(h) Grant
    i. Still waiting to hear back

d. Possibly schedule a Green Team meeting at night to accommodate other people
    i. Possibly create a subcommittee meeting with members of the community

e. Signage
    i. Eliot/Rutgers is asking for input for CSO signage
    ii. Signs are to be educational
    iii. Does not necessarily need to be signs, can be fliers
    iv. Can be catered to relevant activities to the area
    v. Already signs for outfalls; all but the two located on private property are installed
    vi. Fred thinks physical signs are not good and will create sign pollution and vandalism. Should use kiosk, online information, and fliers

f. Student Visitors & possible project
    i. Students from Gloucester Catholic visited
    ii. Looking for projects
    iii. Possibly volunteer for tree foundation

Next Steps:

- Next meeting: November 2nd, 1pm at the municipal building
- Supplemental CSO Meeting: October 26th, 6:30pm at Municipal Building
    - Create and send out agenda and possibly a powerpoint for CSO meeting
    - Redistribute letters to invite stakeholders
- Adriana and Fred to send maps for the Tree Foundation

Gloucester City Environmental Partners

Gloucester City Green Team Agenda
October 11, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Note: Future meetings will be held in second floor conference room

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
  - Awaiting to hear back from EDA
- Sustainable Jersey
  - Still working on certification and will reapply next year for same actions

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
  - Projects will not cost the city, funds coming from the grant
  - Services in kind welcomed
- Demonstration Projects
  - Division Street
  - Water Treatment facility
    - Old tank could be retrofitted to collect water
  - Washington Street Playlot
    - Plan to turn into stormwater park
    - Most expensive project, but also most impactful on stormwater
    - NJ Tree Foundation would like to plant trees in the surrounding neighborhood
  - Firehouse
    - No plans yet
    - Possibly a rain garden
  - Rain gardens would need maintenance (1-2 per yer)
- Community Partners
  - Potential volunteer activity for Lions club and students to maintain gardens
- Schedule of upcoming milestones
  - Will eventually need to present projects before mayor and council

CCMUA & CDM Smith & DEP Updates (Armando)

- Quarterly meeting last week

- Will need to update Eric Fooder
- System Characteristics report will be submitted early next year, ahead of July due date

NJ Tree Foundation (Meredith)

- 2017 Tree Planting Program
    - October 27th TD bank tree planting
    - East Camden resident tree planting on Saturday
    - Gloucester City tree planting date no set yet
    - Construction on Paul and Brown street: 17 trees removed deu to roots
    - Joyce is attending conference for CEUs for forestry management compliance

Other Business

- Next Meeting: 11-8-17

Gloucester City Green Team Minutes

November 2, 2016 at 1:00 PM

Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Agenda:

1) BIG Competition Updates (Jack/Howard)
2) Supplemental CSO Team
3) Other Items
    a. CCMUA & CDM Smith updates (Adriana)
    b. 319(h) Grant (Jeremiah/Eliot)
    c. Tree Foundation

Discussion:

4) BIG Competition Updates (Jack/Howard)
    a. 4 areas of concern including Broadway & Market and Southport
    b. Putting out options with least disturbance and high economic impact
    c. Surveys have done out to business with 8 replies so far
5) Supplemental CSO Team
    a. First Meeting on October 25th, 6:30pm
    b. Fliers from Eliot
        i. To be tailored for Gloucester City (Jeremiah/Mike)
        ii. Include pictures from GC and talk about how to get involved
        iii. Jess might have photos; GC has great trees to show off
        iv. Add info on Green team and CSO team
    c. Educational signage/information
    d. Next Meeting for January
6) Other Items
    a. CCMUA & CDM Smith updates (Adriana)
        i. No updates
    b. 319(h) Grant (Jeremiah/Eliot)
        i. Submitted spending plan
        ii. Hopefully know by December, with Scope of Work to follow and start in spring/early summer
        iii. Looking to coordinate with schools
    c. Tree Foundation
        i. 60 trees planted in Proprietors Park and Freedom Pier
        ii. Jogging path will need to be pruned and trimmed in the future
        iii. Tree committee with Mickie, Adriana, Armando, and gardening group met
            1. Looking to get them in compliance
            2. Mickie to send one page report to DEP

iv. $30k from David and Marilyn Krupnick Foundation to plant tree next spring possibly at Johnson Blvd
    1. Goal is to do 3 maybe 3 plantings so maybe another one in the fall
    2. Johnson Blvd was hit by a maple diseases, so maples are not a good idea to plant
    3. Room for trees at utility building, with a preference for fruit bearing trees

Next Steps:

- Next Meeting: Possibly December 6th at 6pm
- Update and feedback on CSO flyer

Gloucester City Environmental Partners

Gloucester City Green Team Agenda
November 8, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
    - New local contact the EDA, Ed Hummel
    - Very support of the draft application
    - Still need additional job numbers
- Sustainable Jersey

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
    - Plans have been brought to the municipality; no comments or questions
    - Will construction permits be needed?
        - Usually municipal engineer will take a look, but no permits needed
- Demonstration Projects
    - Raingarden at water treatment facility and possible rain harvesting with the tank
    - Division St playground: optimize its current function
    - Washington Street Playlot
        - Full concept may not be funded, may be scaled back or broken into phases
        - Would like more community input
        - Phase 1 would include tree planting, depaving, replanting
    - Fire station still in play
    - Still looking at other municipal properties for smaller plantings
- Schedule of upcoming milestones
    - Next steps:
    - Revise plan
    - Get ok from city, engineer, and DEP
    - Should proceed at no cost with services in kind from city
    - To begin building in the spring

CCMUA & CDM Smith & DEP Updates (Armando)

- No updates
- Armando to speak with Eric Fooder

NJ Tree Foundation (Meredith Brown)

- 2017 Tree Planting Program

Other Business

- Possibly changing the tree commission to a committee
- Next Meeting: Dec 13th

Gloucester City Green Team Minutes

December 6, 2016 at 6:00 PM

Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Doug Burns, Jim Rauchut, George Berglund, Jack Lipsett, Armando Alfonso, Adriana Caldarelli, Jeremiah Bergstrom, Jeff Dey, Michael Duffy

Agenda:

1) BIG Competition Updates (Jack/Howard)
2) Supplemental CSO Team
   a. Next Meeting for January
   b. Educational signage/information
3) CSO Phamphlet
4) Sustainable Jersey Application
5) Other Items
   a. CCMUA & CDM Smith updates (Adriana)
   b. 319(h) Grant (Jeremiah/Eliot)
   c. Tree Foundation

Discussion:

1) BIG Competition Updates (Jack)
   a. There was a meeting for Dec 13th which was cancelled and will reschedule after the new year
   b. A phone conference will now take place on Dec 13th
2) Supplemental CSO Team
   a. January 11th at 1:30PM
   b. Fred will be retiring at the end of the year and replacements are being interviewed
3) CSO Phamphlet
   a. Recommendations regarding tree planting information
   b. Should focus on homeowners, i.e. rain gardens and rain barrels
   c. Cherry St rain garden needs to be fixed
4) Sustainable Jersey Application
   a. Will send around list of actions for next year's application
5) Other Items
   a. CCMUA & CDM Smith updates (Adriana)
      i. Andy is committed to complete by early 2018
   b. 319(h) Grant (Jeremiah/Eliot)
      i. No new updates
   c. Tree Foundation
      i. Jack will reach out to landlord association to be involved

Next Meeting

- January 11th at 1:30PM at Municipal Building; will focus on supplemental CSO team

Gloucester City Environmental Partners

Gloucester City Green Team Agenda
December 13, 2017 at 1:00 PM
Municipal Building - 512 Monmouth Street, Gloucester City, NJ 08030

Attendance: Please see the attached sign-in

Discussion:

Green Team Business (Mike Duffy)

- EDA Grant
  - Continue working on application
  - Still need job numbers
- Sustainable Jersey

Green Infrastructure Municipal Action Team Business (Jeremiah & Rutgers Water Resources Program)

- 319(h) Grant Update
  - Finished first quarter of planning and moving into second quarter of the grant
  - Providing documents to DEP for approval to move forward
- Demonstration Projects
  - Visited High school to scope their courtyard and developing programming with Mark
  - Washington Park: plans for depaving and tree planting
    - NJ Tree Foundation will reach out to community to canvass neighborhood, distribute flyer and gather signatures, determine points of contact, and determine # of concrete cut outs
    - Group to meet before or after next green team meeting
  - Jeremiah to send PDFs of plans
- Schedule of upcoming milestones

CCMUA & CDM Smith & DEP Updates (Armando)

- Armando planning on meeting with Eric
- CCMUA and CDM Smith to submit characterization and sensitive area report
- Gloucester City to determine alternatives and steps after
- Tying together green infrastructure for Southport with CCMUA and CSO permits
- Quarterly report in January

NJ Tree Foundation (Meredith Brown)

- 2017 Tree Planting Program and upcoming 2018

- Looking for plantings in the spring for sometime in February for Gloucester City
- Possibly fruit trees by applying for grant through Campbells

Other Business

- Next Meeting: January 10th at 1pm

New Jersey TREE FOUNDATION
Celebrating 20 years!
Founded in 1998

NJ Tree Foundation

@njtrees

Gloucester City Planting 4/21

27 Photos · Updated 5 months ago

On Saturday, volunteers planted 16 new trees at the Washington St Play lot, Martin Lake, PAL building, and Brown St. Thank you to all volunteers that came out and helped celebrate both Earth & Arbor Day! Special thanks to Gloucester City Green Team, GC Shade Tree Commission, Rutgers Cooperative Extension, and Community Rocks for your partnership!

























Cicera Lacerda, Kristine Sullivan Renshaw, Janet Cooney and 12 others like this.

SPPP Form 5 – Storm Drain Inlet Labeling

SPPP Form 5 – Storm Drain Inlet Labeling

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Storm Drain Inlet Labeling

Describe your storm drain inlet labeling program, including your labeling schedule, the details of your long-term maintenance plan, and plans on coordinating with watershed groups or other volunteer organizations.

All inlets in the MS4 area have been labeled in accordance with the permit. The City's Public Works department shall inspect the state of those labels as part of their annual inlet cleanout activities and coordinate replacements for any that are missing or degraded.

SPPP Form 6 – MS4 Outfall Pipe Mapping

SPPP Form 6 – MS4 Outfall Pipe Mapping

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Explain how you will prepare your map (include its type and scale, and the schedule for the mapping process). Who will prepare your map (e.g., municipal employees, a consultant, etc.)?

Gloucester City has had a map of outfalls prepared by a consultant engineer (attached). The MS4 region consists of 23 publically owned outfalls and 7 privately owned outfalls.

Storm Outfall Map

Gloucester City

Camden County, NJ

ID	LOCATION
1	Essex St @ Swim Club Overflow
2	Johnson Blvd @ Essex St Overflow
3	Nicolson Rd @ Johnson Blvd Overflow
4	Harley Ave
5	Gloucester High School
6	Thompson Ave @ Walnut Ave
7	Temple Ave
8	Martin's Lake overflow
9	Minnie Hole overflow
10	Haverford Ave
11	Klemm Ave & Orlando Ave
12	Park Ave (Head of Minnie Hole Park)
13	Rutgers Ave Overflow
14	Meadow Brook Basin Outfall
15	Meadow Brook Basin
16	Highland Blvd Overflow
17	Goldy Dr Overflow (Millers Lake)
18	Baetzel & Gehrig Ave
19	Harvard Ave
20	Weston Ave @ Millers Lake
21	End of Lehigh Ave
22	Chestnut Ave
23	End of Swarthmore Ave
24	Holt (private)
25	Holt (private)
26	Holt (private)
27	Holt (private)
28	Holt (private)
29	Holt (private)
30	Holt (private)
G1	Charles & Water Street
G2	Sixth Street & Water Street
G3	Jersey Avenue & S King St
G4	Market Street @ King Street
G5	Hudson Street @ Ellis Street
G6	Mercer Street @ Ellis Steet
G7	N Broadway Overflow

Legend

- Outfalls
- Tide Gate Regulators
- Municipal Boundary

Remington & Vernick Engineers
232 Kings Highway East
Haddonfield, NJ 08033
(856) 795-9595, Fax: (856) 795-1882
Web Site Address: www.rve.com

P:\GIS Projects\NJ\Camden County\Gloucester City\0414T421\Outfalls.mxd

SPPP Form 7 – Illicit Connection Elimination Program

SPPP Form 7 – Illicit Connection Elimination Program

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Describe your Illicit Connection Elimination Program, and explain how you plan on responding to complaints and/or reports of illicit connections (e.g., hotlines, etc.). Attach additional pages as necessary.

~~**The City uses the DEP Illicit Connection Inspection Report Form to conduct inspections. Outfall pipes found to have a dry weather flow or evidence of intermittent non-stormwater flow will be rechecked again to locate the illicit connection. If the City is able to locate the illicit connection (and the connection is within Gloucester City), the responsible party will be cited for violation of the Illicit Connection Ordinance and the connection will be eliminated immediately.**~~

~~**If after an appropriate amount of investigation, the City is unable to locate the source of the illicit connection a Closeout Investigation Form will be submitted with the Annual Inspection and Recertification. If an illicit connection is found to originate from another public entity, the City will report the illicit connection to the Department.**~~

~~**The City has a hotline for reporting spills and illegal dumping. The hotline is also available for reporting illicit connections.**~~

SPPP Form 8 – Illicit Connection Records

SPPP Form 8 – Illicit Connection Records

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Prior to May 2, 2006 No illicit connections have been detected in the past year.

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? ____

Number of outfalls found to have a dry weather flow? ____

Number of outfalls found to have an illicit connection? ____

How many illicit connections were eliminated? ____

Of the illicit connections found, how many remain? ____

May 2, 2006 – May 1, 2007

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? ____

Number of outfalls found to have a dry weather flow? ____

Number of outfalls found to have an illicit connection? ____

How many illicit connections were eliminated? ____

Of the illicit connections found, how many remain? ____

May 2, 2007 – May 1, 2008

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? ____

Number of outfalls found to have a dry weather flow? ____

Number of outfalls found to have an illicit connection? ____

How many illicit connections were eliminated? ____

Of the illicit connections found, how many remain? ____

May 2, 2008 – May 1, 2009

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? ____

Number of outfalls found to have a dry weather flow? ____

Number of outfalls found to have an illicit connection? ____

How many illicit connections were eliminated? ____

Of the illicit connections found, how many remain? ____

SPPP Form 9 – Yard Waste Collection/Ordinance Program

SPPP Form 9 – Yard Waste Collection/Ordinance Program

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Please describe your yard waste collection program. Be sure to include the collection schedule and how you will notify the residents and businesses of this schedule. Attach additional pages as necessary.

The City currently has weekly curbside collection of yard waste year-round when requested by residents. Leaf collection begins in October and continues through December.

Notification of this schedule is provided via advertisement in the local newspaper, on electronic billboards outside City buildings, and on the City's website. In addition, prior to leaf collection activities, police post No Parking signs along affected streets to permit collection vehicles easy access to the curb.

An ordinance was past by the City in 2005, which prohibits all yard waste from being placed at the curb or along the street for more than 7 days prior to scheduled collections unless they are bagged or otherwise containerized. The ordinance also prohibits the placing of yard waste closer than 10 feet from any storm sewer inlet along the street, unless they are bagged or containerized.

SPPP Form 10 – Ordinances

SPPP Form 10 - Ordinances

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Jack Lipsett, Adminstrator

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: March 2005 Date of most recent update: October 2018

For each ordinance, give the date of adoption. If not yet adopted, explain the development status:

Pet Waste #O09-2005, 3/21/2005 §71-11

Are information sheets regarding pet waste distributed with pet licenses? Y (●) N ( )

Litter #O09-2005, 3/21/2005 §71-12

Improper Waste Disposal #O09-2005, 3/21/2005 §71-13

Wildlife Feeding #O09-2005, 3/21/2005 §71-14

Yard Waste #O09-2005, 3/21/2005 §71-15

Illicit Connections #O09-2005, 3/21/2005 §71-17

How will these ordinances be enforced?

Gloucester City Health Department, Zoning Board, Engineering Department, Public Works, Code Enforcment, and local police offers will enforce these ordinances. If someone is found to be in violation of an ordinance, they will be issued a written warning for first time offenses, and penalties will be issued for subsequent offenses.

In addition, a log of enforcement actions has been included in the SPPP.

ORDINANCE OF THE CITY OF GLOUCESTER CITY
COUNTY OF CAMDEN, STATE OF NEW JERSEY

#O09-2005

AN ORDINANCE AMENDING §71 OF THE CODE OF GLOUCESTER CITY ENTITLED 'SEWERS', ESTABLISHING ARTICLE III ENTITLED 'STORMWATER REGULATIONS'

WHEREAS, to comply with new State of New Jersey standards and regulations, Gloucester City is required to adopt various local regulations pertinent and relative to stormwater runoff.

NOW, THEREFORE, BE IT ORDAINED by the Mayor and Common Council of the City of Gloucester City that §71 of the Code of Gloucester City, entitled 'Sewers', be amended to include the following article:

ARTICLE III
Stormwater Regulations

§71-10. Purpose.

The purpose of this article is to provide for the proper disposition of yard waste as well as the prohibition of various acts that may lead to the contamination of stormwater runoff.

§71-11. Definitions.

For the purpose of this ordinance, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory. The definitions below may be the same as or are based on corresponding definitions in the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-1.2.

a. **Containerized** – means the placement of yard waste in a trash can, bucket, bag or other vessel, such as to prevent the yard waste from spilling or blowing out into the street and coming into contact with stormwater.

b. **Domestic sewage** – waste and wastewater from humans or household operations.

c. **Feed** – to give, place, expose, deposit, distribute or scatter any edible material with the intention of feeding, attracting or enticing wildlife. Feeding does not include baiting in the legal taking of fish and/or game.

d. **Industrial waste** – non-domestic waste, including but not limited to, those pollutants regulated under Section 307(a), (b), or (c) of the Federal Clean Water Act [33 U.S.C. §1317(a), (b), or (c)].

e. **Illicit connection** – any physical or non-physical connection that discharges domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater) to the municipal separate storm sewer system operated by the City of Gloucester City, unless that discharge is authorized under a NJPDES permit other than the Tier A Municipal Stormwater General Permit (NJPDES Permit Number NJ0141852). Non-physical connections may include, but are not limited to, leaks, flows, or overflows into the municipal separate storm sewer system.

f. **Municipal separate storm sewer system (MS4)** – a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is owned or operated by the City of Gloucester City or other public body, and is designed and used for collecting and conveying stormwater. MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources.

g. **Non-contact cooling water** – water used to reduce temperature for the purpose of cooling. Such waters do not come into direct contact with any raw material, intermediate product (other than heat) or finished product. Non-contact cooling water may however contain algaecides, or biocides to control fouling of equipment such as heat exchangers, and/or corrosion inhibitors.

h. **NJPDES permit** – a permit issued by the New Jersey Department of Environmental Protection to implement the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A.

i. **Person** – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

j. **Process wastewater** – any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. Process wastewater includes, but is not limited to, leachate and cooling water other than non-contact cooling water.

k. **Stormwater** – water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

l. **Street** – means any street, avenue, boulevard, road, parkway, viaduct, drive or other way, which is an existing State, county or municipal roadway, and may comprise of pavement, shoulders, gutters, curbs, sidewalks, parking areas, and other areas within the street lines.

m. **Wildlife** – all animals that are neither human nor domesticated.

n. **Yard Waste** – means leaves and grass clippings.

§71-11. Pet waste.

Requirements for the proper disposal of pet solid waste for the protection of the public health, safety and welfare may be found at §43-17 through §43-18.3, "Sanitary Requirements".

§71-12. Litter control.

Requirements to control littering in the City of Gloucester City so as to protect the public health, safety and welfare, may be found at §59A1-9, "Littering".

§71-13. Improper disposal of waste and prohibited conduct; exceptions.

A. The spilling, dumping or disposal of material other than stormwater to the municipal separate storm sewer system (MS4) operated by the City of Gloucester City is prohibited. The spilling, dumping, or disposal of materials other than stormwater in such a manner as to cause the discharge of pollutants to the municipal separate storm sewer system is also prohibited.

B. The following are exceptions to the above prohibitions:

a. Water line flushing and discharges from potable water sources.
b. Uncontaminated ground water (e.g., infiltration, crawl space or basement sump pumps, foundation or footing drains, rising ground waters).
c. Air conditioning condensate (excluding contact and non-contact cooling water).
d. Irrigation water (including landscape and lawn watering run-off).
e. Flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows.
f. Residential car washing water, and residential swimming pool discharges.
g. Sidewalk, driveway and street wash water.
h. Flows from fire fighting activities.
i. Flows from rinsing the following equipment with clean water:
    I. Beach maintenance equipment immediately following their use for their intended purpose; and
    II. Equipment used in the application of salt and de-icing materials immediately following salt and de-icing applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded. Rinsing of equipment, as noted in the above situation is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

§71-14. Prohibition of feeding wildlife.

No person shall feed, in any public park or on any other property owned or operated by the City of Gloucester City, any wildlife, excluding confined wildlife (e.g., wildlife confined in zoos, parks or rehabilitation centers, or unconfined wildlife at environmental education centers). Any person found in violation of this section shall be ordered to cease the feeding immediately.

§71-15. Requirement to containerize yard waste; prohibited conduct.

All yard waste must be containerized and placed adjacent to the curb for municipal pick-up. The owner or occupant of any property, or any employee or contractor of such owner or occupant engaged to provide lawn care or landscaping services, shall not sweep, rake, blow, or otherwise place yard waste in the street. If yard waste that is not containerized is placed in the street, the party responsible for placement of yard waste must remove the yard waste from the street or said party shall be deemed in violation of this section.

§71-16. Municipal Yard Waste Collection Program.

The requirements of §71-15 shall be suspended during certain announced days of the autumn of the year (or as otherwise announced) as part of the municipal yard waste collection program. Sweeping, raking, blowing or otherwise placing yard waste that is not containerized at the curb or along the street is only permitted during the seven (7) days prior to a scheduled and announced collection, and shall not be placed closed than ten (10) feet from any storm drain inlet. Placement of such yard waste at the curb or along the street at any other time or in any other manner is a violation of this ordinance. If such placement of yard waste occurs, the party responsible for placement of the yard waste must remove the yard waste from the street or said party shall be deemed in violation of this ordinance.

§71-17. Unlawful connection.

No person shall discharge or cause to be discharged through an unlawful or illicit connection to the municipal separate storm sewer system operated by the City of Gloucester City any domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater).

§71-18. Enforcement.

The sections of this article and ordinance shall be enforced by the Gloucester City Police Department.

§71-19. Penalties.

Any person(s) who is found in violation of the provisions of this ordinance shall be subject to a fine of $100.00 for the first offense and not less than $100.00 or more than $1,000.00 for each subsequent offense.

BE IT FURTHER ORDAINED that all prior ordinances inconsistent with this ordinance are repealed only to the extent of such inconsistency.

BE IT FURTHER ORDAINED that if any section, subsection, paragraph, sentence or other part of this Ordinance is adjudged unconstitutional or invalid, such judgment shall not affect, impair or invalidate the remainder of this Ordinance, but shall be confined in its effect to the section, subsection, paragraph, sentence or other part of this Ordinance directly involved in the controversy in which said judgment shall have been rendered and all other provisions of this Ordinance shall remain in full force and effect.

BE IT FURTHER ORDAINED this Ordinance shall take effect immediately upon final adoption and publication in the manner prescribed by law.

Thomas J. Kilcourse, Mayor

Passed on First Reading: 2-22-2005

Adopted by the Mayor and Common Council of Gloucester City this 21st day of March, 2005.

Paul J. Kain, City Clerk

PUBLIC MEETING

NOTICE is hereby given that the foregoing ORDINANCE was introduced and passed at a meeting of the Common Council of the City of Gloucester City, County of Camden, New Jersey, held on the 22nd day of February, 2005 and will be considered for final passage after a public hearing at a meeting of the Common Council of the City of Gloucester City to be held on the 21st day of March, 2005 at 7:00 o'clock PM in the Municipal Building, 512 Monmouth Street, Gloucester City, New Jersey.

Paul J. Kain, City Clerk
City of Gloucester City

I hereby certify that the foregoing ORDINANCE was approved for final adoption by the Mayor and Common Council of the City of Gloucester City, County of Camden, State of New Jersey at a regularly scheduled meeting held on the 21st day of March, 2005.

Paul J. Kain, City Clerk
City of Gloucester City

SPPP Form 11 – Storm Drain Inlet Retrofitting

SPPP Form 11 – Storm Drain Inlet Retrofitting

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: Date of most recent update: October 2018

January 2005

What type of storm drain inlet design will generally be used for retrofitting?

~~**For most projects, the City will use the NJDOT bicyle safe grate style and (if needed) a curb opening with a space no bigger than two (2) inches across the smallest dimensions.**~~

Repaving, repairing, reconstruction or alteration project name	Projected start date	Start date	Date of completion	# of storm drain inlets	# of storm drains w/ hydraulic exemptions

Are you claiming any alternative device exemptions or historic place exemptions for any of the above projects? Please explain:

~~**Gloucester City does not opearate any alternative devices within the municipality. At this time, the City does not plan on installing any such devices for repaving, repairing, reconstruction, or alteration projects. The City also does not plan on claiming any historic place exemptions.**~~

SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance

SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: January 2019

Street Sweeping

Please describe the street sweeping schedule that you will maintain.

(NOTE: Attach a street sweeping log containing the following information: date and area swept, # of miles swept and the total amount of materials collected.)

~~**All City streets are swept at least twice per month. The City has 2 full-time sweeper machines. A sample street sweeping log is attached which documents date of sweeping, location swept, mileage swept, and volume of materials collected.**~~

Road Erosion Control Maintenance

Describe your Road Erosion Control Maintenance Program, including inspection schedules. A list of all sites of roadside erosion and the repair technique(s) you will be using for each site should be attached to this form.

(NOTE: Attach a road erosion control maintenance log containing the following information: location, repairs, date)

No longer applicable requirement.

SPPP Form 13 – Stormwater Facility Maintenance

SPPP Form 13 – Stormwater Facility Maintenance

Municipality Information

Municipality: City of Gloucester city County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: January 2019

Please describe your annual catch basin cleaning program and schedule. Attach a map/diagram or additional pages as necessary.

All catch basins are inspected annually and maintained, if necessary, by Public Works personnel. If at the time of inspection, no sediment, trash, or debris is observed in the catch basin, then that basin will not be cleaned.

Please describe your stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the municipality. Attach additional pages as necessary.

(NOTE: Attach a maintenance log containing information on any repairs/maintenance performed on stormwater facilities to ensure their proper function and operation.)

The City will implement a stormwater facility maintenance program to ensure that all stormwater facilities by the City function property. The City operates the following:

-Catch basins
-Storm drains
-Swales

These stormwater facilities will be inspected annually using Public Works personnel to ensure they are functioning properly. In high risk areas, preventative maintenance will be performed on all stormwater facilities to ensure they do not begin to fail.

At the time of cleaning, the catch basins will also be inspected for proper function. Maintenance will be scheduled for those catch basins that are in disrepair.

Responsible parties for privately owned stormwater BMPs shall be responsible for performing maintenance on those systems in accordance with the site's approved maintenance plan. In the event that privately owned stormwater BMPs are not being maintained, the City shall conduct enforcement action in accordance with Section 27A of the ordinance.

The City maintains copies of all maintenance plans for privately owned facilities.

SPPP Form 14 – Outfall Pipe Stream Scouring Remediation

SPPP Form 14 - Outfall Pipe Stream Scouring Remediation

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: October 2018

Describe your stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control active localized stream and stream bank scouring. Attach additional pages as necessary.

(NOTE: Attach a prioritized list of sites observed to have outfall pipe stream and stream bank scouring, date of anticipated repair, method of repair and date of completion.)

Scouring detection occurs as part of the annual outfall inspections. If scouring is detected, the location is noted and a remediation and maintenance program is developed to mitigate the problem in accordance with the Camden County Soil Conservation District and NJDEP standards.

Currently, there are no detected scouring problems within the City.

SPPP Form 15 – De-Icing Material Storage

SPPP Form 15 – De-icing Material Storage

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: January 2019

De-icing Material Storage

Describe how you currently store your municipality's de-icing materials, and describe your inspection schedule for the storage area. If your current storage practices do not meet the de-icing material storage SBR describe your construction schedule and your seasonal tarping interim measures. If you plan on sharing a storage structure, please include its location, as well as a complete list of all concerned public entities. If you store sand outdoors, describe how it meets the minimum standard.

De-icing materials consist of salt, which is stored inside a permanent salt barn structure at DPW (located at Grove Street and Brick Street). The barn provides 3 walls and a roof above the salt stockpile with the front blocked by haybales to permit access during operations.

The City is no longer using sand for de-icing operations.

Brine storage occurs at the City's water works yard in a fully enclosed tank that does not permit stormwater entry. All brine mixing occurs indoors.

SPPP Form 16 – Standard Operating Procedures

SPPP Form 16 – Standard Operating Procedures

Municipality Information	
	Municipality: City of Gloucester City County: Camden
	NJPDES # : NJ0141852 PI ID #: 50577
	Team Member/Title: Eric G. Fooder
	Effective Date of Permit Authorization (EDPA): January 1, 2018
	Date of Completion: January 2005 Date of most recent update: 09/01/2018

BMP	Date SOP went into effect	Describe your inspection schedule
Fueling Operations (including the required practices listed in ~~Attachment D~~ of the permit) Attachment E	April 2005	<see Attachment E and attached SOP>
Vehicle Maintenance (including the required practices listed in ~~Attachment D~~ of the permit) Attachment E	April 2005	<see Attachment E and attached SOP>
Good Housekeeping Practices (including the required practices listed in ~~Attachment D~~ of the permit) Attachment E **Attach inventory list required by ~~Attachment D~~ of the permit**.	April 2005	<see Attachment E and attached SOP>

Gloucester City Maintenance Yard and Water Works Facility Standard Operating Procedures

These Standard Operating Procedures (SOP) have been prepared to meet the requirements of the City's MS4 permit as well as inform all employees at the Maintenance Yard and Water Works facilities of risks to stormwater and how employees can prevent those risks.

This SOP is divided into general sections which apply to both facilities and sub-sections for when the content relates to a specific facility. Any questions on this SOP should be directed to the Public Works Superintendent.

Inventory List

The SPPP shall include a list of all materials and machinery located at municipal maintenance yards and ancillary operations which could be a source of pollutants in a stormwater discharge. The materials in question include, but are not limited to: raw materials; intermediate products; final products; waste materials; by-products; machinery and fuels; and lubricants, solvents, and detergents that are related to the municipal maintenance yard operations and ancillary operations. Materials or machinery that are not exposed to stormwater at the municipal maintenance yard or related to its operations do not need to be included.

Maintenance Yard

- Waste materials or by-products
    - Waste oil stored in 400 gallon drum (enclosed)
- Machinery and fuels:
    - 2 street sweeping machines
    - Pickup trucks
    - Gasoline
    - Diesel
- Lubricants:
    - None stored or used outside.
- Solvents
    - None stored or used outside.
- Detergents
    - None stored or used outside.

Waterworks

- Solvents
    - Sodium Hypochlorite

Dated: October 2018
Revised: January 2019

Inspections and Good Housekeeping

- General Operations
  - All containers should be properly labeled and marked. All labels shall be maintained and kept clean and visible.
  - All containers must be kept in good condition and tightly closed when not in use.
  - When practical, chemicals, fluids, and other supplies shall be kept indoors and under roof. When impractical to do so, outside storage is permissible if covered and kept upon spill platforms or clean pallets; alternately, they may be stored in a covered area that's been graded to prevent stormwater run-through.
  - Spill kits and drip pans shall be stored in close proximity to any areas where liquid transfer activities are occurring.
  - Absorbent spill clean-up materials and other dry spill cleaning materials shall be stored in maintenance areas and properly disposed of after use.
  - All trash, dirt, and debris shall be properly disposed of in lidded dumpsters.
- Spill Response and Reporting
  - All spills shall be cleaned up immediately upon discovered.
  - Spills are to be cleaned using dry cleaning methods only.
  - If warranted, contact the contact the City of Gloucester City Fire Department at 856-456-0060.
- Maintenance and Inspection
  - Periodically check for leaks and damaged equipment and make repairs as necessary.
  - Monthly inspections shall be performed of all storage locations. Areas requiring attention and remedial actions shall be noted and saved in inspection logs.

Fueling Operations

Maintenance Yard

- General Operations
  - All signage associated with fueling operations shall be maintained and shall include the following at a minimum:
    - "Topping off of vehicles, mobile fuel tanks, and storage tanks is strictly prohibited."
    - "Stay in view of fueling nozzle during dispensing."
    - Contact information for the person(s) responsible for spill response.
  - Any equipment, tanks, pumps, piping, and fuel dispensing equipment found to be leaking or in disrepair shall be repaired immediately.
- Bulk Transfer of Fuels
  - Delivery vehicle shall park next to the standalone tank.
  - Confirm presence spill kit, berms, and other dry spill clean up materials nearby prior to starting bulk transfer.
  - With the motor off, the hose shall be connected to the spout on top of the fuel tank.

    - Drip pans and temporary berms shall be placed beneath all hose and pipe connections.
    - The motor shall be turned on to fill up the tank to no higher than the fill line.
    - Once the tank is filled, the hose shall be held in a manner to prevent spillage and retracted back to the fuel truck.
    - A trained employee shall be present throughout the entirety of the bulk transfer fueling process.
- Vehicle Fueling
    - The engine shall be shutoff prior to any fueling operations.
    - Verify the proper type of fuel.
    - Confirm presence spill kit, berms, and other dry spill clean up materials nearby prior to starting vehicle fueling.
    - Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to prevent overfill.
    - "Topping off" is prohibited.

<u>Water Works</u>

- General Operations
    - All signage associated with fueling operations shall be maintained and shall include the following at a minimum:
        - "Topping off of vehicles, mobile fuel tanks, and storage tanks is strictly prohibited."
        - "Stay in view of fueling nozzle during dispensing."
        - Contact information for the person(s) responsible for spill response.
    - Any equipment, tanks, pumps, piping, and fuel dispensing equipment found to be leaking or in disrepair shall be repaired immediately.
- Bulk Transfer of Fuels
    - Delivery vehicle shall park next to the standalone tank.
    - Confirm presence spill kit, berms, and other dry spill clean up materials nearby prior to starting bulk transfer.
    - With the motor off, the hose shall be connected to the spout on top of the fuel tank.
    - Drip pans and temporary berms shall be placed beneath all hose and pipe connections.
    - The motor shall be turned on to fill up the tank to no higher than the fill line.
    - Once the tank is filled, the hose shall be held in a manner to prevent spillage and retracted back to the fuel truck.
    - A trained employee shall be present throughout the entirety of the bulk transfer fueling process.

<u>Vehicle Maintenance</u>

- Vehicle maintenance shall only be performed in designated indoor locations with an impermeable floor.

- Portable tents or other roofing device shall be used for any maintenance activities that must occur outside and which last for more than a day.
- Drip pans and absorbent spill clean up materials shall be used to collect any liquid wastes from maintenance activities.
- All spills are to be cleaned using dry cleaning methods only including, but not limited to, absorbent pads, bulking material (kitty litter, sawdust, etc.), sweeping.
- All liquid waste shall be collected in properly labeled containers and properly disposed of.
- All tires shall be collected and properly disposed of.
- All batteries shall be collected and properly disposed of.

Salt and De-Icing Material Storage and Handling

Maintenance Yard (Salt Storage)

- General Operations
  - All salt and de-icing material shall be stored in a salt barn.
  - If salt barn is unavailable, then temporary outdoor storage may be utilized per the following requirements:
    - Salt and de-icing materials are stored in a manner that minimizes stormwater run-through.
    - Salt and de-icing materials are tarped when not in use.
    - Temporary operations do not exceeds 30 days without approval from NJDEP.
- Loading and Unloading Operations
  - Whenever possible, perform loading and unloading during dry weather conditions.
  - Minimize distance between spreading vehicle and storage area to minimize risk of spillage.
  - Remove blocking elements from salt barn to access materials.
  - Load spreading vehicle to fill line.
  - The area shall be swept following loading and unloading operations. Sweeping shall include any tracked material.
  - Restore blocking elements to salt barn.
  - All materials used during loading and unloading shall either be reused or properly disposed of.

Water Works (Brine Storage)

- General Operations
  - All brine mixing and loading shall occur under roof.
- Loading Operations (for street deployment)
  - Whenever possible, perform loading during dry weather conditions.
  - Minimize distance between spreading vehicle and storage tank to minimize risk of spillage.

    - A trained employee shall remain with the vehicle for the entirety of the loading operation.
    - Load spreading vehicle to fill line.
    - All materials used during loading and unloading shall either be reused or properly disposed of.

Aggregate Material and Construction Debris Storage

- General Operations
    - All sand, gravel, stone, top soil, road millings, waste concrete, asphalt, brick, block, asphalt-based roofing scrap, and processed aggregate shall be stored in lidded containers within the yard.
    - If any materials are to be stored on the ground, they shall be stored in bays formed by jersey barriers with the opening situated on the upstream side to minimize runoff from these areas.
    - Any storage bays shall be situated at least 50 feet from surface water bodies, inlets, ditches, and other stormwater conveyances.

Street Sweepings, Catch Basin Cleanout, and Other Material Storage

- All road cleanup materials shall be stored in containers with lids within the yard.
- All containers with road clean up material shall be removed for disposal within at 6 months of collection.
- All road clean up materials shall be disposed of at a properly permitted facility.

Attachment E – Best Management Practices for Municipal Maintenance Yards and Other Ancillary Operations

The Tier A Municipality shall implement the following practices at municipal maintenance yards and other ancillary operations owned or operated by the municipality. Inventory of Materials and Machinery, and Inspections and Good Housekeeping shall be conducted at all municipal maintenance yards and other ancillary operations. All other Best Management Practices shall be conducted whenever activities described below occur. Ancillary operations include but are not limited to impound yards, permanent and mobile fueling locations, and yard trimmings and wood waste management sites.

Inventory of Materials and Machinery

The SPPP shall include a list of all materials and machinery located at municipal maintenance yards and ancillary operations which could be a source of pollutants in a stormwater discharge. The materials in question include, but are not limited to: raw materials; intermediate products; final products; waste materials; by-products; machinery and fuels; and lubricants, solvents, and detergents that are related to the municipal maintenance yard operations and ancillary operations. Materials or machinery that are not exposed to stormwater at the municipal maintenance yard or related to its operations do not need to be included.

Inspections and Good Housekeeping

1. Inspect the entire site, including the site periphery, monthly (under both dry and wet conditions, when possible). Identify conditions that would contribute to stormwater contamination, illicit discharges or negative impacts to the Tier A Municipality's MS4. Maintain an inspection log detailing conditions requiring attention and remedial actions taken for all activities occurring at Municipal Maintenance Yards and Other Ancillary Operations. This log must contain, at a minimum, a record of inspections of all operations listed in Part IV.B.5.c. of this permit including dates and times of the inspections, and the name of the person conducting the inspection and relevant findings. This log must be kept on-site with the SPPP and made available to the Department upon request. See the Tier A Municipal Guidance document (www.nj.gov/dep/dwq/tier_a_guidance.htm) for additional information.

2. Conduct cleanups of spills of liquids or dry materials immediately after discovery. All spills shall be cleaned using dry cleaning methods only. Clean up spills with a dry, absorbent material (i.e., kitty litter, sawdust, etc.) and sweep the rest of the area. Dispose of collected waste properly. Store clean-up materials, spill kits and drip pans near all liquid transfer areas, protected from rainfall.

3. Properly label all containers. Labels shall be legible, clean and visible. Keep containers in good condition, protected from damage and spillage, and tightly closed when not in use. When practical, store containers indoors. If indoor storage is not practical, containers may be stored outside if covered and placed on spill platforms or clean pallets. An area that is graded and/or bermed to prevent run-through of stormwater may be used in place of spill platforms or clean pallets. Outdoor storage locations shall be regularly maintained.

Fueling Operations

1. Establish, maintain and implement standard operating procedures to address vehicle fueling; receipt of bulk fuel deliveries; and inspection and maintenance of storage tanks, including the associated piping and fuel pumps.

   a. Place drip pans under all hose and pipe connections and other leak-prone areas during bulk transfer of fuels.

   b. Block storm sewer inlets, or contain tank trucks used for bulk transfer, with temporary berms or temporary absorbent booms during the transfer process. If temporary berms or booms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel shall be within the temporarily bermed or boomed area during the loading/unloading of bulk fuels. A trained employee shall be present to supervise the bulk transfer of fuel.

   c. Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment. Include all of the following:
      - “Topping off of vehicles, mobile fuel tanks, and storage tanks is strictly prohibited”
      - “Stay in view of fueling nozzle during dispensing”
      - Contact information for the person(s) responsible for spill response.

   d. Immediately repair or replace any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair.

Discharge of Stormwater from Secondary Containment

The discharge pipe/outfall from a secondary containment area (e.g. fuel storage, de-icing solution storage, brine solution) shall have a valve and the valve shall remain closed at all times except as described below. A municipality may discharge stormwater accumulated in a secondary containment area if a visual inspection is performed to ensure that the contents of aboveground storage tank have not come in contact with the stormwater to be discharged. Visual inspections are only effective when dealing with materials that can be observed, like petroleum. If the contents of the tank are not visible in stormwater, the municipality shall rely on previous tank inspections to determine with some degree of certainty that the tank has not leaked. If the municipality cannot make a determination with reasonable certainty that the stormwater in the secondary containment area is uncontaminated by the contents of the tank, then the stormwater shall be hauled for proper disposal.

Vehicle Maintenance

1. Operate and maintain equipment to prevent the exposure of pollutants to stormwater.

2. Whenever possible, conduct vehicle and equipment maintenance activities indoors. For projects that must be conducted outdoors, and that last more than one day, portable tents or covers shall be placed over the equipment being serviced when not being worked on, and drip pans shall be used at all times. Use designated areas away from storm drains or block storm drain inlets when vehicle and equipment maintenance is being conducted outdoors.

On-Site Equipment and Vehicle Washing and Wash Wastewater Containment

1. Manage any equipment and vehicle washing activities so that there are no unpermitted discharges of wash wastewater to storm sewer inlets or to waters of the State.

2. Tier A Municipalities which cannot discharge wash wastewater to a sanitary sewer or which cannot otherwise comply with 1, above, may temporarily contain wash wastewater prior to proper disposal under the following conditions:

   a. Containment structures shall not leak. Any underground tanks and associated piping shall be tested for integrity every 3 years using appropriate methods determined by "*The List of Leak Detection Evaluations for Storage Tank Systems*" created by the National Work Group on Leak Detection Evaluations (NWGLDE) or as determined appropriate and certified by a professional engineer for the site specific containment structure(s)**.**

   b. For any cathodically protected containment system, provide a passing cathodic protection survey every three years.

   c. Operate containment structures to prevent overfilling resulting from normal or abnormal operations, overfilling, malfunctions of equipment, and human error. Overfill prevention shall include manual sticking/gauging of the tank before each use unless system design prevents such measurement. Tank shall no longer accept wash wastewater when determined to be at 95% capacity. Record each measurement to the nearest ½ inch.

   d. Before each use, perform inspections of all visible portions of containment structures to ensure that they are structurally sound, and to detect deterioration of the wash pad, catch basin, sump, tank, piping, risers, walls, floors, joints, seams, pumps and pipe connections or other containment devices. The wash pad, catch basin, sump and associated drains should be kept free of debris before each use. Log dates of inspection; inspector's name, and conditions. This inspection is not required if system design prevents such inspection.

   e. Containment structures shall be emptied and taken out of service immediately upon detection of a leak. Complete all necessary repairs to ensure structural integrity prior to placing the containment structure back into service. Any spills or suspected release of hazardous substances shall be immediately reported to the NJDEP Hotline (1-877-927-6337) followed by a site investigation in accordance with N.J.A.C. 7:26C and N.J.A.C 7:26E if the discharge is confirmed.

   f. All equipment and vehicle wash wastewater placed into storage must be disposed of in a legally permitted manner (e.g. pumped out and delivered to a duly permitted and/or approved wastewater treatment facility).

   g. Maintain a log of equipment and vehicle wash wastewater containment structure clean-outs including date and method of removal, mode of transportation (including name of hauler if applicable) and the location of disposal. See Underground Vehicle Wash Water Storage Tank Use Log at end of this attachment.

   h. Containment structures shall be inspected annually by a NJ licensed professional engineer. The engineer shall certify the condition of all structures including: wash pad, catch basin, sump, tank, piping, risers to detect deterioration in the, walls, floors, joints, seams, pumps and pipe connections or other containment devices using the attached Engineer's Certification of Annual Inspection of Equipment and Vehicle Wash Wastewater Containment Structure. This certification may be waived for self-contained systems on a case-by-case basis. Any such waiver would be issued in writing by the Department.

3. Maintain all logs, inspection records, and certifications on-site. Such records shall be made available to the Department upon request.

Salt and De-icing Material Storage and Handling

1. Store material in a permanent structure.
2. Perform regular inspections and maintenance of storage structure and surrounding area.
3. Minimize tracking of material from loading and unloading operations.
4. During loading and unloading:
   a. Conduct during dry weather, if possible;
   b. Prevent and/or minimize spillage; and
   c. Minimize loader travel distance between storage area and spreading vehicle.
5. Sweep (or clean using other dry cleaning methods):
   a. Storage areas on a regular basis;
   b. Material tracked away from storage areas;
   c. Immediately after loading and unloading is complete.
6. Reuse or properly discard materials collected during cleanup.
7. Temporary outdoor storage is permitted only under the following conditions:
   a. A permanent structure is under construction, repair or replacement;
   b. Stormwater run-on and de-icing material run-off is minimized;
   c. Materials in temporary storage are tarped when not in use;
   d. The requirements of 2 through 6, above are met; and
   e. Temporary outdoor storage shall not exceed 30 days unless otherwise approved in writing by the Department;
8. Sand must be stored in accordance with Aggregate Material and Construction Debris Storage below.

Aggregate Material and Construction Debris Storage

1. Store materials such as sand, gravel, stone, top soil, road millings, waste concrete, asphalt, brick, block and asphalt based roofing scrap and processed aggregate in such a manner as to minimize stormwater run-on and aggregate run-off via surface grading, dikes and/or berms (which may include sand bags, hay bales and curbing, among others) or three sided storage bays. Where possible the open side of storage bays shall be situated on the upslope. The area in front of storage bays and adjacent to storage areas shall be swept clean after loading/unloading.

2. Sand, top soil, road millings and processed aggregate may only be stored outside and uncovered if in compliance with item 1 above and a 50-foot setback is maintained from surface water bodies, storm sewer inlets, and/or ditches or other stormwater conveyance channels.

3. Road millings must be managed in conformance with the "Recycled Asphalt Pavement and Asphalt Millings (RAP) Reuse Guidance" (see www.nj.gov/dep/dshw/rrtp/asphaltguidance.pdf) or properly disposed of as solid waste pursuant to N.J.A.C. 7:26-1 et seq.

4. The stockpiling of materials and construction of storage bays on certain land (including but not limited to coastal areas, wetlands and floodplains) may be subject to regulation by the Division of Land Use Regulation (see www.nj.gov/dep/landuse/ for more information).

Street Sweepings, Catch Basin Clean Out, and Other Material Storage

1. For the purposes of this permit, this BMP is intended for road cleanup materials as well as other similar materials. Road cleanup materials may include but are not limited to street sweepings, storm sewer clean out materials, stormwater basin clean out materials and other similar materials that may be collected during road cleanup operations. These BMPs do not cover materials such as liquids, wastes which are removed from municipal sanitary sewer systems or material which constitutes hazardous waste in accordance with N.J.A.C. 7:26G-1.1 et seq.

2. Road cleanup materials must be ultimately disposed of in accordance with N.J.A.C. 7:26-1.1 et seq. See the "Guidance Document for the Management of Street Sweepings and Other Road Cleanup Materials" (www.nj.gov/dep/dshw/rrtp/sweeping.htm).

3. Road cleanup materials placed into storage must be, at a minimum:

   a. Stored in leak-proof containers or on an impervious surface that is contained (e.g. bermed) to control leachate and litter; and

   b. Removed for disposal (in accordance with 2, above) within six (6) months of placement into storage.

Yard Trimmings and Wood Waste Management Sites

1. These practices are applicable to any yard trimmings or wood waste management site:

   a. Owned and operated by the Tier A Municipality;
      i. For staging, storing, composting or otherwise managing yard trimmings, or
      ii. For staging, storing or otherwise managing wood waste, and

   b. Operated in compliance with the Recycling Rules found at N.J.A.C. 7:26A.

2. Yard trimmings or wood waste management sites must be operated in a manner that:

   a. Diverts stormwater away from yard trimmings and wood waste management operations; and
   b. Minimizes or eliminates the exposure of yard trimmings, wood waste and related materials to stormwater.

3. Yard trimmings and wood waste management site specific practices:

   a. Construct windrows, staging and storage piles:
      i. In such a manner that materials contained in the windrows, staging and storage piles (processed and unprocessed) do not enter waterways of the State;
      ii. On ground which is not susceptible to seasonal flooding;
      iii. In such a manner that prevents stormwater run-on and leachate run-off (e.g. use of covered areas, diversion swales, ditches or other designs to divert stormwater from contacting yard trimmings and wood waste).

   b. Maintain perimeter controls such as curbs, berms, hay bales, silt fences, jersey barriers or setbacks, to eliminate the discharge of stormwater runoff carrying leachate or litter from the site to storm sewer inlets or to surface waters of the State.

   c. Prevent on-site storm drain inlets from siltation using controls such as hay bales, silt fences, or filter fabric inlet protection.

   d. Dry weather run-off that reaches a municipal stormwater sewer system is an illicit discharge. Possible sources of dry weather run-off include wetting of piles by the site operator; uncontrolled pile leachate or uncontrolled leachate from other materials stored at the site.

   e. Remove trash from yard trimmings and wood waste upon receipt.

   f. Monitor site for trash on a routine basis.

   g. Store trash in leak-proof containers or on an impervious surface that is contained (e.g. bermed) to control leachate and litter;

   h. Dispose of collected trash at a permitted solid waste facility.

   i. Employ preventative tracking measures, such as gravel, quarry blend, or rumble strips at exits.

Roadside Vegetation Management

1. Tier A Municipalities shall restrict the application of herbicides along roadsides in order to prevent it from being washed by stormwater into the waters of the State and to prevent erosion caused by de-vegetation, as follows: Tier A Municipalities shall not apply herbicides on or adjacent to storm drain inlets, on steeply sloping ground, along curb lines, and along unobstructed shoulders. Tier A Municipalities shall only apply herbicides within a 2 foot radius around structures where overgrowth presents a safety hazard and where it is unsafe to mow.

SPPP Form 17 – Employee Training

SPPP Form 17 – Employee Training

Municipality Information

Municipality: City of Gloucester City County: Camden

NJPDES # : NJ0141852 PI ID #: 50577

Team Member/Title: Eric G. Fooder, Director of Utilities

Effective Date of Permit Authorization (EDPA): January 1, 2018

Date of Completion: January 2005 Date of most recent update: January 2019

Describe your employee training program. For each required topic, list the employees that will receive training on that topic, and the date the training will be held. Attach additional pages as necessary.

New public works employees shall be trained on the following requirements within 3 months of commencement of their duties; other public works employees shall be retrained on these topics at least every 2 years:
-Yard Waste Collection Program, Street Sweeping, Illicit Connections, Outfall Pipe Stream Scouring Detection and Control, Waste Disposal Education, Municipal Ordinances, Construction Activity/Post-Construction Stormwater Management in New Development and Redevelopment

In addition, employees will be trained on the following topics within 3 months of commencement of their duties and then at least annually:
-Maintenance Yard Operations, Stormwater Facility Maintenance, SPPP, Recordkeeping, other items applicable to employee's title and duties.

In addition, Public Works employees comply with continuing education requirements in order to maintain active certifications. At least annually, Public Works employees shall attend classes that provide CEU credits for the maintenance of those certifications.

Review staff shall be required to complete NJDEP approved review course at least once every 5 years.

Members of the Planning and Zoning Board, City Council, and any other board within the City tasked with stormwater review, shall complete NJDEP's Asking the Right Questions training module within 6 months of commencement of duties.

TMDL Reports

TOTAL MAXIMUM DAILY LOADS FOR POLYCHLORINATED BIPHENYLS (PCBs) FOR ZONES 2 - 5 OF THE TIDAL DELAWARE RIVER

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

DELAWARE RIVER BASIN COMMISSION
WEST TRENTON, NEW JERSEY

December 2003

Acknowledgements

This report was prepared by the Delaware River Basin Commission staff: Carol R. Collier, Executive Director. Dr. Thomas J. Fikslin and Dr. Namsoo Suk were the principal authors of the report. Dr. Fikslin is the Head of the Commission's Modeling & Monitoring Branch. Dr. Suk is a Water Resources Engineer/Modeler in the Modeling & Monitoring Branch. Significant technical contributions were made by Gregory J. Cavallo, Dr. Daniel S. L. Liao, Dr. Ronald A. MacGillivray, and John R. Yagecic. Richard W. Greene is gratefully acknowledged for his efforts in summarizing fish tissue data for PCBs, and for providing Figures 2 and 3 of the report. Technical recommendations were provided by the Commission's Toxic Advisory Committee and its TMDL Policies and Procedures Subcommittee.

Special acknowledgment is made to the following organizations for their support in development of the report and the studies leading up to it:

Delaware Department of Natural Resources & Environmental Control
New Jersey Department of Environmental Protection
Pennsylvania Department of Environmental Protection
U.S. Environmental Protection Agency, Region II
U.S. Environmental Protection Agency, Region III
Rutgers University
Limno-Tech, Inc.

Suggested Citation

Fikslin, T.J. and N.S. Suk. 2003. Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2 - 5 of the Tidal Delaware River. Delaware River Basin Commission. West Trenton, NJ. December 2003.

EXECUTIVE SUMMARY

Introduction

On behalf of the states of Delaware, New Jersey and Pennsylvania, and in cooperation with the Delaware River Basin Commission, the United States Environmental Protection Agency Regions II and III (EPA) establish these total maximum daily loads (TMDLs) for polychlorinated biphenyls (PCBs) in the Delaware River Estuary. EPA establishes these TMDLs in order to achieve and maintain the applicable water quality criteria for PCBs designed to protect human health from the carcinogenic effects of eating the contaminated fish now found in the Delaware Estuary. In accordance with Section 303(d) of the Clean Water Act (CWA) and its implementing regulations, these TMDLs provide allocations to point sources (WLAs) discharging PCBs as well as allocations to nonpoint sources (LAs) of PCBs, and an explicit margin of safety to account for uncertainties. This TMDL report and its appendices set forth the basis for these TMDLs and allocations and discusses follow up strategies that will be necessary to achieve these substantial reductions of PCBs. EPA will continue to work with the Commission and the States to develop enhanced Stage 2 PCB TMDLs based on information to be collected and analyzed over the next several years. While EPA acknowledges that implementation of these TMDLs will be difficult and may take decades to fully achieve, the establishment of these TMDLs sets forth a framework and specific goals to protect human health and restore the Delaware River from the effects of PCB pollution.

Background

The states of Delaware, New Jersey and Pennsylvania have identified the Delaware Estuary as impaired on their respective lists pursuant to Section 303(d) of the CWA. The States identified the impairments based on their findings of elevated levels of polychlorinated biphenyls (PCBs) in the tissue of fish caught in this portion of the Delaware River. The listing was based upon failure to attain one of the estuary's primary designated uses – fishable waters and the inherent protection of human health from consumption of unsafe fish. When water quality standards, including a numeric criterion and a designated use, are not attained despite the technology-based control of industrial and municipal wastewater (point sources), the Clean Water Act requires that the impaired water be identified on the state's Section 303(d) list of impaired waters and that a total maximum daily load (TMDL) be developed. A TMDL expresses the maximum amount of a pollutant that a water body can receive and still attain standards. Once the load is calculated, it is allocated to all sources in the watershed – point and nonpoint – which then must reduce loads to the allocated levels in order to achieve and maintain the applicable water quality standards.

For management purposes, the Delaware River Estuary has been designated by the Delaware River Basin Commission (also referred to in this report as the Commission) as that section of the main stem of the Delaware River and the tidal portions of the tributaries thereto, between the head of Delaware Bay (River Mile 48.2) and the head of the tide at Trenton, New Jersey (River Mile 133.4). The portion of the Delaware where the river meets the sea, the estuary is characterized by varying degrees of salinity and complex water movements affected by river flows, wind and ocean tides. A map of the estuary showing the water quality management zones 2 through 5 that comprise the tidal Delaware River appears on the following page.

In the late 1980s, the states of Delaware, New Jersey and Pennsylvania began issuing fish consumption advisories for portions of the Delaware Estuary due to elevated concentrations of PCBs measured in fish tissue. Today, the states' advisories cover the entire estuary and bay. The advisories range from a no-consumption recommendation for all species taken between the C&D Canal and the Delaware-Pennsylvania border to consumption of no more than one meal per month of striped bass or white perch in Zones 2 through 4. Why the need for such advisories? PCBs are classified as a probable human carcinogen by the U.S. Environmental Protection Agency (EPA). They also have been shown to have an adverse impact on human reproductive and immune systems and may act as an endocrine disruptor.

PCBs are a class of synthetic compounds that were typically manufactured through the progressive chlorination of batches of biphenyl to achieve a target percentage of chlorine by weight. Individual PCB compounds called congeners can have up to 10 chlorine atoms attached to a basic biphenyl structure consisting of two connected rings of six carbon atoms each. There are 209 patterns in which chlorine atoms may be attached, resulting in 209 possible PCB compounds. These compounds can be grouped into "homologs" defined by the number of chlorine atoms attached to the carbon rings. Thus, for example, PCB compounds that contain five chlorine atoms comprise a homolog referred to as pentachlorobiphenyls or penta-PCBs.


Blue Marsh Reservoir
Reading
Pottstown
Green Lane
Lake Galena
Delaware River
Assunpink Cr.
Neshaminy Creek
RM 133.4
Trenton
Crosswicks Creek
Blacks Creek
Perkiomen Creek
Wissahickon Cr.
Schuylkill River
RM 108.4
Zone 2
Marsh Creek Reservoir
Pennsylvania
Philadelphia
Rancocas Creek
West Br. Brandywine Cr.
Brandywine Creek
Geist
Crum Cr.
Pennsauken Cr.
Camden
Zone 4
RM 95
Zone 3
RM 78.83
Cooper River
White Clay Cr.
Mantua Cr.
Big Timber Cr.
Wilmington
Hoopes Res.
Raccoon Cr.
New Jersey
Oldmans Cr.
Christina River
Maryland
Salem River
Zone 5
Maurice River
C & D Canal
Salem
Cohansey River
Alloway Cr.
Stowe Cr.
Union Lake
RM 48.23
Zone 6
Smyrna River
Delaware
Leipsic River
Dover
Dennis Cr.
N
St. Jones River
Delaware Bay
Murderkill River
0 5 10
Miles
Mispillion River
Cedar Cr.
Milford
RM 0
Atlantic Ocean
Broadkill River
Lewes

Due to their stable properties, PCBs were used in hundreds of industrial and commercial applications, including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics and rubber products; and in pigments, dyes and carbonless copy paper, among other applications. PCB laden oil is often associated with electrical transformers. More than 1.5 billion pounds of PCBs were manufactured in the United States before their manufacture and general use, with a few small exceptions, was banned by the EPA in the late 1970s. Existing uses in some electrical equipment continue to be allowed. PCBs are hydrophobic and thus tend to bind to organic particles in sediment and soils. Their chemical stability allows them to persist in the environment for years. PCBs accumulate in the tissue of fish and other wildlife, entering the organism through absorption or ingestion. As a result, they may be present in fish and marine mammals at levels many times higher than in the surrounding water and at levels unsuitable for human consumption.

The water quality standards that form the basis for the TMDLs are the current Delaware River Basin Commission water quality criteria for total PCBs for the protection of human health from carcinogenic effects. These criteria were identified as the TMDL targets by a letter dated April 16, 2003 from the Regional Administrators of EPA Regions II and III to the Executive Director of the Delaware River Basin Commission. The criteria are 44.4 picograms per liter in Zones 2 and 3, 44.8 picograms per liter in Zone 4 and the upper portion of Zone 5, and 7.9 picograms per liter in lower Zone 5. The more stringent criterion in the lower estuary reflects a higher fish consumption rate utilized by the Commission and the State of Delaware, based upon an evaluation of fish consumption there. A consequence of the inconsistency in criteria is that a critical location occurs at the point between upper and lower Zone 5 where the criteria drop sharply from 44.8 picograms per liter to 7.9 picograms per liter. Achieving the lower standard in a portion of Zone 5 will require much larger reductions in the upper zones than would otherwise be necessary. Significant reductions are required throughout the estuary in any case, as ambient concentrations of PCBs in the water body currently exceed the criteria by two to three orders of magnitude.

PCBs have been dispersed throughout the environment by human activity. They enter the atmosphere as a gas, spill into soils and waterways, and lodge in sediments. They continue to be generated as a byproduct by some industrial processes. Thus, the sources of PCBs to the Delaware Estuary are multiple. They include loadings from the air, the main stem Delaware River above Trenton, tributaries to the Delaware both above and below Trenton, industrial and municipal point source discharges, combined sewer overflows, and storm water runoff, including runoff from seriously contaminated sites. For purposes of these TMDLs, point sources include all municipal and industrial discharges subject to regulation by the NPDES permit program, including combined sewer overflows and stormwater discharges. All other discharges are considered nonpoint sources.

Interagency and Interstate Cooperation

In the latter half of the 1990s, the three estuary states included the portions of Zones 2 through 5 of the Delaware River within their borders on their lists of impaired waters under Section 303(d) of the Clean Water Act, due to elevated levels of PCBs in estuary fish. This action required the states and EPA to agree upon a schedule for establishing TMDLs for PCBs. In order to provide for a single TMDL adoption process for the shared water body, one date for completion of the TMDLs – December 15, 2003 – was established. This is the date set for completion of the PCB TMDLs by a 1997 Consent Decree and Settlement Agreement in an action entitled *American Littoral Society and Sierra Club v. the United States Environmental Protection Agency et al.*, which established dates for adoption of TMDLs in the Delaware

Estuary. Because a unified legal process for issuance of the TMDLs could not be accomplished easily through independent state actions, at the request of the states, EPA agreed to issue the TMDLs for PCBs in the estuary on the states' behalf.

In the spring of 2000, the states and EPA asked the Delaware River Basin Commission to take the lead in developing the technical basis for the estuary PCB TMDLs. In consultation with its Toxics Advisory Committee (TAC), comprised of representatives from the states, EPA Regions II and III, municipal and industrial dischargers, academia, agriculture, public health, environmental organizations and fish and wildlife interests, the Commission undertook to do so. In September of 2000, the Commission established a panel of scientists expert in the modeling of hydrophobic contaminants such as PCBs to advise it and the TAC on the development of the complex hydrodynamic and water quality model required to develop the TMDLs. The Commission also initiated an extensive program of scientific investigations and data collection efforts. In response to a recommendation of the expert panel, in May of 2002 the Commission engaged a consultant experienced in water quality modeling to work closely with Commission staff to develop the model.

In consultation with the TAC, the Commission staff and the Delaware Estuary Program developed a strategy to address contamination of the Delaware Estuary by PCBs (the PCB Strategy). The PCB Strategy includes the following nine components: (1) determination of the water quality targets for PCBs; (2) characterization of PCB concentrations in the estuary ecosystem; (3) identification and quantification of all point and nonpoint sources and pathways of PCBs; (4) determination of the transport and fate of PCB loads to the estuary; (5) calculation of the TMDLs, including the wasteload and load allocations required for a TMDL;(6) development of an implementation plan to reduce PCBs entering the estuary; (7) initiation of an effort to increase public awareness of toxicity issues in the estuary; (8) long-term monitoring of PCB concentrations in air, water and sediments of the estuary; and (9) long-term monitoring of PCB concentrations in living resources of the estuary and impacts upon living resources of the estuary. The PCB Strategy is one component of EPA's reasonable assurance that the allocations of these TMDLs will ultimately be achieved.

In a cooperative effort, EPA, the Commission, the states, municipal and industrial dischargers and other stakeholders, have now completed the PCB Strategy components necessary for issuance of the TMDLs. This TMDL report discusses the identification of water quality targets for the TMDLs and calculation of the TMDLs in more detail below (components 1 and 5). An extensive program of scientific investigations and data collection efforts to further characterize PCB sources, concentrations and pathways in the estuary ecosystem is ongoing (components 2, 3 and 8). To date, studies have been assembled or undertaken on fish tissue, ambient water quality, sediment, air deposition, air-water exchange, bioaccumulation pathways, tributary loading, point source discharges, and stormwater loadings. The transport and fate of PCBs in the estuary ecosystem (component 4) has been established through the development of a complex mathematical model, also discussed below. The Commission has established a TMDL Implementation Advisory Committee (IAC) to develop strategies over the next two years for reducing PCB loads to the estuary and achieving the TMDLs (component 6). An effort to educate the public about toxicity issues in the estuary (component 7) began with a series of public information sessions in February and March of 2001. In October of 2002, a coalition of municipal and industrial dischargers sponsored a science symposium, at which the various scientific investigators presented their findings to date. A meeting among regulators and stakeholders on the TMDLs and their regulatory implications was held in April, 2003 (see Appendix 1).

EPA with assistance from the Commission and the States held three informational meetings about the proposed TMDLs on September 22, 24 and 25, 2003, and conducted a public hearing on the proposed

TMDLs on October 16, 2003. During the public comment period EPA received numerous written comments in addition to the testimony provided at the public hearing. EPA considered those comments in finalizing these TMDLs and prepared a Response to Comments document that is part of the record of this decision. Ongoing education initiatives regarding these issues continue to be carried out through the Delaware Estuary Program and the Partnership for the Delaware Estuary.

Development of the TMDLs

The three-year schedule for development of the estuary TMDLs by December 15, 2003 resulted in a decision to develop the TMDLs using a staged approach. The Stage 1 and Stage 2 TMDLs will each comply fully with EPA requirements and guidance. The staged approach will provide for adaptive implementation through execution of load reduction strategies while additional monitoring and modeling efforts proceed. As discussed below, these Stage 1 TMDLs are based on the best water quality-related monitoring data, modeling and scientific analysis available at this time. EPA expects that additional monitoring data and modeling results will be collected and developed following issuance of the Stage 1 TMDLs. This additional information will enable a more refined analysis to form the basis of the Stage 2 TMDLs. EPA will continue to work with the Commission and the States to develop and complete the Stage 2 TMDLs. Until the Stage 1 TMDLs are amended or replaced, the Stage 1 TMDLs are the final and effective TMDLs for purposes of the CWA.

EPA's regulations implementing Section 303(d) of the Clean Water Act provide that a TMDL must be expressed as the sum of the individual wasteload allocations (WLA) for point sources plus the load allocation (LA) for nonpoint sources plus a margin of safety (MOS). This definition may be expressed as the equation: TMDL = WLA + LA + MOS. A separate TMDL has been developed for each water quality management zone of the estuary. Each of the TMDLs must provide for achievement of the applicable water quality standards within the zone and also must ensure that water quality in downstream zones is adequately protected.

In June of 2002, the expert panel recommended that for the TMDLs to be completed by December 15, 2003, the Commission should develop and calibrate a water quality model for only one of the PCB homologs and use it to develop a set of TMDLs from which TMDLs for total PCBs could be extrapolated. This process became known as Stage 1 of an iterative approach to establishing the TMDLs for PCBs in the estuary. Since pentachlorobiphenyls were the dominant homolog in fish tissue monitored in the estuary, and since ambient data indicated that throughout the estuary this homolog represents approximately 25 percent of the total PCBs present, the pentachlorobiphenyls (penta-PCBs) were selected. Based on these recommendations and a review of the available data, EPA adopted this approach. Thus, based on the best scientific estimates and analysis as discussed further below, the Stage 1 TMDLs, WLAs and LAs for total PCBs were extrapolated, using a factor of 4 to 1, from TMDLs and allocations developed for penta-PCBs. EPA, the Commission and the States expect that the Stage 2 TMDLs, WLAs and LAs will be based on the summation of the PCB homolog groups, without the use of extrapolation. The partners intend that the Stage 2 TMDLs will be developed using all additional data collected and modeling performed after the establishment of these TMDLs. It is anticipated that the Stage 2 WLAs will be based upon an enhanced allocation methodology. When they are developed and established, the partners expect that the Stage 2 TMDLs will replace the Stage 1 TMDLs.

The TMDLs were calculated using both a conservative chemical model and a penta-PCB water quality model run until equilibrium was observed. This procedure was used because hydrophobic contaminants like PCBs sorb to particulates and interact significantly with the sediments of the estuary. Sediments respond more slowly than the water column to changes in PCB concentrations in either medium, and allowing the water column and sediments to come into equilibrium is necessary to ensure that water quality criteria are met. A modified version of the TOXI5 water quality model was used (DRBC 2003a and 2003b). Both models utilized outputs from a DYNHYD5 hydrodynamic model that was extended from the head of the Delaware Bay to the mouth of the bay (DRBC 2003a). The models cycled inputs from the period February 1, 2002 until January 31, 2003. This one-year period was considered to be representative of long-term hydrological conditions for two important reasons. First, during this period flows of the two main tributaries to the estuary – the main stem Delaware River and the Schuylkill River – reasonably represent the flows during the approximately 90- and 70-year periods of record, respectively, for the two tributaries (see Figures 5 and 6). Precipitation data during the one-year period also is in good agreement with the long-term precipitation record with respect to the number and percentage of days with and without precipitation. Upon the recommendation of the expert panel, in order to maintain hydrological and meteorological relationships between the various inputs to the model, effluent flows were based upon data for the same one-year period, rather than on design flows. The same approach was used for inputs such as air temperature, water temperature and wind speed.

Penta-PCB TMDLs were calculated in a four step procedure. The procedure initially utilized the conservative chemical model to establish contribution factors for two of the major tributaries to the estuary – the Delaware River at Trenton and the Schuylkill River – and each of the four estuary zones. The contribution factor reflects the influence of the loading attributable to each tributary or zone on the PCB concentration at the critical location in Zone 5 where the water quality criterion for PCBs drops from 44.4 picograms per liter to 7.9 picograms per liter. If the criterion at this location is met, then the water quality criteria are met throughout the estuary. Once the contribution factors were established, the TMDLs were calculated over a one-year period to determine an annual median loading. The annual median was used in order to be consistent with the model simulations and the 70-year exposure for human health criteria. A description of the four steps follows:

1. Calculate the contribution factor (CF) for each of the estuary zones and two of the tributary model boundaries to that critical location in Zone 5 where the criterion of 7.9 picograms per liter (approximately 2.0 picograms per liter of penta-PCBs) is controlling.

2. Calculate the allowable loadings from each of these sources that will still ensure that the water quality target is met at the critical location utilizing the CF and the proportion of the assimilative capacity at the critical location allocated to each source. Iteratively determine the amount of assimilative capacity (in picograms per liter) provided by the sediments, and add this concentration to the penta-PCB water quality target. Recalculate the allowable loadings from each of the six sources using this revised water quality target.

3. Utilize the water quality model for penta-PCBs with these allowable loadings to confirm that the sediment concentrations have reached pseudo-steady state, and confirm that the penta-PCB water quality target is met in Zones 2 through 5.

4. Estimate the gas phase concentrations that would be in equilibrium with the penta-PCB water concentrations when the water quality targets are met, include these in the water quality model, and then iteratively adjust the gas phase concentration of penta-PCBs in the air until the water quality target is reached.

For purposes of calculating the TMDLs, EPA notes that the model assumes that PCB loads from the ocean, the C&D Canal, the major tributaries and the air are at levels that ensure that the water quality standards are achieved, rather than at the actual levels, which in every case are higher. Thus, in developing the TMDLs, both the ocean boundary and the C&D Canal boundary were set to an equivalent penta-PCB criterion of 2.0 picograms per liter, corresponding to a total PCB water quality criterion of 7.9 picograms per liter, the criterion in lower Zone 5 where each of these water bodies meets the estuary. Other programs and factors beyond the scope of these TMDLs will be necessary to reduce PCB loads from these sources. The actual concentration at the mouth of the Bay exceeds the water quality criterion by one to two orders of magnitude, while the current concentration at the C&D Canal boundary exceeds this value by almost three orders of magnitude. Similarly, the Schuylkill and Delaware River boundary conditions were set to 9.68 picograms per liter and 10.72 picograms per liter respectively, although the actual concentrations in the two water bodies at the point where they enter the estuary are 1800 and 1600 picograms per liter respectively. The air concentration of PCBs also is considered by the model. When water quality standards are achieved, however, there will be no significant net exchange between dissolved PCBs in water and gas phase PCBs in the air. Because gas phase PCBs do not provide a load to the estuary when the water quality standards are met, they are not allocated any portion of the TMDLs. Actual air concentrations in the estuary region, however, currently exceed the levels required for equilibrium by two orders of magnitude.

The TMDLs for penta-PCBs calculated with the four-step procedure were 64.34 milligrams per day for Zone 2, 4.46 milligrams per day for Zone 3, 14.18 milligrams per day for Zone 4, and 12.02 milligrams per day for Zone 5. The higher TMDLs in Zones 2 and 4 are the result of the assimilative capacity provided by the flows from the main stem Delaware River in Zone 2 and the Schuylkill River in Zone 4.

Each of the zone TMDLs was then apportioned into three components: the WLA, LA and MOS. EPA has based these allocations upon recommendations of the Commission's TAC. The committee recommended that an explicit MOS of 5% be allocated in each estuary zone, and further recommended that for the Stage 1 TMDLs, the proportion of the TMDLs allocated to WLAs and LAs should be based upon the current proportion of loadings from the various PCB source categories to each of the zones during the one-year cycling period of February 1, 2002 to January 31, 2003.

Stage 1 TMDLs were then calculated using the ratio of penta-PCBs to total PCBs observed in ambient water samples collected during five surveys that encompass the range of hydrological conditions typically observed in the estuary. Median penta- to total PCB ratios of 0.23, 0.25, 0.25 and 0.23 were observed in Zones 2 to 5, respectively. For these TMDLs, a fixed value of 0.25 was used for all zones to scale up the zone-specific TMDLs, WLAs, LAs and MOSs. The following table summarizes the TMDLs for each estuary zone for total PCBs as well as the allocations to WLAs, LAs and the MOSs.

Stage 1 TMDLs for Total PCBs

Estuary Zone	TMDL	WLA	LA	MOS
	mg/day	mg/day	mg/day	mg/day
Zone 2	257.36	11.03	233.46	12.87
Zone 3	17.82	5.67	11.26	0.89
Zone 4	56.71	6.54	47.34	2.84
Zone 5	48.06	15.62	30.04	2.40
Sum	379.96	38.86	322.10	19.00

In the proposed PCB TMDLs, the LAs contained the loadings from municipal separate storm sewer systems (MS4s), which are regulated as NPDES point sources. Loadings from MS4s are now identified and included as part of the WLAs with the LAs adjusted accordingly.

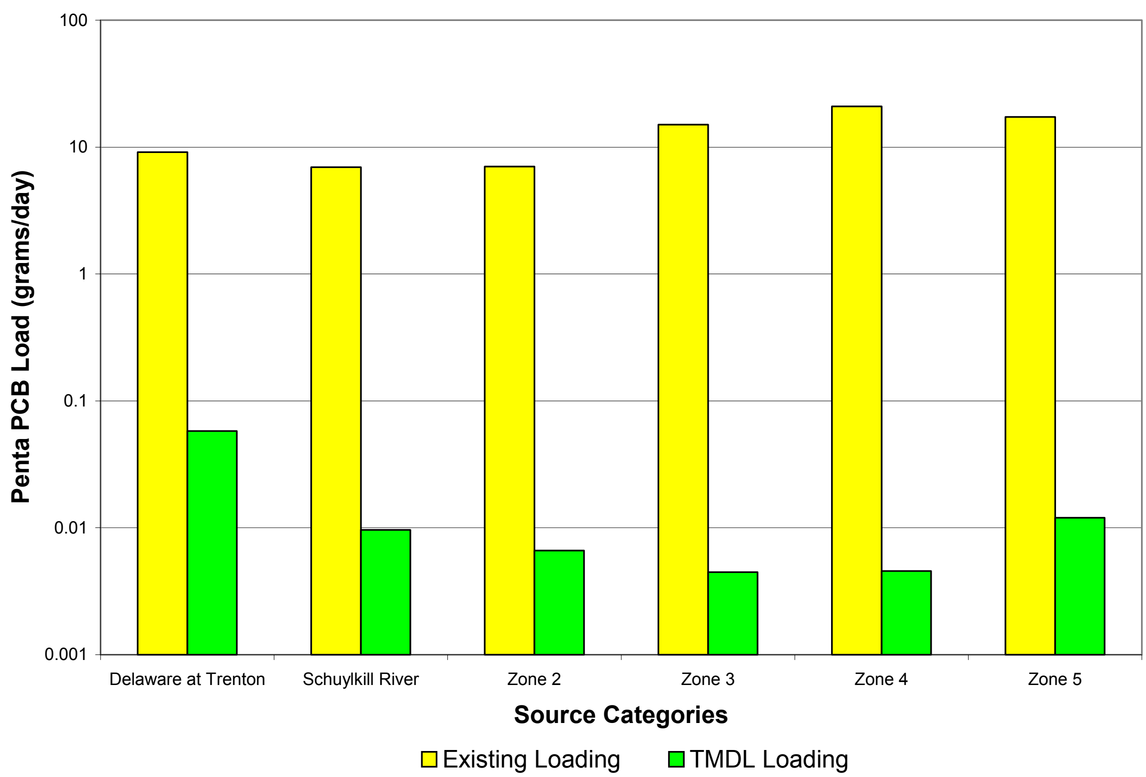
The portion of the TMDLs allocated to non-point sources is higher than the portion of the TMDLs allocated to point sources in all four estuary zones when the current loading proportions are used as the basis for allocating the zone TMDLs. This result is not unexpected. Nonpoint sources include, among other sources, contaminated sites, non-point source runoff, and the two main tributaries, which contribute greater loadings to the zones than the NPDES discharges (including stormwater discharges and combined sewer overflows) that comprise the point source contributions. The proportions vary between zones, with Zones 3 and 5 having the highest allocations to point sources (approximately 30%).

Implementing Load Reductions to Achieve the TMDLs

The following figure compares the current penta-PCB loadings for water quality management Zones 2 through 5 and the Delaware and Schuylkill Rivers to the Stage 1 TMDL penta-PCB loadings:

The chart illustrates that existing loadings are roughly two to three orders of magnitude higher than the TMDLs. Achieving the water quality standards for PCBs in the Delaware Estuary will require significant reductions from current loadings from both point and nonpoint sources. In addition to reducing PCB loads from sources discharging directly to the estuary, reductions from sources in the non-tidal portion of the river, local and regional air emissions, and sources contributing to elevated PCB concentrations in the Atlantic Ocean will be necessary to achieve and maintain the applicable PCB standards and adequately protect human health.

These TMDLs focus on the instream conditions which need to be met to protect human health and establish individual wasteload allocations (WLAs) for 142 point sources that are deemed to be potential sources of penta-PCBs (see Appendix 2). In order to begin to implement these TMDLs, the NPDES permitting authorities believe that it is appropriate for these discharges to receive non-numeric water quality-based effluent limits (WQBELs) consistent with their



respective individual WLAs when their NPDES permits are reissued or otherwise modified.[1] The Delaware River Basin Commission may also separately require actions to implement these TMDLs. On December 3, 2003, the DRBC passed Resolution 2003-27 authorizing and directing the Executive Director to require dischargers and other responsible parties to conduct monitoring and/or other data collection and analyses to further characterize point and non-point loadings of toxic contaminants, including PCBs, to the Delaware Estuary for purposes of developing and implementing TMDLs or actions under the DRBC Water Quality Regulations. Requirements in NPDES permits or through DRBC regulations may include: (1) the use of Method 1668A, a highly sensitive analytical method capable of detecting very small amounts of PCBs, for any monitoring of influent and effluent to better quantify individual PCB congeners; (2) the development of a PCB minimization plan; and (3) implementation of appropriate PCB minimization measures identified through PCB minimization planning. The respective NPDES permitting authorities will determine the discharge-specific effluent controls consistent with the WLAs, and may consider the following factors: the relative loading of penta-PCBs, the type of discharge, the type of analytical method used to measure the 19 penta-PCB congeners, the number of the penta-PCB congeners that were detected, and the proportion of the zone WLA that is represented by the discharge loading. When Stage 2 TMDLs are issued, it is expected that all NPDES permits issued, reissued or modified will include numeric or non-numeric requirements consistent with the Stage 2 WLAs for each zone. The implementation strategy for the development of NPDES permit effluent limits consistent with the WLAs is discussed at greater length in Appendix 3 of this report.

Reducing point source discharges alone will not be sufficient to achieve the estuary water quality standards. Runoff from contaminated sites is a significant source of PCBs. For these TMDLs, EPA and the states evaluated forty-nine contaminated sites within the estuary watershed (see Appendix 4). The combined loads from these sites are estimated to comprise 57.09% of the loading to Zone 3; 38.04% of the loading to Zone 4 and 46% of the loading to Zone 5 (see Table 7). Contaminated sites make up a much smaller proportion of the loading in Zone 2 – only 0.42% – because of the lack of contaminated sites and the significant influence in this zone of the main stem Delaware River. In order to achieve the reductions required by the TMDLs, EPA and the States would need to undertake a concerted effort using the authorities under CERCLA, RCRA and the related state statutes.

Significant reductions will be required in point and nonpoint sources to the major tributaries. Currently, concentrations of PCBs in the Schuylkill and Delaware Rivers where they discharge to the estuary are approximately 1800 and 1600 picograms per liter, respectively. Even if all the TMDLs are achieved, the water quality criteria in the estuary will not be attained until the

[1]The States have indicated that a typical permit will include, among other requirements, the requirement to monitor the discharge using Method 1668A and to implement a PCB pollutant minimization program. The regulation at 40 CFR 122.44(k) allows the use of non-numeric, BMP-based WQBELs where a BMP is determined to be an appropriate means to control pollutants under specified circumstances. Where a permit uses such BMP WQBELs, compliance may be achieved by implementing such requirements.

concentration in the Schuylkill is reduced to 9.68 picograms per liter and the concentration in the main stem Delaware River falls to 10.72 picograms per liter.

Although the ocean boundary has a less significant influence on Zone 5 than does the main stem Delaware River, sources contributing to elevated PCB concentrations in the Atlantic Ocean also must be reduced. The concentration of PCBs in ocean water at the estuary boundary currently exceeds the water quality criterion for Delaware Bay by one to two orders of magnitude.

Finally, air concentrations of PCBs in the region currently are two orders of magnitude above the concentration required to achieve equilibrium and halt contributions of PCBs from the air to the water. Air monitoring data collected at several sites in New Jersey, Delaware and Pennsylvania suggest that PCB air concentrations primarily result from local sources. Thus, source reductions must focus on PCBs in the local and regional airshed.

These reductions cannot be achieved overnight. The Commission has created a TMDL Implementation Advisory Committee (IAC), with members from each of the estuary states, the major municipal dischargers and two of the smaller ones, industrial dischargers, and fishery, wildlife and environmental organizations. EPA Regions II and III also will participate, in an advisory role. The IAC will meet over a two-year period to develop creative and cost-effective strategies for achieving load reductions in the short term and attaining water quality standards in the longer term. Notably, some large dischargers already have undertaken studies to track down PCBs on a voluntary basis. However, due to the scope and complexity of the problem that has been defined through development of these TMDLs, achieving the estuary water quality standards for PCBs will take decades.

Additional Information

A notice about the proposed TMDLs for PCBs in the Delaware Estuary was published in the *Federal Register* and in each of the estuary states' registers on September 2, 2003. Additional notices were published in regional newspapers. The notices contained details about the comment period which closed on October 21, 2003, informational meetings and the public hearing for these TMDLs. Details about these events were also provided on the Commission's web site, at http://www.drbc.net. EPA received oral testimony from 8 groups or individuals and written comments from 30 groups or individuals from various sectors. After consideration of all data and information contained in the public comments, a document providing responses to these public comments has been prepared and appropriate revisions made to these final TMDLs.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Regulatory Background

Total Maximum Daily Loads or TMDLs are one of the approaches defined in the Clean Water Act (CWA) for addressing water pollution. The first approach of the CWA that was implemented by the U.S. EPA was the technology-based approach to controlling pollutants (Section 301). This approach was implemented in the mid-1970s through the issuance of permits authorized under Section 402 of the Act. The approach specified minimum levels of treatment for sanitary sewage and for various categories of industries. The other water quality-based approach was implemented in the 1980s. This approach includes water quality-based permitting and planning to ensure that standards of water quality established by States are achieved and maintained.

Section 303(d) of the Act establishes TMDLs as one of the tools to address those situations where the technology-based controls are not sufficient to meet applicable water quality standards for a water body (U.S. EPA, 1991). They are defined as the maximum amount of a pollutant that can be assimilated by a water body without causing the applicable water quality standard to be exceeded. The basis of a TMDLs is thus the water quality standard. This standard may be established for the protection of aquatic life, human health through ingestion of drinking water or resident fish, or wildlife. Under Section 303(d), States are required to identify, establish a priority ranking, and to develop TMDLs for those waters that do not achieve or are not expected to achieve water quality standards approved by the U.S. EPA. Federal regulations implementing Section 303(d) of the Clean Water Act provide that a TMDL must be expressed as the sum of the individual wasteload allocations for point sources (WLA) plus the load allocation for nonpoint sources (LA) plus a margin of safety (MOS). This definition may be expressed as the equation:

$$TMDL = WLA + LA + MOS$$

1.2 Study Area

Zones 2 through 5 of the Delaware River (Figure 1) have been designated by the Delaware River Basin Commission as that section of the mainstem of the Delaware River and the tidal portions of the tributaries thereto, between the head of Delaware Bay (River Mile 48.2) and the head of the tide at Trenton, New Jersey (River Mile 133.4). Zones 2 to 4 are bordered by the State of New Jersey and the Commonwealth of Pennsylvania. Zone 5 is bordered by the States of Delaware and New Jersey. Zone 2 encompasses the area from the head of the tide at Trenton to River Mile 108.4. Zone 3 encompasses the area from River Mile 108.4 to River Mile 95.0. Zone 4 encompasses the area from River Mile 95.0 to River Mile78.8, and Zone 5 encompasses the area from River Mile 78.8 to the head of Delaware Bay.

In 1989, the Delaware River Basin Commission created the Estuary Toxics Management Program to address the impact of toxic pollutants in the tidal Delaware River (also called the Delaware Estuary. The mission of this program was to develop policies and procedures to control the discharge of substances toxic to humans and aquatic biota from point sources discharging to this water body. In 1993, Commission staff identified several classes of pollutants and specific chemicals that were likely to exceed water quality criteria currently being developed under the program. These included polychlorinated biphenyls (PCBs), volatile organics, metals, chlorinated pesticides, chronic toxicity and acute toxicity. This list was subsequently included in the Delaware Estuary Programs's Comprehensive Conservation and Management Plan in 1996.

Beginning in the late 1980's, concern regarding the possible contamination of fish populations that were rebounding as dissolved oxygen levels improved resulted in a number of investigations of contaminant levels in resident and anadromous fish species. These species included the white perch, channel catfish and striped bass. The studies subsequently identified PCBs and several chlorinated organics at elevated levels (DRBC, 1988; Greene and Miller, 1994; Hauge et al, 1990; U.S. F&WS, 1991 and 1992). These studies and other data collected by DRBC and the states resulted in fish consumption advisories being issued by all three states bordering the Estuary beginning in 1989. These advisories were principally based upon PCB contamination; and to a lesser degree, chlorinated pesticides such as DDT and its metabolites DDE and DDD, and chlordane.

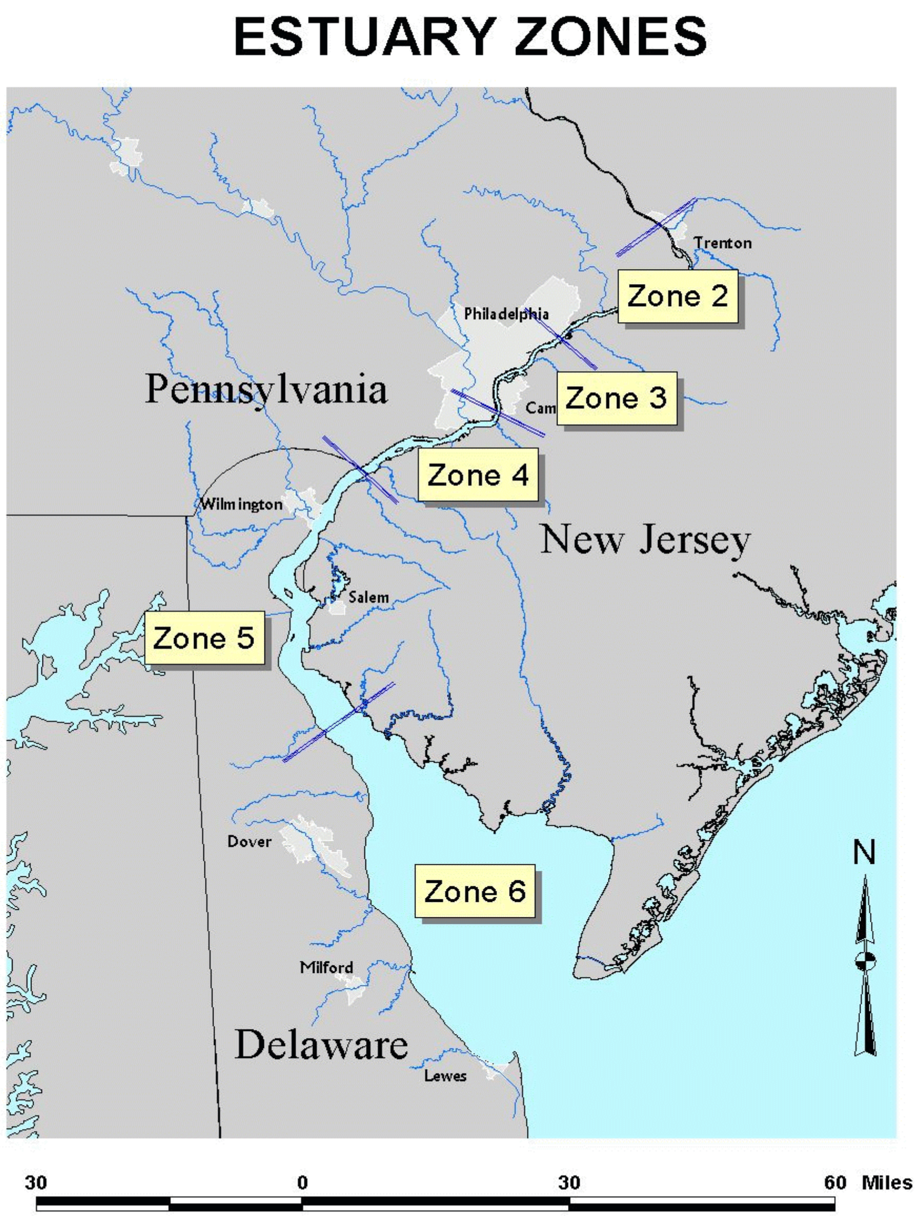
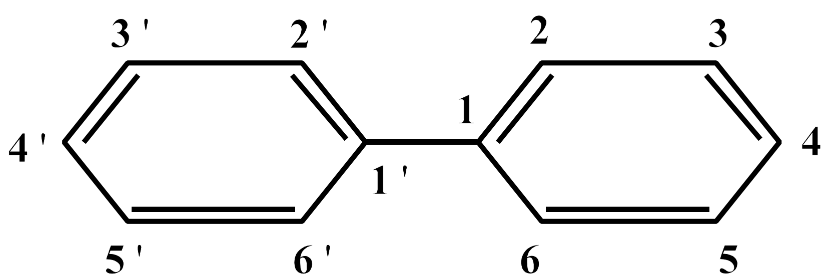


Figure1: Water Quality Zones of the Delaware River.

1.3 Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a class of man-made compounds that were manufactured and used extensively in electrical equipment such as transformers and capacitors, paints, printing inks, pesticides, hydraulic fluids and lubricants. Individual PCB compounds called congeners can have up to 10 chlorine atoms on a basic structure consisting of two connected rings of carbon atoms. There are 209 possible patterns where chlorine atoms can occur resulting in 209 possible PCB compounds. PCB compounds can be grouped by the number of chlorine atoms attached to the carbon rings. These groups are called homologs. PCB compounds containing five chlorine atoms, for example, are referred to as the pentachlorobiphenyls or penta-PCBs.



Although their manufacture and use were generally banned by federal regulations in the late 1970s, existing uses in electrical equipment and certain exceptions to the ban were allowed. In addition, PCBs may also be created as a by-product in certain manufacturing processes such as dye and pigment production. PCBs are hydrophobic, sorbing to organic particles such as soils and sediments and concentrating in the tissues of aquatic biota either directly or indirectly through the food chain.

1.4 Applicable Water Quality Standards and Numerical Target for TMDLs

Water quality criteria for toxic pollutants including Total PCBs were adopted on October 23, 1996 by the Commission and are included in Section 3.30 of Article 3 of the Commission's water quality regulations. The criteria do, however, differ between the zones of the estuary depending on the designated uses of the zone. In Zones 2 and 3, use of the water for public water supply after reasonable treatment is a designated use. In these two zones, human health criteria are based upon exposure to PCBs through ingestion of water and fish taken from these estuary zones. In Zone 4 and upper Zone 5 (above River Mile 68.75), use of the water for public water supply is not a designated use. In these two zones, human health criteria are based solely upon exposure to PCBs through ingestion of fish taken from these estuary zones. Current DRBC criteria assume a consumption rate of 6.5 grams per day (~½ pound meal every 35 days) is used in Zones 2, 3, 4, and the upper portion of Zone 5. This rate was the default national rate for freshwater fish consumption utilized in EPA's 1980 methodology for deriving human health criteria, and was used by the States in developing their freshwater water quality criteria. A consumption rate of 37.0 grams per day (~½ pound meal every 6 days) is used in the lower portion of Zone 5. This consumption rate is consistent with the rate utilized by the State of Delaware following a recent evaluation of available information on consumption rates.

Although criteria to protect aquatic life from acute and chronic effects of PCBs and criteria to protect human health from the carcinogenic and non-carcinogenic of PCBs were adopted, the most stringent standards adopted were based upon protecting human health from the carcinogenic effect of PCBs through ingestion of water and fish taken from these estuary zones (Table 1). The applicable DRBC water quality criteria are therefore:

Table 1: DRBC Water Qaulity Criteria for Zones 2 to 5 of the Delaware Estuary

Estuary Zone	**Exposure Route**	
	Water & Fish Consumption	Fish Consumption Only
Zone 2 & 3	44.4 picograms per liter	
Zone 4 and upper Zone 5		44.8 picograms per liter
Lower Zone 5		7.9 picograms per liter

These criteria are currently the same as criteria adopted by State of New Jersey and the Commonwealth of Pennsylvania. The DRBC criteria for the lower portion of Zone 5 is also the same as the water quality criteria adopted by the State of Delaware; however, a slightly higher and therefore less stringent criteria was adopted for the upper portion of Zone 5.

As part of the effort to establish TMDLs for total PCBs and to update adopted water quality standards based upon new information, the Commission's Toxic Advisory Committee did consider adopting wildlife criteria for total PCBs and revising the human health criteria for carcinogens. The latter was necessitated by two actions by the U.S. Environmental Protection Agency: the updating of the cancer potency factor (i.e., slope factor), one of the key elements used to calculate the criterion, in December 1998 (U.S. EPA, 1998); and the issuance of revised guidance on developing human health water quality criteria in October 2000 (U.S. EPA, 2000). In February 2003, the Toxics Advisory Committee recommended adoption of a revised human health criterion for carcinogens Zones 2 through 5, and that the NJ state-wide water quality criterion for total PCBs for the Delaware Estuary (Zones 2 though 6) for the protection of wildlife be adopted following the impending adoption by the New Jersey Department of Environmental Protection. Refinement of the wildlife criterion based upon site-specific data could then proceed. The Committee also recommended that the Commission consider alternatives to the current risk level of 10^{-6} (another element in the calculation of the human health criterion for carcinogens). On March 19, 2003, the Commission passed a resolution authorizing public participation of the revised human health criteria for carcinogens and directing the Toxics Advisory Committee to initiate development of site-specific wildlife criteria for Zones 2 through 6 of the Delaware River. Since the basis for the TMDLs could be affected by criteria adoption by either the NJDEP or the DRBC, and the TMDLs must be based on the water quality criteria in force when the TMDL is approved, the Commission further directed that the Commission's Executive Director request U.S. Environmental Protection Agency Regions II and II to identify which criteria should be the basis for the TMDLs at this time. In a letter dated April 16, 2003, both U.S. EPA regional offices indicated that the current and applicable DRBC water quality criteria should be the basis for the TMDLs being developed by Commission staff for December 2003.

1.5 Listing under Section 303(d)

Until recently, the attainment of water quality standards for total PCBs could not be measured directly in samples of ambient water so States relied on measurements of contaminants in fish fillet samples collected from the estuary. This is possible since the amount in fish tissue is related to the water concentration by a factor known as the bioaccumulation factor or BAF. This factor accounts for the uptake and concentration of a contaminant in the tissue either directly from the water or through the target species' food chain. Current and historical concentrations of total PCBs in filet samples collected from channel catfish in Zones 2 through 5 and white perch collected in Zones 2 through 6 are shown in Figures 2 and 3. While tissue concentrations have declined since the banning in the late 1970s, current levels in both species are approximately 800 to 1000 parts per billion (ppb), two to three orders of magnitude above the level expected to occur when estuary waters are at the water quality standards for total PCBs.

New Jersey was the first state to issue an advisory recommending no consumption of channel catfish in 1989. This was followed in 1990 by Pennsylvania who recommended no consumption of white perch, channel catfish and American eel caught between Yardley, PA above Trenton to the Pennsylvania/Delaware border.

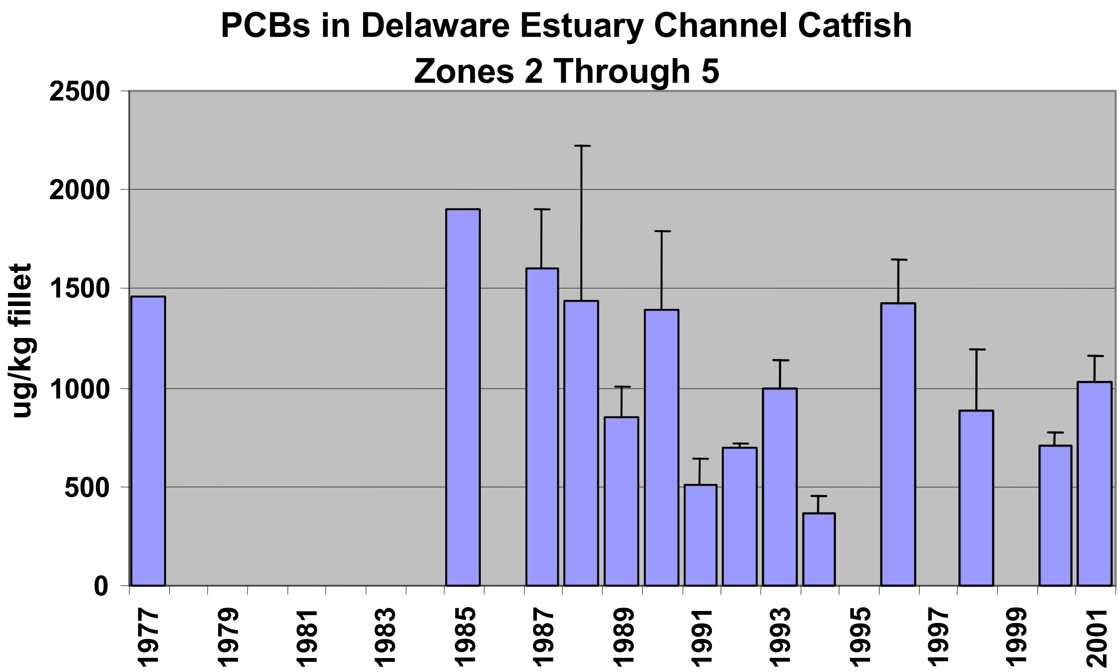


Figure 2: PCB concentrations in fillet samples of channel catfish collected from Zones 2 through 5 of the Delaware Estuary from 1977 to 2001. Units are in micrograms per kilogram or parts per billion (ppb). Graphs provided by Richard Greene, Delaware DNREC.

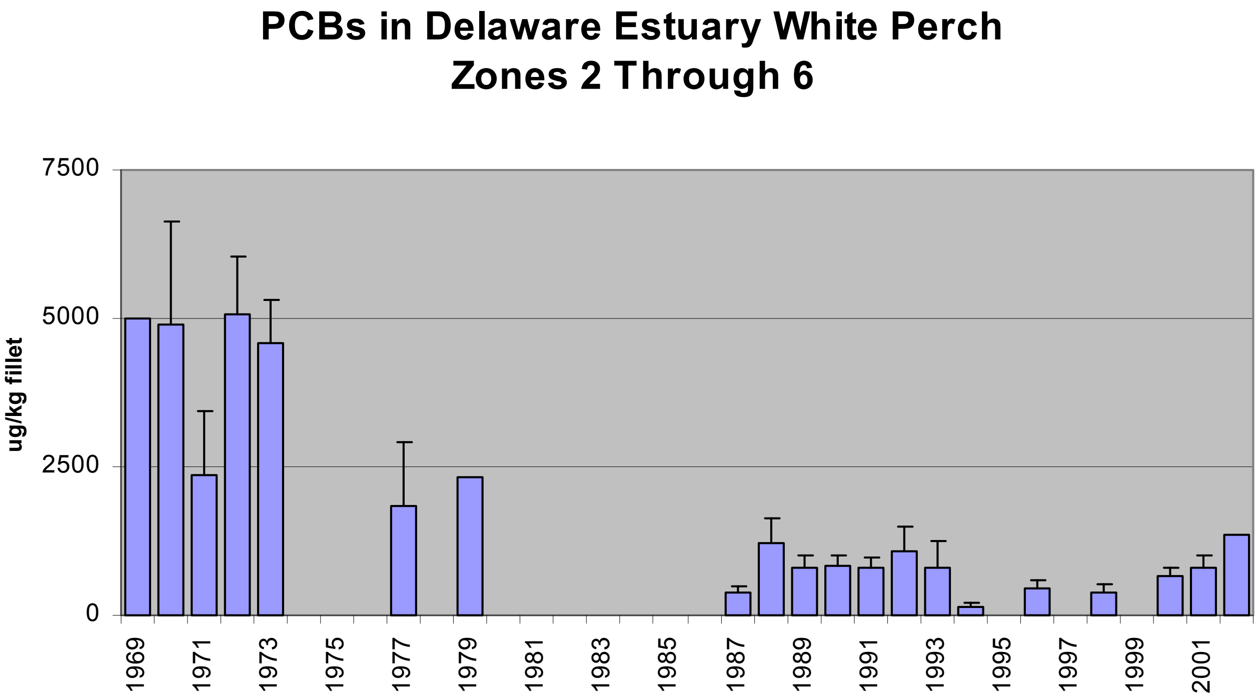


Figure 3: PCB concentrations in fillet samples of white perch collected from Zones 2 through 6 of the Delaware Estuary from 1977 to 2001. Units are in micrograms per kilogram or parts per billion (ppb). Graphs provided by Richard Greene, Delaware DNREC.

After conducting additional sampling in the lower tidal river, Delaware issued an advisory in 1994 recommending no consumption of striped bass, white perch, channel catfish and white catfish caught between the Pennsylvania/Delaware border and the Chesapeake and Delaware Canal (C&D Canal). These advisories remained essentially unchanged until 1999, when Pennsylvania recommended limited consumption (one meal per month) of white perch and striped bass, and one meal every two months for channel catfish in the same advisory area. Delaware meanwhile, increased the restrictions on consuming fish caught between the Pennsylvania/Delaware border and the C&D Canal to all fish species, and reduced the recommended consumption of striped bass, white perch, white catfish, channel catfish and American eel to one meal per year. In January 2003, New Jersey issued updated state-wide and water body-specific advisories due to PCB contamination that included Zones 2 through 5. These advisories contained recommended meal frequencies for two levels of lifetime cancer risk (10^{-5} and 10^{-6}), and for high risk individuals (children, infants, pregnant or nursing women, and women of child-bearing age). Recommended consumption (at a risk level of 10^{-6}) of channel catfish in Zones 2 to 4 is 6 meals per year while no consumption of striped bass in Zone 4 and all finfish in Zone 5 is recommended.

The New Jersey Department of Environmental Protection subsequently included Zones 2 through 5 of the Delaware River for PCBs in a report entitled "1998 Identification and Setting of Priorities for Section 303(d) Water Quality Limited Waters in New Jersey", September 15, 1998. By Memorandum of Agreement between U.S. Environmental Protection Agency, Region II and the New Jersey Department of Environmental Protection dated May 12, 1999, the NJDEP agreed to develop, public notice, respond to comments and submit to EPA, Total Maximum Daily Loads (TMDLs) for PCBs in the Delaware Estuary by September 15, 2003. This date was subsequently extended to December 31, 2003 in a revised Memorandum of Agreement dated September 16, 2002.

The Delaware Department of Natural Resources & Environmental Control (DNREC) first listed Zone 5 of the Delaware River for toxics in 1996. In 1998, DNREC again listed Zone 5 of the Delaware River, but specifically listed PCBs as a pollutant contributing to the impairment. In Attachment B to a Memorandum of Agreement between the Delaware Department of Natural Resources & Environmental Control and the U.S. Environmental Protection Agency, Region III dated July 25, 1997, DNREC agreed to complete the TMDLs for Zone 5 by December 31, 2002 provided that funding and certain other conditions were met. The MOA also provided that EPA Region III establish the TMDLs if DNREC was unable to complete the TMDLs by the date set forth in Attachment B. In a Consent Decree between the American Littoral Society, the Sierra Club, and the U.S. Environmental Protection Agency dated July 31, 1997, the U.S. EPA agreed to establish TMDLs by December 15, 2003 of the year following the state's deadline.

In a Consent Decree between the American Littoral Society and Public Interest Group of Pennsylvania, dated April 9, 1997, EPA agreed to approve or establish TMDLs for all water quality-limited segments listed on the 1996 303(d) list as impaired by sources other than acid mine drainage by April 9, 2007. PADEP listed Zones 2 to 5 of the Delaware River (included in areas E and G of the Pennsylvania State Water Plan) for priority organics including PCBs in both 1996 and 1998. No date has been set by PADEP for completion of the TMDLs for these water quality segments. The TMDLs currently being proposed will satisfy the commitments that resulted from these listings for each respective state.

1.6 Pollutant sources, loadings and ambient data

The basis for the inclusion of Zones 2 through 5 on the Section 303(d) lists of the estuary states was the levels of PCBs observed in fish tissue collected from the estuary. This was necessary since the common analytical method used for ambient water and wastewater had detection limits for total PCBs in the 500 nanogram per liter range. New Jersey was the first state to issue an advisory recommending no consumption of channel catfish in 1989. This was followed in 1990 by Pennsylvania who recommended no consumption of white perch, channel catfish and American eel caught between Yardley, PA above Trenton to the Pennsylvania/Delaware border. After conducting additional sampling in the lower tidal river, Delaware issued an advisory in 1994 recommending no consumption of striped bass, white perch, channel catfish and white catfish caught between the Pennsylvania/Delaware border and the Chesapeake and Delaware Canal C&D Canal.

Loadings of PCBs to the estuary from point sources were first investigated by the Delaware River Basin Commission in 1996 and 1997 (DRBC, 1998a). This study utilized a new analytical methodology (high resolution gas chromatography/high resolution mass spectrometry or HRGC/HRMS) and focused on discharges from five large sewage treatment plants and one industrial facility. The results of the study found effluent concentrations ranging from 1,430 to 45,140 picograms/L during dry weather, and 2,020 to 20,240 pg/L during wet weather. The dry weather sample from the effluent of the industrial facility had a concentration of 10,270 pg/L. In the spring of 2000, the Commission required 94 NPDES permittees to conduct monitoring of their continuous and stormwater discharges for 81 PCB congeners utilizing analytical methods that could achieve picogram per liter detection limits. The results of this monitoring were submitted to the Commission over the next two years, and indicated that loadings to the estuary zones from point sources were significant and of such magnitude to cause the water quality standards to be exceeded. Figures 4 and 5 present the cumulative loadings of total PCBs from continuous point source discharges during dry weather and wet weather, respectively.

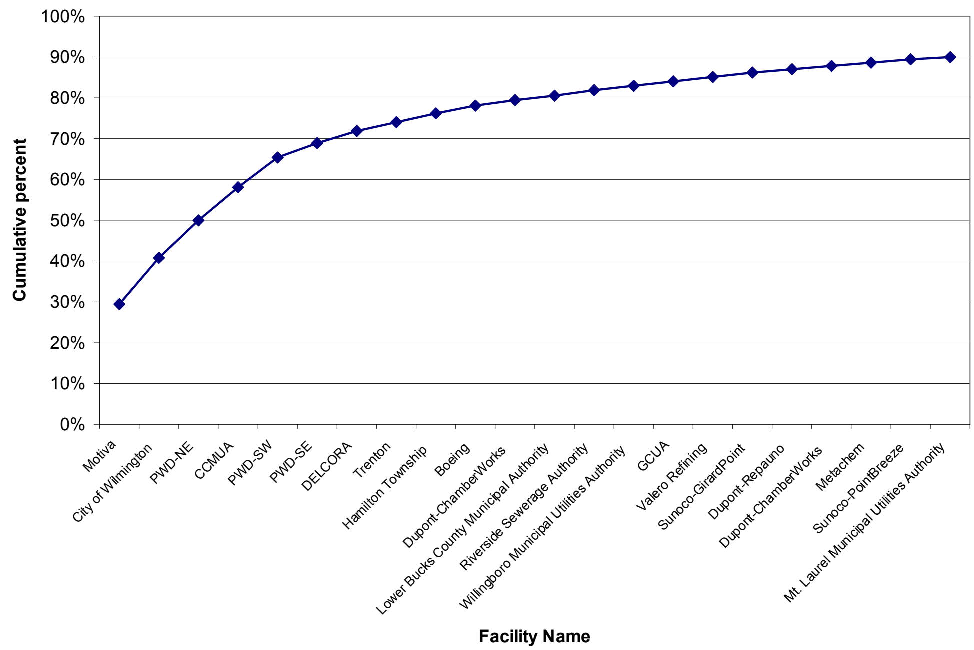


Figure 4: Cumulative loadings from continuous point source dischargers when the discharge was not influenced by precipitation (dry weather loadings).

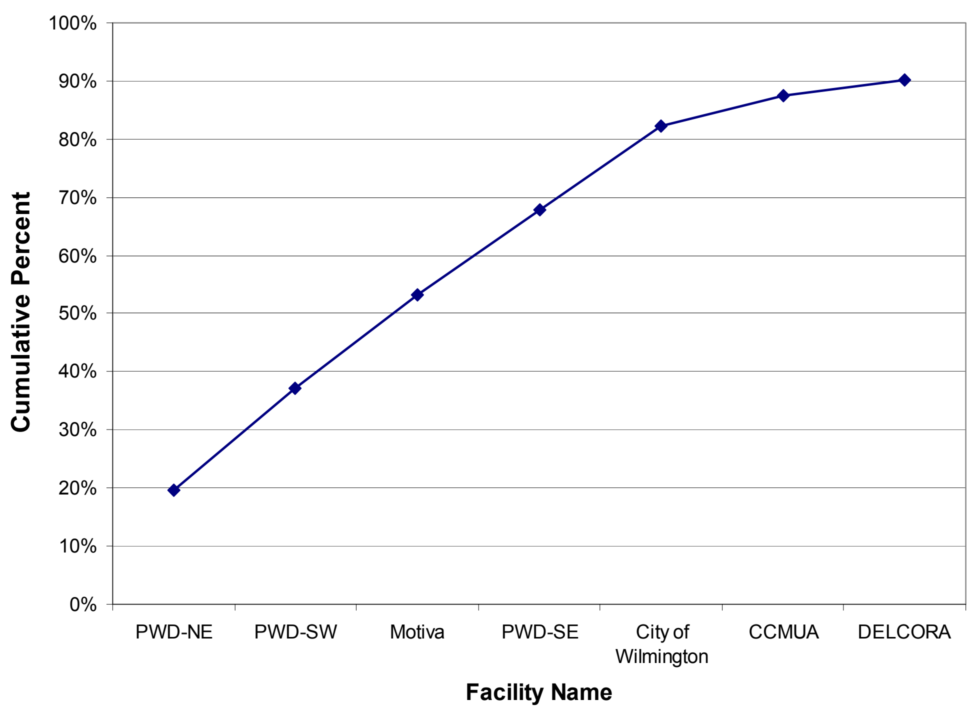


Figure 5: Loadings from continuous point source dischargers when the discharge was influenced by precipitation (wet weather loadings).

Beginning in September 2001, the Commission initiated surveys of the ambient waters of Zones 2 through 5 using the more sensitive HRGC/HRMS method (Method 1668A) and larger sample volumes to obtain data on PCBs adsorbed to particulate matter, PCBs adsorbed to dissolved organic matter and truly dissolved PCBs. Each survey involves sampling on a transect across the river at 15 locations between the C&D Canal and Trenton. A total of nine surveys have been completed to date with a focus on periods of intermediate and high inflows to the estuary. Figure 6 presents the results from surveys conducted in September 2001, May 2002, October 2002 and March 2003. Low flow conditions occurred during the September and October surveys (~3,300 cfs). Intermediate flow conditions (~16,000 cfs) occurred during the May survey, and high flow conditions (36,100 cfs) occurred during the March survey. As indicated in this graph, ambient concentrations of total PCBs based upon the sum of 124 congeners analyzed ranges between 443 and 10,136 pg/L with the highest values generally occurring during lower river inflows.

1.7 Other Required Elements for Establishing TMDLs

1.7.1 Seasonal variation

TMDL regulations at Section 130.32(b)(9) require the consideration of seasonal variation in environmental factors that affect the relationship between pollutant loadings and water quality impacts. Although seasonal variation is usually not as important for TMDLs based upon human health criteria for carcinogens since the duration for this type of criteria is a 70 year exposure, the Stage 1 TMDLs for total PCBs do include seasonal variation in several ways. Due to the interaction of PCBs with the sediments of the estuary, long-term model

.

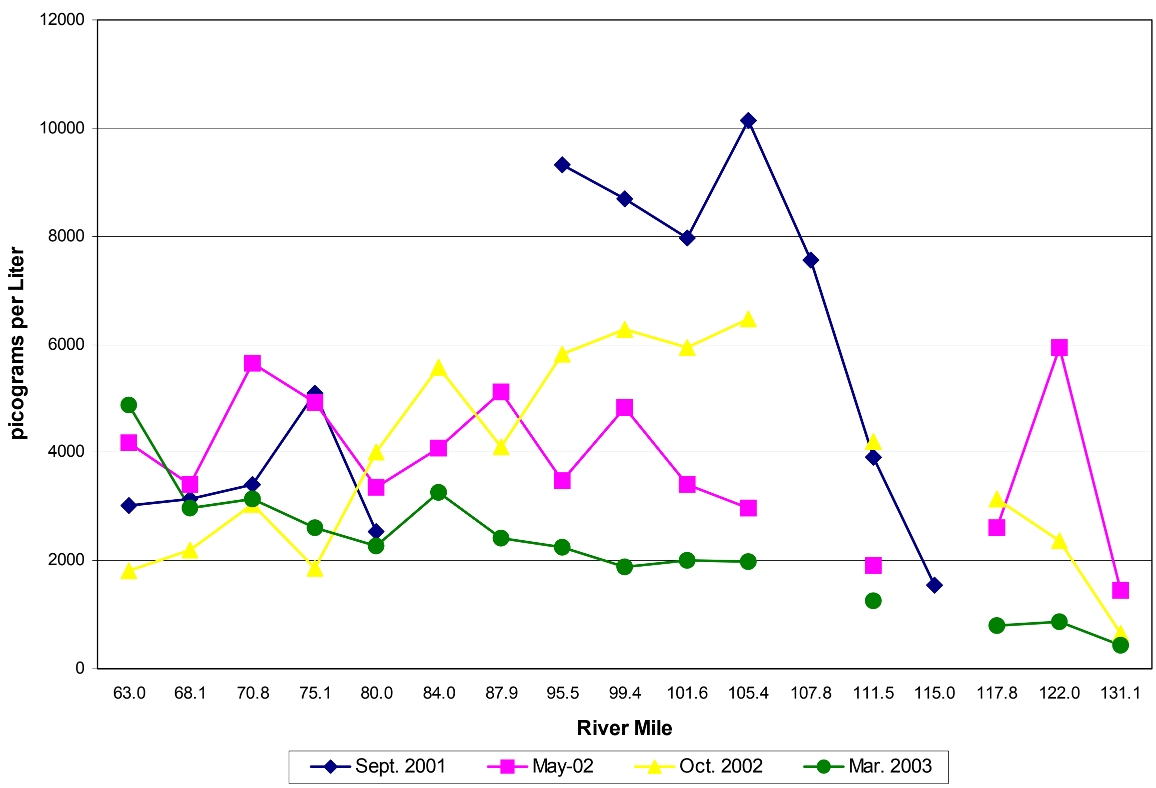


Figure 6: Concentrations of 124 PCB congeners at 15 locations in Zones 2 to 5 of the Delaware Estuary during varying flow conditions.

simulations were necessary to both confirm the model parameters established during the short-term calibration, and evaluate the time required for the sediments to reach pseudo steady-state with the overlying water column as loadings of PCBs were reduced.

The model will cycle model inputs from the period February 1, 2002 until January 31, 2003. This one year period is considered to be representative of long-term conditions (see Section 3.2.3.1), and is the same period utilized for long-term, decadal scale model simulations. Use of this one year cycling period, allowed consideration of seasonal variation in model input parameters such as tributary flows, tidal forcing functions, air and water temperature, wind velocity and loadings of penta-PCBs.

1.7.2 Monitoring Plan

The Delaware River Basin Commission has conducted nine surveys of the ambient waters of the Delaware Estuary between September 2001 and April 2003 to provide data for calibrating the water quality model for penta-PCBs that was used to establish the Stage 1 TMDLs. Samples collected during these surveys were analyzed using a more sensitive HRGC/HRMS method (Method 1668A) and larger sample volumes to obtain data at picogram per liter levels. The Commission plans to conduct additional surveys in both Zones 2 to 5 and in Delaware Bay (Zone 6) as part of the effort to calibrate water quality models for the other PCB homologs, and to establish and refine the TMDLs and associated WLAs and LAs for Stage 2. Contingent on available funding, the Commission plans to continue the ambient water surveys on a yearly basis to track the progress in achieving the load reductions and applicable water quality standards for PCBs.

In the spring of 2000, the Commission required 94 NPDES permittees to conduct monitoring of their continuous and stormwater discharges for 81 PCB congeners utilizing analytical methods that could achieve picogram per liter detection limits. The results of this monitoring indicated that loadings to the estuary zones from point sources were significant and of such magnitude to cause the water quality standards to be exceeded. These results have also be used to determine the need for and the frequency of additional monitoring in NPDES permits have been reissued in the last few years. Following approval of the Stage 1 TMDLs, most of the NPDES permittees included in the 2000 monitoring requirements will be required to conduct some additional monitoring using Method 1668A. These monitoring requirements will provided data in future years to assess the progress in achieving the TMDLs.

The Commission is also planning, contingent on available funding, to work cooperatively with the NJDEP and Rutgers University to continue air monitoring at Lums Pond near the western end of the C&D Canal and at a site in the NJ Pinelands which are located east of the estuary. Monitoring data at these sites and at a long-term site at Rutgers University will provided data to assess the long-term trends in regional background concentrations of PCBs (Lums Pond) and in regional concentrations in the estuary airshed.

1.7.3 Implementation Plan

Current EPA regulations do not require an implementation plan to be included with TMDLs. EPA NPDES regulations do require that effluent limitations must be consistent with approved WLAs [40 CFR Part 122.44(d)(1)(vii)(B)]. EPA regulations allow the use of non-numeric effluent limits in certain circumstances [40 CFR Part 122.44(K)]. In addition to EPA regulations, the Commission and its signatory parties currently have in place an implementation procedure for utilizing wasteload allocations and other effluent requirements formally issued by the Commission's Executive Director. This procedure has been in use for over 25 years with wasteload allocations for carbonaceous oxygen demand and other pollutants that were developed for discharges to the estuary. Section 4.30.7B.2.c.6). of the Commission regulations requires that WLAs developed by the Commission shall be referred to the appropriate state agency for use, as appropriate, in developing effluent limitations, schedules of compliance and other effluent requirements in NPDES permits.

As part of the implementation strategy, the NPDES permitting authorities believe that it is appropriate for 142 NPDES point source discharges to receive non-numeric WQBELs consistent with the WLAs. It is expected that the non-numeric WQBELs resulting from the Stage 1 WLAs require PCB minimization and reduction programs and additional monitoring using Method 1668A consistent with state and federal NPDES regulations. See Appendix 3 for details on the permit implications of this TMDL. These permit requirements are intended to expedite the reduction in PCB loadings to the estuary while Stage 2 TMDLs and WLAs are being completed.

A unique aspect of the implementation of these TMDLs is the establishment of a TMDL Implementation Advisory Committee (IAC)by the DRBC, which shall be asked to develop creative and cost-effective strategies for reducing PCB loadings and achieving the TMDLs for PCBs in the Delaware Estuary. The IAC will be encouraged to engage in creative, collaborative problem-solving. Its recommendations will be submitted to the Commission, which will consider them in consultation with all regulatory agencies whose approval is required to implement them. Each regulatory agency also will be represented on the IAC. The committee is expected to convene six times a year for two years.

1.7.4 Reasonable Assurance that the TMDLs will be Achieved

Data available to assess whether the TMDLs will be achieved include ambient water quality data collected by the Commission during routine surveys of Zones 2 through 6 of the Delaware River. Effluent quality data and source minimization plans required through NPDES permits issued by state permitting authorities will provide the basis for assessments regarding consistency with the WLAs developed or issued in Stage 1 and Stage 2. Commission regulations also require that the WLAs be reviewed and, if required, revised every five years, or as directed by the Commission. This will ensure that additional discharges of the pollutant or increased non-point source loadings in the future will be considered.

Achieving the reductions in the load allocations for tributaries will require the listing of the tributary on future Section 303(d) lists submitted by the estuary states for those tributaries that are not currently listed for impairment by PCBs, and completion and implementation of TMDLs for PCBs for those tributaries that are already listed as impaired by PCBs. Achieving the load reductions required for contaminated sites will require close coordination with the federal CERCLA programs and state programs overseeing the assessment and cleanup of these sites. In addition, the Commission has broad powers under Article 5 of the Delaware River Basin Compact (Public Law 87-328) to control future pollution and abate existing pollution in the waters of the basin including Section 2.3.5B of the Commission's Rules of Practice and Procedure (DRBC, 2002).

2. TWO STAGE APPROACH TO ESTABLISHING AND ALLOCATING TMDLs FOR PCBs

2.1 Background

Developing TMDLs for a complex pollutant in a complex estuarine ecosystem with numerous point and non-point sources is an enormous task requiring substantial levels of effort, funding and time. As discussed above, the deadlines contained in the Section 303(d) lists prepared by the States and approved by the U.S. EPA, Memoranda of Understanding, and Consent Decrees discussed above allocated five years for developing the TMDLs. A coordinated effort to develop the TMDLs was initiated in 2000 when Carol R. Collier, Executive Director of the Delaware River Basin Commission in a letter dated May 25, 2000 requested that U.S. EPA Regions II and III endorse the Commission as the lead agency in developing the TMDLs for PCBs in the Delaware Estuary. In a letter dated August 7, 2000, Region II endorsed the Commission's role as the lead agency to develop the TMDLs. An August 11, 2000 letter from Region III also acknowledge the important role of the Commission while identifying the legal constraints on the date for establishing the TMDLs. On July 26, 2000, the Commission passed Resolution 2000-13 stating that the Commission would continue its ongoing program to control the discharge of toxic substances, including PCBs, to the Delaware Estuary, and would work cooperatively with the signatory parties to the Delaware River Basin Compact and their agencies and affected parties in this effort.

2.2 Staged Approach

The complexity of a TMDL for a class of compounds such as PCBs, the limited time and data available, and the benefits of refining it through time with more data led to a decision to develop the TMDLs for PCBs in two stages consistent with EPA TMDL guidance. A staged approach provides for adaptive implementation through execution of load reduction strategies while additional monitoring and modeling efforts proceed. The approach recognizes that additional monitoring data and modeling results will be available following issuance of the Stage 1 TMDLs to enable a more refined analysis to form the basis of the Stage 2 TMDLs.

In the first stage, TMDLs and individual wasteload allocations were developed for each zone. Stage 1 WLAs were based upon a simplified methodology, while still meeting all of the regulatory requirements for establishing a TMDL. Consistent with the recommendations of an expert panel of scientists experienced with PCB modeling, these TMDLs were extrapolated from penta homolog data using the observed ratio in the Delaware Estuary of the penta homolog to total PCBs (see Section 3.4).

Stage 2 TMDLs, individual WLAs and LAs are targeted for development by December 31, 2005. Once the Stage 2 TMDLs are finalized, EPA expects the WLAs developed in Stage 2 to replace the Stage 1 WLAs. EPA expects the Stage 2 WLAs and LAs to be based on all of the monitoring data obtained through the development of the Stage 2 TMDLs, and the additional modeling that will be performed following the establishment of the Stage 1 TMDLs. Stage 2 TMDLs will also be based on the summation of the PCB homolog groups, without the use of extrapolation. It is anticipated that the Stage 2 WLAs will be based upon a more sophisticated allocation methodology than the Stage 1 WLAs, and will likely reflect application of the procedures set forth in the DRBC Water Quality Regulations.

As described in the documents released in April 2003 (Appendix 1) and following establishment of these TMDLs, the water quality-based effluent limitations (WQBELs) in NPDES permits that are issued, reissued or modified after the approval date must be consistent with the WLAs. The NPDES permitting authorities believe that these WQBELs will include non-numeric controls in the form of a best management practices (BMP) approach as the most appropriate way to identify and control discharges of PCBs consistent with the Stage 1 WLAs. Federal regulations (40 CFR Part 122.44(k)(4)) allow the use of non-numeric, BMP-based WQBELs in permits.

Guidelines describing appropriate NPDES permitting actions resulting from individual WLAs that may result following the establishment of the Stage 1 TMDLs by the U.S. Environmental Protection Agency are presented in Appendix 3. The guidelines include 1) the use of Method 1668A for any monitoring of the wastewater influent and effluent at a facility, 2) development of a PCB minimization plan, and 3) implementation of appropriate, cost-effective PCB minimization measures identified through the plan.

The identification of point source dischargers that are potentially significant sources of total PCBs is a dynamic process that depends on several factors including the availability and extent of PCB congener data for each discharge, the detection limit of the method used to analyze for PCB congeners, the flows used for each discharge, the procedure used to calculate the loadings, the location of the discharge in the estuary, and the proximity and loading of other sources of PCBs. EPA specifically requested comment on the list of significant point source dischargers, and has incorporated those comments, where appropriate, into this document (see Section 3.5). Expectations as to how the NPDES permits may appropriately address these specific WLAs can be found in Appendix 3.

An important component of the staged approach is the assessment and evaluation of options to control non-point sources of PCBs. These sources include contaminated sites (sites covered under CERCLA or RCRA), non-NPDES regulated stormwater discharges, tributaries to the estuary, air deposition, and contaminated sediments (see Section 1.4 and Appendix Tables 4-1). Addressing these sources is particularly important since contaminated sites and non-point stormwater discharges have been identified as the two largest categories of PCB loadings in this TMDL based upon current data and assessment procedures.

3. STAGE 1 APPROACH TO ESTABLISHING TMDLs

3.1 Background

TMDLs for total PCBs are estimates of the loading of the sum of all the PCB homologs that can enter the estuary and still meet the current water quality criteria. TMDLs are, by nature, abstract. They are the *projected*, not the current, loadings from all sources that should result in the achievement of water quality standards at all points in the estuary. Since current concentrations of PCB homologs are 500 times higher than the water quality criteria, the TMDLs and associated individual WLAs and LAs will be proportionately less.

In order to meet standards at all points in the estuary, some parts of the estuary will have to be less than the standard for that portion of the estuary. This is particularly true for these TMDLs in the Delaware Estuary since the water quality standards vary between the zones, and the standard in lower Zone 5 below the Delaware Memorial Bridges is approximately 5 times lower than the standards in Zones 2 to upper Zone 5 (see Section 1.4).

While simplistic approaches can be used to estimate TMDLs, significant effort has been devoted to developing and calibrating a hydrodynamic and water quality model for the Delaware Estuary to be used in establishing PCB TMDLs for this water body (DRBC, 2003a; DRBC, 2003b; DRBC, 2003c). There are several reasons why a more sophisticated approach is appropriate. These reasons include:

1. Zones 2 – 5 of the Delaware River are significantly influenced by tidal forces producing a 6 foot tidal range at Trenton, NJ and tidal excursions of up to 12 miles. The model incorporates this tidal movement in the hydrodynamic model (DRBC, 2003a).
2. PCBs are hydrophobic, sorb to dissolved, colloidal and particulate carbon, and are transported with carbon molecules and particulates associated with carbon. The model incorporates these

characteristics, partitions PCBs to each of these phases, and simulates the concentrations of the 3 phases in the estuary (DRBC, 2003b).

3. PCBs are a class of chemicals; each having different physical-chemical properties such as volatilization rate and partitioning rate. The model can incorporate these properties for each of the ten homolog groups (DRBC, 2003b).
4. There are many sources of PCBs enter the estuary at different locations in different amounts and at different times. The model can simulate the spatial and temporal nature of these sources (DRBC, 2003c).
5. A model can simulate the additional assimilative capacity provided by the burial of PCBs into the deeper layers of the estuary sediments, and the exchange of PCBs in the gas phase in the estuary airshed with the dissolved phase of PCBs in the ambient waters of the estuary (DRBC, 2003b).

3.2 Conceptual Approach

3.2.1 Guiding Principles

The TMDLs require that each source of PCBs including the sediment, air deposition meets water quality criteria by itself and in conjunction with all other sources. The procedure used to establish the TMDLs incorporates these principles by initially determining the concentration or loading from each source category followed by an assessment of the attainment of the water quality standards when loadings from all source categories are considered.

Another principle is that, when the water quality standards are met, additional loading of PCBs to the estuary is dependent on dilution by flows from other sources into the estuary, and the loss of PCBs through fate processes occurring in the estuary. Two of the source categories do not explicitly provide additional flows to the estuary and therefore do not provide assimilation capacity. The two sources are atmospheric dry deposition and gas phase transfer of PCBs, and contaminated sites. Ground and surface water flow from contaminated sites do occur, but these flows have not been adequately characterized and are not included in the current version of the penta-PCB model. As a result, the assimilative capacity for these sources must be obtained from other source categories.

All source categories and sources within categories are not created equally. Reductions in PCB loads in any source category will provide different amounts of assimilative capacity in different areas of the estuary. Figure7 illustrates this principle for the four boundaries of the penta-PCB model. In this example, each of the boundaries is set at a concentration of 100 milligrams per liter with the resulting model predicting ambient conservative chemical concentrations throughout the estuary. Of the four boundaries, the C&D Canal and the Schuylkill River have the smallest influence on conservative chemical concentrations in the estuary. This influence is also localized to the area where the source enters the estuary. The influence of the ocean boundary at the mouth of Delaware Bay appears to be limited to the Bay and the lower portions of Zone 5 (up to approximately River Mile 65). The Delaware River at Trenton, however, has a significant influence on the estuary conservative chemical concentrations from Zone 2 through Zone 5. Reductions in PCB loadings from the Delaware River at Trenton will therefore provide substantially more assimilative capacity in a larger area of the estuary.

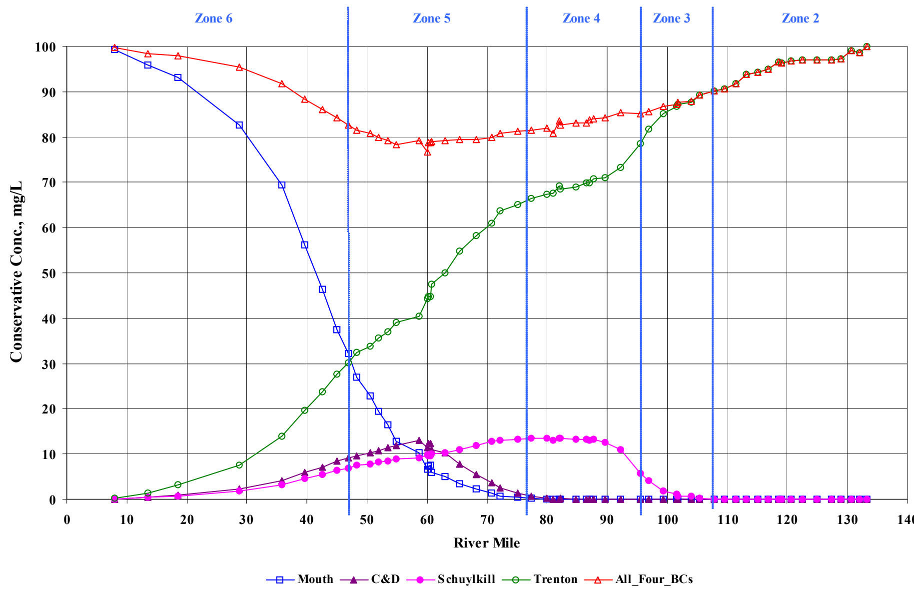


Figure 7: Relative impact of the four boundaries when the conservative chemical concentrations are set at 100 milligrams per liter.

Estuary sediments function as a sink or loss mechanism for PCBs through burial of PCBs that settle to the bottom of the estuary. This small (<1 cm/year) net deposition of particulates provides additional assimilation capacity in the estuary, and is incorporated in the calculation of the TMDLs for each of the zones.

Recent monitoring of air concentrations in the regional airshed surrounding the Delaware Estuary indicate that PCB concentrations are particularly high in the Philadelphia-Camden area, and contribute PCBs to the estuary through dry and wet deposition, and exchange of PCBs in the gas phase (Van Ry et al, 2002 and Figure 8). While the proportional loading of PCBs from dry and wet deposition is explicitly included in the load allocation portion of the TMDLs, the transfer of PCBs in the gas phase with dissolved PCBs in the estuarine waters is not since there will be no significant net exchange between dissolved PCBs in water and gas phase PCBs in the air (i.e., they will reach equilibrium) when water quality standards are achieved. The modeling approach used to develop the TMDLs takes this into account by setting the gas phase air concentrations at the equilibrium concentrations (see Section 3.3.1 and 3.3.5).

The difference between the current gas phase concentrations and the gas phase concentrations when the estuary meets standards, is a significant TMDL implementation issue since water quality standards will not be achieved without reducing the gas phase concentrations to a level where they are in equilibrium with the dissolved PCB concentrations at the water quality standard. Figure 8 illustrates the relative difference between the current gas phase air concentration of penta-PCBs in Zone 3 and the gas phase concentration at equilibrium with the dissolved penta-PCB concentrations when the TMDL is achieved.

Finally, the boundaries of the model which include the head of tide of the tributaries, the C&D Canal, and the mouth of Delaware Bay were assigned concentrations of penta-PCBs in determining the TMDLs and establishing WLAs. Section 4.20.4B.1 of the Commission's Water Quality Regulations specify that in establishing WLAs, the concentrations at the boundaries of the area of interest shall be set at the lower of actual data or the applicable water quality criteria (DRBC, 1996). Thus for modeling purposes, tributaries or other boundaries cannot exceed the water quality criteria for the zone of the estuary that they enter or border. In developing these TMDLs, both the C&D Canal boundary and the mouth of Delaware Bay boundary were set to 7.9 pg/L. This is the criterion for Zone 5 where the canal enters the mainstem of the Delaware River, and is the current criterion for Zone 6 (Delaware Bay). The current concentrations of PCBs at the mouth of the Bay exceed this value by 2 orders of magnitude, while current concentrations at the C&D Canal boundary exceed this value by almost 3 orders of magnitude. Thus like the gas phase concentrations of PCBs in the air, PCB concentrations at both the C&D Canal and the ocean boundary must also be reduced in order to achieve the water quality standards. The relative influence of these boundaries at the critical compliance location must also be considered in determining the relative importance of the required reductions (see Figure 7).

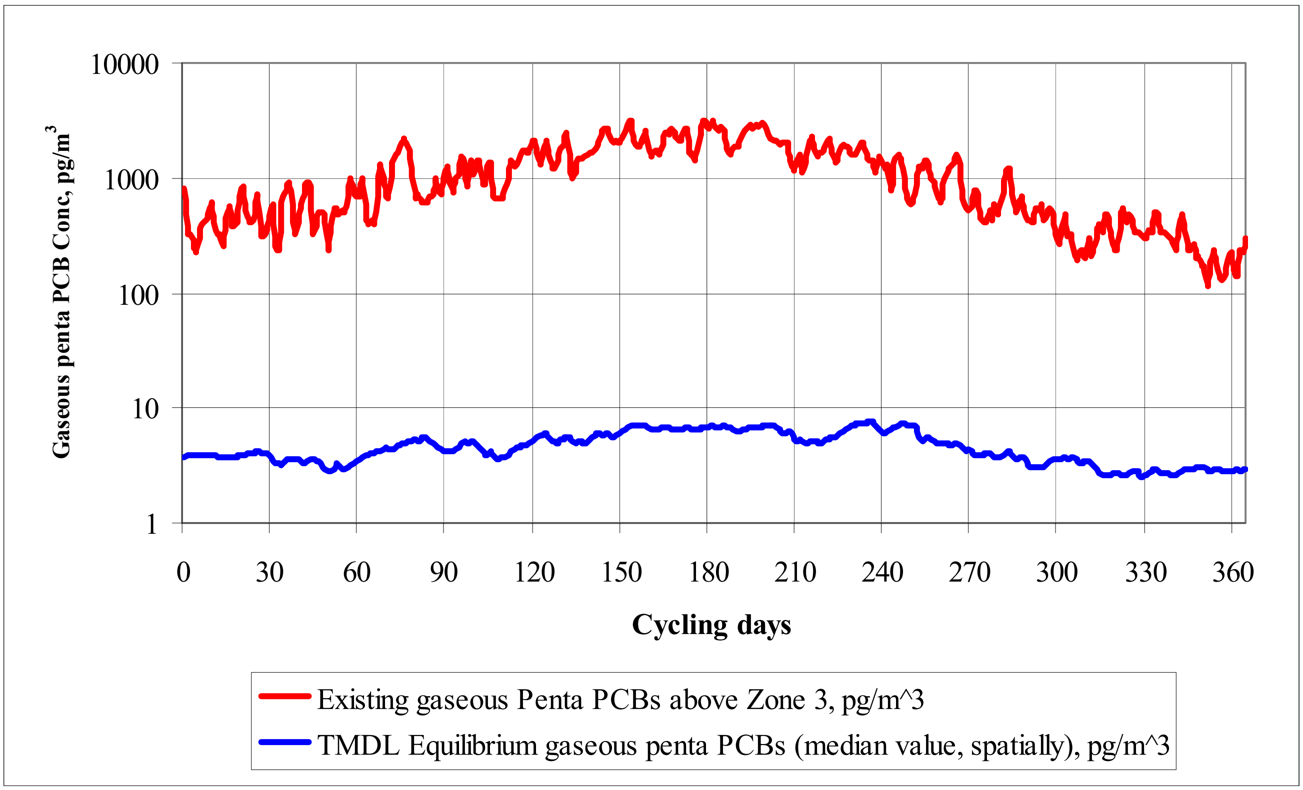


Figure 8: Atmospheric gas phase penta-PCB concentrations during the one year model cycling period based upon current data and the expected penta-PCB concentrations when the TMDLs are achieved.

3.2.2 Modeling Approach

Several mathematical models are used to develop the TMDLs for PCBs. The first is a hydrodynamic model that was extended to included Delaware Bay (Zone 6). The hydrodynamic model is discussed in Section 3.2.4.1 and fully described in the report entitled "DYNHYD5 Hydrodynamic Model (Version 2.0) and Chloride Water Quality Model for the Delaware River Estuary" (DRBC, 2003a). The water quality models used in this effort included an updated TOXI5 model for chlorides, and a new model for pentachlorobiphenyls (penta-PCBs)(DRBC, 2003b). The hydrodynamic and chloride models are discussed in Section 3.2.4.1 and

3.2.4.1, respectively and described in detail in the report on the hydrodynamic model (DRBC, 2003a). The organic carbon and penta-PCB models are discussed in Section 3.2.4.3 and fully described in the report entitled "PCB Water Quality Model for the Delaware Estuary (DELPCB)" (DRBC, 2003b).

TMDLs are calculated using both the conservative chemical model, and the penta-PCB water quality model run until equilibrium is observed. The model cycles model inputs from the period February 1, 2002 until January 31, 2003. This one year period is considered to be representative of long-term conditions (see Section 3.2.3.1), and is the same period utilized for the decadal scale (74 year) model simulations by HydroQual, Inc.

3.2.3 TMDL Approach

Although the water quality standards are expressed as total PCBs and the TMDLs must be expressed as Total PCBs, the current water quality model only addresses penta-PCBs. As discussed in Section 2.2, the TMDLs for total PCBs are extrapolated from TMDLs for penta-PCBs using the observed ratio in the Delaware River/Estuary of the penta homolog to total PCBs. Therefore, a water quality target for penta-PCBs must be established for use in the TMDL procedures. This target is determined by assuming that the ratio of penta-PCBs to total PCBs is approximately 0.25.

TMDLs for total PCBs for Zones 2 through 5 of the Delaware Estuary are established using a four step procedure. TMDLs are calculated over a one year period (annual median) to be consistent with both the model simulations and the 70 year exposure used for human health criteria. The procedure initially utilizes the conservative chemical model to establish contribution factors (Cfs) for two of the major tributaries to the estuary (the Delaware River at Trenton and the Schuylkill River), and each of the estuary zones. Allowable loadings are then calculated for each of these sources utilizing the CF and the proportion of the water quality target at the critical location allocated to each source. These loadings are used in the conservative chemical and penta-PCB models to establish the assimilative capacity provided by burial of PCBs into the estuary sediments. The gas phase concentrations that would be in equilibrium with the penta-PCB water concentrations when the water quality targets are met are then included in the water quality model. The model is then run to confirm that the water quality targets are still being met.

Following establishment of the TMDLs for each zone, each of the zone TMDLs are apportioned using the current percentage contribution for each of the source categories excluding loads from the Delaware River, Schuylkill River and contaminated sites based upon the respective loadings during the period Feb. 1, 2002 to Jan. 31, 2003 (Table 2, Figure 9)

Table 2: Apportionment of Zone TMDLs to Wasteload and Load Allocations excluding loads from the Delaware River, Schuylkill River and contaminated sites.

ZONE	WASTELOAD ALLOCATION	LOAD ALLOCATION
2	44.1%	55.9 %
3	78.1%	21.9 %
4	60.8%	39.2 %
5	63.4 %	36.6 %

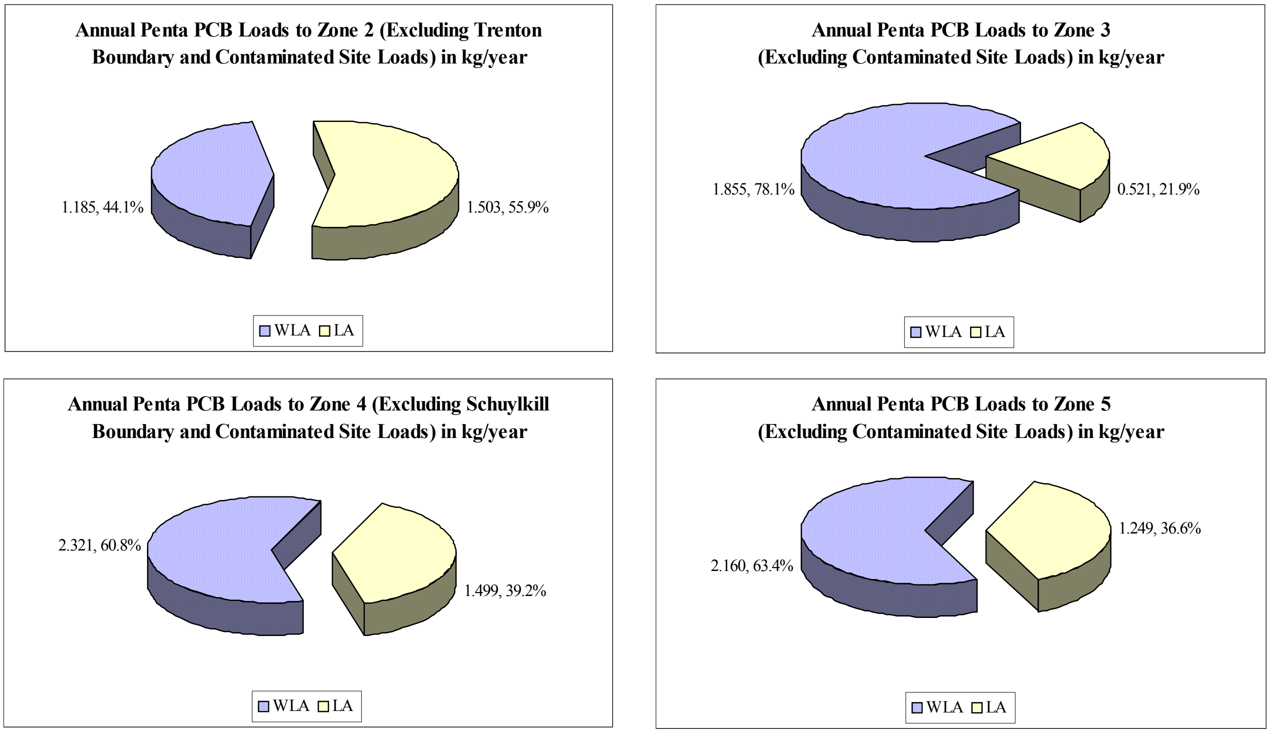


Figure 9: Apportionment of Zone TMDLs in kilograms per year (kg/year) to Wasteload and Load Allocations excluding loads from the Delaware River, Schuylkill River and contaminated sites.

The wasteload allocation portion of the TMDL represents those source categories that are regulated under the NPDES program (point sources, combined sewer overflows or CSOs, and municipal separate storm sewer systems or MS4s). The load allocation portion of the TMDL represents the remaining categories including contaminated sites, non-NPDES regulated stormwater discharges, tributaries and air deposition).

In accordance with the TMDL regulations, a portion of each zone TMDL must be allocated to a margin of safety. The margin of safety (MOS) is intended to account for any lack of knowledge concerning the relationships between pollutant loadings and receiving water quality. Commission regulations also require that a portion of the TMDL be set aside as a margin of safety, with the proportion reflecting the degree of uncertainty in the data and resulting water quality-based controls. The MOS can be incorporated into the TMDL either implicitly in the design conditions under which the TMDL is calculated or explicitly by assigning a fixed proportion of the TMDL. Since the conditions under which the TMDL is determined like tributary flows are related to the long-term conditions and not to design conditions associated with human health water quality standard for carcinogens (such as the harmonic mean flow of tributaries), expression of the MOS as an explicit percentage of each zone TMDL was considered the more appropriate approach. An explicit percentage of 5% was then utilized in the apportionment of the zone TMDLs. Both the apportionment of the zone TMDLs using the current percentage contribution and use of a margin of safety of 5% were recommended by the Commission's Toxic Advisory Committee.

3.2.4 Model Descriptions and Inputs

3.2.4.1 Hydrodynamic Model

Inputs to the hydrodynamic, conservative chemical and PCB models included daily tributary flows at the two major tributary boundary conditions, the Delaware River at Trenton and the Schuylkill River, and at 20 minor tributaries for the period February 1, 2002 to January 31, 2003. A comparison of the cumulative distribution curve for this one year period to the curve for the period of record for the Delaware River at Trenton (1912 to March 2003) and the Schuylkill River (1934 to March 2003) is presented in Figures 10 and 11, respectively. The figures indicate that the flows occurring during the one year cycling period are a reasonable representation of the flows during the period of record for these two tributaries.

The hydrodynamic model also includes precipitation induced flows for both point and non-point sources. The precipitation pattern occurring during the one year cycling period was compared to historical precipitation records (1872 to March 2003) maintained by the Franklin Institute (2003) to determine the degree to which the precipitation pattern for the one year cycling period was representative of the long term record. This comparison indicated good agreement for both the number and percentage of days when precipitation exceeded 0.01 inches, and the number and percentage of days when precipitation was less than 0.01 inches (Figures 12 and 13). This precipitation data was used to both calculate the flow of each discharge during precipitation events and determine when data collected during precipitation events would be used in loading calculations.

The tidal forcing function in the hydrodynamic model was based upon actual tide data for the one year cycling period. Since the major component of the tidal function has a periodicity of 12.42 hours and minor components with lunar and annual periodicity, this data set was considered representative of long-term tidal conditions. In addition, the expert panel recommended that alternative model inputs based upon design conditions not be used in TMDL simulations in order to maintain any hydrological relationships between the various inputs. For this reason, actual discharge flows for the point sources included in this TMDL determination during the one year cycling period were used rather than design effluent flows such as those specified in Section 4.30.7A.8. of the Commission's Water Quality Regulations or federal NPDES regulations. This is particularly important in the establishment of PCB TMDLs for the Delaware Estuary since the flow from a number of the point sources is significantly influenced by precipitation. For example, design effluent flows for the City of Philadelphia's wastewater treatment plants are approximately 200 million gallons per day, but can double during precipitation events. In addition, procedures have not been developed nor does the Commission's regulations specify procedures to establish design effluent flows for those discharges that are solely driven by precipitation (i.e., stormwater discharges). Such procedures and regulations will be developed for application in the Stage 2 TMDLs for PCBs, if necessary. The similarity of the precipitation pattern observed during the one year cycling period to the long term precipitation record suggests that the precipitation induced flows for both continuous and stormwater discharges used to develop the Stage 1 TMDLs may ultimately serve as design flows for these discharges.

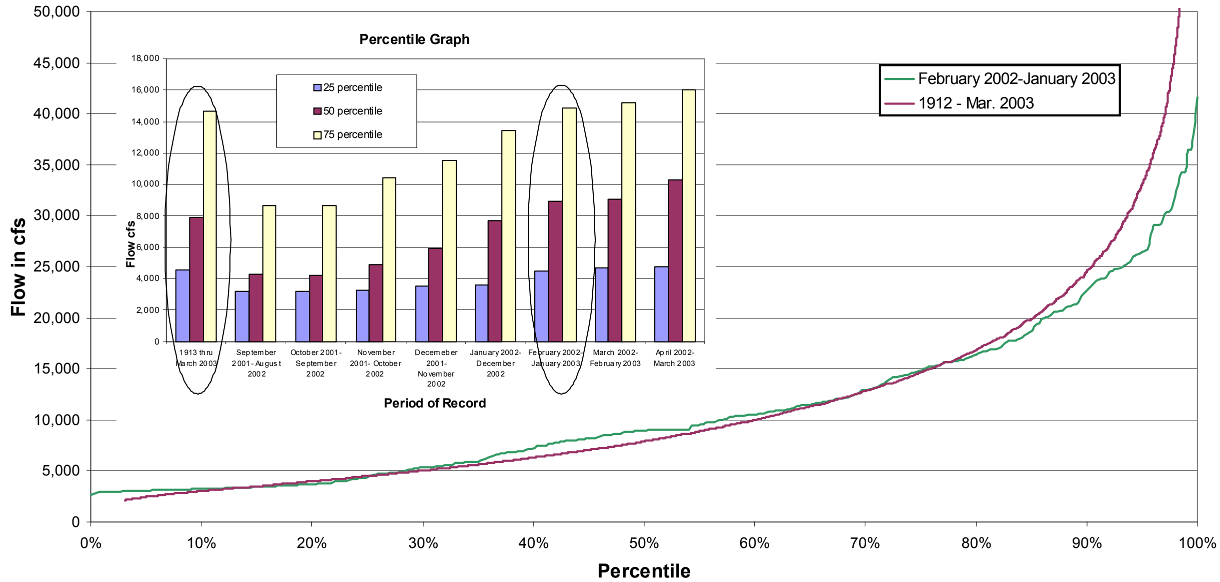


Figure 10: Cumulative distribution curve for the period of record for the Delaware River at Trenton (1912 to March 2003) compared to the period February 1, 2002 to January 31, 2003.

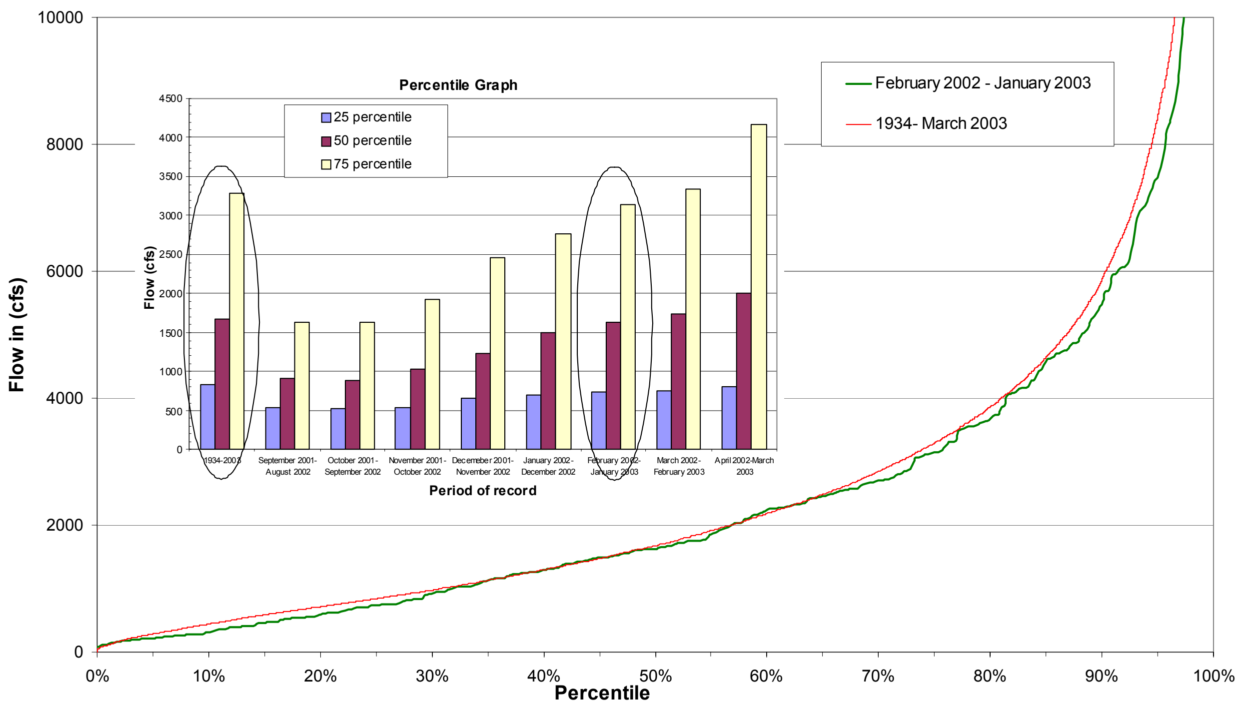


Figure 11: Cumulative distribution curve for the period of record for the Schuylkill River (1934 to March 2003) compared to the period February 1, 2002 to January 31, 2003.

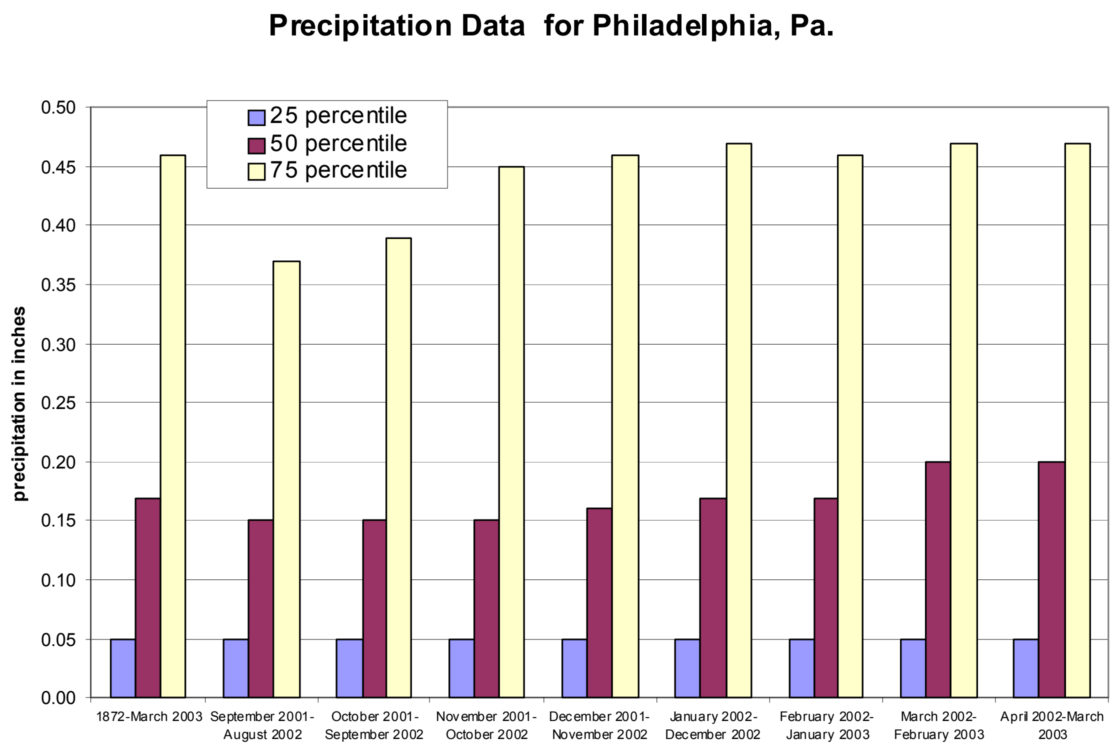


Figure 12: Percentile curves for precipitation data (events > 0.01 inches) for Philadelphia, PA from 1872 to March 2003 compared to the period February 1, 2002 to January 31, 2003.

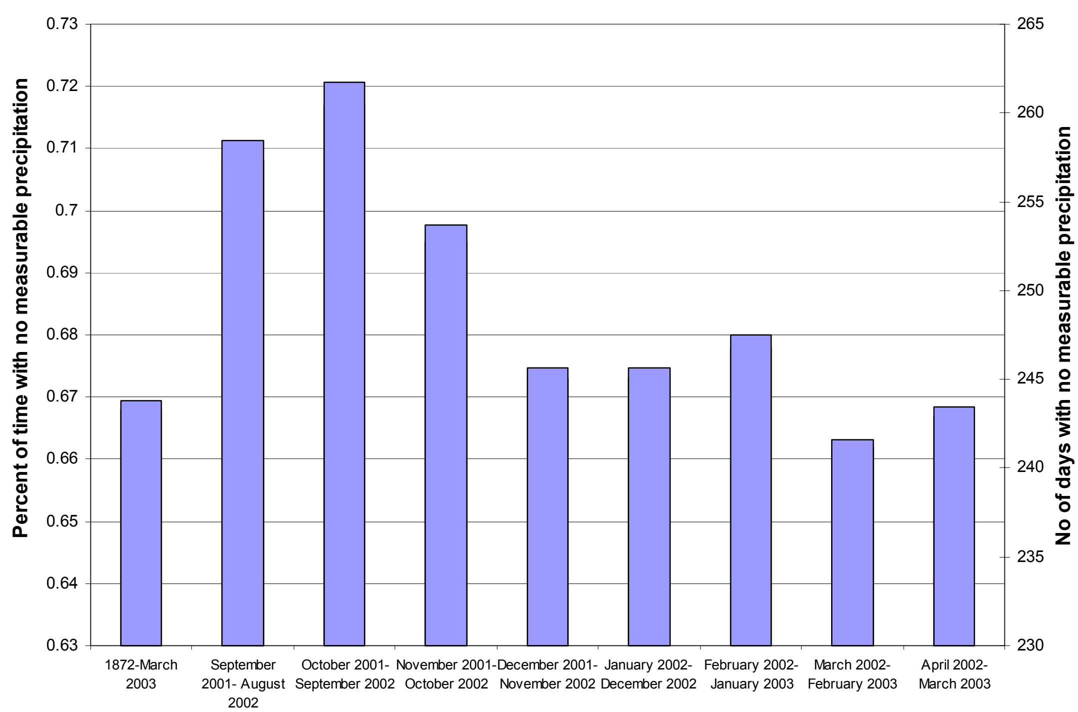


Figure 13: Percentile curves for precipitation data (days with precipitation < 0.01 inches) for Philadelphia, PA from 1872 to March 2003 compared to the period February 1, 2002 to January 31, 2003.

3.2.4.2 Conservative Chemical Water Quality Model

A TOXI5 (water quality) model consisting of 87 water column segments was then linked with the outputs from the calibrated DYNHYD5 hydrodynamic model and calibrated against the chloride concentrations. This model is based upon the U.S. EPA's Water Quality Simulation Program (WASP) Version 5.12., and does not include any fate processes for chlorides or any interaction of the chlorides with the sediment. The main objective in this calibration process was the determination of an advection factor and a set of dispersion coefficients for the water quality model to correctly simulate the dispersive mixing within the Estuary. Review of comparison plots and the results of regression analyses indicated that the model was able to reproduce the temporal and spatial trends, and the magnitude of the chloride concentrations, within a reasonable range throughout the tidal portion of the Delaware River.

3.2.4.3 Penta-PCB and Organic Carbon Water Quality Models

The calibrated hydrodynamic and conservative chemical model are used to drive mass balance models of organic carbon and penta-PCBs (DELPCB). DELPCB is a simulation program enhanced from the U.S. EPA's Water Quality Simulation Program (WASP) Version 5.12, and is fully described in DRBC (2003c). The organic carbon model has two organic carbon state variables and one inorganic solid (IS) as a control state variable. These variables are integrated with the one-dimensional hydrodynamic DYNHYD5 model to dynamically simulate these sorbent variables. The two carbon variables are biotic carbon (BIC), carbon generated internally by phytoplankton, and particulate detrital carbon (PDC) which consists of detritus and other forms of non-living carbon. The model treats the two organic carbon sorbents as non-conservative state variables that are advected and dispersed among water segments, that settle to and erode from benthic segments, and that move between benthic layer segments through net sedimentation.

The model also partitions penta-PCBs into particulate- PCB, truly dissolved-PCB, and dissolved organic carbon (DOC) bound phases treated as individual state variables. The real time model simulates tide-induced flows, and the spatial and temporal distributions of the organic carbon and penta-PCB variables. During the modeling process, using data generated by the hydrodynamic model, DELPCB simulates the spatial and temporal distributions of water quality parameters including BIC, PDC, total penta-PCB, particulate penta-PCB, and truly dissolved PCB, and DOC-bound PCB. The sum of the latter two is total dissolved penta-PCB.

3.2.4.4 Model Inputs

Additional inputs to the models include air and water temperature, wind data and the loadings of penta-PCBs from various source categories for the period February 1, 2002 to January 31, 2003. Water temperature data were obtained from three automatic water quality monitoring stations operated cooperatively by the DRBC and the U.S. Geological Survey at the Ben Franklin Bridge, Chester, PA and Reedy Island. Air temperature and wind speed data were obtained from the National Weather Service at the Philadelphia International Airport station.

Daily loadings of organic carbon and penta -PCBs were estimated for relevant source categories, including contaminated sites, non-point sources, point discharges, atmospheric deposition, and model boundaries, for each day of the one year cycling period. Detailed discussion of load development for each source category is described in Section 2 of the report entitled "Calibration of the PCB Water Quality Model for the Delaware Estuary for Carbon and Penta-PCBs" (DRBC, 2003c).

3.3 Procedure for Establishing TMDLs

3.3.1 Summary

TMDLs for total PCBs for Zones 2 through 5 of the Delaware Estuary are established using a multi-step procedure that incorporated the guiding principles discussed in Section 3.2.1. As discussed in Section 1.4, the existing DRBC water quality standards are used as the basis for the Stage 1 TMDLs. The selection of these standards establishes the transition from a standard of 44.8 pg/L in upper Zone 5 to a standard of 7.9 pg/L in lower Zone 5 as the critical location for ensuring that standards are met throughout the estuary. Standards that are lower than upstream water quality standards typically require ambient water concentrations in upstream waters to be lower than the applicable standards for those waters. In tidal waters such as the Delaware Estuary, downstream waters with less stringent water quality standards can have the same effect on upstream waters depending on the extent of upstream movement during flooding tides. With the use of the existing DRBC water quality standards as the basis for the TMDLs in Stage 1, the critical location occurs where the 7.9 pg/L standard becomes effective (River Mile 68.75, the site of the Delaware Memorial Bridges).

The procedure initially utilizes the conservative chemical model to establish contribution factors for two of the major tributaries to the estuary (the Delaware River at Trenton and the Schuylkill River), and each of the estuary zones. The reasons for utilizing the contribution factor approach and the conservative model are 1) TMDLs are controlled by the value of the standard at the critical location, and 2) computer simulation time is minimized permitting the numerous iterations necessary to perform the procedure (approximately five hours for a 50 year simulation with the penta-PCB water quality model). The factors represent the contribution of each of the six sources in picograms per liter to the concentration of penta-PCBs at the critical compliance location. The loading into each zone is assigned as distributed loadings by utilizing a weighting factor calculated using the surface area of the model segments within the zone. For each of the estuary zones, the contribution factor has the units of pg/L per unit of loading. The unit of loading is relative to magnitude of the water quality standard. For example, conventional pollutants with standards in units of milligrams per liter (parts per million) and toxic pollutants with standards in micrograms per liter (parts per billion), loading is often expressed in kilograms per day. With the standard for PCBs in the picograms per liter range, however, loading is more appropriately expressed in terms of milligrams per day. Different units are used for the two major tributaries since the model calculates the loading of PCBs from these tributaries using the daily flows and the concentration of penta-PCBs. Therefore, the contribution factor for these two sources are expressed in units of pg/L per pg/L of penta-PCBs at the tributary boundary compared to pg/L per 100 mg/day for the loadings from the zones.

TMDLs are calculated in a four step procedure (Figure 14). The four steps are:

1. Calculate the contribution factor for each of the estuary zones and two of the tributary model boundaries to the critical compliance point with the penta-PCB water quality target.
2. Determine the proportion of the water quality target allocated to each of these six sources utilizing the median daily flow contributed by each during the one year model cycling period. Calculate the allowable loadings from each of these sources utilizing the CF and the proportion of the water quality target at the critical location allocated to each source. Then utilize these loadings in the conservative chemical and penta-PCB models to establish the assimilative capacity provided by burial of PCBs into the estuary sediments. Iteratively determine the amount of assimilative capacity (in pg/L) provided by the sediments, and add this concentration to the penta-PCB water quality target. Recalculate the allowable loadings from each of the six sources using this revised water quality target.
3. Utilize the water quality model for penta-PCBs with these allowable loadings to confirm that the sediment concentrations have reached pseudo-steady state, and confirm that the penta-PCB water quality target is met in Zones 2 through 5. Initial

penta-PCB conditions in the water and sediments are updated to shorten the simulation time to reach peudo steady-state in Step 4.

4. Estimate the gas phase concentrations that would be in equilibrium with the penta-PCB water concentrations when the water quality targets are met, include these in the water quality model and then confirm that the water quality targets are still being met. Iteratively adjust the gas phase concentration of penta-PCBs in the air until the water quality target is reached. The air will neither be a source or sink for penta-PCBs when the estuary meets the water quality standard and gas phase concentrations are reduced to the equilibrium concentration.

3.3.2 Step 1

In determining the contribution factor for the two tributary boundaries and the four estuary zones, the boundary of interest is set to 1 pg/L and all other model boundaries except the one of interest are set to zero pg/L. Model simulations are then run for 10 years to ensure that equilibrium conditions are achieved, and the annual median value is then calculated for each model segment in the main stem of the river. Figures 15 through 17 illustrate how the contribution factor is determined for the four model boundaries. These figures indicate the concentration of penta-PCBs at the critical point when a concentration of 1 pg/L is set at the model boundary.

Table 3 lists the contribution factors determined by this analysis for all of the model boundaries and each of the estuary zones.

Table 3: Summary of the contribution factors from the model boundaries and the estuary zones at the criteria critical point (Model segment 24 - River Mile 68.1).

Estuary Zone/Boundary	**Contribution Factor [pg/L] per [100 mg/day]**	**Contribution Factor [pg/L] per [pg/L]**
Zone 2	1.9668	-
Zone 3	2.1428	-
Zone 4	2.2813	-
Zone 5	0.96704	-
Delaware River @ Trenton	-	0.5815
Schuylkill River	-	0.11839
Ocean & C&D Canal	-	-

3.3.3 Step 2

Once the contribution factors are determined, the next step is to determine the allowable loadings from each of these sources that will still ensure that the water quality target is met at the critical location. The following assumptions are made in determining these loadings:

a. The assimilative capacity at the critical location controls the allowable loadings from each source. In concentration units, this assimilative capacity is equal to one-quarter of the applicable water quality standard or 1.975 pg/L of penta-PCBs.
b. The influence from ocean (the mouth of Delaware Bay) and the C&D Canal are treated as background. This is based in part upon their minimal influence at the critical location..
c. Net burial of PCBs into the sediment results in a loss of PCBs from the system. This removal of PCBs provides assimilative capacity that can be utilized by other sources. At the critical location, this additional assimilative capacity is approximately 0.5 pg/L of penta-PCBs.
d. When the concentration of penta-PCBs meets the water quality targets throughout the estuary, the concentration of penta-PCBs in the gas phase will be at equilibrium with the truly dissolved penta-PCBs in the water column, and the net flux of penta-PCBs will be zero. Thus, the air will neither be a source or sink for penta-PCBs when the estuary meets the water quality standard and gas phase are concentrations are reduced to the equilibrium concentration.

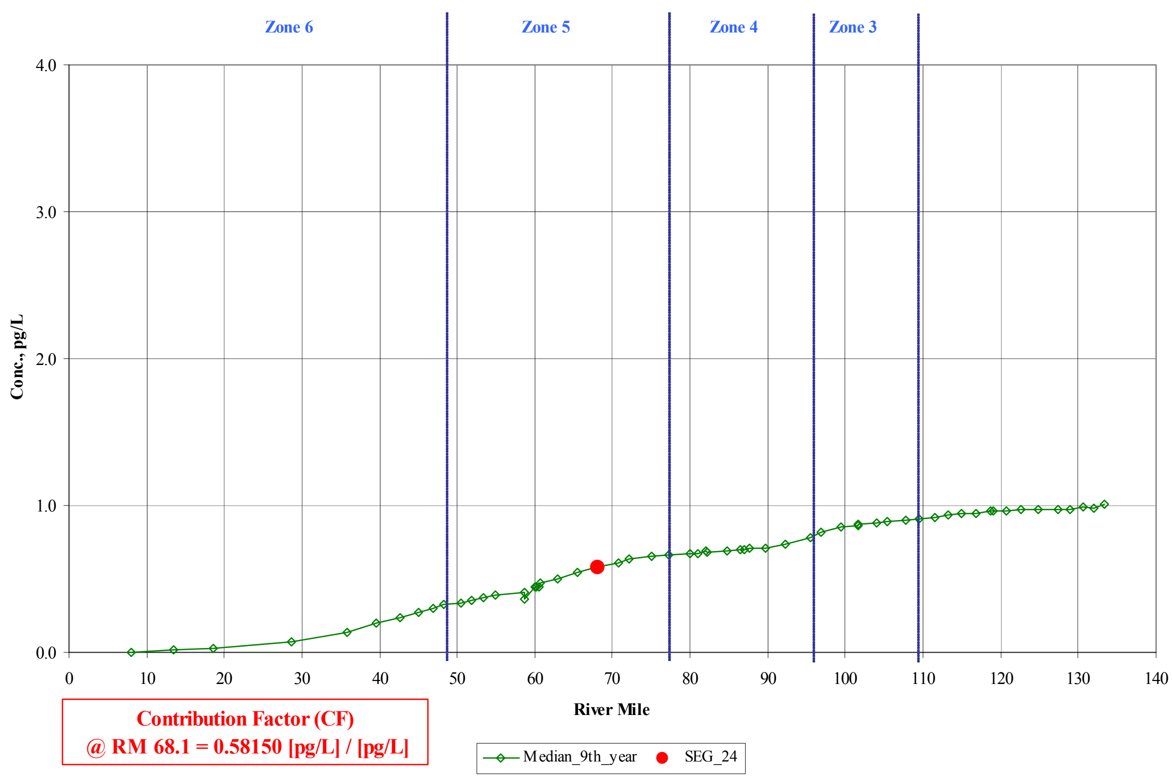


Figure 15: Simulated penta-PCB concentrations in the water column when the concentration of the Delaware River at Trenton, NJ is set to 1 picogram per liter.

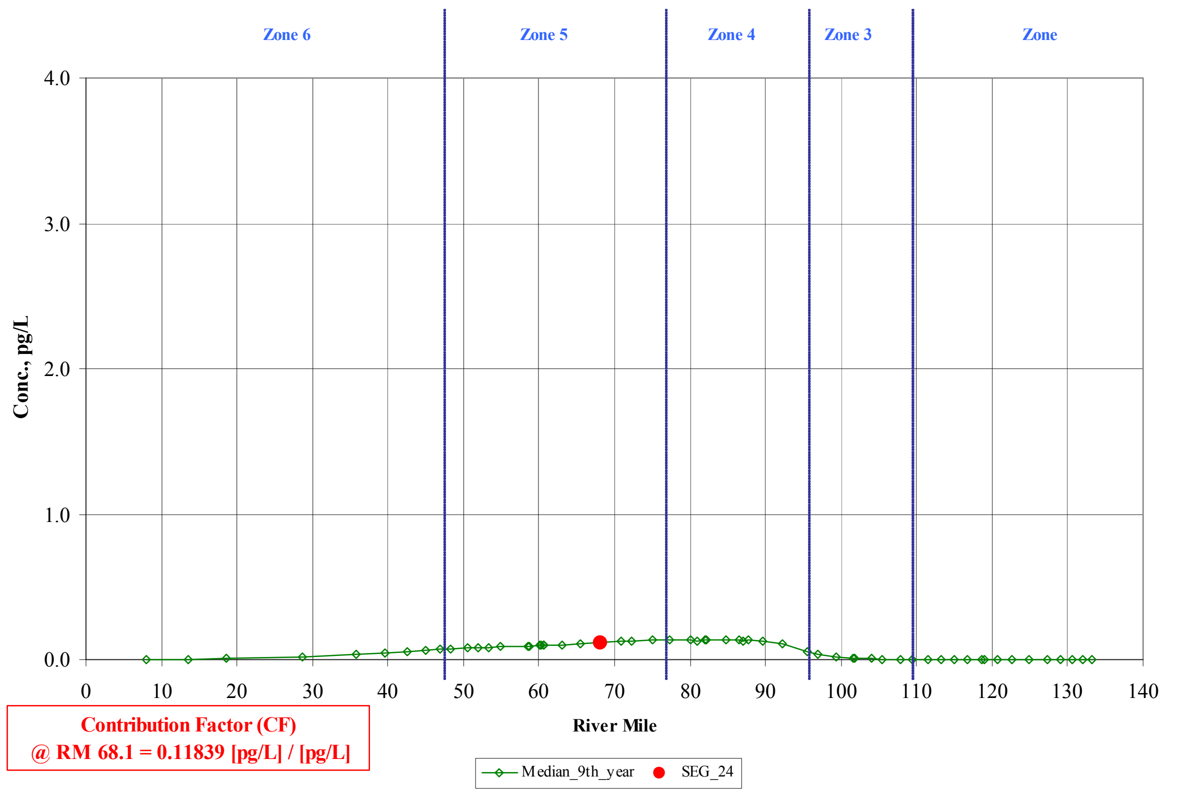


Figure 16: Simulated penta-PCB concentrations in the water column when the concentration of the Schuylkill River is set to 1 picogram per liter.

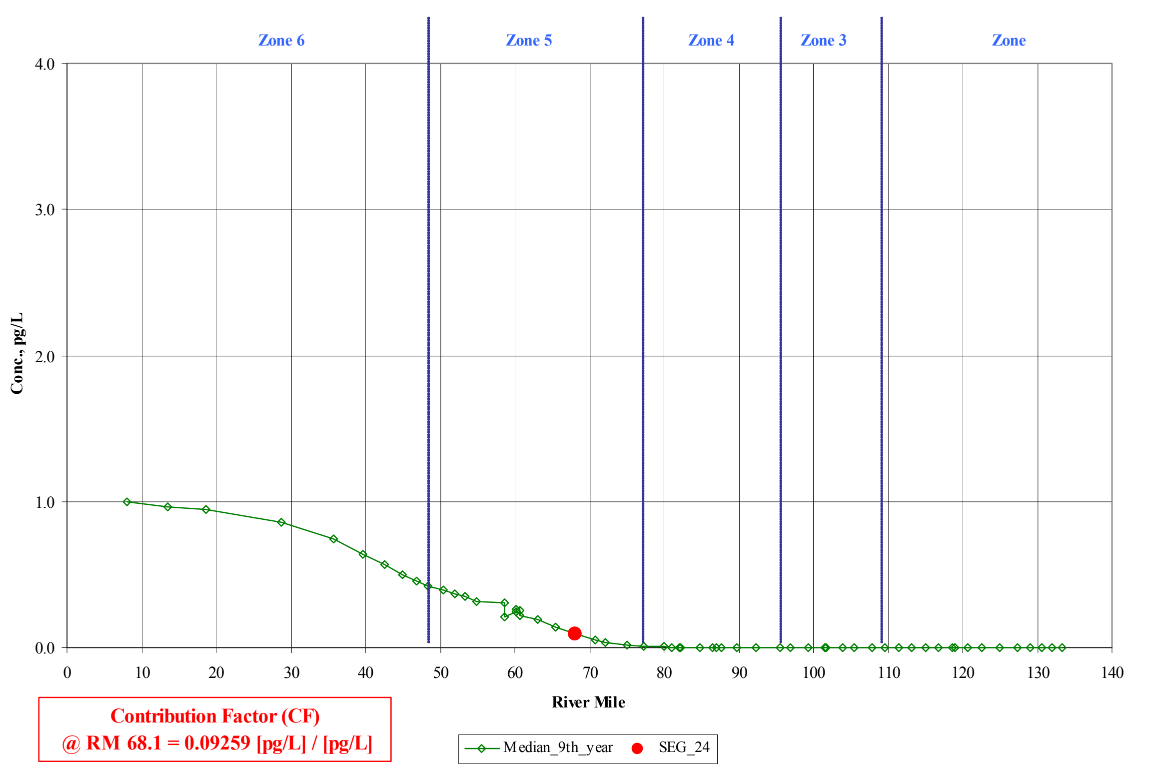


Figure 17: Simulated penta-PCB concentrations in the water column when the concentration at the mouth of Delaware Bay and the C&D Canal is set to 1 picogram per liter.

Using the principle that the assimilative capacity of the two tributary boundaries and each of the zones is based upon the inflow provided by each source, the percentage distribution of the assimilative capacity for each of these sources is established. Table 4 presents the flows for each of the sources during the one year model cycling period and the percentage distribution of the assimilative capacity based upon these flows. This distribution percentage is then applied to the penta-PCB water quality target of 1.975 pg/L to establish the contribution of each of the sources in picograms/liter to the target (Table 4). The influence of the mouth of Delaware Bay and the C&D Canal is first removed since this influence is considered background based in part on their minimal influence at the critical location. The additional assimilative capacity provided by the burial of PCBs into the estuary sediments was then estimated by inserting these loads in the conservative chemical and penta-PCB models. The results of this process was that the additional assimilative capacity was estimated to be 0.5 pg/L. This increased the assimilative capacity to 2.2921 pg/L (1.975 pg/L minus 0.183 pg/L for the background influences, plus 0.500 pg/L additional for burial by sediments) at the critical location. The contribution of each of the sources in picograms/liter to the target was then recalculated and used with the contribution factor to establish the allowable concentration or loadings for each of the tributary boundaries and estuary zones, respectively (Table 4).

At this point, a total allowable loading or assimilative capacity of 94.99 mg/day of penta-PCBs for all six sources was calculated. The majority of this loading was assigned to the two tributary boundaries, the Delaware River at Trenton and the Schuylkill River. Figure 18 graphically presents the available assimilative capacity at the critical location and the apportionment to each of the sources and estuary zones. Figure 19 presents the results of simulations using the conservative chemical model demonstrating that the calculated loadings result in attainment of the revised water quality target of 2.475 pg/L.

Table 4: Summary of Steps 1 and 2 of the Procedure for Establishing TMDLs

Sources of Loadings	**Contribution Factor (CF)**	**Mean Daily Flow During 1 Year Cycling Period**	**Distribution Percentage**	**Concentration at the Critical Location**	**Allowable Concentrations or Loadings.**	**Allowable Loadings (TMDL)**
Units	[pg/L] / [pg/L] or [pg/L] / [100mg/day]		%	pg/L	pg/L or mg/day	mg/day
Trenton	0.581500*	249.19	68.0	1.559	2.68*	57.727
Schuylkill	0.118390*	45.87	12.5	0.287	2.42*	9.609
Zone 2	1.966800	20.79	5.7	0.130	6.61	6.613
Zone 3	2.142800	15.26	4.2	0.095	4.46	4.455
Zone 4	2.281300	16.66	4.5	0.104	4.57	4.569
Zone 5	0.967040	18.57	5.1	0.116	12.02	12.016
Sum		366.3	100	2.2921	-	94.99

* - Units are either [pg/L] / [pg/L] or pg/L.

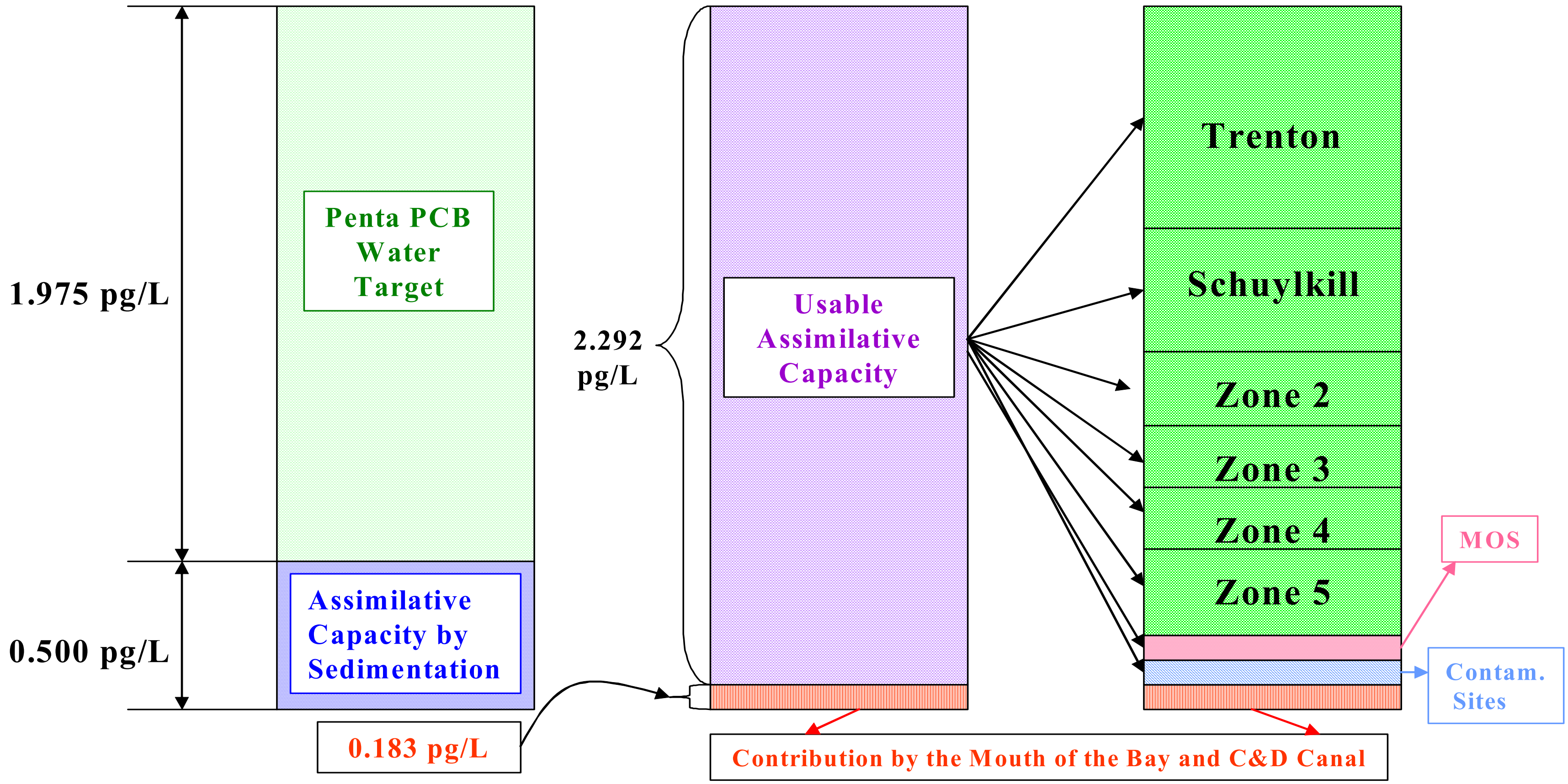


Figure 18: Graphical presentation of the allocation of the assimilative capacity at the critical location.

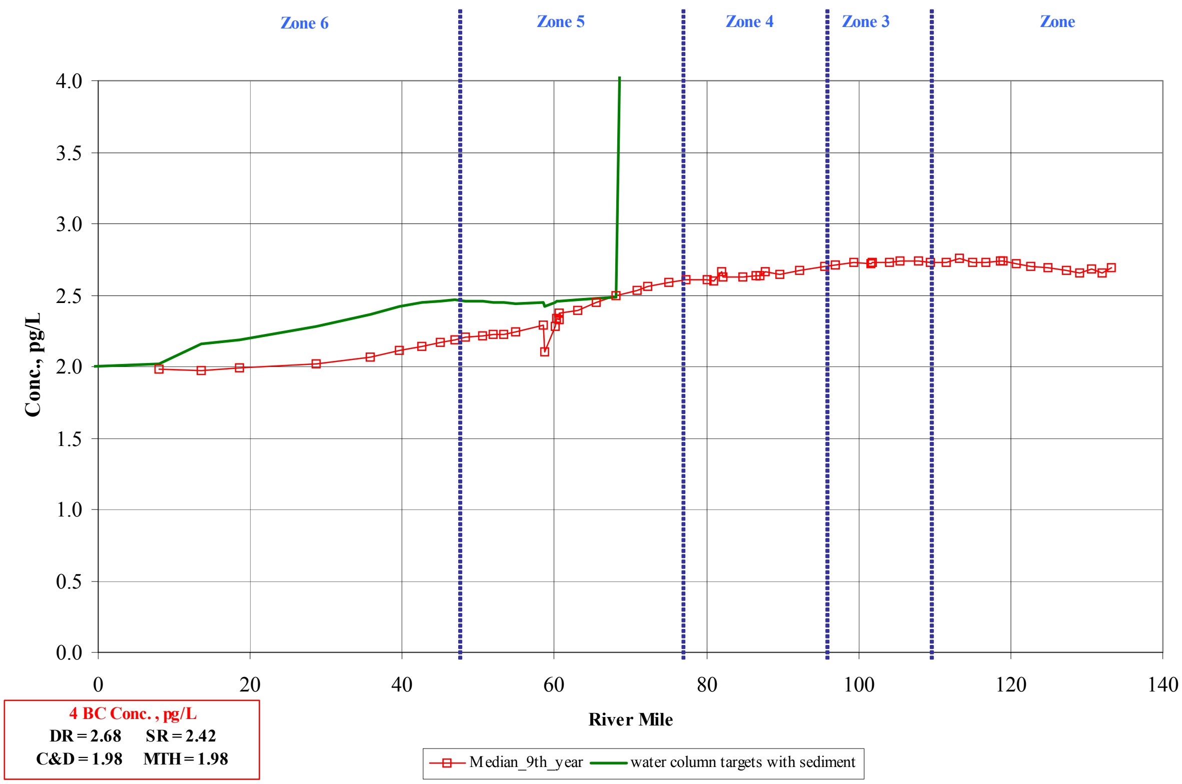


Figure 19: Simulated penta-PCB concentrations in the water column when loadings established in Step1 are used in the conservative chemical model.

3.3.4 Step 3

The next two steps will utilize the water quality model for penta-PCBs to confirm the assimilative capacity that was added due to the loss of PCBs by burial by the sediment, to confirm that sediment concentrations have reached steady-state, and to make final adjustments to account for the exchange of penta-PCBs in the truly dissolved phase with penta-PCBs in the gaseous phase in the estuary airshed.

In this step, the PCB water quality model is run with the initial water column concentrations set to the concentrations described by the final simulation with the conservative chemical model (Figure 19), the loadings from the model boundaries and to each estuary zone that were determined in Step 2, initial penta-PCB concentrations in the sediment, and no air-water exchange of gaseous penta-PCBs. The purpose of this simulation is to determine the sediment concentrations that are in equilibrium with the estuary concentrations that will meet the water quality target of 1.975 pg/L at the critical location. These simulations were run for 50 years to establish the point at which equilibrium was reach between the water column and the sediments. Figure 20 indicates the sediment concentration of penta-PCBs at six locations in the estuary corresponding to a model segment in each of the estuary zones and Delaware Bay. Note that sediment concentrations in all segments reach equilibrium after 20 to 30 years from the assigned initial conditions. The simulated median sediment concentrations at each of the model segments is presented in Figure 21. The amount of assimilative capacity provided by the loss of penta-PCBs to the sediment is illustrated in Figure 22. The figure indicates that the amount of assimilative capacity provided by the sediments varies along the estuary due to the varying burial rates computed by the model. The assimilation capacity provided is about 0.5 pg/L at the critical location.

The penta-PCB model was then rerun for ten years with the initial sediment conditions set to these values along with the loadings from the model boundaries and to each of the estuary zones to confirm that the water quality target at the critical location was being met. Figure 23 presents a plot of the annual median values during the ninth year of the simulation, confirming that the water quality target is being met. Figure 24 demonstrates that the sediments are in equilibrium during the simulation period.

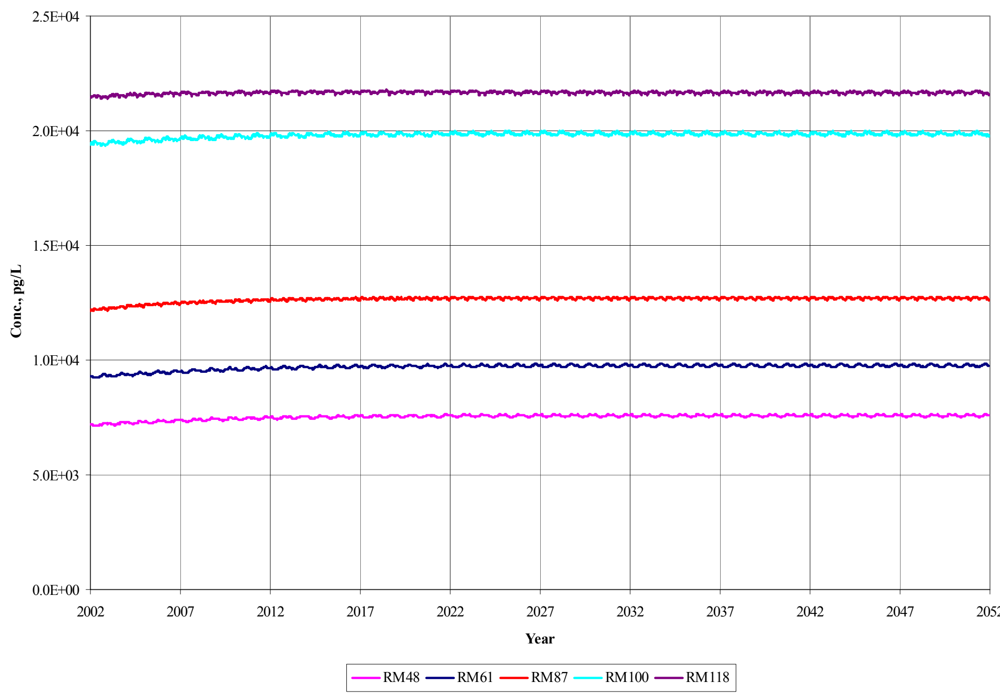


Figure 20: Temporal plot of penta-PCB concentrations in surface sediment layer during a 100 year simulation using the loads established in Step 2.

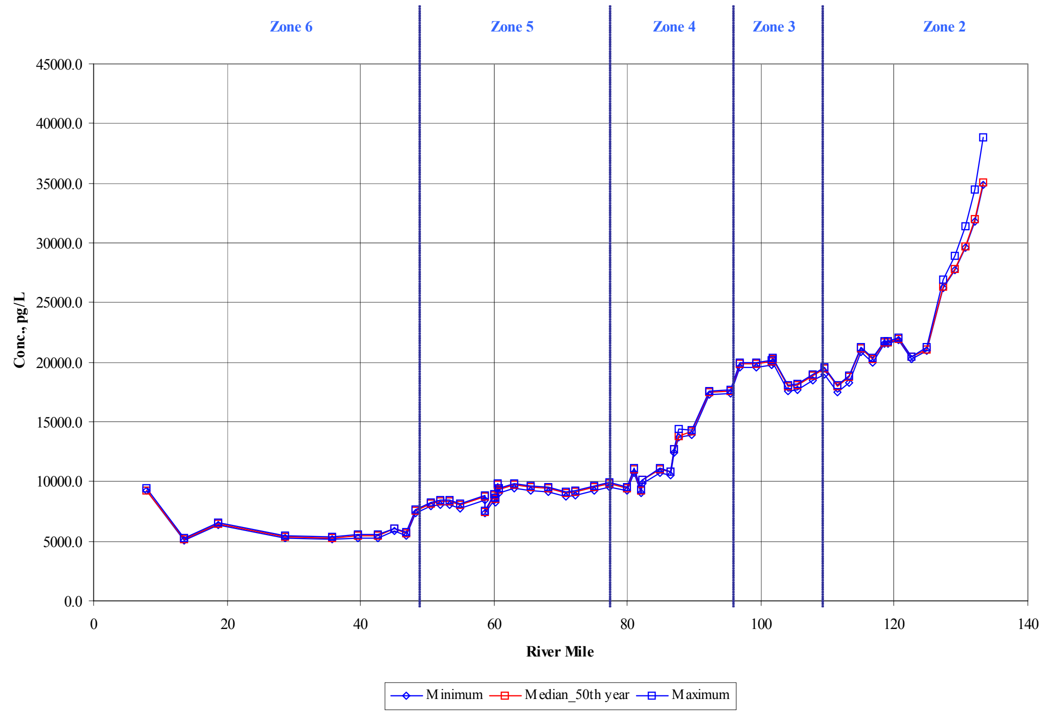


Figure 21: Spatial plot of simulated surface sediment concentrations of penta-PCBs in surface sediment layer during a 50 year simulation using the loads established in Step 2.

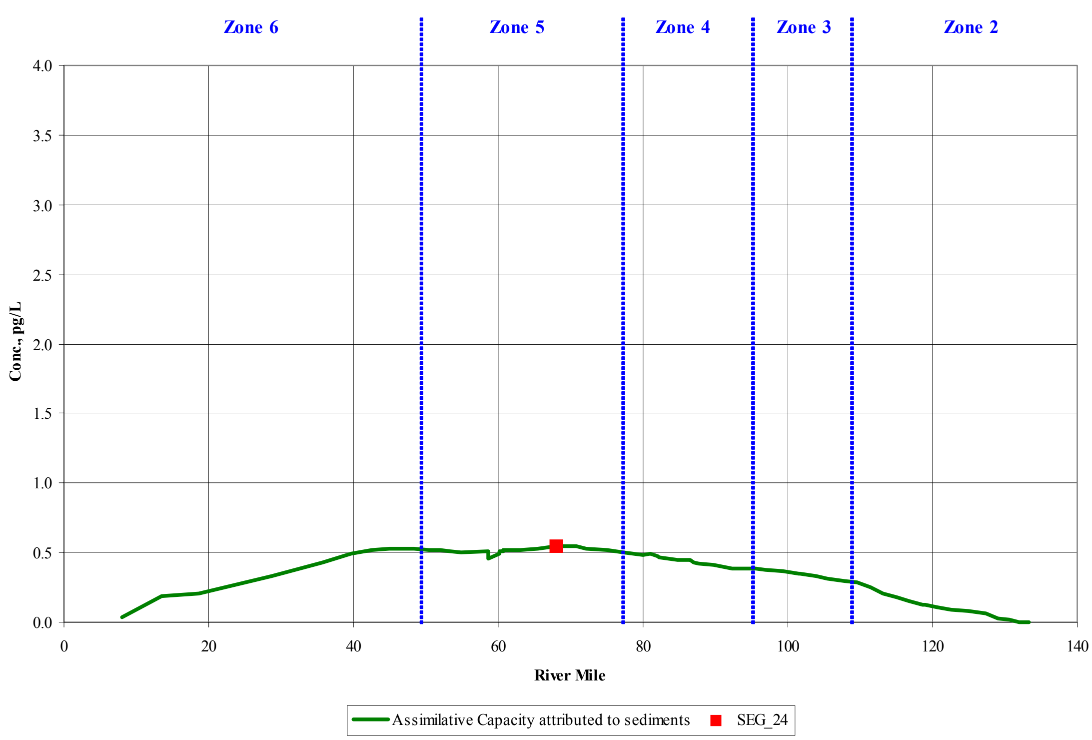


Figure 22: Spatial plot of the assimilative capacity in pg/L provided by the sediment layer.

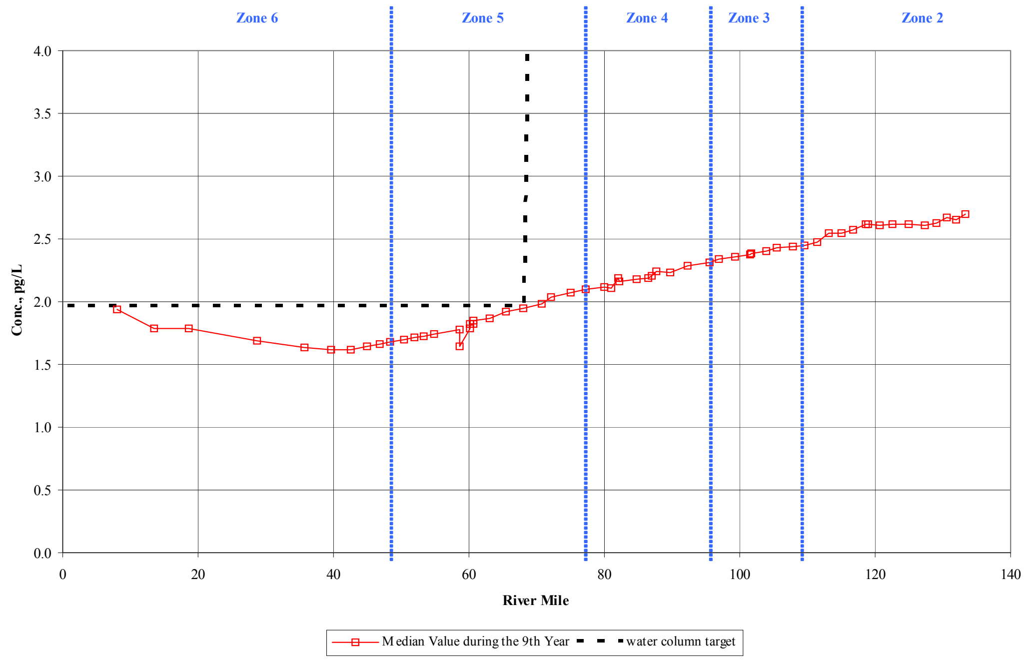


Figure 23: Spatial plot of the penta-PCBs in the water column during a 10 year simulation using the loads established in Step 2 and with new sediment initial conditions.

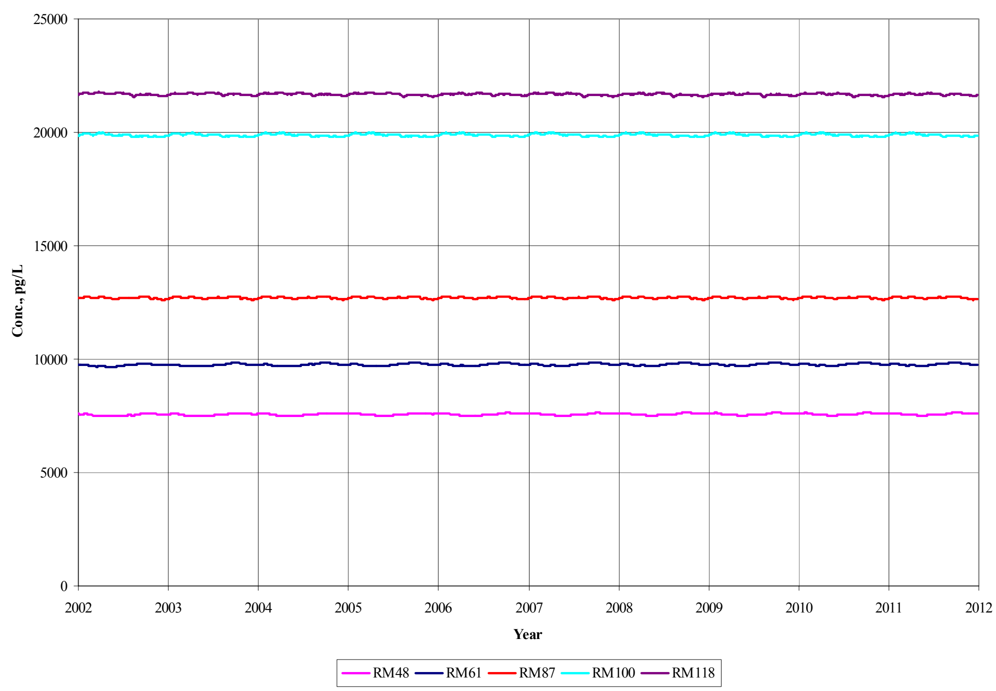


Figure 24: Temporal plot of the concentration of penta-PCBs in the surface sediment layer during a 10 year simulation using the loads established in Step 2 and with new sediment initial conditions.

3.3.5 Step 4

The final step in developing TMDLs for penta-PCBs for Zones 2 through 5 of the Delaware Estuary is to include the exchange of penta-PCBs between the gas phase in the atmosphere and truly dissolved penta-PCBs in the water. In the current model framework, the gas phase air concentrations are assigned, and are not dynamically simulated by the model. However, when the TMDL is achieved there should be close to zero net exchange between the water and air. It was therefore necessary to estimate the gas phase concentration that would be in equilibrium with the water quality targets (Figure 8) and then confirm that the water quality targets are still being met.

The penta-PCB water quality model utilizes the following formula to determine the volatilization rate of a chemical:

$$\frac{\partial C}{\partial t} = \frac{K_V}{D}\left[C_W - \frac{C_A}{H/RT_K}\right]$$

where:
- K_V = the transfer rate, meters per day
- D = model segment depth in meters
- C_W = truly dissolved fraction of the chemical in water, mg/L
- C_A = atmospheric gas phase concentration, mg/L
- H = Henry's Law Constant, atm-m^3/day
- R = universal gas constant
- T_K = water temperature in degrees Kelvin

At equilibrium, the volatilization rate will be zero. Therefore:

$$\left[C_W - \frac{C_A}{H/RT_K}\right] = 0$$

Rearranging this formula to calculate the atmospheric gas phase concentration for penta-PCBs:

$$C_W \times H/RT_K = C_A$$

Figure 25 presents the truly dissolved penta-PCB water concentrations predicted by the model from Step 4 and the corresponding equilibrium air concentrations of gaseous phase penta-PCBs for the one year cycling period.

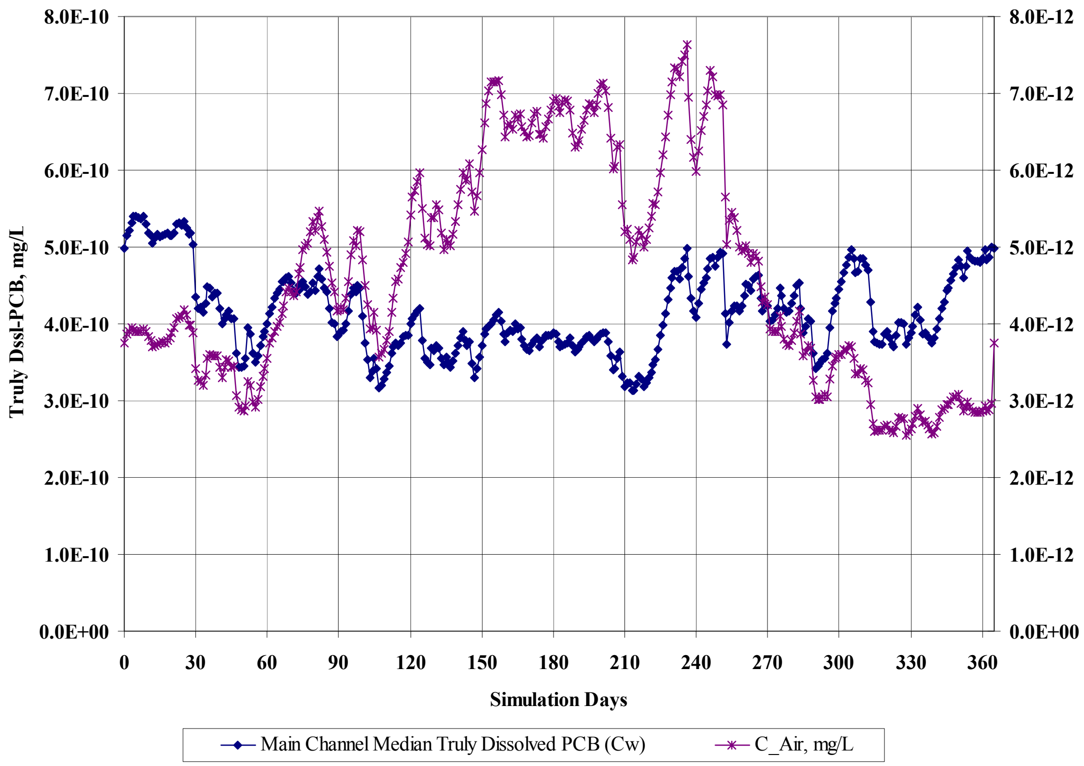


Figure 25: Back-calculated, equilibrium, median, gas phase penta-PCB concentrations during the one year model cycling period.

The penta-PCB water quality model is then run with the conditions obtained from Step 2 and 3 including the loadings from the model boundaries and to each estuary zone, initial penta-PCB concentrations in the sediment (Figure 24), and with back-calculated, equilibrium, median, gas phase penta-PCB concentrations during the one year model cycling period (Figure 25). The purpose of this simulation is to confirm that the penta-PCB concentrations in the sediments and the penta-PCB gas phase air concentrations are in equilibrium with the estuary concentrations that will meet the water quality target of 1.975 pg/L at the critical location when all fate processes are enabled in the model. These simulations were also run for 100 years to establish the point at which equilibrium was reached between the water column and the sediments. Figure 26 indicates the sediment concentration of penta-PCBs at five locations in the estuary corresponding to a model segment in each of the estuary zones and Delaware Bay. Note that sediment concentrations in all segments reach equilibrium after approximately 20 years. The simulated sediment concentrations at each of the model segments is presented in Figure 27. Figure 28 presents a plot of the annual median values during the 99th and 100th year of the simulation, confirming that the water quality target is being met.

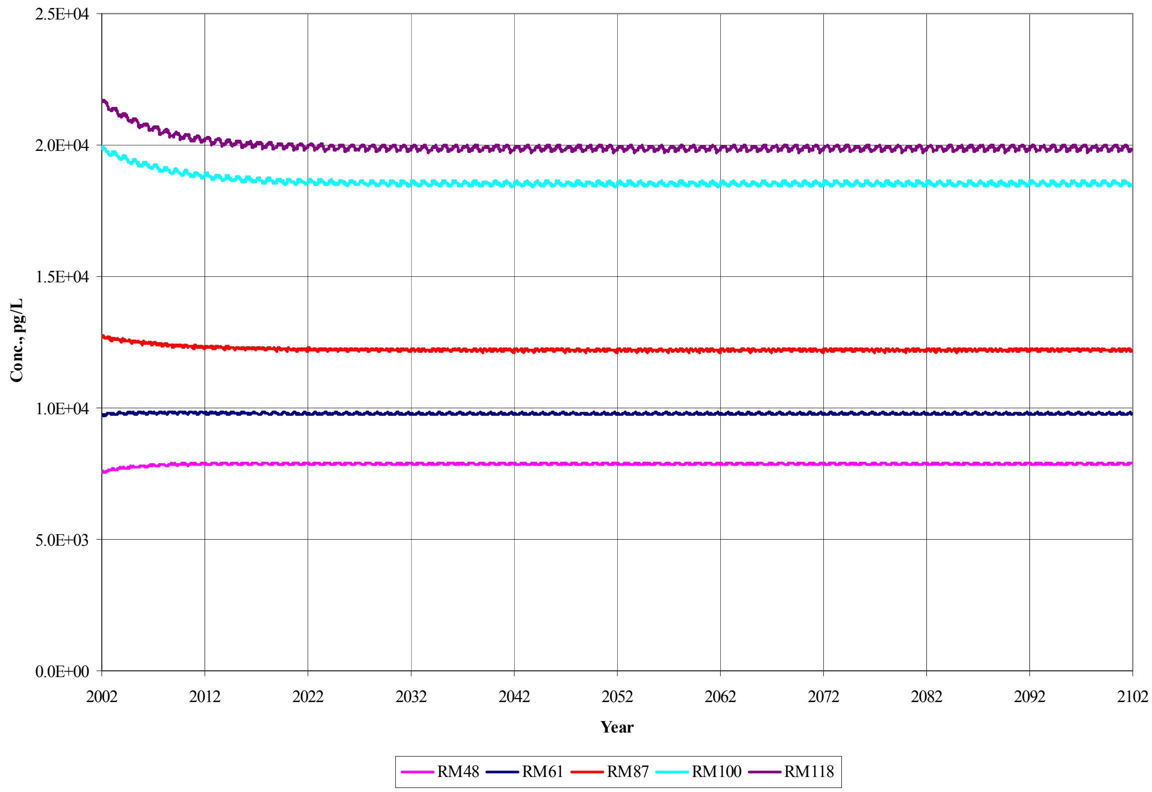


Figure 26: Temporal plot of penta-PCB concentrations in the surface sediment layer during a 100 year simulation with air-water exchange processes enabled.

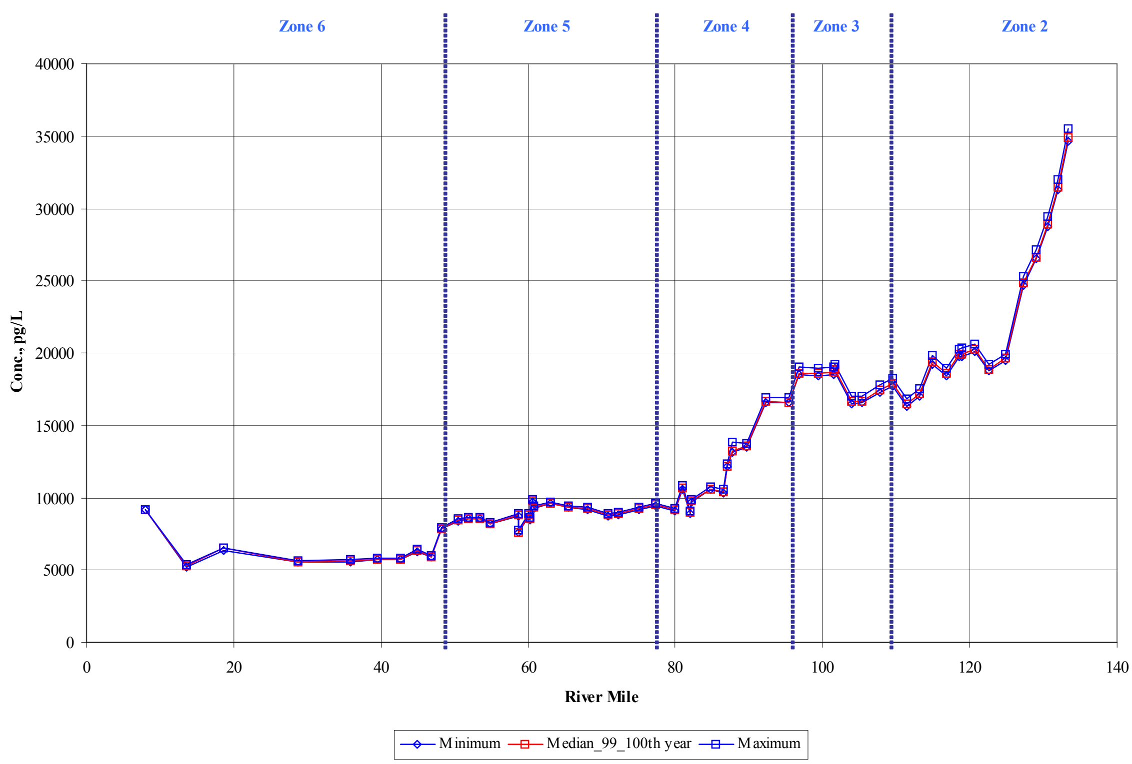


Figure 27: Spatial plot of penta-PCB concentrations in the surface sediment layer during a 100 year simulation with air-water exchange processes.

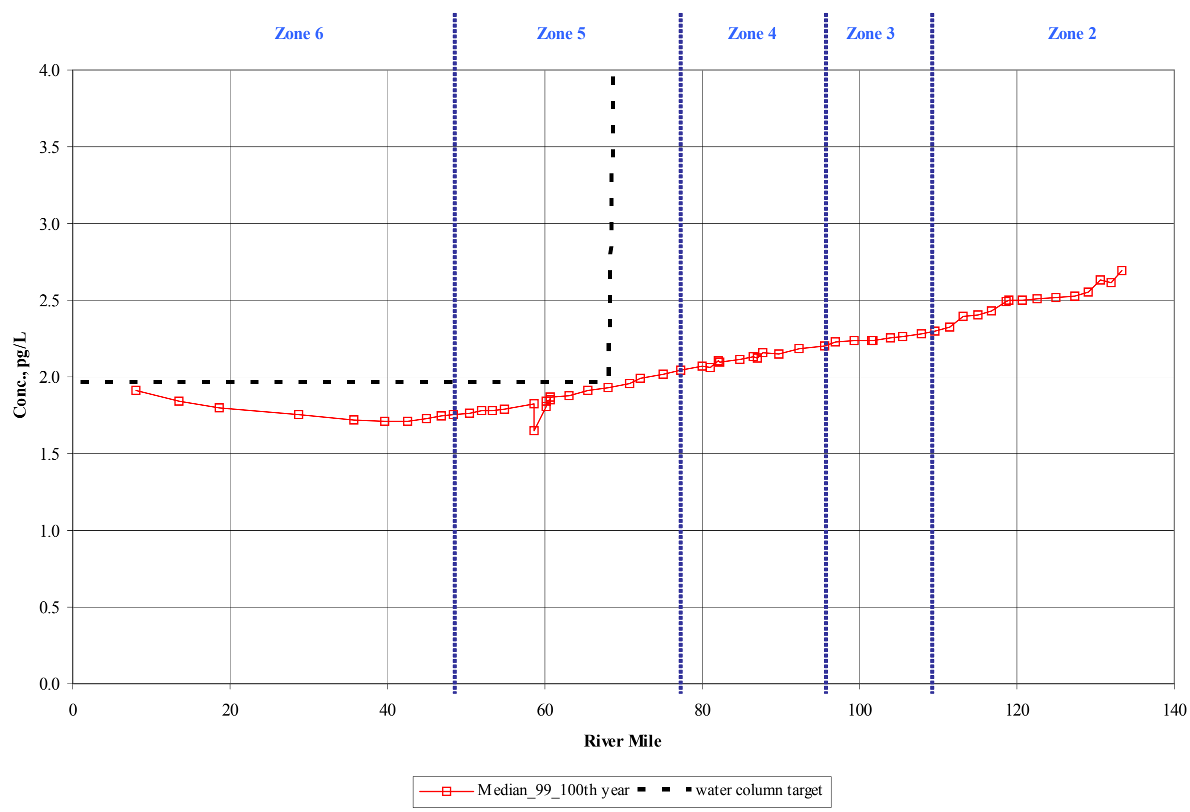


Figure 28: Spatial plot of the penta-PCBs in the water column during a 100 year simulation using the loads established in Step 2, new sediment initial conditions, and with air-water exchange processes enabled

4. TMDLs, WLAs and LAs for Total PCBs for Zones 2 to 5

4.1 TMDLs, WLAs and LAs for Penta- PCBs

Table 5 summarizes the calculated TMDLs (allowable loadings) for penta-PCBs for Zones 2 to 5 of the Delaware Estuary that were derived in Section 3.3.5. The loadings from the Delaware River at Trenton and the Schuylkill River are included in the Zone 2 and 4 TMDLs, respectively. The next step is to allocate the zone-specific TMDLs to a wasteload allocation portion or WLA, a load allocation portion or LA, and a margin of safety.

Table 5: TMDLs for penta-PCBs for Zones 2 through 5 of the Delaware Estuary

Estuary Zone	TMDL (milligrams / day)
Zone 2	64.3400
Zone 3	4.4555
Zone 4	14.1779
Zone 5	12.0157
Sum	94.9891

The Commission's Toxics Advisory Committee has made several recommendations on the policies and procedures to be used to establish these allocations. Federal regulations at 40 CFR Part 130.7(c)(1) require a margin of safety or MOS to be included in a TMDL to account for any lack of knowledge concerning the relationships between pollutant loadings and receiving water quality. Commission regulations also require that a portion of the TMDL be set aside as a margin of safety, with the proportion reflecting the degree of uncertainty in the data and resulting water quality-based controls. The margin of safety can be incorporated either implicitly in the design conditions used in establishing the TMDLs or explicitly by assigning a proportion of each TMDL. Both of these approaches were considered by the Toxics Advisory Committee who recommended that an explicit margin of safety of 5% be assigned in allocating the zone-specific TMDLs. This recommendation was based upon the use of a one year cycling period for the hydrodynamic and water quality model that mimics the period of record for the two major tributaries to the estuary rather than design tributary flows; and the use of tide data, precipitation data and the actual effluent flows that occurred during the one year cycling period. EPA finds these recommendations reasonable and supported by the evidence, and adopted them in these TMDLs. Table 6 presents the MOS allocation for each of the zones as well as the two tributary boundaries. This is necessary since the loadings from these tributaries are part of the PCB loadings to Zones 2 and 4

Table 6: Allocation of the Zone TMDLs to the 5% Margin of Safety

Sources of Loadings	Contribution Factor (CF)	TMDL	MOS	TMDL - MOS
	[pg/L] / [pg/L] or [pg/L] / [100mg/day]	mg/day	mg/day	mg/day
Delaware River	0.581500	57.727	2.886	54.841
Schuylkill River	0.118390	9.609	0.48	9.129
Zone 2	1.966800	6.613	0.331	6.282
Zone 3	2.142800	4.455	0.223	4.232
Zone 4	2.281300	4.569	0.228	4.341
Zone 5	0.967040	12.016	0.601	11.415
Sum		**94.989**	**4.749**	**90.24**

The committee recommended that for the Stage 1 TMDLs, the proportion of the TMDLS that are allocated to WLAs and LAs should be based upon the current loadings from the various PCB source categories to each of the zones during the one year cycling period (February 1, 2002 to January 31, 2003) used in the TMDL model simulations. EPA finds these recommendations reasonable and adopted them in these TMDLs.

Prior to allocation of the remaining portion of the TMDL between WLA and LA, the portion of the assimilative capacity allocated to contaminated sites was determined since the assimilative capacity for this source must also be shared between the estuary zones and the two boundary tributaries (see Section 3.2.1). Table 7 presents the load allocated to the contaminated sites by source and the remaining assimilative capacity that must still be allocated.

Table 7: Allocation of the Zone TMDLs to Contaminated Sites

Sources of Loadings	TMDL - MOS	% of Total Loading to Zone	Contaminated Site Allocation	TMDL - MOS - CS
	mg/day		mg/day	
Delaware River	54.841	-	0.229	54.612
Schuylkill River	9.129	-	3.473	5.656
Zone 2	6.282	0.42	0.026	6.256
Zone 3	4.233	57.09	2.416	1.816
Zone 4	4.340	38.04	1.651	2.689
Zone 5	11.415	46	5.251	6.164
	94.989	**-**	**13.046**	**77.193**

The remaining assimilative capacity can now be apportioned to WLAs and the rest of the sources that contribute to the LAs (Table 8). The WLA source categories include the continuous point source NPDES discharges, stormwater discharges permitted under the NPDES program, and combined sewer overflows (CSOs), and municipal separate storm sewer systems (MS4s).

EPA's regulations require NPDES-regulated storm water discharges to be addressed by the WLA component of a TMDL. Assessing the estimated loading from such discharges is relatively difficult compared to traditional point source discharges, as storm water discharge is typically calculated by quantifying the area of urban and residential land uses in a basin. For this reason, it is important to have updated land use data and runoff coefficients.

In developing the Stage 1 TMDLs, the existing WLAs were calculated for traditional point source discharges based on effluent concentrations and the actual effluent flows during the one year model cycling period (see Section 3.2.4.1). A November 22, 2002 EPA Memorandum entitled, "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm water Source and NPDES Permit Requirements Based on Those WLAs" clarified existing regulatory requirements for municipal separate storm sewer systems (MS4s) connected with TMDLs. Where a TMDL has been developed, the MS4 community must receive a WLA rather than a LA. The Stage 1 TMDL explicitly assigns a portion of each of the zone WLAs to storm water discharges that do not have an individual NPDES permit. Appendix 6 presents the procedure used to develop each of these zone allocations to MS4s and the resulting MS4 loading in milligrams per day (mg/day).

The LA source categories also include the other smaller tributaries, non-point source loads not permitted under the NPDES program, dry and wet atmospheric deposition. Tables 9 and 10 summarize the categories included in the aggregate allocations to WLAs and LAs in each zone, respectively. Table 11 summarizes the allocations to WLAs, LAs and the MOS. Figures 29 to 32 graphically illustrate the proportion allocated.

Table 8: Summary of Zone TMDLs for penta-PCBs and the allocation to the major source categories for PCBs.
.

Sources of Loadings	Contribution Factor (CF)	TMDL	MOS	Contaminated Site Allocation	Remaining Allocation	Allocation to Continuous Point Sources	Allocation to CSOs	Allocation to MS4s	Remaining Portion to the rest of LAs
	[pg/L] / [pg/L] or [pg/L] / [100mg/day]	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day
Trenton	0.581500	57.727	2.886	0.229	54.611	0.000			
Schuylkill	0.118390	9.609	0.480	3.473	5.656	0.000			
Zone 2	1.966800	6.613	0.331	0.026	6.256	1.241	0.006	1.511	3.498
Zone 3	2.142800	4.455	0.223	2.416	1.816	0.771	0.462	0.185	0.398
Zone 4	2.281300	4.569	0.228	1.651	2.689	0.614	0.677	0.342	1.055
Zone 5	0.967040	12.016	0.601	5.250	6.165	3.132	0.182	0.592	2.259
Sum		94.989	4.749	13.046	77.193	5.758	1.327	2.630	7.211

Table 9: Summary of the Zone WLAs for penta-PCBs and their allocation to source categories.

Estuary Zone	WLA	NPDES continuous discharging point sources	CSOs	Municipal separate stormwater sewer service
	mg/day	mg/day	mg/day	mg/day
Zone 2	2.7574	1.2408	0.0059	1.5107
Zone 3	1.4180	0.7713	0.4620	0.1847
Zone 4	1.6338	0.6143	0.6772	0.3423
Zone 5	3.9062	3.1319	0.1822	0.5922
Sum	9.7155	5.7583	1.3272	2.6300

Table 10: Summary of the Zone LAs for penta-PCBs and their allocation to source categories.

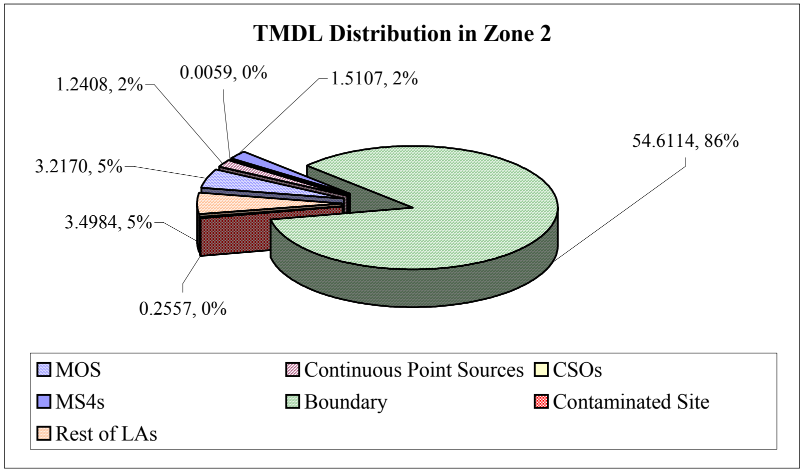
Estuary Zone	LAs	Boundary *	Contaminated Site	Others
	mg/day	mg/day	mg/day	mg/day
Zone 2	58.3656	54.6114	0.2557	3.4984
Zone 3	2.8147	0.0000	2.4164	0.3983
Zone 4	11.8351	5.6558	5.1240	1.0554
Zone 5	7.5087	0.0000	5.2501	2.2586
Sum	80.5242	60.2672	13.0462	7.2107

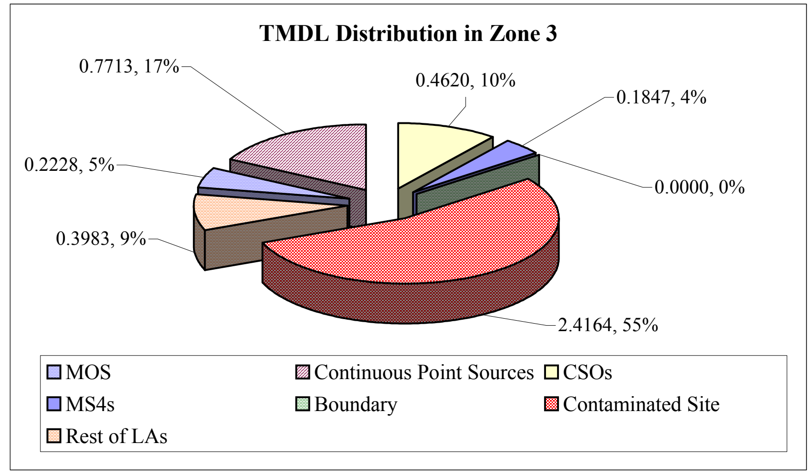
* - The boundary in Zone 2 is the Delaware River at Trenton, and the boundary in Zone 4 is the Schuylkill River.

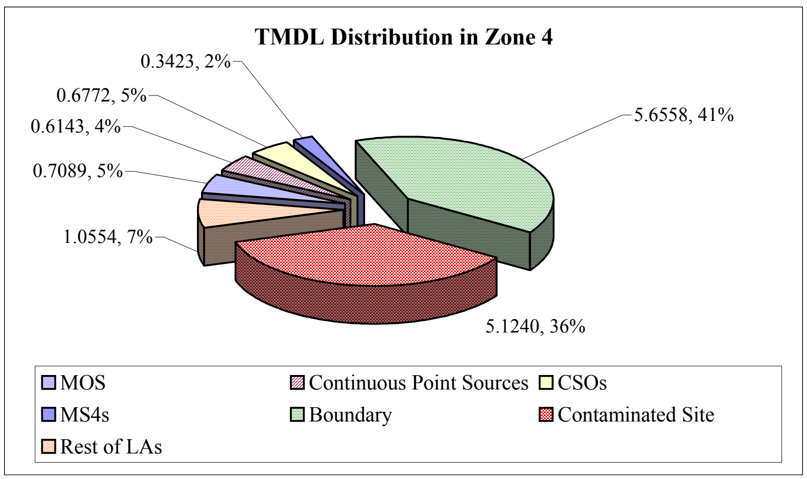
Table 11: Summary of the Zone TMDLs for penta-PCBs and their allocation to WLAs, LAs and a MOS.

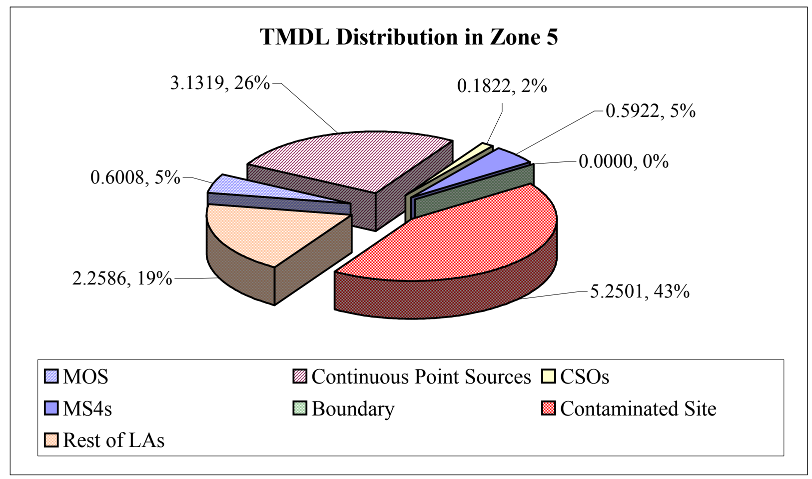
Estuary Zone	TMDL	WLA	LA	MOS
	mg/day	mg/day	mg/day	mg/day
Zone 2	64.3400	2.7574	58.3656	3.2170
Zone 3	4.4555	1.4180	2.8147	0.2228
Zone 4	14.1779	1.6338	11.8351	0.7089
Zone 5	12.0157	3.9062	7.5087	0.6008
Sum	94.9891	9.7155	80.5242	4.7495

Figures 29 - 32: Distribution of Zone TMDLs to Point sources and CSOs, and the Remainder of the Non-Point Sources (tributary boundary loads, the MOS and the Contaminated Site loading excluded).









4.2 TMDLs, WLAs and LAs for Total PCBs

4.2.1 Extrapolation from Penta to Total PCBs

As discussed in Sections 2.2 and 3.2.2, TMDLs for Total PCBs will be extrapolated from penta homolog data using the observed ratio in the Delaware Estuary of the penta homolog to total PCBs. This approach was recommended by the expert panel established by the Commission due to time limitations and the technical difficulty in developing and calibrating a PCB model for each of the ten PCB homologs. Data available to the panel at that time indicated that the proportion of penta-PCBs to Total PCBs at 15 locations sampled in the estuary ranged between 0.2 and 0.3 (20 to 30% of Total PCBs). Figure 33 presents the ratio of penta-PCBs to Total PCBs for each zone based upon data currently available. EPA finds this extrapolation to be reasonable and supported by the best available data.

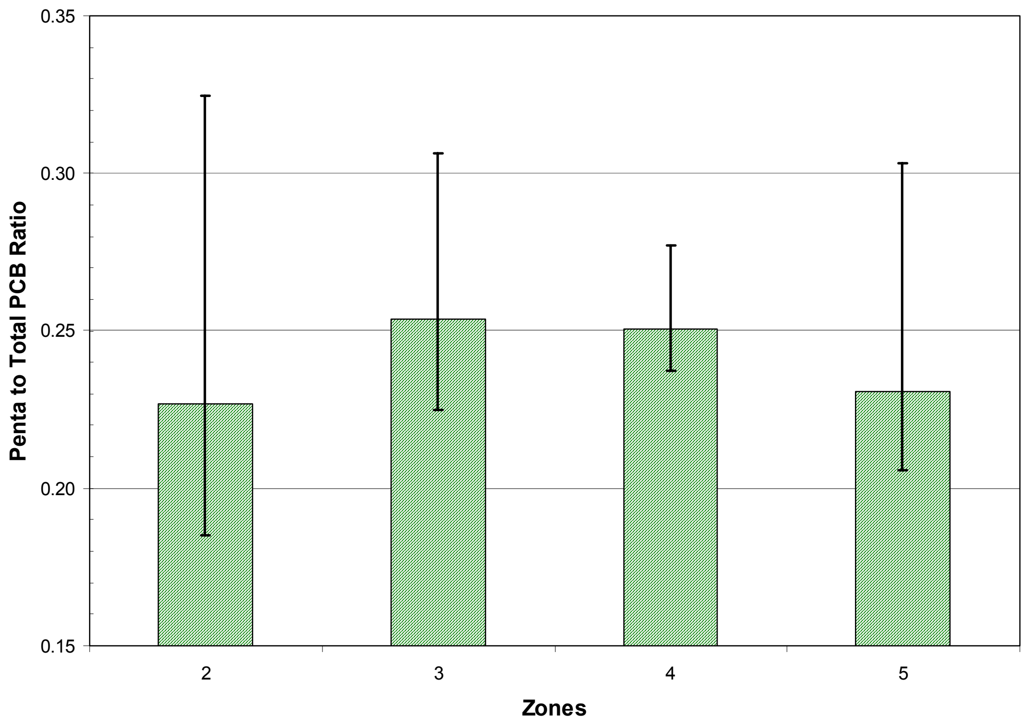


Figure 33: Ratio of Penta-PCBs to Total PCBs in ambient water samples collected from 15 sites in the Delaware Estuary during surveys conducted on September 18, 2001, March 15, 2002, April 11, 2002, October 8, 2002 and March19, 2003. Error bars indicate the minimum and maximum ratios observed at any sampling site during all five surveys.

This data supports the original data and indicates median penta- to total PCB ratios of 0.23, 0.25, 0.25 and 0.23 for Zones 2 to 5, respectively. For Stage 1 TMDLs, a fixed value of 0.25 was used for all zones to scale up the zone-specific TMDLs, WLAs, LAs and MOSs.

4.2.2 TMDLs, WLAs and LAs for Total PCBs

Table 12 summarizes the TMDLs for each estuary zone for total PCBs as well as the allocations to WLAs, LAs and the MOSs.

Table 12: TMDLs, WLAs, LAs and MOSs for Total PCBs for Zones 2 to 5 of the Delaware Estuary.

Estuary Zone	TMDL	WLA	LA	MOS
	mg/day	mg/day	mg/day	mg/day
Zone 2	257.36	11.03	233.46	12.87
Zone 3	17.82	5.67	11.26	0.89
Zone 4	56.71	6.54	47.34	2.84
Zone 5	48.06	15.63	30.04	2.40
Sum	379.96	38.86	322.10	19.00

4.2.3 Uncertainty Analysis for TMDLs, WLAs and LAs for Total PCBs

Uncertainty is associated with three elements of the Stage 1 TMDLs: 1) the use of annual median values for determining compliance with the penta-PCB water quality target, 2) the loading of penta-PCBs for each of the source categories that is used to apportion the TMDLs, and 3) the extrapolation of the penta-PCB TMDLs, aggregate and individual WLAs, and LAs to total PCBs.

As discussed in Section 3.2.1, TMDLs are calculated over a one year period (annual median) to be consistent with both the model simulations and the 70 year exposure used for human health criteria. The estuary, however, is dynamic with ambient PCB concentrations being affected by the amount of inflow from the tributaries, the variation in the tides over lunar and annual time scales, changes in both continuous and precipitation-induced wastewater flows, and the prevailing air and water temperature. Thus, ambient PCB concentrations will vary on both a daily and monthly basis about the annual median. The magnitude of this variation can be seen by plotting the annual minimum and annual maximum values that occur during long-term model simulations like those used to check whether a given set of loading assumptions results in compliance with the penta-PCB water quality target at the critical location (see Figure 28). Figure 34 illustrates the uncertainty associated with the use of annual median values by comparing annual minimum and maximum plots of water column concentrations of penta-PCBs during a 100 year simulation. The figure indicates that the annual variation is approximately +15% to -25%.

The uncertainty in the loading estimates for each of the source categories is discussed in Section 2.7 of the model calibration report (DRBC, 2003c). A Monte Carlo analysis was performed to examine and compare the uncertainty for the loading estimates for each PCB source category that were used in the 577 day model calibration period. This analysis indicated that the greatest uncertainty was associated with the tidal non-point source loads (90^{th} and 10^{th} percentiles of loading were 44.82 and 2.28 kilograms, respectively) followed by the contaminated site loads (90^{th} and 10^{th} percentiles of loading were 24.94 and 4.23 kilograms, respectively). Less uncertainty was associated with the loading from point sources (90^{th} and 10^{th} percentiles of loading were 8.53 and 5.16 kilograms, respectively)

The uncertainty in the extrapolation from penta-PCBs to total PCBs is illustrated in Figure 33. This figure indicates that while the zone ratios of penta-PCBs to total PCBs is close to 0.25, the uncertainty associated with the ratios varies between zones with the largest uncertainty occurring in Zone 2 (0.19 to 0.32) and the smallest occurring in Zone 4 (0.24 to 0.28).

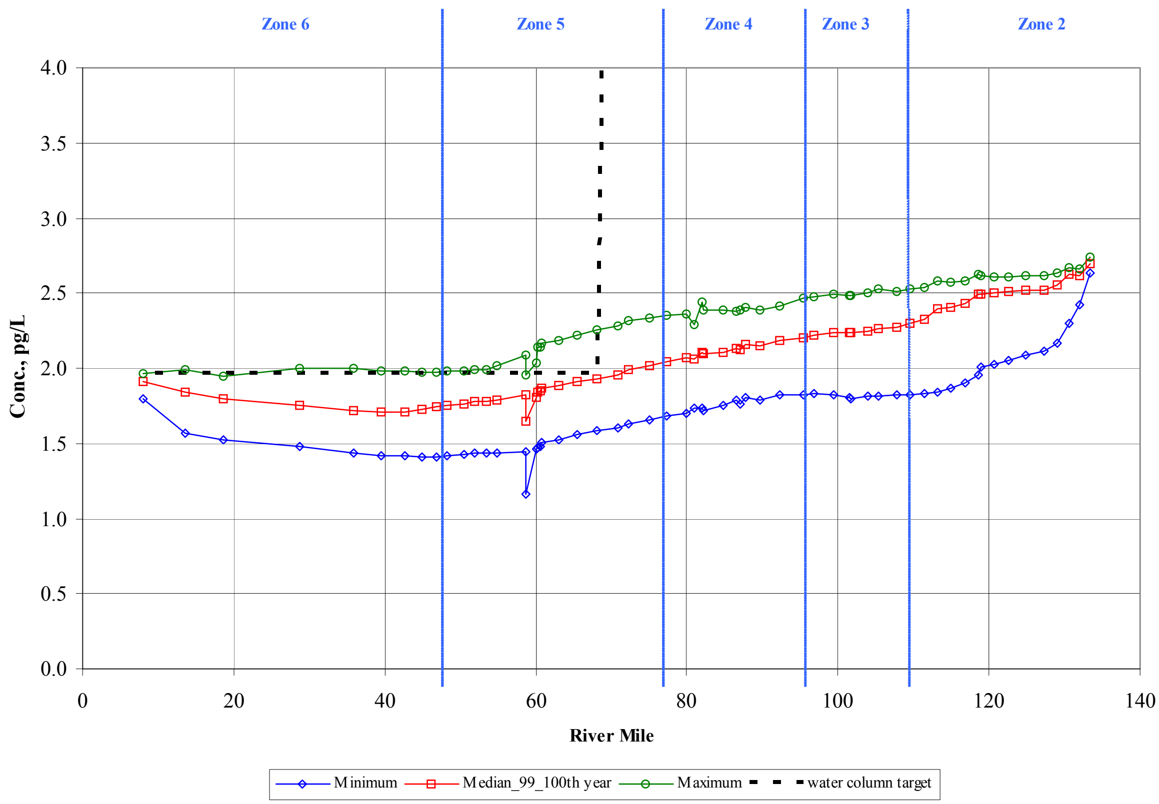


Figure 34: Spatial plots of the annual median, annual minimum and annual maximum values of water column penta-PCB concentrations during a 100 year simulation using the TMDL loads.

5. REFERENCES

Delaware River Basin Commission. 1988. Fish Health and Contamination Study. Delaware Estuary Use Attainability Project. Delaware River Basin Commission. West Trenton, NJ. March 1988.

Delaware River Basin Commission. 1996. Administrative Manual - Part III, Water Quality Regulations. Delaware River Basin Commission. West Trenton, NJ. October 1996.

Delaware River Basin Commission. 1998a. Study of the Loadings of Polychlorinated Biphenyls from Tributaries and Point Sources Discharging to the Tidal Delaware River. Delaware River Basin Commission. West Trenton, NJ. June 1998.

Delaware River Basin Commission. 1998b. Calibration and Validation of a Water Quality Model for Volatile Organics and Chronic Toxicity in the Delaware River Estuary. Delaware River Basin Commission. West Trenton, NJ. December 1998.

Delaware River Basin Commission. 2003a. DYNHYD5 Hydrodynamic Model (Version 2.0) and Chloride Water Quality Model for the Delaware Estuary. Delaware River Basin Commission. West Trenton, NJ. September 2003.

Delaware River Basin Commission. 2003b. PCB Water Quality Model for the Delaware Estuary (DELPCB). Delaware River Basin Commission. West Trenton, NJ. September 2003.

Delaware River Basin Commission. 2003c. Calibration of the PCB Water Quality Model of the Delaware Estuary for Penta-PCBs and Carbon. Delaware River Basin Commission. West Trenton, NJ. September 2003.

Franklin Institute. 2003. Franklin's Forecast. Accessed 30 July 2003. http://www.fi.edu/weather.

Greene R.W. and R.W. Miller. 1994. Summary and Assessment of Polychlorinated Biphenyls and Selected Pesticides in Striped Bass from the Delaware Estuary. Delaware Department of Natural Resources & Environmental Control. Dover, DE. March 1994.

Hauge, P., P. Morton, M. Boriek, J. McClain and G. Casey. 1990. Polychlorinated Biphenyl (PCBs), Chlordane, and DDTs in Selected Fish and Shellfish From New Jersey Waters, 1986-1987: Results from New Jersey's Toxics in Biota Monitoring Program. New Jersey Department of Environmental Protection. Trenton, NJ. 66pp.

Van Ry, D.A., C.L. Gigliotti, T.R. Glenn, E.D. Nelson, L.A. Totten, and S.J. Eisenreich. 2002. Wet Deposition of Polychlorinated Biphenyls in Urban and Background Areas of the Mid-Atlantic States. Envir. Sci. & Tech. 36(15):3201-3209.

U.S. Environmental Protection Agency. 1998. National Recommended Water Quality Criteria; Notice; Republication. Federal Register Vol. 63, No. 237, Pages 68354-68364.

U.S. Environmental Protection Agency. 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000). Office of Water. Office of Science and Technology. Washington, D.C. EPA-822-B-00-004. October 2000.

U.S. Fish & Wildlife Service. 1991. Assessment of Organochlorine and Metal Contamination in the Lower Delaware River Estuary (AFO-C91-04). U.S. Fish and Wildlife Service, Environmental Contaminants Division. Annapolis, MD.

U.S. Fish & Wildlife Service. 1992. Concentrations of Organochlorines and Trace Elements in Fish and Blue Crabs from the Delaware River, Easton to Deepwater. Special Project Report 93-5. U.S. Fish and Wildlife Service. State College, PA.

Appendix 1

REDUCING PCB LOADINGS TO THE DELAWARE ESTUARY:
A Staged Approach to Establishing TMDLs

Documents distributed at the April 29, 2003 meeting convened by the

U.S. Environmental Protection Agency, Regions II and III

Delaware River Basin Commission

Delaware Department of Natural Resources & Environmental Control

New Jersey Department of Environmental Protection

Pennsylvania Department of Environmental Protection

Appendix 2

Individual Wasteload Allocations for NPDES Discharges: Stage 1 TMDLs for Total PCBs for Zones 2 to 5 of the Delaware Estuary

Appendix Table 2-1: Individual wasteload allocations for the point source discharges except CSOs and MS4s.

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
1	1	Morrisville WWTP	PA0026701	001	2	132.9	76	2	65.566	0.057280	0.229120
2	2	Trenton	NJ0020923	001	2	132.2	75	1	243.612	0.212825	0.851301
3	3	PSEG-Mercer	NJ0004995	441A	2	130.4	74	2	0.000	0.000000	0.000000
4	4	PSEG-Mercer	NJ0004995	441C	2	130.4	74	1	5.010	0.004377	0.017508
5	5	MSC Pre Finish Metals	PA0045021	001	2	130.1	74	2	0.646	0.000564	0.002256
6	6	Hamilton Township	NJ0026301	001	2	128.0	73	2	220.791	0.192889	0.771555
7	7	Yates Foil	NJ0004332	001B	2	128.0	73	2	0.070	0.000061	0.000244
8	8	Yates Foil	NJ0004332	002A	2	128.0	73	2	0.000	0.000000	0.000000
9	9	Bordentown Sewerage Authority	NJ0024678	001	2	128.0	71	2	26.292	0.022969	0.091877
10	10	U.S. Steel	PA0013463	002	2	127.4	71	1	61.390	0.053632	0.214527
11	11	U.S. Steel	PA0013463	103	2	127.0	71	1	10.056	0.008785	0.035141
12	12	U.S. Steel	PA0013463	203	2	127.0	71	1	3.787	0.003308	0.013234
13	13	Exelon-Fairless	PA0057088	001	2	126.6	71	2	0.000	0.000000	0.000000
14	14	Waste Management Grows Landfill	PA0043818	001	2	125.5	70	2	1.182	0.001033	0.004131
15	15	Lower Bucks County Municipal Authority	PA0026468	001	2	121.9	69	2	129.179	0.112854	0.451417
16	16	Florence Township	NJ0023701	001	2	121.4	68	2	15.682	0.013700	0.054802
17	17	GEON Company (Burlington) Polyone	NJ0004235	001A	2	120.3	68	2	15.051	0.013149	0.052595
18	18	Bristol Borough	PA0027294	001	2	118.7	66	2	29.383	0.025669	0.102677
19	19	US Pipe & Foundry	NJ0005266	002A	2	118.1	66	1	0.807	0.000705	0.002821
20	20	City of Burlington	NJ0024660	002	2	117.6	64	2	46.336	0.040480	0.161921
21	21	PSEG-Burlington	NJ0005002	WTPA	2	117.4	64	1	0.929	0.000812	0.003246
22	22	Rohm&Haas-Bristol	PA0012769	009	2	117.1	64	1	5.710	0.004988	0.019952

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
23	23	Burlington Township	NJ0021709	001	2	117.0	64	2	34.901	0.030490	0.121961
24	24	Colorite Polymers	NJ0004391	002A	2	117.0	64	2	0.008	0.000007	0.000030
25	25	Colorite Polymers	NJ0004391	003A	2	117.0	64	2	0.740	0.000646	0.002585
26	26	Bristol Township	PA0026450	001	2	116.8	64	2	34.732	0.030342	0.121370
27	27	Beverly Sewerage Authority	NJ0027481	001	2	114.7	63	1	18.890	0.016503	0.066010
28	28	Delran Sewerage Authority	NJ0023507	001	2	110.8	60	2	37.419	0.032691	0.130762
29	29	Mt. Holly Municipal Utilities Authority	NJ0024015	001	2	110.8	61	2	54.904	0.047965	0.191862
30	30	Mt. Laurel Municipal Utilities Authority	NJ0025178	001A	2	110.8	60	2	67.433	0.058911	0.235646
31	31	Riverton Borough	NJ0021610	001	2	110.8	61	1	3.853	0.003366	0.013464
32	32	Willingboro Municipal Utilities Authority	NJ0023361	001	2	110.8	61	2	123.392	0.107798	0.431194
33	33	AFG Industries	NJ0033022	001A	2	109.6	59	1	10.258	0.008962	0.035848
34	34	AFG Industries	NJ0033022	002	2	109.4	59	2	0.092	0.000080	0.000321
35	35	Hoeganaes Corp.	NJ0004375	001A	2	109.4	59	2	0.330	0.000288	0.001151
36	36	Hoeganaes Corp.	NJ0004375	003A	2	109.4	59	2	0.000	0.000000	0.000000
37	37	Cinnaminson Sewerage Authority	NJ0024007	001	2	108.9	59	1	27.980	0.024444	0.097778
38	38	Riverside Sewerage Authority	NJ0022519	001	2	108.8	59	1	124.107	0.108423	0.433693
39	1	Palmyra Borough	NJ0024449	001	3	107.7	58	2	19.235	0.005384	0.021536
40	2	Rohm&Haas-Philadelphia	PA0012777	001	3	106.1	56	2	15.974	0.004471	0.017885
41	3	Rohm&Haas-Philadelphia	PA0012777	003	3	106.1	56	1	2.175	0.000609	0.002435
42	4	Rohm&Haas-Philadelphia	PA0012777	007	3	106.1	56	2	0.003	0.000001	0.000003
43	5	NGC Industries	NJ0004669	001A	3	104.4	55	2	1.528	0.000428	0.001710
44	6	PWD-NE	PA0026689	001	3	104.1	55	1	1238.662	0.346711	1.386845
45	7	Citgo Petroleum	NJ0131342	001A	3	103.4	55	2	0.012	0.000003	0.000014
46	8	Exelon-Delaware	PA0011622	001	3	101.2	52	2	0.044	0.000012	0.000049

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
47	9	Exelon-Delaware	PA0011622	002	3	101.2	52	1	0.655	0.000183	0.000733
48	10	Exelon-Delaware	PA0011622	004	3	101.2	52	2	0.011	0.000003	0.000013
49	11	Exelon-Delaware	PA0011622	006	3	101.1	52	2	0.000	0.000000	0.000000
50	12	CCMUA	NJ0026182	001	3	98.0	49	1	818.459	0.229093	0.916372
51	13	PWD-SE	PA0026662	001	3	96.8	49	1	657.721	0.184101	0.736405
52	1	Coastal Mart / Coastal Eagle Point Oil	NJ0005401	003A	4	94.7	48	2	0.006	0.000002	0.000007
53	2	Coastal Mart / Coastal Eagle Point Oil	NJ0005401	001A	4	94.3	48	2	55.368	0.014863	0.059451
54	3	Metro Machine	PA0057479	DD2	4	93.2	44	1	49.040	0.013164	0.052656
55	4	Metro Machine	PA0057479	DD3	4	93.1	44	2	17.845	0.004790	0.019161
56	5	Kvaerner	PA0057690	019	4	92.8	44	1	0.100	0.000027	0.000108
57	6	Kvaerner	PA0057690	021	4	92.8	44	1	0.100	0.000027	0.000108
58	7	Kvaerner	PA0057690	012	4	92.7	44	1	22.608	0.006069	0.024275
59	8	Kvaerner	PA0057690	047	4	92.5	45	2	0.005	0.000001	0.000005
60	9	Sunoco-GirardPoint	PA0011533	015	4	92.5	45	2	99.167	0.026620	0.106481
61	10	Sunoco-PointBreeze	PA0012629	002	4	92.5	46	2	75.899	0.020374	0.081496
62	11	PWD-SW	PA0026671	001	4	90.7	43	1	1020.466	0.273932	1.095729
63	12	Ausimont	NJ0005185	001A	4	90.7	43	1	0.840	0.000225	0.000902
64	13	Ausimont	NJ0005185	002A	4	90.7	43	1	0.077	0.000021	0.000082
65	14	Chevron	NJ0064696	001A	4	90.5	43	2	0.157	0.000042	0.000169
66	15	Colonial Pipeline	NJ0033952	001A	4	90.5	43	2	0.087	0.000023	0.000094
67	16	BP Paulsboro	NJ0005584	002A	4	89.6	43	2	0.352	0.000095	0.000378
68	17	BP Paulsboro	NJ0005584	003A	4	89.4	43	2	7.006	0.001881	0.007522
69	18	GCUA	NJ0024686	001	4	88.4	43	1	113.497	0.030467	0.121868
70	19	Air Products	NJ0004278	001A	4	88.2	42	2	10.041	0.002695	0.010782

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
71	20	Valero Refining	NJ0005029	001A	4	87.7	42	1	99.473	0.026702	0.106809
72	21	Hercules	NJ0005134	001A	4	87.5	42	1	4.120	0.001106	0.004424
73	22	Greenwich Township	NJ0030333	001	4	87.0	42	2	12.110	0.003251	0.013003
74	23	Dupont-Repauno	NJ0004219	007	4	86.6	42	1	1.433	0.000385	0.001538
75	24	Dupont-Repauno	NJ0004219	001A	4	85.6	38	1	80.773	0.021682	0.086730
76	25	Boeing	PA0013323	002	4	85.4	38	1	158.353	0.042508	0.170032
77	26	Boeing	PA0013323	016	4	85.4	38	1	0.149	0.000040	0.000160
78	27	Tinicum Township	PA0028380	001	4	85.4	40	1	15.450	0.004147	0.016590
79	28	Boeing	PA0013323	001	4	85.2	38	1	29.068	0.007803	0.031212
80	29	Boeing	PA0013323	003	4	85.2	38	1	0.404	0.000108	0.000433
81	30	Boeing	PA0013323	007	4	85.2	38	1	0.235	0.000063	0.000252
82	31	Boeing	PA0013323	008	4	85.2	38	2	0.018	0.000005	0.000019
83	32	Exelon-Eddystone	PA0013716	001	4	85.2	38	1	0.064	0.000017	0.000069
84	33	Exelon-Eddystone	PA0013716	005	4	85.2	38	1	0.509	0.000137	0.000546
85	34	Exelon-Eddystone	PA0013716	007	4	85.2	38	2	0.000	0.000000	0.000000
86	35	Exelon-Eddystone	PA0013716	008	4	85.2	38	2	0.000	0.000000	0.000000
87	36	Kimberly Clark	PA0013081	029	4	83.2	36	1	0.086	0.000023	0.000092
88	37	DeGuessa-Huls Corp.	PA0051713	001	4	82.2	36	2	9.063	0.002433	0.009731
89	38	DELCORA	PA0027103	001	4	80.6	34	1	309.423	0.083061	0.332244
90	39	ConocoPhillips	PA0012637	002	4	80.2	34	2	0.000	0.000000	0.000000
91	40	ConocoPhillips	PA0012637	006	4	80.2	34	2	0.029	0.000008	0.000032
92	41	ConocoPhillips	PA0012637	007	4	80.2	34	1	0.511	0.000137	0.000549
93	42	ConocoPhillips	PA0012637	008	4	80.2	34	1	0.111	0.000030	0.000119
94	43	Harrison Township-Mullica Hill	NJ0020532	001	4	79.8	79	2	6.093	0.001636	0.006543

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
95	44	Safety Kleen	NJ0005240	001A	4	79.8	79	2	7.440	0.001997	0.007989
96	45	Safety Kleen	NJ0005240	002A	4	79.8	79	1	3.512	0.000943	0.003772
97	46	Swedesboro	NJ0022021	001	4	79.8	79	2	3.296	0.000885	0.003539
98	47	ConocoPhillips	PA0012637	101	4	79.6	34	2	0.000	0.000000	0.000000
99	48	ConocoPhillips	PA0012637	201	4	79.6	34	2	48.580	0.013041	0.052163
100	49	Logan Township	NJ0027545	001	4	79.5	34	2	12.114	0.003252	0.013007
101	50	Solutia	NJ0005045	001	4	79.2	34	2	12.228	0.003282	0.013130
102	1	General Chemical	DE0000655	001	5	77.9	33	2	0.000	0.000000	0.000000
103	2	Geon Company (Pedricktown) Polyone	NJ0004286	003	5	75.9	32	2	0.011	0.000007	0.000030
104	3	Geon Company (Pedricktown) Polyone	NJ0004286	001A	5	74.9	32	2	1.690	0.001135	0.004542
105	4	Dupont-Edgemoor	DE0000051	001	5	73.2	31	1	32.214	0.021641	0.086564
106	5	Dupont-Edgemoor	DE0000051	004	5	72.2	31	1	0.153	0.000103	0.000412
107	6	Conectiv-Edgemoor	DE0000558	041	5	71.8	31	2	0.008	0.000005	0.000020
108	7	City of Wilmington	DE0020320	001	5	71.6	31	2	1297.745	0.871802	3.487207
109	8	Carney's Point	NJ0021601	001	5	71.3	25	2	10.265	0.006896	0.027584
110	9	AMTRAK	DE0050962	003	5	70.7	30	1	2.002	0.001345	0.005378
111	10	AMTRAK	DE0050962	004	5	70.7	30	1	35.822	0.024065	0.096259
112	11	Penns Grove Sewer Authority	NJ0024023	001	5	70.7	28	1	23.206	0.015589	0.062357
113	12	Dupont-ChamberWorks	NJ0005100	001A	5	69.8	25	1	138.476	0.093026	0.372103
114	13	Dupont-ChamberWorks	NJ0005100	662A	5	69.8	25	1	102.854	0.069096	0.276383
115	14	Conectiv-Deepwater	NJ0005363	003A	5	69.1	24	2	0.000	0.000000	0.000000
116	15	Conectiv-Deepwater	NJ0005363	005	5	69.1	24	2	0.035	0.000024	0.000094
117	16	Conectiv-Deepwater	NJ0005363	006	5	69.1	24	2	0.006	0.000004	0.000017
118	17	Conectiv-Deepwater	NJ0005363	017	5	69.1	24	1	0.284	0.000191	0.000763

Serial No.	Serial No. per Zone	Facility Name	NPDES	DSN	ZONE	RM	Model Segment	Potential Group (category)	Current Loadings (Sept. 2003) mg/day	Pent-PCBs WLA mg/day	Total PCBs WLA mg/day
119	18	Dupont-ChamberWorks	NJ0005100	011A	5	68.9	24	2	0.004	0.000003	0.000010
120	19	Dupont-ChamberWorks	NJ0005100	013A	5	68.9	24	2	0.000	0.000000	0.000000
121	20	Pennsville Sewerage Authority	NJ0021598	001	5	65.1	23	1	63.353	0.042559	0.170237
122	21	OxyChem	DE0050911	001	5	62.2	81	1	1.798	0.001208	0.004831
123	22	OxyChem	DE0050911	002	5	62.2	81	1	0.168	0.000113	0.000453
124	23	Conectiv-DelawareCity	DE0050601	016	5	61.9	22	2	0.123	0.000082	0.000330
125	24	Conectiv-DelawareCity	DE0050601	033	5	61.9	22	2	0.005	0.000003	0.000012
126	25	Conectiv-DelawareCity	DE0050601	034	5	61.9	22	2	0.015	0.000010	0.000040
127	26	Metachem	DE0020001	002	5	61.9	22	1	1.713	0.001151	0.004604
128	27	Metachem	DE0020001	003	5	61.9	22	1	2.176	0.001462	0.005848
129	28	Metachem	DE0020001	001	5	61.5	21	2	81.182	0.054537	0.218147
130	29	Motiva	DE0000256	001	5	61.5	21	2	0.000	0.000000	0.000000
131	30	Motiva	DE0000256	601	5	61.5	21	1	0.000	0.000000	0.000000
132	31	Kaneka Delaware Corp.	DE0000647	001	5	61.4	21	2	2.266	0.001522	0.006089
133	32	Formosa Plastics	DE0000612	001	5	61.3	21	2	4.885	0.003281	0.013126
134	33	Motiva	DE0000256	101	5	61.0	21	1	2843.225	1.910027	7.640108
135	34	Delaware City STP (New Castle Co.)	DE0021555	001	5	60.1	18	2	4.085	0.002744	0.010976
136	35	City of Salem	NJ0024856	001	5	58.8	15	2	10.062	0.006760	0.027038
137	36	Port Penn STP (New Castle Co.)	DE0021539	001	5	54.8	12	2	0.487	0.000327	0.001308
138	37	PSEG-HopeCreek	NJ0025411	461A	5	52.0	11	2	0.000	0.000000	0.000000
139	38	PSEG-HopeCreek	NJ0025411	461C	5	52.0	11	1	0.915	0.000614	0.002457
140	39	PSEG-HopeCreek	NJ0025413	462A	5	52.0	11	2	0.011	0.000007	0.000029
141	40	PSEG-Salem	NJ0005622	485	5	51.0	77	2	0.000	0.000000	0.000000
142	41	PSEG-Salem	NJ0005622	489	5	51.0	77	1	0.984	0.000661	0.002644

Appendix 3

Permit Implications for NPDES Dischargers resulting from Stage 1 TMDLs for PCBs

The staged approach to establishing TMDLs for PCBs for Zones 2 to 5 of the Delaware Estuary that was presented to interested parties in April 2003 by the regulatory agencies described appropriate NPDES permitting actions that would result following the establishment of the Stage 1 TMDLs by the U.S. Environmental Protection Agency. The criteria that were presented at that time utilized a cumulative loading approach to identify those discharges with the largest loading of penta-PCBs. The criteria have been expanded and refined since that time to include the quality of the penta-PCB data used to develop the loading estimates for the NPDES dischargers.

Approach:

NPDES dischargers (excluding CSOs and MS4s) were divided into two groups based upon the type of analytical method used to measure the 19 penta-PCB congeners, and the number of the penta-PCB congeners that were detected. Five criteria are considered in classifying NPDES point discharges into two groups.

The criteria for grouping the discharges is as follows:

1. Method used:
   a. 1668A
   b. 8082A

2. Discharge consists principally of non-contact cooling water.

3. If Method 1668A was used, the data was submitted at the detection limits specified in the method:
   a. Yes
   b. No

4. Average number of detected penta congeners per sampling event:
   a. 4 or greater
   b. Less than 4

5. Calculated loadings
   a. A discharge using Method 1668A with lower detection limits which is one of a group of discharges whose total cumulative loading is less than 10% of the zone waste load allocation.

<u>Group 1</u>

1. All discharges, except non-contact cooling water discharges, which have detected 4 or more penta PCB congeners per sampling event regardless of the method used and detection limits achieved, with the exception of those discharges using Method 1668A at the method specified detection limits whose cumulative loadings are less than the 10 percent of zone WLAs.

<u>Group 2</u>

1. All discharges with less than 4 congener detected per sampling event.
2. All discharges which have detected 4 or more penta PCB congeners per sampling event using Method 1668A at the method specified detection limits whose cumulative loadings are less than the 10 percent of zone WLAs.
3. All non-contact cooling water, regardless of the number of penta congeners detected, method used, or detection limits.

Permit Requirements:

Federal regulations implementing the NPDES program at 40 CFR Part 122.44(k)(4) allow the use of non-numeric, Best Management Practices-based WQBELs where a BMP approach is the reasonably necessary means to control pollutants to achieve the goals of the Clean Water Act. The uncertainty associated with several elements of the current TMDL development process including the PCB loadings calculations, the model inputs, and the extrapolation from penta-PCBs to total PCBs support this approach for Stage 1. EPA recommends that the groups receive the following permit requirements consisten with state and federal NPDES permit regulations.

Group 1 - Permit requirements will include waste minimization and reduction programs and additional monitoring with Method 1668A. Both requirements will be performed concurrently, and will be imposed when permit is reissued or modified. DRBC may also impose the requirements.

Group 2 - Permit requirements will include waste minimization and reduction programs (WMRP) and additional monitoring with Method 1668A. Monitoring will be performed in the first two years to confirm the presence and concentration of PCB congeners followed by the WMRP in the third year if the monitoring results confirm the concentrations and associated loading estimates for penta-PCBs, or result in loading estimates for other PCB homologs that exceed the individual WLAs for total PCBs for the discharge.

It is recommended that both requirements will be imposed when permit is reissued or modified. DRBC may also impose the requirements for selected discharges (i.e., non-contact cooling water discharges).

Note: Dischargers in both Groups are receiving individual WLAs. Therefore, the sum of all individual WLAs plus the aggregate WLA for CSOs will equal the proportion of the TMDL for each zone that is allocated to WLAs (Zone WLA).

EPA specifically requested comment and additional information during the public comment period regarding the assignment of discharges to each group. Based upon the comments received, no changes to the group assignments were necessary. The draft TMDL document utilizes data from point discharges that were submitted by April 2003. Some dischargers utilized method 1668A for analysis, however the data reported did not adhere to method detection limits specified by the method. Therefore all dischargers which utilized method 1668A were required to re-submit data at the detection limits specified by the method. As of the April date, some dischargers had resubmitted the data , however, there remained a group of dischargers who did not provide the data by April 2003. Many of these dischargers have provided data since April and the resubmitted data has been used to generate revised loadings and number of penta congeners detected (Appendix Tables 3-2 to 3-5). The resubmitted data had essentially two effects. It typically increased the number of detected congeners and changed the loadings estimates for the discharges.

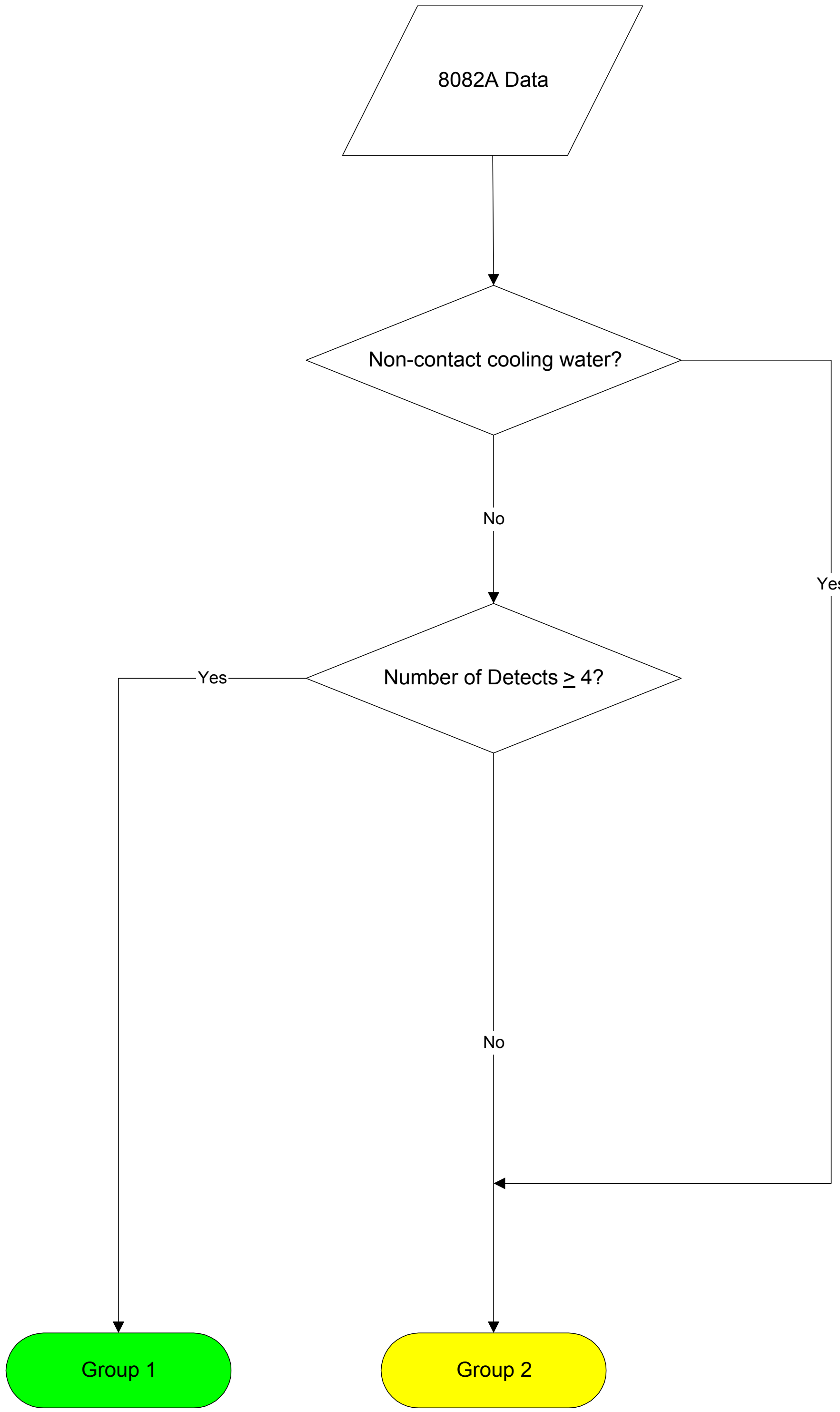
There are however, a small number of dischargers which utilized method 1668A for which we have not received resubmitted data as of September 11, 2003.

As indicated at that time, the identification of significant point source dischargers is a dynamic process that depends on several factors including the availability and extent of PCB congener data for each discharge, the flows used for each discharge, the procedure used to calculate the loadings, the location of the discharge in the estuary, and the proximity and loading of other sources of PCBs. As a result, the list of point source dischargers is subject to change both prior to December 2003 and during the development of the Stage 2 TMDLs.

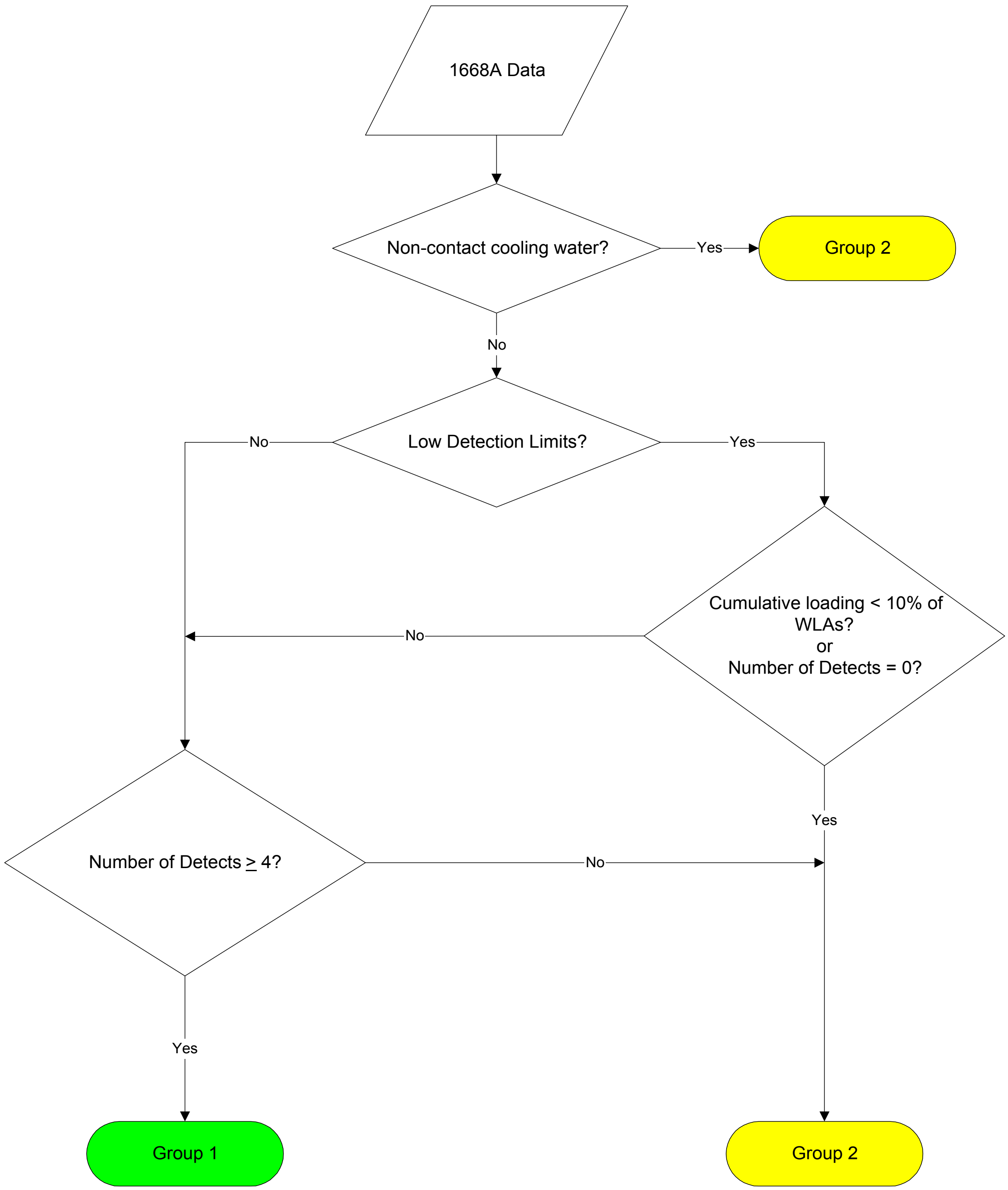
Appendix Tables 3-2 to 3-5 list the discharges assigned to each group as of September 11, 2003. Individual discharges from combined sewer overflows (CSOs) and municipal separate storm sewer systems (MS4s) have not been included in the tables. Table 9 lists the categorical allocation by zone to these two sources. Individual wasteload allocations for the point source dischargers included in the Stage 1 TMDLs are also listed in each table.

Appendix Table 3-1: Distribution of NPDES Discharges to each group in each zone of the Delaware Estuary.

	Number of Discharges				
	Zone 2	Zone 3	Zone 4	Zone 5	Total
Group 1	13	5	25	17	60
Group 2	25	8	25	24	82
Total	38	13	50	41	142



Appendix Figure 3-1: Selection process for permit requirements for NPDES discharges using Method 8082A.



Appendix Figure 3-2: Selection process for permit requirements for NPDES discharges using Method 1668A.

Appendix Table 3-2: Data used to assign the permit requirements for NPDES discharges in Zone 2.

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
1	Trenton	NJ0020923-001	132.2	3	3	Yes	Yes	11.2	No	243.612	*	1
2	PSEG-Burlington	NJ0005002-WTPA	117.4	3	1	Yes	Yes	10.3	No	0.929	*	1
3	U.S. Steel	PA0013463-103	127.0	5	1	Yes	Yes	9.7	No	10.056	*	1
4	U.S. Steel	PA0013463-002	127.4	3	1	Yes	Yes	9.5	No	61.390	*	1
5	U.S. Steel	PA0013463-203	127.0	2	1	Yes	Yes	9.3	No	3.787	*	1
6	Rohm&Haas-Bristol	PA0012769-009	117.1	3	0	Yes	Yes	9.0	No	5.710	*	1
7	Riverside Sewerage Authority	NJ0022519-001	108.8	2	0	No	N/A	7.0	No	124.107	*	1
8	Beverly Sewerage Authority	NJ0027481-001	114.7	1	0	No	N/A	7.0	No	18.890	*	1
9	PSEG-Mercer	NJ0004995-441C	130.4	1	0	Yes	Yes	7.0	No	5.010	*	1
10	AFG Industries	NJ0033022-001A	109.6	1	0	No	N/A	6.0	No	10.258	*	1
11	US Pipe & Foundry	NJ0005266-002A	118.1	0	2	No	N/A	5.0	No	0.807	*	1
12	Cinnaminson Sewerage Authority	NJ0024007-001	108.9	3	3	No	N/A	4.0	No	27.980	*	1
13	Riverton Borough	NJ0021610-001	110.8	1	0	No	N/A	4.0	No	3.853	*	1
1	GEON Company (Burlington) Polyone	NJ0004235-001A	120.3	1	1	No	N/A	3.5	No	15.051	*	2
2	Willingboro Municipal Utilities Authority	NJ0023361-001	110.8	3	0	No	N/A	3.0	No	123.392	*	2
3	Hamilton Township	NJ0026301-001	128.0	3	0	No	N/A	2.7	No	220.791	*	2
4	Bristol Borough	PA0027294-001	118.7	3	3	No	N/A	2.3	No	29.383	*	2
5	City of Burlington	NJ0024660-002	117.6	3	0	No	N/A	2.0	No	46.336	*	2
6	Bristol Township	PA0026450-001	116.8	3	3	No	N/A	1.5	No	34.732	*	2
7	AFG Industries	NJ0033022-002	109.4	0	1	No	N/A	1.0	No	0.092	*	2
8	Mt. Holly Municipal Utilities Authority	NJ0024015-001	110.8	3	0	No	N/A	0.7	No	54.904	*	2
9	Delran Sewerage Authority	NJ0023507-001	110.8	3	0	No	N/A	0.3	No	37.419	*	2
10	Burlington Township	NJ0021709-001	117.0	3	0	No	N/A	0.3	No	34.901	*	2
11	Florence Township	NJ0023701-001	121.4	3	0	No	N/A	0.3	No	15.682	*	2
12	Lower Bucks County Municipal Authority	PA0026468-001	121.9	3	3	No	N/A	0.2	No	129.179	*	2

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
13	Bordentown Sewerage Authority	NJ0024678-001	128.0	3	3	No	N/A	0.2	No	26.292	*	2
14	Mt. Laurel Municipal Utilities Authority	NJ0025178-001A	110.8	3	0	No	N/A	0.0	No	67.433	*	2
15	Morrisville WWTP	PA0026701-001	132.9	3	0	No	N/A	0.0	No	65.566	*	2
16	Waste Management Grows Landfill	PA0043818-001	125.5	1	0	No	N/A	0.0	No	1.182	*	2
17	MSC Pre Finish Metals	PA0045021-001	130.1	1	0	No	N/A	0.0	No	0.646	*	2
18	Hoeganaes Corp.	NJ0004375-001A	109.4	1	1	No	N/A	0.0	No	0.330	*	2
19	Hoeganaes Corp.	NJ0004375-003A	109.4	0	1	No	N/A	0.0	No	0.000	*	2
20	Exelon-Fairless	PA0057088-001	126.6	3	0	Yes	Yes	9.0	Yes	0.000	*	2
21	PSEG-Mercer	NJ0004995-441A	130.4	3	0	Yes	Yes	6.3	Yes	0.000	*	2
22	Colorite Polymers	NJ0004391-003A	117.0	1	0	Yes	Yes	2.0	No	0.740	65.9	2
23	Colorite Polymers	NJ0004391-002A	117.0	1	1	Yes	Yes	4.0	No	0.008	0.7	2
24	Yates Foil	NJ0004332-002A	128.0	0	1	Yes	Yes	2.0	No	0.000	0.0	2
25	Yates Foil	NJ0004332-001B	128.0	1	0	Yes	Yes	0.0	No	0.070	6.3	2

RM: River Mile
DW: Dry Weather
WW: Wet Weather
* Cumulative loading percentages to Zone WLA (minus portions to CSOs and MS4) are shown up to 100 percent.

Appendix Table 3-3: Data used to assign the permit requirements for NPDES discharges in Zone 3.

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
1	PWD-NE	PA0026689-001	104.1	3	3	Yes	Yes	10.5	No	1238.662	*	1
2	CCMUA	NJ0026182-001	98.0	3	3	Yes	Yes	10.0	No	818.459	*	1
3	Exelon-Delaware	PA0011622-002	101.2	3	0	Yes	Yes	9.7	No	0.655	92.5	1
4	PWD-SE	PA0026662-001	96.8	3	3	Yes	Yes	9.7	No	657.721	*	1
5	Rohm&Haas-Philadelphia	PA0012777-003	106.1	1	0	Yes	Yes	7.0	No	2.175	*	1
1	NGC Industries	NJ0004669-001A	104.4	1	1	No	N/A	0.0	No	1.528	*	2
2	Palmyra Borough	NJ0024449-001	107.7	1	0	No	N/A	0.0	No	19.235	*	2
3	Exelon-Delaware	PA0011622-006	101.1	3	0	Yes	Yes	9.3	Yes	0.000	*	2
4	Rohm&Haas-Philadelphia	PA0012777-001	106.1	3	1	Yes	Yes	3.8	No	15.974	*	2
5	Citgo Petroleum	NJ0131342-001A	103.4	1	0	Yes	No	0.0	No	0.012	*	2
6	Rohm&Haas-Philadelphia	PA0012777-007	106.1	1	0	Yes	Yes	6.0	No	0.003	0.4	2
7	Exelon-Delaware	PA0011622-004	101.2	0	1	Yes	Yes	11.0	No	0.011	1.8	2
8	Exelon-Delaware	PA0011622-001	101.2	0	1	Yes	Yes	12.0	No	0.044	7.5	2

RM: River Mile
DW: Dry Weather
WW: Wet Weather
* Cumulative loading percentages to Zone WLA (minus portions to CSOs and MS4) are shown up to 100 percent.

Appendix Table 3-4: Data used to assign the permit requirements for NPDES discharges in Zone 4.

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
1	Dupont-Repauno	NJ0004219-007	86.6	0	1	No	N/A	12.0	No	1.433	*	1
2	Exelon-Eddystone	PA0013716-001	85.2	0	1	Yes	Yes	12.0	No	0.064	14.2	1
3	Dupont-Repauno	NJ0004219-001A	85.6	3	1	Yes	Yes	11.5	No	80.773	*	1
4	Boeing	PA0013323-002	85.4	1	1	Yes	Yes	11.5	No	158.353	*	1
5	Kvaerner	PA0057690-019	92.8	0	1	Yes	Yes	11.0	No	0.100	57.0	1
6	Kvaerner	PA0057690-021	92.8	0	1	Yes	Yes	11.0	No	0.100	73.3	1
7	Boeing	PA0013323-001	85.2	1	0	Yes	Yes	11.0	No	29.068	*	1
8	PWD-SW	PA0026671-001	90.7	3	3	Yes	Yes	10.8	No	1020.466	*	1
9	Valero Refining	NJ0005029-001A	87.7	4	1	Yes	Yes	10.6	No	99.473	*	1
10	Exelon-Eddystone	PA0013716-005	85.2	0	1	Yes	Yes	10.0	No	0.509	*	1
11	Ausimont	NJ0005185-001A	90.7	0	1	Yes	Yes	10.0	No	0.840	*	1
12	Boeing	PA0013323-003	85.2	0	1	Yes	Yes	9.0	No	0.404	*	1
13	Boeing	PA0013323-016	85.4	0	1	Yes	Yes	8.0	No	0.149	97.5	1
14	Boeing	PA0013323-007	85.2	0	1	Yes	Yes	8.0	No	0.235	*	1
15	Tinicum Township	PA0028380-001	85.4	3	3	Yes	Yes	8.0	No	15.450	*	1
16	Safety Kleen	NJ0005240-002A	79.8	0	1	No	N/A	7.0	No	3.512	*	1
17	Kvaerner	PA0057690-012	92.7	3	0	Yes	Yes	7.0	No	22.608	*	1
18	DELCORA	PA0027103-001	80.6	3	3	Yes	Yes	6.7	No	309.423	*	1
19	GCUA	NJ0024686-001	88.4	5	0	Yes	Yes	6.4	No	113.497	*	1
20	ConocoPhillips	PA0012637-008	80.2	0	1	No	N/A	6.0	No	0.111	*	1
21	Metro Machine	PA0057479-DD2	93.2	4	0	No	N/A	6.0	No	49.040	*	1
22	Hercules	NJ0005134-001A	87.5	1	1	Yes	Yes	6.0	No	4.120	*	1
23	Kimberly Clark	PA0013081-029	83.2	0	2	Yes	Yes	5.5	No	0.086	40.6	1
24	ConocoPhillips	PA0012637-007	80.2	0	1	No	N/A	5.0	No	0.511	*	1
25	Ausimont	NJ0005185-002A	90.7	1	0	Yes	Yes	5.0	No	0.077	26.7	1

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
1	ConocoPhillips	PA0012637-006	80.2	0	1	No	N/A	3.0	No	0.029	*	2
2	Coastal Mart / Coastal Eagle Point Oil	NJ0005401-003A	94.7	0	1	No	N/A	2.0	No	0.006	*	2
3	ConocoPhillips	PA0012637-002	80.2	3	1	No	N/A	1.5	Yes	0.000	*	2
4	ConocoPhillips	PA0012637-101	79.6	3	1	No	N/A	1.0	Yes	0.000	*	2
5	Swedesboro	NJ0022021-001	79.8	1	0	No	N/A	1.0	No	3.296	*	2
6	Logan Township	NJ0027545-001	79.5	1	1	No	N/A	1.0	No	12.114	*	2
7	Safety Kleen	NJ0005240-001A	79.8	3	0	No	N/A	0.7	No	7.440	*	2
8	Metro Machine	PA0057479-DD3	93.1	3	0	No	N/A	0.7	No	17.845	*	2
9	Chevron	NJ0064696-001A	90.5	1	0	No	N/A	0.0	No	0.157	*	2
10	Harrison Township-Mullica Hill	NJ0020532-001	79.8	1	0	No	N/A	0.0	No	6.093	*	2
11	DeGuessa-Huls Corp.	PA0051713-001	82.2	1	0	No	N/A	0.0	No	9.063	*	2
12	Air Products	NJ0004278-001A	88.2	1	0	No	N/A	0.0	No	10.041	*	2
13	Greenwich Township	NJ0030333-001	87.0	1	0	No	N/A	0.0	No	12.110	*	2
14	ConocoPhillips	PA0012637-201	79.6	3	0	No	N/A	0.0	No	48.580	*	2
15	Coastal Mart / Coastal Eagle Point Oil	NJ0005401-001A	94.3	3	0	No	N/A	0.0	No	55.368	*	2
16	Exelon-Eddystone	PA0013716-008	85.2	4	0	Yes	Yes	11.8	Yes	0.000	*	2
17	Exelon-Eddystone	PA0013716-007	85.2	3	0	Yes	Yes	11.7	Yes	0.000	*	2
18	Solutia	NJ0005045-001	79.2	3	0	Yes	No	1.3	No	12.228	*	2
19	Colonial Pipeline	NJ0033952-001A	90.5	0	1	Yes	No	0.0	No	0.087	*	2
20	BP Paulsboro	NJ0005584-002A	89.6	0	1	Yes	No	0.0	No	0.352	*	2
21	BP Paulsboro	NJ0005584-003A	89.4	1	0	Yes	No	0.0	No	7.006	*	2
22	Sunoco-PointBreeze	PA0012629-002	92.5	3	3	Yes	No	0.0	No	75.899	*	2
23	Sunoco-GirardPoint	PA0011533-015	92.5	3	3	Yes	No	0.0	No	99.167	*	2
24	Kvaerner	PA0057690-047	92.5	0	1	Yes	Yes	10.0	No	0.005	0.8	2
25	Boeing	PA0013323-008	85.2	0	1	Yes	Yes	13.0	No	0.018	3.7	2

Appendix Table 3-5: Data used to assign the permit requirements for NPDES discharges in Zone 5.

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
1	AMTRAK	DE0050962-003	70.7	0	3	Yes	Yes	12.3	No	2.002	*	1
2	AMTRAK	DE0050962-004	70.7	0	3	Yes	Yes	12.0	No	35.822	*	1
3	OxyChem	DE0050911-002	62.2	0	3	Yes	Yes	11.0	No	0.168	16.8	1
4	Conectiv-Deepwater	NJ0005363-017	69.1	0	1	Yes	Yes	11.0	No	0.284	25.9	1
5	PSEG-Salem	NJ0005622-489	51.0	1	0	Yes	Yes	11.0	No	0.984	86.5	1
6	Metachem	DE0020001-003	61.9	0	4	No	N/A	9.5	No	2.176	*	1
7	Metachem	DE0020001-002	61.9	0	3	No	N/A	9.3	No	1.713	*	1
8	Dupont-Edgemoor	DE0000051-004	72.2	0	3	Yes	Yes	9.0	No	0.153	11.5	1
9	Dupont-Edgemoor	DE0000051-001	73.2	3	0	Yes	Yes	8.7	No	32.214	*	1
10	Dupont-ChamberWorks	NJ0005100-662	69.8	3	0	Yes	Yes	8.7	No	102.854	*	1
11	Dupont-ChamberWorks	NJ0005100-001	69.8	3	0	Yes	Yes	8.0	No	138.476	*	1
12	Motiva	DE0000256-101	61.0	3	3	Yes	Yes	7.5	No	2843.225	*	1
13	OxyChem	DE0050911-001	62.2	3	0	Yes	Yes	7.0	No	1.798	*	1
14	Penns Grove Sewer Authority	NJ0024023-001	70.7	1	0	No	N/A	7.0	No	23.206	*	1
15	PSEG-HopeCreek	NJ0025411-461C	52.0	1	0	Yes	Yes	5.0	No	0.915	55.1	1
16	Motiva	DE0000256-601	61.5	3	0	Yes	Yes	5.0	No	0.000 **	*	1
17	Pennsville Sewerage Authority	NJ0021598-001	65.1	3	0	No	N/A	4.7	No	63.353	*	1
1	Carney's Point	NJ0021601-001	71.3	3	0	No	N/A	2.7	No	10.265	*	2
2	General Chemical	DE0000655-001	77.9	3	3	No	N/A	2.2	Yes	0.000	*	2
3	Port Penn STP (New Castle Co.)	DE0021539-001	54.8	1	0	No	N/A	1.0	No	0.487	*	2
4	Metachem	DE0020001-001	61.5	3	3	No	N/A	1.0	No	81.182	*	2
5	City of Wilmington	DE0020320-001	71.6	3	3	No	N/A	0.8	No	1297.745	*	2
6	Geon Company (Pedricktown) Polyone	NJ0004286-003	75.9	0	1	No	N/A	0.0	No	0.011	*	2
7	Geon Company (Pedricktown) Polyone	NJ0004286-001A	74.9	1	0	No	N/A	0.0	No	1.690	*	2
8	Kaneka Delaware Corp.	DE0000647-001	61.4	1	1	No	N/A	0.0	No	2.266	*	2
9	Delaware City STP (New Castle Co.)	DE0021555-001	60.1	1	0	No	N/A	0.0	No	4.085	*	2

Serial No.	Facility Name	DRBC ID	RM	# of DW SAMPLES	# of WW SAMPLES	Analytical Method 1668a	Submitted data at Method 1668A detection limits	Avg. # of congeners per sampling event (Sept 2003)	Non-Contact Cooling water	Current Loadings (Sept. 2003) mg/day	Cumulative loading percentage to WLA	Potential Group (category)
10	Formosa Plastics	DE0000612-001	61.3	1	0	No	N/A	0.0	No	4.885	*	2
11	City of Salem	NJ0024856-001	58.8	3	0	No	N/A	0.0	No	10.062	*	2
12	PSEG-HopeCreek	NJ0025411-461A	52.0	3	0	Yes	Yes	9.7	Yes	0.000	*	2
13	Dupont-ChamberWorks	NJ0005100-013	68.9	3	0	Yes	Yes	9.3	Yes	0.000	*	2
14	PSEG-Salem	NJ0005622-485	51.0	3	0	Yes	Yes	9.0	Yes	0.000	*	2
15	Motiva	DE0000256-001	61.5	3	0	Yes	Yes	8.7	Yes	0.000	*	2
16	Conectiv-Deepwater	NJ0005363-003A	69.1	1	0	Yes	Yes	8.0	Yes	0.000	*	2
17	Dupont-ChamberWorks	NJ0005100-011	68.9	1	1	Yes	Yes	11.0	No	0.004	0.1	2
18	Conectiv-DelawareCity	DE0050601-033	61.9	0	3	Yes	Yes	11.7	No	0.005	0.3	2
19	Conectiv-Deepwater	NJ0005363-006	69.1	0	1	Yes	Yes	12.0	No	0.006	0.5	2
20	Conectiv-Edgemoor	DE0000558-041	71.8	0	3	Yes	Yes	10.7	No	0.008	0.7	2
21	PSEG-HopeCreek	NJ0025411-462A	52.0	0	1	Yes	Yes	0.0	No	0.011	1.0	2
22	Conectiv-DelawareCity	DE0050601-034	61.9	0	4	Yes	Yes	11.5	No	0.015	1.5	2
23	Conectiv-Deepwater	NJ0005363-005	69.1	0	1	Yes	Yes	10.0	No	0.035	2.6	2
24	Conectiv-DelawareCity	DE0050601-016	61.9	0	3	Yes	Yes	11.7	No	0.123	6.6	2

RM: River Mile
DW: Dry Weather
WW: Wet Weather
* Cumulative loading percentages to Zone WLA (minus portions to CSOs and MS4) are shown up to 100 percent.
** Flow is set to zero in the loading calculation because DSN 601 is an upstream monitoring point of DSN 101.

Appendix 4

Contaminated Sites and Municipalities with Combined Sewer Overflows (CSOs) that were evaluated as part of the Stage 1 TMDLs

Appendix Table 4-1: Contaminated Sites evaluated as part of the Stage 1 TMDLs and their estimated Penta-PCB Load.

Facility	Daily penta-PCB Load (kg/day)	Estimate Prepared by
Castle Ford - DE-192	1.4374E-06	EPA
Forbes Steel & Wire Corp. - DE-165	5.1989E-06	EPA
Rogers Corner Dump - DE-246	1.0465E-04	EPA
Industrial Products - DE-030	5.1129E-05	EPA
Chicago Bridge and Iron - DE-038	3.2768E-03	EPA
ABM-Wade, 58th Street Dump - PA-0179	1.9739E-06	EPA
O'Donnell Steel Drum - PA-0305	3.4939E-07	EPA
Conrail-Wayne Junction - PA-215	2.3043E-03	EPA
CONRAIL, Morrisville Lagoons - PA-441*	5.4056E-06	EPA
Pennwalt Corp. - Cornwells Heights - PA-0031*	3.1227E-07	EPA
Front Street Tanker - PA-2298	1.9914E-06	EPA
8th Street Drum - PA-3272	8.9655E-07	EPA
East 10th Street Site - PA-2869	1.0076E-02	EPA
Metal Bank - PA-2119	9.9092E-05	EPA
Lower Darby Creek Area Site - PA-3424	1.8481E-04	EPA
Roebling Steel Co.	4.9609E-05	EPA
Bridgeport Rental & Oil Services (BROS)	5.8140E-04	EPA
Dana Transport Inc.	3.8523E-08	EPA
Harrison Avenue Landfill	6.2542E-03	EPA
Metal Bank groundwater pathway	9.8312E-07	DRBC
AMTRAK Former Refueling Facility	1.3182E-03	DNREC
Gates Engineering	6.8226E-10	DNREC
AMTRAK Wilmington Railyard	1.6238E-03	DNREC
Diamond State Salvage	0.0000E+00	DNREC
NeCastro Auto Salvage	1.2867E-05	DNREC
Hercules Research Center	4.6121E-06	DNREC
Dravo Ship Yard	5.3216E-05	DNREC
DP&L/Congo Marsh	2.7290E-07	DNREC
American Scrap & Waste	7.4230E-04	DNREC
Pusey & Jones Shipyard	1.6033E-06	DNREC
Delaware Car Company	0.0000E+00	DNREC
Bafundo Roofing	1.5692E-04	DNREC
Kreiger Finger Property	1.5828E-04	DNREC
Clayville Dump	0.0000E+00	DNREC
Electric Hose & Rubber	8.8694E-05	DNREC
Penn Del Metal Recycling	1.1407E-04	DNREC
E. 7th Street North & South	5.7992E-05	DNREC
Delaware Compressed Steel	6.2877E-06	DNREC
Newport City Landfill	0.0000E+00	DNREC
DuPont Louviers – MBNA	9.5516E-08	DNREC
North American Smelting Co.	1.2821E-05	DNREC
RSC Realty	3.4113E-05	DNREC
AMTRAK CNOC	0.0000E+00	DNREC
Wilmington Coal Gas – N	2.2378E-06	DNREC

Facility	Daily penta-PCB Load (kg/day)	Estimate Prepared by
Del Chapel Place	2.2515E-06	DNREC
Kruse Playground	1.0643E-06	DNREC
Budd Metal	6.3450E-06	DNREC
Fox Point Park Phase II	1.1708E-04	DNREC
Bensalem Redev LP (Elf Atochem)	1.7561E-05	PADEP

Appendix Table 4-2: Municipalities or Regional Authorities with Combined Sewer Overflows (CSOs) that were evaluated as part of the Stage 1 TMDLs

Municipality/Regional Authority	NPDES Nos.	Zone
City of Philadelphia Water Department	PA0026662 PA0026671 PA0026689	2, 3 and 4
Camden County Municipal Utilities Authority	NJ0108812 NJ0026182	3 and 4
Delaware County Regional Authority (DELCORA)	PA0027103	4
City of Wilmington	DE0020320	5

Appendix 5

Municipalities in Delaware, New Jersey, and Pennsylvania,
designated as Phase II Separate Stormwater Sewer Systems (MS4s)
within urbanized areas in the Delaware River Watershed

Appendix Table 5-1: Municipalities with Separate Stormwater Sewer Systems that have the potential to be included in the waste load allocation (LA) for PCBs for Zones 2 to 5 of the Delaware Estuary.

State	County Name	Municipality Name
DE	KENT	CAMDEN TOWN
DE	KENT	DOVER CITY
DE	KENT	KENT COUNTY
DE	NEW CASTLE	NEWARK CITY
DE	NEW CASTLE/DE DOT	ARDEN
DE	NEW CASTLE/DE DOT	ARDENTOWN
DE	NEW CASTLE/DE DOT	ARDENCROFT
DE	NEW CASTLE/DE DOT	BELLEFONTE
DE	NEW CASTLE/DE DOT	DELAWARE CITY
DE	NEW CASTLE/DE DOT	ELSMERE
DE	NEW CASTLE/DE DOT	MIDDLETOWN
DE	NEW CASTLE/DE DOT	NEWPORT
DE	NEW CASTLE/DE DOT	NEW CASTLE
DE	NEW CASTLE/DE DOT	ODDESSA
DE	NEW CASTLE/DE DOT	TOWNSEND
DE	NEW CASTLE/DE DOT	CITY OF WILMINGTON
DE	KENT	WYOMING TOWN

State	County Name	Municipality Name
NJ	ATLANTIC	BUENA BORO
NJ	ATLANTIC	BUENA VISTA TWP
NJ	BURLINGTON	BEVERLY CITY
NJ	BURLINGTON	BORDENTOWN CITY
NJ	BURLINGTON	BORDENTOWN TWP
NJ	BURLINGTON	BURLINGTON CITY
NJ	BURLINGTON	BURLINGTON TWP
NJ	BURLINGTON	CHESTERFIELD TWP
NJ	BURLINGTON	CINNAMINSON TWP
NJ	BURLINGTON	CINNAMINSON TWP
NJ	BURLINGTON	DELANCO TWP
NJ	BURLINGTON	DELRAN TWP
NJ	BURLINGTON	EASTAMPTON TWP
NJ	BURLINGTON	EDGEWATER PARK TWP
NJ	BURLINGTON	EVESHAM TWP
NJ	BURLINGTON	EVESHAM TWP
NJ	BURLINGTON	FIELDSBORO BORO
NJ	BURLINGTON	FLORENCE TWP
NJ	BURLINGTON	HAINESPORT TWP
NJ	BURLINGTON	LUMBERTON TWP
NJ	BURLINGTON	MANSFIELD TWP
NJ	BURLINGTON	MAPLE SHADE TWP
NJ	BURLINGTON	MEDFORD LAKES BORO
NJ	BURLINGTON	MEDFORD TWP
NJ	BURLINGTON	MOORESTOWN TWP
NJ	BURLINGTON	MOORESTOWN TWP
NJ	BURLINGTON	MOUNT HOLLY TWP

State	County Name	Municipality Name
NJ	BURLINGTON	MOUNT LAUREL TWP
NJ	BURLINGTON	MOUNT LAUREL TWP
NJ	BURLINGTON	NEW HANOVER TWP
NJ	BURLINGTON	NORTH HANOVER TWP
NJ	BURLINGTON	PALMYRA BORO
NJ	BURLINGTON	PALMYRA BORO
NJ	BURLINGTON	PEMBERTON BORO
NJ	BURLINGTON	PEMBERTON TWP
NJ	BURLINGTON	RIVERSIDE TWP
NJ	BURLINGTON	RIVERTON BORO
NJ	BURLINGTON	SHAMONG TWP
NJ	BURLINGTON	SOUTHAMPTON TWP
NJ	BURLINGTON	SPRINGFIELD TWP
NJ	BURLINGTON	TABERNACLE TWP
NJ	BURLINGTON	TABERNACLE TWP
NJ	BURLINGTON	WESTAMPTON TWP
NJ	BURLINGTON	WILLINGBORO TWP
NJ	BURLINGTON	WOODLAND TWP
NJ	BURLINGTON	WRIGHTSTOWN BORO
NJ	CAMDEN	AUDUBON BORO
NJ	CAMDEN	AUDUBON PARK BORO
NJ	CAMDEN	BARRINGTON BORO
NJ	CAMDEN	BELLMAWR BORO
NJ	CAMDEN	BERLIN BORO
NJ	CAMDEN	BERLIN TWP
NJ	CAMDEN	BERLIN TWP
NJ	CAMDEN	BROOKLAWN BORO
NJ	CAMDEN	CAMDEN CITY
NJ	CAMDEN	CHERRY HILL TWP
NJ	CAMDEN	CLEMENTON BORO
NJ	CAMDEN	COLLINGSWOOD BORO
NJ	CAMDEN	GIBBSBORO BORO
NJ	CAMDEN	GIBBSBORO BORO
NJ	CAMDEN	GIBBSBORO BORO
NJ	CAMDEN	GLOUCESTER CITY
NJ	CAMDEN	GLOUCESTER CITY
NJ	CAMDEN	GLOUCESTER TWP
NJ	CAMDEN	GLOUCESTER TWP
NJ	CAMDEN	HADDON HEIGHTS BORO
NJ	CAMDEN	HADDON TWP (EAST)
NJ	CAMDEN	HADDON TWP (NORTH)
NJ	CAMDEN	HADDON TWP (SOUTH)
NJ	CAMDEN	HADDONFIELD BORO
NJ	CAMDEN	HI-NELLA BORO
NJ	CAMDEN	LAUREL SPRINGS BORO
NJ	CAMDEN	LAWNSIDE BORO
NJ	CAMDEN	LINDENWOLD BORO
NJ	CAMDEN	MAGNOLIA BORO
NJ	CAMDEN	MERCHANTVILLE BORO
NJ	CAMDEN	MOUNT EPHRAIM BORO
NJ	CAMDEN	OAKLYN BORO
NJ	CAMDEN	PENNSAUKEN TWP
NJ	CAMDEN	PINE HILL BORO
NJ	CAMDEN	PINE HILL BORO
NJ	CAMDEN	PINE VALLEY BORO
NJ	CAMDEN	RUNNEMEDE BORO
NJ	CAMDEN	SOMERDALE BORO
NJ	CAMDEN	STRATFORD BORO
NJ	CAMDEN	TAVISTOCK BORO
NJ	CAMDEN	VOORHEES TWP
NJ	CAMDEN	VOORHEES TWP

STATE	COUNTY NAME	MUNICIPALITY NAME
NJ	CAMDEN	VOORHEES TWP
NJ	CAMDEN	VOORHEES TWP
NJ	CAMDEN	WINSLOW TWP
NJ	CAMDEN	WINSLOW TWP
NJ	CAMDEN	WINSLOW TWP
NJ	CAMDEN	WOODLYNNE BORO
NJ	CAPE_MAY	CAPE MAY POINT BORO
NJ	CAPE_MAY	DENNIS TWP
NJ	CAPE_MAY	LOWER TWP
NJ	CAPE_MAY	LOWER TWP
NJ	CAPE_MAY	MIDDLE TWP
NJ	CAPE_MAY	WEST CAPE MAY BORO
NJ	CAPE_MAY	WOODBINE BORO
NJ	CUMBERLAND	BRIDGETON CITY
NJ	CUMBERLAND	COMMERCIAL TWP
NJ	CUMBERLAND	DEERFIELD TWP
NJ	CUMBERLAND	DOWNE TWP
NJ	CUMBERLAND	FAIRFIELD TWP
NJ	CUMBERLAND	GREENWICH TWP
NJ	CUMBERLAND	HOPEWELL TWP
NJ	CUMBERLAND	LAWRENCE TWP
NJ	CUMBERLAND	MAURICE RIVER TWP
NJ	CUMBERLAND	MILLVILLE CITY
NJ	CUMBERLAND	SHILOH BORO
NJ	CUMBERLAND	STOW CREEK TWP
NJ	CUMBERLAND	UPPER DEERFIELD TWP
NJ	CUMBERLAND	VINELAND CITY
NJ	GLOUCESTER	CLAYTON BORO
NJ	GLOUCESTER	DEPTFORD TWP
NJ	GLOUCESTER	DEPTFORD TWP
NJ	GLOUCESTER	DEPTFORD TWP
NJ	GLOUCESTER	EAST GREENWICH TWP
NJ	GLOUCESTER	ELK TWP
NJ	GLOUCESTER	ELK TWP
NJ	GLOUCESTER	ELK TWP
NJ	GLOUCESTER	FRANKLIN TWP
NJ	GLOUCESTER	GLASSBORO BORO
NJ	GLOUCESTER	GLASSBORO BORO
NJ	GLOUCESTER	GREENWICH TWP
NJ	GLOUCESTER	HARRISON TWP
NJ	GLOUCESTER	LOGAN TWP
NJ	GLOUCESTER	LOGAN TWP
NJ	GLOUCESTER	MANTUA TWP
NJ	GLOUCESTER	MONROE TWP
NJ	GLOUCESTER	MONROE TWP
NJ	GLOUCESTER	MONROE TWP
NJ	GLOUCESTER	NATIONAL PARK BORO
NJ	GLOUCESTER	NEWFIELD BORO
NJ	GLOUCESTER	PAULSBORO BORO
NJ	GLOUCESTER	PITMAN BORO
NJ	GLOUCESTER	SOUTH HARRISON TWP
NJ	GLOUCESTER	SOUTH HARRISON TWP
NJ	GLOUCESTER	SWEDESBORO BORO
NJ	GLOUCESTER	WASHINGTON TWP
NJ	GLOUCESTER	WASHINGTON TWP
NJ	GLOUCESTER	WASHINGTON TWP
NJ	GLOUCESTER	WENONAH BORO
NJ	GLOUCESTER	WEST DEPTFORD TWP
NJ	GLOUCESTER	WEST DEPTFORD TWP
NJ	GLOUCESTER	WESTVILLE BORO

State	County Name	Municipality Name
NJ	GLOUCESTER	WOODBURY CITY
NJ	GLOUCESTER	WOODBURY CITY
NJ	GLOUCESTER	WOODBURY HEIGHTS BORO
NJ	GLOUCESTER	WOOLWICH TWP
NJ	GLOUCESTER	WOOLWICH TWP
NJ	MERCER	HAMILTON TWP
NJ	MERCER	TRENTON CITY
NJ	MERCER	TRENTON CITY
NJ	MERCER	WASHINGTON TWP
NJ	MONMOUTH	ALLENTOWN BORO
NJ	MONMOUTH	MILLSTONE TWP
NJ	MONMOUTH	UPPER FREEHOLD TWP
NJ	OCEAN	JACKSON TWP
NJ	OCEAN	JACKSON TWP
NJ	OCEAN	JACKSON TWP
NJ	OCEAN	LACEY TWP
NJ	OCEAN	MANCHESTER TWP
NJ	OCEAN	PLUMSTED TWP
NJ	SALEM	ALLOWAY TWP
NJ	SALEM	ALLOWAY TWP
NJ	SALEM	CARNEYS POINT TWP
NJ	SALEM	ELMER BORO
NJ	SALEM	ELSINBORO TWP
NJ	SALEM	LOWER ALLOWAYS CREEK TWP
NJ	SALEM	LOWER ALLOWAYS CREEK TWP
NJ	SALEM	LOWER ALLOWAYS CREEK TWP
NJ	SALEM	MANNINGTON TWP
NJ	SALEM	OLDMANS TWP
NJ	SALEM	PENNS GROVE BORO
NJ	SALEM	PENNSVILLE TWP
NJ	SALEM	PILESGROVE TWP
NJ	SALEM	PITTSGROVE TWP
NJ	SALEM	QUINTON TWP
NJ	SALEM	QUINTON TWP
NJ	SALEM	SALEM CITY
NJ	SALEM	UPPER PITTSGROVE TWP
NJ	SALEM	UPPER PITTSGROVE TWP
NJ	SALEM	WOODSTOWN BORO

State	County Name	Municipality Name
PA	Bucks	Bensalem Twp.
PA	Bucks	Bristol Boro
PA	Bucks	Bristol Twp.
PA	Bucks	Buckingham Twp.
PA	Bucks	Bucks County
PA	Bucks	Chalfont Boro
PA	Bucks	Doylestown Boro
PA	Bucks	Doylestown Twp.
PA	Bucks	East Rockhill Twp.
PA	Bucks	Falls Twp.
PA	Bucks	Hilltown Twp.
PA	Bucks	Hulmeville Boro
PA	Bucks	Ivyland Boro
PA	Bucks	Langhorne Boro
PA	Bucks	Langhorne Manor Boro
PA	Bucks	Lower Makefield Twp.
PA	Bucks	Lower Southampton Twp.
PA	Bucks	Middletown Twp.
PA	Bucks	Morrisville Boro
PA	Bucks	New Britain Boro
PA	Bucks	New Britain Twp.
PA	Bucks	Newtown Boro
PA	Bucks	Newtown Twp.
PA	Bucks	Northampton Twp.
PA	Bucks	Penndel Boro
PA	Bucks	Perkasie Boro
PA	Bucks	Plumstead Twp.
PA	Bucks	Sellersville Boro
PA	Bucks	Silverdale Boro
PA	Bucks	Solebury Twp.
PA	Bucks	Tullytown Boro

State	County Name	Municipality Name
PA	Bucks	Upper Makefield Twp.
PA	Bucks	Upper Southampton Twp.
PA	Bucks	Warminster Twp.
PA	Bucks	Warrington Twp.
PA	Bucks	Warwick Twp.
PA	Bucks	West Rockhill Twp.
PA	Bucks	Wrightstown Twp.
PA	Bucks	Yardley Boro
PA	Chester	Avondale Boro
PA	Chester	Birmingham Twp.
PA	Chester	Caln Twp.
PA	Chester	Charlestown Twp.
PA	Chester	Chester County
PA	Chester	Coatesville City
PA	Chester	Downingtown Boro
PA	Chester	East Bradford Twp.
PA	Chester	East Brandywine Twp.
PA	Chester	East Caln Twp.
PA	Chester	East Fallowfield Twp.
PA	Chester	East Goshen Twp.
PA	Chester	East Marlborough Twp.
PA	Chester	East Pikeland Twp.
PA	Chester	East Vincent Twp.
PA	Chester	East Whiteland Twp.
PA	Chester	Easttown Twp.
PA	Chester	Franklin Twp.
PA	Chester	Honeybrook Twp.
PA	Chester	Kennett Square Boro
PA	Chester	Kennett Twp.
PA	Chester	London Britain Twp.
PA	Chester	London Grove Twp.

State	County Name	Municipality Name
PA	Chester	Malvern Boro
PA	Chester	Modena Boro
PA	Chester	New Garden Twp.
PA	Chester	New London Twp.
PA	Chester	Newlin Twp.
PA	Chester	Parkesburg Boro
PA	Chester	Penn Twp.
PA	Chester	Pennsbury Twp.
PA	Chester	Phoenixville Boro
PA	Chester	Pocopson Twp.
PA	Chester	Sadsbury Twp.
PA	Chester	Schuylkill Twp.
PA	Chester	South Coatesville Boro
PA	Chester	Spring City Boro
PA	Chester	Thornbury Twp.
PA	Chester	Tredyffrin Twp.
PA	Chester	Upper Oxford Twp.
PA	Chester	Upper Uwchlan Twp.
PA	Chester	Uwchlan Twp.
PA	Chester	Valley Twp.
PA	Chester	Wallace Twp.
PA	Chester	West Bradford Twp.
PA	Chester	West Brandywine Twp.
PA	Chester	West Caln Twp.
PA	Chester	West Chester Boro
PA	Chester	West Goshen Twp.
PA	Chester	West Grove Boro
PA	Chester	West Pikeland Twp.
PA	Chester	West Sadsbury Twp.
PA	Chester	West Vincent Twp.
PA	Chester	West Whiteland Twp.

State	County Name	Municipality Name
PA	Chester	Westtown Twp.
PA	Chester	Willistown Twp.
PA	Delaware	Aldan Boro
PA	Delaware	Aston Twp.
PA	Delaware	Bethel Twp.
PA	Delaware	Brookhaven Boro
PA	Delaware	Chadds Ford Twp.
PA	Delaware	Chester City
PA	Delaware	Chester Heights Boro
PA	Delaware	Chester Twp.
PA	Delaware	Clifton Heights Boro
PA	Delaware	Collingdale Boro
PA	Delaware	Colwyn Boro
PA	Delaware	Concord Twp.
PA	Delaware	Darby Boro
PA	Delaware	Darby Twp.
PA	Delaware	Delaware County
PA	Delaware	East Lansdowne Boro
PA	Delaware	Eddystone Boro
PA	Delaware	Edgemont Twp.
PA	Delaware	Folcroft Boro
PA	Delaware	Glenolden Boro
PA	Delaware	Haverford Twp.
PA	Delaware	Lansdowne Boro
PA	Delaware	Lower Chichester Twp.
PA	Delaware	Marcus Hook Boro
PA	Delaware	Marple Twp.
PA	Delaware	Media Boro
PA	Delaware	Middletown Twp.
PA	Delaware	Millbourne Boro
PA	Delaware	Morton Boro

State	County Name	Municipality Name
PA	Delaware	Nether Providence Twp.
PA	Delaware	Newtown Twp.
PA	Delaware	Norwood Boro
PA	Delaware	Parkside Boro
PA	Delaware	Prospect Park Boro
PA	Delaware	Radnor Twp.
PA	Delaware	Ridley Park Boro
PA	Delaware	Ridley Twp.
PA	Delaware	Rose Valley Boro
PA	Delaware	Rutledge Boro
PA	Delaware	Sharon Hill Boro
PA	Delaware	Springfield Twp.
PA	Delaware	Swarthmore Boro
PA	Delaware	Thornbury Twp.
PA	Delaware	Tinicum Twp.
PA	Delaware	Trainer Boro
PA	Delaware	Upland Boro
PA	Delaware	Upper Chichester Twp.
PA	Delaware	Upper Darby Twp.
PA	Delaware	Upper Providence Twp.
PA	Delaware	Yeadon Boro
PA	Montgomery	Abington Twp.
PA	Montgomery	Ambler Boro
PA	Montgomery	Bridgeport Boro
PA	Montgomery	Bryn Athyn Boro
PA	Montgomery	Cheltenham Twp.
PA	Montgomery	Collegeville Boro
PA	Montgomery	Conshohocken Boro
PA	Montgomery	East Greenville Boro
PA	Montgomery	East Norriton Twp.
PA	Montgomery	Franconia Twp.

State	County Name	Municipality Name
PA	Montgomery	Green Lane Boro
PA	Montgomery	Hatboro Boro
PA	Montgomery	Hatfield Boro
PA	Montgomery	Hatfield Twp.
PA	Montgomery	Horsham Twp.
PA	Montgomery	Jenkintown Boro
PA	Montgomery	Lansdale Boro
PA	Montgomery	Limerick Twp.
PA	Montgomery	Lower Frederick Twp.
PA	Montgomery	Lower Gwynedd Twp.
PA	Montgomery	Lower Merion Twp.
PA	Montgomery	Lower Moreland Twp.
PA	Montgomery	Lower Pottsgrove Twp.
PA	Montgomery	Lower Providence Twp.
PA	Montgomery	Lower Salford Twp.
PA	Montgomery	Marlborough Twp.
PA	Montgomery	Montgomery Twp.
PA	Montgomery	Narberth Boro
PA	Montgomery	Norristown Boro
PA	Montgomery	North Wales Boro
PA	Montgomery	Pennsburg Boro
PA	Montgomery	Perkiomen Twp.
PA	Montgomery	Plymouth Twp.
PA	Montgomery	Red Hill Boro
PA	Montgomery	Rockledge Boro
PA	Montgomery	Royersford Boro
PA	Montgomery	Salford Twp.
PA	Montgomery	Schwenksville Boro
PA	Montgomery	Skippack Twp.
PA	Montgomery	Souderton Boro
PA	Montgomery	Springfield Twp.

State	County Name	Municipality Name
PA	Montgomery	Telford Boro
PA	Montgomery	Towamencin Twp.
PA	Montgomery	Trappe Boro
PA	Montgomery	Upper Dublin Twp.
PA	Montgomery	Upper Frederick Twp.
PA	Montgomery	Upper Gwynedd Twp.
PA	Montgomery	Upper Hanover Twp.
PA	Montgomery	Upper Merion Twp.
PA	Montgomery	Upper Moreland Twp.
PA	Montgomery	Upper Providence Twp.
PA	Montgomery	Upper Salford Twp.
PA	Montgomery	West Conshohocken Boro.
PA	Montgomery	West Norriton Twp.
PA	Montgomery	Whitemarsh Twp.
PA	Montgomery	Whitpain Twp.
PA	Montgomery	Worcester Twp.
PA	Philadelphia	Philadelphia City
PA	Philadelphia	Philadelphia County

Appendix 6

Wasteload Allocation Estimates for Municipal Separate Storm Sewer Systems (MS4s)

A November 22, 2002 EPA Memorandum entitled, "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm water Source and NPDES Permit Requirements Based on Those WLAs" clarified existing regulatory requirements for municipal separate storm sewer systems (MS4s) connected with TMDLs, i.e. that where a TMDL has been developed, the MS4 community must receive a WLA rather than a LA. In the draft TMDL document, EPA identified two options for assigning MS4 WLAs. This Appendix outlines the method used to assign each zone with a single categorical WLA for multiple point sources of storm water discharges.

EPA's regulations require NPDES-regulated storm water discharges to be addressed by the WLA component of a TMDL. In order to estimate the portion of the Load Allocation (LA) that corresponds to separate storm sewer systems (MS4) so that these MS4 allocations could be converted to Wasteload Allocations (WLAs) we considered the land uses within each zone, downstream of the tributary monitoring locations. In order to be consistent with the WLAs, we only considered MS4's likely to discharge to the mainstem Delaware or tidal portions of tributaries. Since delineated MS4 service areas have not been identified for many communities, we assumed that approximately 90% of areas categorized as *High Intensity Residential* area, and 70% of areas categorized as either *Low Intensity Residential* or *Commercial / Industrial / Transportation* are served by MS4 systems. We assumed that the entire PCB load associated with MS4s would correspond to the Non-Point Source Runoff category previously defined. Appendix Figure 6-1 below shows the Non-Point Source area contributing to each Zone. Zone 6 is not included in this analysis, since no Zone 6 WLAs are being developed as part of this TMDL.

Appendix Figure 6-1. Non-point Source Areas by Zone.

In order to determine what portion of Non-Point Source Runoff volume corresponds to MS4 service areas, we computed both MS4 and non-MS4 runoff volumes for the 19 month continuous simulation period using the methodologies contained in *Urban Hydrology for Small Watersheds, Technical Release 55,* Soil Conservation Service (currently, Natural Resources Conservation Service), June 1986. Appendix Table 6-1 below shows the computation of the composite Curve Number (CN) for both the MS4 and non-MS4 areas by zone. Land use categories corresponding to wetlands and open water were not included in the calculation of composite CNs.

Appendix Table 6-1. Computation of Composite Curve Numbers for MS4 and Non-MS4 Areas by Zone.

	Land Use Value	Land Use Category	area (m^2)	CN	% MS4	MS4 Area (m^2)	Non-MS4 Area (M2)	CN x MS4 Area	Composite MS4 CN	CN x Non-MS4 Area	Composite Non-MS4 CN
zone 2	21	Low Intensity Residential	149,942,000	80	70.00%	104,959,400	44,982,600	8,396,752,000		3,598,608,000	
	22	High Intensity Residential	35,470,900	90	90.00%	31,923,810	3,547,090	2,873,142,900		319,238,100	
	23	Commercial/Industrial/Transportation	51,066,300	94	70.00%	35,746,410	15,319,890	3,360,162,540		1,440,069,660	
	32	Quarries/Strip Mines/Gravel Pits	13,057,200	95	0.00%	0	13,057,200	0		1,240,434,000	
	33	Transitional	3,193,340	91	0.00%	0	3,193,340	0		290,593,940	
	41	Deciduous Forest	110,273,000	76	0.00%	0	110,273,000	0		8,380,748,000	
	42	Evergreen Forest	3,564,690	76	0.00%	0	3,564,690	0		270,916,440	
	43	Mixed Forest	52,161,800	76	0.00%	0	52,161,800	0		3,964,296,800	
	81	Pasture/Hay	180,362,000	79	0.00%	0	180,362,000	0		14,248,598,000	
	82	Row Crops	54,280,000	82	0.00%	0	54,280,000	0		4,450,960,000	
	85	Urban/Recreational Grasses	8,976,360	79	0.00%	0	8,976,360	0		709,132,440	
			662,347,590			172,629,620	489,717,970	14,630,057,440	84.75	38,913,595,380	79.46
zone3	21	Low Intensity Residential	43,022,200	80	70.00%	30,115,540	12,906,660	2,409,243,200		1,032,532,800	
	22	High Intensity Residential	52,358,200	90	90.00%	47,122,380	5,235,820	4,241,014,200		471,223,800	
	23	Commercial/Industrial/Transportation	37,042,800	94	70.00%	25,929,960	11,112,840	2,437,416,240		1,044,606,960	
	32	Quarries/Strip Mines/Gravel Pits	104,987	95	0.00%	0	104,987	0		9,973,765	
	33	Transitional	8,749	91	0.00%	0	8,749	0		796,149	
	41	Deciduous Forest	8,324,080	76	0.00%	0	8,324,080	0		632,630,080	
	42	Evergreen Forest	67,075	76	0.00%	0	67,075	0		5,097,685	
	43	Mixed Forest	2,448,720	76	0.00%	0	2,448,720	0		186,102,720	
	81	Pasture/Hay	1,076,110	79	0.00%	0	1,076,110	0		85,012,690	
	82	Row Crops	1,238,450	82	0.00%	0	1,238,450	0		101,552,900	
	85	Urban/Recreational Grasses	2,780,200	79	0.00%	0	2,780,200	0		219,635,800	
			148,471,571			103,167,880	45,303,691	9,087,673,640	88.09	3,789,165,349	83.64
zone4	21	Low Intensity Residential	118,875,000	80	70.00%	83,212,500	35,662,500	6,657,000,000		2,853,000,000	
	22	High Intensity Residential	30,808,700	90	90.00%	27,727,830	3,080,870	2,495,504,700		277,278,300	
	23	Commercial/Industrial/Transportation	65,573,900	94	70.00%	45,901,730	19,672,170	4,314,762,620		1,849,183,980	
	32	Quarries/Strip Mines/Gravel Pits	1,148,050	95	0.00%	0	1,148,050	0		109,064,750	
	33	Transitional	4,413,330	91	0.00%	0	4,413,330	0		401,613,030	
	41	Deciduous Forest	143,833,000	76	0.00%	0	143,833,000	0		10,931,308,000	
	42	Evergreen Forest	4,900,350	76	0.00%	0	4,900,350	0		372,426,600	
	43	Mixed Forest	46,163,000	76	0.00%	0	46,163,000	0		3,508,388,000	
	81	Pasture/Hay	98,138,200	79	0.00%	0	98,138,200	0		7,752,917,800	
	82	Row Crops	37,478,300	82	0.00%	0	37,478,300	0		3,073,220,600	
	85	Urban/Recreational Grasses	15,321,200	79	0.00%	0	15,321,200	0		1,210,374,800	
			566,653,030			156,842,060	409,810,970	13,467,267,320	85.87	32,338,775,860	78.91
zone5	21	Low Intensity Residential	86,418,600	80	70.00%	60,493,020	25,925,580	4,839,441,600		2,074,046,400	
	22	High Intensity Residential	12,247,500	90	90.00%	11,022,750	1,224,750	992,047,500		110,227,500	
	23	Commercial/Industrial/Transportation	48,787,700	94	70.00%	34,151,390	14,636,310	3,210,230,660		1,375,813,140	
	32	Quarries/Strip Mines/Gravel Pits	5,088,940	95	0.00%	0	5,088,940	0		483,449,300	
	33	Transitional	1,818,800	91	0.00%	0	1,818,800	0		165,510,800	
	41	Deciduous Forest	151,311,000	76	0.00%	0	151,311,000	0		11,499,636,000	
	42	Evergreen Forest	8,114,110	76	0.00%	0	8,114,110	0		616,672,360	
	43	Mixed Forest	62,097,600	76	0.00%	0	62,097,600	0		4,719,417,600	
	81	Pasture/Hay	141,668,000	79	0.00%	0	141,668,000	0		11,191,772,000	
	82	Row Crops	198,928,000	82	0.00%	0	198,928,000	0		16,312,096,000	
	85	Urban/Recreational Grasses	18,823,700	79	0.00%	0	18,823,700	0		1,487,072,300	
			735,303,950			105,667,160	629,636,790	9,041,719,760	85.57	50,035,713,400	79.47

Using the composite CNs for MS4 and Non-MS4 areas and daily 24-hour precipitation totals, we computed daily runoff volumes. The daily 24-hour precipitation totals are daily means of the recorded totals from the Wilmington, Philadelphia, and Neshaminy precipitation gages. As indicated in Appendix Table 6-2 below, only storm events exceeding the computed initial abstraction (Ia) for each area result in runoff. Similarly, only days with measurable precipitation are included in Appendix Table 6-2. We summed the total runoff depth for the 19-month continuous simulation period and multiplied by the area to compute a total runoff volume. We computed the percentage of the total volume associated with the MS4 areas by dividing the MS4 runoff volume by the total of the MS4 and Non-MS4 runoff volumes. The percentage of the MS4 runoff volume is shown at the bottom of Appendix Table 6-2 below.

Appendix Table 6-2. Computation of Runoff Volume Generated by MS4s.

		Zone 2		Zone 3		Zone 4		Zone 5	
		MS4	Non-MS4	MS4	Non-MS4	MS4	Non-MS4	MS4	Non-MS4
	CN	84.75	79.46	88.09	79.46	88.09	83.64	85.87	79.47
	Area (m^2)	172,629,620	489,717,970	103,167,880	45,303,691	156,842,060	409,810,970	105,667,160	629,636,790
	Area (ft^2)	1,858,169,693	5,271,280,154	1,110,489,775	487,644,849	1,688,233,818	4,411,168,398	1,137,391,800	6,777,353,740
	S	1.80	2.58	1.35	2.58	1.35	1.96	1.65	2.58
	Ia	0.36	0.52	0.27	0.52	0.27	0.39	0.33	0.52
Date	Precip. (in)	Runoff (in)							
9/4/2001	0.72	0.060	0.015	0.112	0.015	0.112	0.047	0.075	0.015
9/10/2001	0.02	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9/14/2001	0.63	0.036	0.005	0.077	0.005	0.077	0.027	0.047	0.005
9/20/2001	0.31	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
9/21/2001	0.13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9/24/2001	0.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9/25/2001	0.22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
…	…	…	…	…	…	…	…	…	…
2/21/2003	0.20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2/22/2003	1.96	0.751	0.515	0.936	0.515	0.936	0.696	0.809	0.515
2/23/2003	0.30	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
2/27/2003	0.02	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2/28/2003	0.05	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/2/2003	0.83	0.099	0.035	0.165	0.035	0.165	0.082	0.118	0.035
3/5/2003	0.34	0.000	0.000	0.003	0.000	0.003	0.000	0.000	0.000
3/6/2003	0.60	0.029	0.003	0.066	0.003	0.066	0.021	0.039	0.003
3/13/2003	0.04	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/16/2003	0.04	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/17/2003	0.04	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/20/2003	1.55	0.472	0.293	0.620	0.293	0.620	0.429	0.518	0.294
3/21/2003	0.08	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/26/2003	0.27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/28/2003	0.03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3/29/2003	0.34	0.000	0.000	0.003	0.000	0.003	0.000	0.000	0.000
3/30/2003	0.20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Runoff (in)	4.997	2.397	7.866	2.397	7.866	4.293	5.818	2.399
	Runoff (ft)	0.416447206	0.199708498	0.655529917	0.199708498	0.655529917	0.357726343	0.484831079	0.199887138
	Runoff (ft3)	773,829,578	1,052,719,443	727,959,270	97,386,821	1,106,687,774	1,577,991,140	551,442,894	1,354,705,843
	% of Runoff from MS4	**42%**		**88%**		**41%**		**29%**	

The current MS4 loads for the cycling one year period are calculated using the runoff volume ratio as shown in Appendix Table 6-2 and non-point source runoff loads. Then, proportions of MS4 loads to total loads are calculated. Note that the total loads are defined as sum of point and non-point source loads excluding Trenton and Schuylkill boundary and contaminated site loads for this calculation. The existing MS4 load proportions are summarized in Appendix Table 6-3.

Appendix Table 6-3. Existing loads and proportions of MS4 loads by Zone for the cycling one year period.

Estuary Zone	NPS plus MS4 Loads	MS4 Loads	Total Loads* (Point plus Non-Point sources)	Proportion of MS4 loads to Total Loads*
	kg/365days	kg/365days	kg/365days	%
2	1.545	1.545 x 42 % = 0.649	2.688	24.15
3	0.275	0.275 x 88 % = 0.242	2.376	10.17
4	1.186	1.186 x 41 % = 0.486	3.820	12.73
5	1.129	1.129 x 29 % = 0.327	3.409	9.61

** Total loads, indicated here, are defined excluding Trenton and Schuylkill boundary and contaminated sites loads.*

Appendix Table 6-4 shows the Zone TMDLs excluding Trenton and Schuylkill boundary loads. In addition, the Table contains Zone specific MOS, allocations to contaminated site loads and allocatable portion to the rest of point and non-point source categories. The allocations to MS4s are calculated by proportion of MS4 loads to Total Loads shown in Appendix Table 6-3 and Allocatable portion to the rest of categories shown in Appendix Table 6-4. Summary of categorical WLAs and LAs are presented in Table 9 and Table 10 of the main text.

Appendix Table 6-4. Summary of the Zone TMDLs for penta-PCBs excluding Trenton and Schuylkill boundaries.

Estuary Zone	TMDL	MOS	Contaminated Site	Allocatable portion to the rest of categories	Allocations to MS4s
	mg/day	mg/day	mg/day	mg/day	mg/day
Zone 2	6.613	0.331	0.026	6.256	1.511
Zone 3	4.455	0.223	2.416	1.816	0.185
Zone 4	4.569	0.228	1.651	2.689	0.342
Zone 5	12.016	0.601	5.250	6.165	0.592

Amendment to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans

Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition to Address 122 HUC 14s Statewide

Proposed: June 15, 2009
Established: September 10, 2009
Approved: September 25, 2009
Adopted: June 10, 2010

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

TABLE OF CONTENTS

Appendices

Tables

Figures

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 or NJDEP) published the *2008 Integrated Water Quality Monitoring and Assessment Report*, which provides information on water quality conditions and trends, and various management strategies and actions being employed to protect and improve water quality. The report includes the List of Water Quality Limited Waters, also known as the 303(d) List, which identifies waters that do not attain an applicable designated use because of a known pollutant and for which a TMDL must be established. On March 3, 2008, the Department proposed the *2008 List of Water Quality Limited Waters* (40NJR4835(c)) 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 in accordance with the Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). The Environmental Protection Agency has approved this list. The *2008 List of Water Quality Limited Waters* identifies 256 waters as impaired with respect to mercury, as indicated by the presence of mercury concentrations in fish tissue in excess of New Jersey fish consumption advisories and/or not complying with the Surface Water Quality Standards (SWQS) for mercury at N.J.A.C. 7:9B.

A TMDL has been developed to address mercury impairment in 122 waters identified in Table 1 below. These are waters whose main source of contamination is air deposition. Waters that are tidal, where there are other significant sources of mercury or where cooperative efforts have been or are expected to be undertaken are not addressed in this TMDL pending additional study.

Table 1. Assessment Units Covered by this TMDL

Watershed Management Area (WMA)	Assessment Unit ID	Waterbody Name	2006 Integrated list	2008 Integrated list
01	02040104090020	Clove Brook (Delaware R)	Sublist 5	Sublist 5
01	02040104130010	Little Flat Brook (Beerskill and above)	Sublist 5	Sublist 5
01	02040104140010	Big Flat Brook (above Forked Brook)	Sublist 5	Sublist 5
01	02040105030020	Swartswood Lake and tribs	Sublist 5	Sublist 5
01	02040105030030	Trout Brook	Sublist 5	Sublist 5
01	02040105050040	Yards Creek	Sublist 3	Sublist 3*
01	02040105090040	Mountain Lake Brook	Sublist 5	Sublist 5
01	02040105140040	Merrill Creek	Sublist 5	Sublist 5
01	02040105140060	Pohatcong Ck (Springtown to Merrill Ck)	Sublist 3	Sublist 3*
01	02040105150020	Lake Hopatcong	Sublist 5	Sublist 5
01	02040105150060	Cranberry Lake / Jefferson Lake & tribs	Sublist 5	Sublist 5
02	02020007040040	Highland Lake/Wawayanda Lake	Sublist 5	Sublist 5
03	02030103050020	Pacock Brook	Sublist 5	Sublist 5
03	02030103050030	Pequannock R (above OakRidge Res outlet)	Sublist 5	Sublist 5
03	02030103050040	Clinton Reservior/Mossmans Brook	Sublist 5	Sublist 5

03	02030103050060	Pequannock R(Macopin gage to Charl'brg)	Sublist 5	Sublist 5
03	02030103050080	Pequannock R (below Macopin gage)	Sublist 5	Sublist 5
03	02030103070030	Wanaque R/Greenwood Lk(aboveMonks gage)	Sublist 5	Sublist 5
03	02030103070050	Wanaque Reservior (below Monks gage)	Sublist 5	Sublist 5
03	02030103110020	Pompton River	Sublist 5	Sublist 5
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	Sublist 5	Sublist 5
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	Sublist 5	Sublist 5
06	02030103020080	Troy Brook (above Reynolds Ave)	Sublist 5	Sublist 5
06	02030103030030	Rockaway R (above Longwood Lake outlet)	Sublist 5	Sublist 5
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	Sublist 5	Sublist 5
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	Sublist 5	Sublist 5
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	Sublist 5	Sublist 5
06	02030103030110	Beaver Brook (Morris County)	Sublist 5	Sublist 5
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	Sublist 5	Sublist 5
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	Sublist 5	Sublist 5
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	Sublist 5	Sublist 5
08	02030105010030	Raritan River SB(above Rt 46)	Sublist 5	Sublist 5
08	02030105010040	Raritan River SB(74d 44m 15s to Rt 46)	Sublist 3	Sublist 3*
08	02030105010050	Raritan R SB(LongValley br to 74d44m15s)	Sublist 3	Sublist 3*
08	02030105010060	Raritan R SB(Califon br to Long Valley)	Sublist 3	Sublist 3*
08	02030105020040	Spruce Run Reservior / Willoughby Brook	Sublist 5	Sublist 5
08	02030105020090	Prescott Brook / Round Valley Reservior	Sublist 5	Sublist 5
08	02030105020100	Raritan R SB(Three Bridges-Prescott Bk)	Sublist 3	Sublist 3*
08	02030105040010	Raritan R SB(Pleasant Run-Three Bridges)	Sublist 3	Sublist 3*
08	02030105040040	Raritan R SB(NB to Pleasant Run)	Sublist 3	Sublist 3*
09	02030105080020	Raritan R Lwr (Rt 206 to NB / SB)	Sublist 3	Sublist 3*
09	02030105080030	Raritan R Lwr (Millstone to Rt 206)	Sublist 3	Sublist 3*
09	02030105120080	South Fork of Bound Brook	Sublist 3	Sublist 3*
09	02030105120100	Bound Brook (below fork at 74d 25m 15s)	Sublist 3	Sublist 3*
09	02030105120140	Raritan R Lwr(I-287 Piscatway-Millstone)	Sublist 5	Sublist 5
09	02030105130050	Lawrence Bk (Church Lane to Deans Pond)	Sublist 3	Sublist 3*
09	02030105130060	Lawrence Bk (Milltown to Church Lane)	Sublist 3	Sublist 3*

09	02030105140020	Manalapan Bk(incl LkManlpn to 40d16m15s)	Sublist 3	Sublist 3*
09	02030105140030	Manalapan Brook (below Lake Manalapan)	Sublist 5	Sublist 5
09	02030105160030	Duhernal Lake / Iresick Brook	Sublist 3	Sublist 3*
10	02030105090050	Stony Bk(Province Line Rd to 74d46m dam)	Sublist 3	Sublist 3*
10	02030105100130	Bear Brook (below Trenton Road)	Sublist 3	Sublist 5
10	02030105110020	Millstone R (HeathcoteBk to Harrison St)	Sublist 3	Sublist 5
10	02030105110110	Millstone R (BlackwellsMills to BedenBk)	Sublist 3	Sublist 3*
10	02030105110140	Millstone R(AmwellRd to BlackwellsMills)	Sublist 3	Sublist 3*
10	02030105110170	Millstone River (below Amwell Rd)	Sublist 3	Sublist 3*
12	02030104060020	Matawan Creek (above Ravine Drive)	Sublist 3	Sublist 3*
12	02030104060030	Matawan Creek (below Ravine Drive)	Sublist 5	Sublist 5
12	02030104070070	Swimming River Reservior / Slope Bk	Sublist 3	Sublist 3*
12	02030104070090	Nut Swamp Brook	Sublist 3	Sublist 5
12	02030104090030	Deal Lake	Sublist 3	Sublist 3*
12	02030104090080	Wreck Pond Brook (below Rt 35)	Sublist 3	Sublist 5
12	02030104100050	Manasquan R (gage to West Farms Rd)	Sublist 5	Sublist 5
13	02040301030040	Metedeconk R SB (Rt 9 to Bennetts Pond)	Sublist 5	Sublist 5
13	02040301060050	Dove Mill Branch (Toms River)	Sublist 5	Sublist 5
13	02040301070010	Shannae Brook	Sublist 5	Sublist 5
13	02040301070030	Ridgeway Br (Hope Chapel Rd to HarrisBr)	Sublist 5	Sublist 5
13	02040301070040	Ridgeway Br (below Hope Chapel Rd)	Sublist 5	Sublist 5
13	02040301070080	Manapaqua Brook	Sublist 3	Sublist 5
13	02040301070090	Union Branch (below Blacks Br 74d22m05s)	Sublist 5	Sublist 5
13	02040301080030	Davenport Branch (above Pinewald Road)	Sublist 3	Sublist 5
13	02040301090050	Cedar Creek (GS Parkway to 74d16m38s)	Sublist 5	Sublist 5
13	02040301130030	Mill Ck (below GS Parkway)/Manahawkin Ck	Sublist 3	Sublist 3*
13	02040301130050	Westecunk Creek (above GS Parkway)	Sublist 5	Sublist 5
13	02040301140020	Mill Branch (below GS Parkway)	Sublist 3	Sublist 3*
13	02040301140030	Tuckerton Creek (below Mill Branch)	Sublist 3	Sublist 3*
14	02040301150080	Batsto R (Batsto gage to Quaker Bridge)	Sublist 5	Sublist 5
14	02040301160030	Mullica River (Rt 206 to Jackson Road)	Sublist 5	Sublist 5
14	02040301160140	Mullica River (39d40m30s to Rt 206)	Sublist 5	Sublist 5
14	02040301160150	Mullica R (Pleasant Mills to 39d40m30s)	Sublist 5	Sublist 5
14	02040301180060	Oswego R (Andrews Rd to Sim Place Resv)	Sublist 3	Sublist 3*
14	02040301180070	Oswego River (below Andrews Road)	Sublist 5	Sublist 5

14	02040301190050	Wading River WB (Jenkins Rd to Rt 563)	Sublist 5	Sublist 5
14	02040301200010	Beaver Branch (Wading River)	Sublist 5	Sublist 5
14	02040301200050	Bass River EB	Sublist 3	Sublist 3*
15	02040302030020	GEHR (AC Expressway to New Freedom Rd)	Sublist 5	Sublist 5
15	02040302040050	Collings Lakes trib (Hospitality Branch)	Sublist 5	Sublist 5
15	02040302040130	GEHR (Lake Lenape to Mare Run)	Sublist 5	Sublist 5
15	02040302050120	Middle River / Peters Creek	Sublist 3	Sublist 3*
16	02040206210050	Savages Run (above East Creek Pond)	Sublist 5	Sublist 5
16	02040206210060	East Creek	Sublist 5	Sublist 5
17	02040206030010	Salem River (above Woodstown gage)	Sublist 5	Sublist 5
17	02040206070030	Canton Drain (above Maskell Mill)	Sublist 5	Sublist 5
17	02040206080050	Cohansey R (incl CornwellRun - BeebeRun)	Sublist 3	Sublist 5
17	02040206090030	Cohansey R (Rocaps Run to Cornwell Run)	Sublist 5	Sublist 5
17	02040206100060	Nantuxent Creek (above Newport Landing)	Sublist 3	Sublist 3*
17	02040206130010	Scotland Run (above Fries Mill)	Sublist 5	Sublist 5
17	02040206130040	Scotland Run (below Delsea Drive)	Sublist 5	Sublist 5
17	02040206140010	MauriceR(BlkwtrBr to/incl WillowGroveLk)	Sublist 5	Sublist 5
17	02040206150050	Muddy Run (incl ParvinLk to Palatine Lk)	Sublist 3	Sublist 3*
17	02040206180050	Menantico Creek (below Rt 552)	Sublist 3	Sublist 3*
18	02040202100020	Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	Sublist 3	Sublist 5
18	02040202110030	Cooper River (above Evesham Road)	Sublist 5	Sublist 5
18	02040202110040	Cooper R (Wallworth gage to Evesham Rd)	Sublist 5	Sublist 5
18	02040202110050	Cooper River (Rt 130 to Wallworth gage)	Sublist 5	Sublist 5
18	02040202120010	Big Timber Creek NB (above Laurel Rd)	Sublist 5	Sublist 5
18	02040202120020	Big Timber Creek NB (below Laurel Rd)	Sublist 5	Sublist 5
18	02040202120030	Big Timber Creek SB (above Lakeland Rd)	Sublist 5	Sublist 5
18	02040202120040	Big T Ck SB(incl Bull Run to LakelandRd)	Sublist 5	Sublist 5
18	02040202120050	Big Timber Creek SB (below Bull Run)	Sublist 5	Sublist 5
18	02040202120060	Almonesson Creek	Sublist 5	Sublist 5
18	02040202120090	Newton Creek (LDRV-Kaighn Ave to LT Ck)	Sublist 5	Sublist 5
18	02040202120100	Woodbury Creek (above Rt 45)	Sublist 5	Sublist 5
18	02040202130030	Chestnut Branch (above Sewell)	Sublist 5	Sublist 5
18	02040202150020	Raccoon Ck (Rt 45 to/incl Clems Run)	Sublist 3	Sublist 3*
18	02040202150040	Raccoon Ck (Russell Mill Rd to Rt 45)	Sublist 5	Sublist 5
19	02040202030050	Bucks Cove Run / Cranberry Branch	Sublist 5	Sublist 5
19	02040202050050	Friendship Ck (below/incl Burrs Mill Bk)	Sublist 3	Sublist 3*

19	02040202050060	Rancocas Creek SB(above Friendship Ck)	Sublist 3	Sublist 3*
19	02040202050080	Rancocas Ck SB (Vincentown-FriendshipCk)	Sublist 3	Sublist 3*
19	02040202050090	Rancocas Ck SB (BobbysRun to Vincentown)	Sublist 3	Sublist 3*
20	02040201090030	LDRV tribs (Assiscunk Ck to Blacks Ck)	Sublist 5	Sublist 5

* Data became available in these assessment units after the 2008 list was approved indicating fish tissue levels that would result in listing of these waters in accordance with the current listing methodology; therefore, these assessment units will also be addressed in this TMDL.

The target for the TMDL is a concentration of 0.18 µg/g in fish tissue, which is the concentration at which the recommended rate of fish consumption for the high risk population is not more than 1 meal per week of top trophic level fish. At this concentration unlimited consumption is appropriate for the general population. An overall reduction of 84.3% in existing mercury loads is required to achieve the target. In its *New Jersey Mercury Reduction Plan*, the Department outlines measures needed to achieve these reductions.

The TMDLs in this report were proposed on June 15, 2009 and, having completed the public participation process, shall be adopted by the Department as amendments to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans in accordance with N.J.A.C. 7:15-6.4. This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA or EPA) May 20, 2002 guidance document entitled, "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992" (Sutfin, 2002), which describes the general statutory and regulatory requirements for approvable TMDLs, as well as EPA's more specific guidance memo for the subject type of TMDL, dated September 29, 2008 and entitled "Elements of Mercury TMDLs Where Mercury Loadings are Predominantly from Air Deposition" (Hooks, 2008).

1.0. Introduction

Mercury is a persistent, bio-accumulative toxin that can be found in solid, liquid, or vapor form. Mercury can cause a variety of harmful health effects including damage to the brain, central nervous system, and kidneys and is particularly harmful to children and pregnant and nursing women. Mercury comes from various natural and anthropogenic sources, including volcanic activity, burning of some forms of coal, use in dental procedures and manufacturing, use and disposal of products containing mercury. Most often, mercury enters the environment in gas or particulate form and is deposited on surfaces, often through precipitation, which washes deposited mercury into waterways. There it undergoes a natural chemical process and is converted to a more toxic form – methyl mercury. The methyl mercury builds up in the tissues of fish and animals, increasing its concentration as it moves up through the food chain, which results in high levels of mercury in some of the foods we eat. At certain levels, fish consumption advisories are triggered.

Mercury contamination in the environment is ubiquitous, not only in New Jersey, but worldwide. Mercury contamination is a global issue because the overwhelming source of mercury is air deposition. Consequently, mercury pollution will not be abated on a state by state basis alone, but must be controlled by regional, national and international efforts. In recognition of this, the New England Interstate Water Pollution Control Commission (NEIWPCC) established the *Northeast Regional Mercury Total Maximum Daily Load* dated October 24, 2007 (Northeast Regional TMDL), a regional TMDL for the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont which addressed impairments due to mercury contamination of waterbodies where the main source of mercury contamination is air deposition. It was approved by EPA on December 20, 2007. As EPA has approved establishment of regional TMDLs for mercury impairments where the primary source is air deposition using the NEIWPCC approach, the Department has determined that it is appropriate for New Jersey to develop a similar TMDL for comparable impairments in New Jersey, not only to recommend a course of action to reduce mercury contamination in New Jersey, but to further emphasize that substantial source reductions from outside New Jersey will be needed to achieve water quality objectives. Therefore, New Jersey has developed a statewide TMDL that will complement the Northeast Regional TMDL developed for the northeast states.

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 Surface Water Quality Standards (SWQS) after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. 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 Department combines these reports into the Integrated Water Quality Monitoring and Assessment Report and assigns each designated use within the assessment unit to one of five sublists. An assessment unit is listed as Sublist 1 if all designated uses are assessed and attained. (The Department does not include the fish consumption use for this sublist.) If some but not all uses are attained, an assessment unit is placed on Sublist 2 for attained uses. If the Department did not have data to assess a use, the assessment unit is placed on Sublist 3 for that use. If a use is not attained, the assessment unit will be placed on Sublist 5, or Sublist 4 if there is an approved TMDL, there are other enforceable management measures in effect or the impairment is due to pollution, not a pollutant. Sublist 5 constitutes the list of waters for which a TMDL may be required, also known as the 303(d) list. In accordance with the *2008 Integrated Water Quality Monitoring and Assessment Methods*, although there is a State-wide fish consumption advisory for mercury, only waters with actual fish tissue monitoring data that exceed the threshold which results in a consumption restriction (greater than 0.07 mg/kg) are placed on Sublist 5. All other assessment units are listed on Sublist 3 for this use. Based on the TMDL analysis, which demonstrates that reduction of natural sources of mercury would be needed in order to achieve the level necessary to allow unlimited consumption for high risk populations, the Department intends to revise its Assessment Method when developing future Integrated Water Quality Monitoring and Assessment Reports to allow that a limit of 1 meal per week for the high risk population would be considered as attaining the use with respect to mercury-based fish consumption (listing threshold would be results greater than 0.18 μg/g).

The *2008 List of Water Quality Limited Waters* currently identifies 256 Assessment Units as impaired due to mercury in surface water and/or fish tissue. This report establishes 122 TMDLs for mercury contamination based on fish tissue concentration whose source is largely air deposition. Waters where there are other significant sources of mercury in a waterbody, as indicated by a water column concentration in excess of the Surface Water Quality Standards, documentation of high levels of mercury in ground water or the presence of hazardous waste sites where mercury is a contaminant of concern, are deferred at this time, pending additional study. Tidal waters are also excluded because the approach used in this TMDL is intended for waters not affected by tidal dynamics. In addition, areas that are included in the spatial extent of the on-going interstate effort to address mercury impairments in the New York/New Jersey Harbor are excluded from this TMDL. A similar interstate effort is an appropriate means of addressing mercury impairments in the shared waters of the Atlantic Ocean and the Delaware River and Estuary, and these waters are deferred as well.

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).

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. EPA has also issued guidance for the development of TMDLs for mercury impairments that are due primarily to air deposition (Hooks, 2008).

2.0. Pollutant of Concern, Applicable Surface Water Quality Standards, and Area of Interest

2.1 Pollutant of Concern

The pollutant of concern for these TMDLs is mercury. According to the current assessment methodology, an assessment unit is listed as impaired for mercury if the data show water column concentrations in excess of the Surface Water Quality Standards (SWQS) or fish tissue concentrations that would result in any limitations on fish consumption. These advisories are not SWQS, but they do indicate a limitation on the use of the waters. As previously discussed, this TMDL is limited to assessment units where impairment is attributed to fish tissue in excess of advisory thresholds, where the mercury is primarily from air deposition. The assessment units addressed are identified in Table 1. These listings have a medium priority ranking in the *2008 List of Water Quality Limited Waters* (40NJR4835(c)).

2.2 Applicable Surface Water Quality Standards and Fish Consumption Advisory Criteria

Most of the waters addressed in this report are classified in the Surface Water Quality Standards (SWQS) at N.J.A.C. 7:9B as Fresh Water 2 (FW2), either Non-Trout (NT), Trout Maintenance (TM) or Trout Production (TP). Some waters are classified as Pinelands (PL) or Freshwater 1 (FW1). A few Assessment Units include waters classified as FW2-NT/SE1 or FW2-NT/SE2. If the measured salinity is less than 3.5 parts per thousand at mean high tide, the FW2-NT classification applies. The TMDL does not apply to fresh or saline tidal waters. If the majority of the waters in the HUC 14 subwatershed are fresh and non-tidal, that assessment unit was included in this TMDL. Therefore, even though portions of some assessment units are noted as including the SE (Saline Estuarine) designation, these designations are not affected and are not discussed below. Table 2 below lists the surface water classifications for the assessment units addressed in this document and Table 3 provides the numeric criteria for mercury.

Table 2. Surface Water Classifications for the Assessment Units Addressed Under this TMDL

WMA	Assessment Unit ID	Waterbody Name	Surface Water Classifications
01	2040104090020	Clove Brook (Delaware River)	FW1, FW1-TP, FW2-TPC1, FW2-TPMC1
01	2040104130010	Little Flat Brook (Beerskill And Above)	FW1, FW2-TP, FW2-TPC1, FW2-NTC1
01	2040104140010	Big Flat Brook (Above Forked Brook)	FW1, FW2-NTC1
01	2040105030020	Swartswood Lake And Tributaries	FW2-TM, FW2-TMC1, FW2-NT, FW2-NTC1
01	2040105030030	Trout Brook	FW2-TPC1, FW2-NT
01	2040105050040	Yards Creek	FW2-TPC1, FW2-NT
01	2040105090040	Mountain Lake Brook	FW2-TM, FW2-NT

01	2040105140040	Merrill Creek	FW2-TPC1, FW2-TM
01	2040105140060	Pohatcong Creek (Springtown To Merrill Creek)	FW2-TPC1, FW2-TMC1
01	2040105150020	Lake Hopatcong	FW2-TM, FW2-NT
01	2040105150060	Cranberry Lake / Jefferson Lake & Tributaries	FW2-TMC1, FW2-NT, FW2-NTC1
02	2020007040040	Highland Lake/Wawayanda Lake	FW2-NT, FW2-NTC1
03	2030103050020	Pacock Brook	FW1, FW1-TP, FW2-NTC1
03	2030103050030	Pequannock River (Above Oak Ridge Reservoir Outlet)	FW1-TP, FW1-TM, FW2-TP, FW2-TPC1, FW2-TMC1, FW2-NT
03	2030103050040	Clinton Reservior/Mossmans Brook	FW1, FW2-TPC1, FW2-TP, FW2-TMC1, FW2-NTC1
03	2030103050060	Pequannock River (Macopin Gage To Charl'brg)	FW1-TM, FW2-TPC1, FW2-TP, FW2-TM, FW2-TMC1, FW2-NT
03	2030103050080	Pequannock River (Below Macopin Gage)	FW2-TPC1, FW2-TP, FW2-NTC1, FW2-TM, FW2-NT
03	2030103070030	Wanaque River /Greenwood Lake (Above Monks Gage)	FW2-TPC1, FW2-TM, FW2-TMC1, FW2-NT, FW2-NTC1
03	2030103070050	Wanaque Reservoir (Below Monks Gage)	FW2-TPC1, FW2-TMC1, FW2-NTC1
03	2030103110020	Pompton River	FW2-NT
06	2030103010170	Passaic River Upper (Rockaway To Hanover Rr)	FW2-NT
06	2030103020040	Whippany River(Lake Pocahontas To Washington Valley Rd)	FW2-TM, FW2-NT
06	2030103020080	Troy Brook (Above Reynolds Ave)	FW2-NT
06	2030103030030	Rockaway River (Above Longwood Lake Outlet)	FW2-NTC1
06	2030103030040	Rockaway River (Stephens Brook To Longwood Lake)	FW2-NTC1
06	2030103030070	Rockaway RIVER (74d 33m 30s To Stephens Brook)	FW1, FW2-NTC1, FW2-TPC1, FW2-TMC1
06	2030103030090	Rockaway River (BM 534 Bridge To 74d 33m 30s)	FW2-NTC1, FW2-NT
06	2030103030110	Beaver Brook (Morris County)	FW2-TPC1, FW2-TMC1, FW2-NTC1
06	2030103030140	Rockaway River (Stony Brook To BM 534 Bridge)	FW2-NTC1
06	2030103030150	Rockaway River (Boonton Dam To Stony Brook)	FW2-TMC1, FW2-NTC1, FW2-NT
06	2030103030170	Rockaway River (Passaic River To Boonton Dam)	FW2-NT
08	2030105010030	Raritan River South Branch (Above Route 46)	FW2-NT, FW2-TM, FW2-NTC1
08	2030105010040	Raritan River South Branch(74d 44m 15s To Route 46)	FW2-NTC1, FW2-TPC1, FW2-NT, FW2-TMC1

08	2030105010050	Raritan River South BRANCH(Longvalley Brook To 74d44m15s)	FW2-TPC1, FW2-NT
08	2030105010060	Raritan River South Branch(Califon Brook To Long Valley)	FW2-TPC1, FW2-NT
08	2030105020040	Spruce Run Reservior / Willoughby Brook	FW2-TPC1, FW2-TMC1, FW2-TM, FW2-NT
08	2030105020090	Prescott Brook / Round Valley Reservoir	FW2-TPC1, FW2-TM, FW2-NT
08	2030105020100	Raritan River South Branch(Three Bridges-Prescott Brook)	FW2-TM, FW2-NT
08	2030105040010	Raritan River South Branch(Pleasant Run-Three Bridges)	FW2-NT
08	2030105040040	Raritan River South Branch(North Branch To Pleasant Run)	FW2-NT
09	2030105080020	Raritan River Lower (Route 206 To North Branch / South Branch)	FW2-NT
09	2030105080030	Raritan River Lower (Millstone To Route 206)	FW2-NT
09	2030105120080	South Fork Of Bound Brook	FW2-NT
09	2030105120100	Bound Brook (Below Fork At 74d 25m 15s)	FW2-NT
09	2030105120140	Raritan River Lwr(I-287 Piscatway-Millstone)	FW2-NT
09	2030105130050	Lawrence Brook (Church Lane To Deans Pond)	FW2-NT
09	2030105130060	Lawrence Brook (Milltown To Church Lane)	FW2-NT
09	2030105140020	Manalapan Brook(Incl Lakemanlpn To 40d16m15s)	FW2-NT
09	2030105140030	Manalapan Brook (Below Lake Manalapan)	FW2-NT
09	2030105160030	Duhernal Lake / Iresick Brook	FW2-NT
10	2030105090050	Stony Brook(Province Line Rd To 74d46m Dam)	FW2-NT
10	2030105100130	Bear Brook (Below Trenton Road)	FW2-NT
10	2030105110020	Millstone River (Heathcotebk To Harrison St)	FW2-NT
10	2030105110110	Millstone River (Blackwellsmills To Beden Brook)	FW2-NT
10	2030105110140	Millstone River(Amwellrd To Blackwellsmills)	FW2-NT
10	2030105110170	Millstone River (Below Amwell Rd)	FW2-NT
12	2030104060020	Matawan Creek (Above Ravine Drive)	FW2-NT/SE1
12	2030104060030	Matawan Creek (Below Ravine Drive)	FW2-NT/SE1
12	2030104070070	Swimming River Reservoir / Slope Brook	FW2-NTC1
12	2030104070090	Nut Swamp Brook	FW2-NT/SE1
12	2030104090030	Deal Lake	FW2-NT/SE1
12	2030104090080	Wreck Pond Brook (Below Route 35)	FW2-NT, FW2-NT/SE1
12	2030104100050	Manasquan River (Gage To West Farms Road)	FW2-TMC1, FW2-NTC1

13	2040301030040	Metedeconk River South Branch (Rt 9 To Bennetts Pond)	FW2-TMC1, FW2-NTC1
13	2040301060050	Dove Mill Branch (Toms River)	FW2-NTC1, PL
13	2040301070010	Shannae Brook	FW2-NT, PL
13	2040301070030	Ridgeway Brook (Hope Chapel Rd To Harrisbrook)	PL
13	2040301070040	Ridgeway Brook (Below Hope Chapel Rd)	PL, FW2-NT/SE1
13	2040301070080	Manapaqua Brook	PL, FW2-NT/SE1
13	2040301070090	Union Branch (Below Blacks Brook 74d22m05s)	PL, FW2-NT/SE1
13	2040301080030	Davenport Branch (Above Pinewald Road)	PL
13	2040301090050	Cedar Creek (GS Parkway To 74d16m38s)	PL
13	2040301130030	Mill Creek (Below Gs Parkway)/Manahawkin Creek	PL, FW2-NT, FW2-NTC1/SE1
13	2040301130050	Westecunk Creek (Above Garden State Parkway)	PL
13	2040301140020	Mill Branch (Below Garden State Parkway)	FW2-NT/SE1
13	2040301140030	Tuckerton Creek (Below Mill Branch)	PL, FW2-NTC1/SE1, FW2-NT/SE1
14	2040301150080	Batsto River (Batsto Gage To Quaker Bridge)	FW1, PL
14	2040301160030	Mullica River (Route 206 To Jackson Road)	PL
14	2040301160140	Mullica River (39d40m30s To Rt 206)	PL
14	2040301160150	Mullica RIVER (Pleasant Mills To 39d40m30s)	PL
14	2040301180060	Oswego River (Andrews Rd To Sim Place Reservoir)	PL
14	2040301180070	Oswego River (Below Andrews Road)	PL
14	2040301190050	Wading River West Branch (Jenkins Road To Route 563)	PL
14	2040301200010	Beaver Branch (Wading River)	PL
14	2040301200050	Bass River East Branch	PL, FW1
15	2040302030020	Great Egg Harbor (Atlantic City Expressway To New Freedom Road)	PL, FW2-NT
15	2040302040050	Collings Lakes Tributary (Hospitality Branch)	PL
15	2040302040130	Great Egg Harbor (Lake Lenape To Mare Run)	PL
15	2040302050120	Middle River / Peters Creek	FW1, /SE1 C1, FW2-NTC1/SE1
16	2040206210050	Savages Run (Above East Creek Pond)	FW1, PL,
16	2040206210060	East Creek	FW1, PL, FW2-NTC1/SE1, FW2-NT/SE1
17	2040206030010	Salem River (Above Woodstown Gage)	FW2-NTC1, FW2-NT
17	2040206070030	Canton Drain (Above Maskell Mill)	FW2-NT/SE1

17	2040206080050	Cohansey River (Including Cornwell Run – Beebe Run)	FW2-NT/SE1
17	2040206090030	Cohansey R (Rocaps Run To Cornwell Run)	FW2-NT/SE1
17	2040206100060	Nantuxent Creek (Above Newport Landing)	FW1, FW2-NTC1/SE1, FW2-NT/SE1
17	2040206130010	Scotland Run (Above Fries Mill)	FW2-NT
17	2040206130040	Scotland Run (Below Delsea Drive)	FW2-NT
17	2040206140010	Mauriceriver(Blackwater Book To Include Willow Grovelake)	FW2-NT, FW2-NTC1
17	2040206150050	Muddy Run (Including Parvin Lake To Palatine Lake)	FW2-NT, FW2-NTC1
17	2040206180050	Menantico Creek (Below Route 552)	FW2-NT, FW2-NTC1
18	2040202100020	Pennsauken Creek North Branch (Including Strawbridge Lake-Njtpk)	FW2-NT
18	2040202110030	Cooper River (Above Evesham Road)	FW2-NT
18	2040202110040	Cooper River (Wallworth Gage To Evesham Road)	FW2-NT
18	2040202110050	Cooper River (Route 130 To Wallworth Gage)	FW2-NT
18	2040202120010	Big Timber Creek North Branch (Above Laurel Road)	FW2-NT
18	2040202120020	Big Timber Creek North Branch (Below Laurel Road)	FW2-TPC1, FW2-NT
18	2040202120030	Big Timber Creek South Branch (Above Lakeland Road)	FW2-NT
18	2040202120040	Big Timber Creek South Branch(Including Bull Run To Lakeland Road)	FW2-NT
18	2040202120050	Big Timber Creek South Branch (Below Bull Run)	FW2-NT
18	2040202120060	Almonesson Creek	FW2-NT
18	2040202120090	Newton Creek (Ldrv-Kaighn Ave To Lt Creek)	FW2-NT
18	2040202120100	Woodbury Creek (Above Rt 45)	FW2-NT/SE2
18	2040202130030	Chestnut Branch (Above Sewell)	FW2-NT/SE2
18	2040202150020	Raccoon Creek (Rt 45 To/Include Clems Run)	FW2-NT/SE2
18	2040202150040	Raccoon Creek (Russell Mill Road To Route 45)	FW2-NT/SE2
19	2040202030050	Bucks Cove Run / Cranberry Branch	PL
19	2040202050050	Friendship Creek (Below/Including Burrs Mill Brook)	PL
19	2040202050060	Rancocas Creek South Branch(Above Friendship Creek)	PL
19	2040202050080	Rancocas Creek South Branch (Vincentown-Friendship Creek)	PL, FW2-NT
19	2040202050090	Rancocas Creek South Branch (Bobbys Run To Vincentown)	FW2-NT
20	2040201090030	Lower Delaware River Tributaries (Assiscunk Creek To Blacks Creek)	FW2-NT

C1 refers to Category One, a specific category of water relevant with respect to the antidegradation policies in the SWQS.

In all FW1 waters, the designated uses are (NJAC 7:9B-1.12):

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

In all FW2 waters, the designated uses are (NJAC 7:9B-1.12):

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

In all PL waters, the designated uses are (NJAC 7:9B-1.12):

1. Cranberry bog water supply and other agricultural uses;
2. Maintenance, migration and propagation of the natural and established biota indigenous to this unique ecological system;
3. 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;
4. Primary and secondary contact recreation; and
5. Any other reasonable uses.

Table 3. Mercury Water Column Criteria (µg/l)

Toxic substance	Fresh Water (FW2) Criteria		
	Aquatic		Human Health
	Acute	Chronic	
Mercury	1.4(d) (s)	0.77(d) (s)	0.05(h)(T)

d = criterion expressed as a function of the water effects ratio
T = total
h = noncarcinogenic effect-based human health criteria
s = dissolved

Surface water quality criteria for FW1 waters are that they shall be maintained as to quality in their natural state. PL waters shall be maintained as to quality in their existing state or that quality necessary to attain or protect the designated uses, whichever is more stringent.

In addition N.J.A.C. 7:9B-1.5(a) 4 includes the requirement that "Toxic substances in water shall not be at levels that are toxic to humans or the aquatic biota so as to render them unfit for human consumption."

Fish consumption advisories are jointly issued by the New Jersey Department of Environmental Protection and the New Jersey Department of Health and Senior Services. They provide advice to the general population and high-risk individuals (for example, women of childbearing age and children) concerning the number of meals that represent safe levels of consumption of recreational fish from New Jersey waters. Fish consumption advisories for mercury include information on how to limit risk by providing guidance on the types and sizes of fish and the number of meals to eat. They are not promulgated standards, but they are used for determining whether the fish consumption use is met. Where fish tissue levels exceed the advisory thresholds, a waterbody is listed on the 303(d) list. The New Jersey fish consumption advisories are as follows:

Table 4. New Jersey Fish Consumption Advisory Thresholds (from Toxics in Biota Committee 1994)

Advisories for the high risk population*	
Mercury (TR) Concentration in Fish Tissue	**Advisory**
Greater than 0.54 µg/g (ppm)	Do not eat
Between 0.19 and 0.54 µg/g (ppm)	One meal per month
Between 0.08 and 0.18 µg/g (ppm)	One meal per week
0.07 µg/g (ppm) or less	Unlimited consumption
Advisories for the general population	
Mercury (TR) Concentration in Fish Tissue	**Advisory**
Greater than 2.81 µg/g (ppm)	Do not eat
Between 0.94 and 2.81 µg/g (ppm)	One meal per month
Between 0.35 and 0.93 µg/g (ppm)	One meal per week
0.34 µg/g (ppm) or less	Unlimited consumption

TR – Total Recoverable Mercury

* The high risk population consists of women of childbearing years, pregnant and nursing mothers and children.

Under the current assessment methodology, an assessment unit was listed as not attaining the fish consumption use if fish tissue data indicated that any restriction of consumption would be necessary, in other words if the fish tissue concentration was above 0.07 µg/g. However, based on this TMDL analysis, this level in fish tissue can be caused solely by natural sources of mercury in some waters (see Section 5 *TMDL Calculations* below). Therefore, the Department intends to revise the assessment methodology in the development of future lists (2010) to reflect a minimal level of consumption advisory for the high risk population. It is expected that the future assessment method will use a tissue concentration of greater than 0.18 µg/g as the listing threshold, which would allow consumption by the high risk population of one meal per week. Therefore, the target for this TMDL is 0.18 µg/g total mercury fish tissue concentration. Big Timber Creek would not have been listed using this listing threshold, however, because it is listed on the 2008 303(d) list, it will be included in this TMDL document. All other waters included in this TMDL exceed the 0.18 ug/g fish tissue target.

Because fish consumption advisories are not SWQS and a TMDL must demonstrate attainment of the applicable SWQS, it is necessary to demonstrate that using this fish tissue target will also attain the applicable SWQS for mercury. This is done using bioaccumulation factors (BAFs), to convert the levels found in the fish tissue to a water column value so there can be a direct comparison with the State's current water quality criterion of 0.050 µg/L as total mercury. There is no numerical standard for waters classified as PL or FW1. The 0.18 ug/g fish tissue target is a human health endpoint which is protective of all waters, regardless of a waterbody's designation. NJAC 7:9B-1.5(a) 4's narrative standard regarding toxic substances is applicable to all waters. Absent a numeric standard for FW1 and PL waters, the narrative standard was applied and implemented using the 0.18 ug/g mercury fish tissue target. In addition the target of 0.18 µg/L requires the reduction of mercury to near natural background levels (see TMDL calculations in section 5 below) and as such is protective of waters with PL and FW1 designations.

New Jersey is engaged in an ongoing effort to develop regional BAFs. As this work is not complete, the EPA national default values will be used for this TMDL. A BAF of 1,690,000 L/kg was selected, which is based on the averaging of EPA national default values for trophic level 3 and trophic level 4 fish of 2,700,000 and 680,000 L/kg, respectively. Averaging the two values assumes a diet of 50% of these higher trophic level fish. This BAF is for methyl mercury. A further conversion to a corresponding total mercury concentration in the water column can be calculated by using the ratio of dissolved methyl mercury to total mercury. Data available from the various regions of New Jersey show that the ratios range from 0.059 to 0.005 (pers. comm. G. A. Buchanan, NJDEP, May 5, 2009). A ratio of 0.055 can be calculated from national data (EPA, 1997). The water column mercury concentration, 0.021 ug/L, expressed as total mercury using the selected BAF and the most conservative conversion factor (0.005) is lower than the mercury surface water criterion of 0.050 ug/L. Therefore, the use of a fish tissue criterion as a TMDL target ensures that the SWQS will be met if the TMDL fish tissue target is met.

The following formula was used for this comparison:

WCV (µg/L) =[Fish Tissue Value (mg/kg)/BAF (L/kg) x 1000 µg/mg] / dissolved MeHg to total Hg

Where:

WCV = water column mercury concentration
Fish Tissue Value = 0.18 mg/kg
BAF = 1,690,000 L/kg

Therefore:

WCV (µg/L)(as total Hg) = [0.18 mg/Kg/1,690,000 L/kg x 1000 µg/mg]/ 0.005 = **0.021 µg/L total Hg**

In other words, when a fish tissue target of 0.18 mg/kg is met, the water column mercury concentration would be 0.021 μg/L, which is below the surface water quality criterion of 0.050 μg/L).

2.3 Area of Interest

In accordance with the *2008 Integrated Water Quality Monitoring and Assessment Methods*, although there is a State-wide fish consumption advisory for mercury, only waters with actual fish tissue monitoring data that exceed the threshold which results in a consumption restriction (greater than 0.07 mg/kg) are placed on Sublist 5. All other assessment units are listed on Sublist 3 for this use.

The *2008 List of Water Quality Limited Waters* currently identifies 256 assessment units as impaired due to mercury in surface water and/or fish tissue. This report establishes 122 TMDLs for mercury contamination based on fish tissue concentration whose source is largely air deposition. Waters where there are other significant sources of mercury in a waterbody, as indicated by a water column concentration in excess of the Surface Water Quality Standards (61 listings), documentation of high levels of mercury in ground water (15 listings) or the presence of hazardous waste sites where mercury is a contaminant of concern (8), are deferred at this time, pending additional study. Tidal waters (35) are also excluded because the approach used in this TMDL is intended for waters not affected by tidal dynamics. In addition, areas that are included in the spatial extent of the on-going interstate effort to address mercury impairments in the New York/New Jersey Harbor are excluded from this TMDL (6). A similar interstate effort is an appropriate means of addressing mercury impairments in the shared waters of the Atlantic Ocean (37) and the Delaware River and Estuary (9) and these waters are deferred as well. See Appendix A for a listing of the deferred assessment units.

Additional fish tissue data not available when the *2008 List of Water Quality Limited Waters* was developed were evaluated and 37 additional assessment units were found to have fish tissue concentrations that would have resulted in listing of those assessment units under the current assessment methodology (see those indicated with an asterisk in Table 1). These assessment units also meet the other criteria for being addressed under this TMDL (no other significant sources, non-tidal, outside the spatial extent of interstate study). Therefore, these assessment units will be addressed under this TMDL.

As additional fish tissue data is obtained, it is expected that other assessment units will be identified that conform to the parameters established for this TMDL approach and would appropriately be addressed by this TMDL, had the data been available. Therefore, in addition to the impaired waters listed Table 1, this TMDL may, in appropriate circumstances, also apply to waterbodies that are identified in the future as being impaired for mercury. For such waterbodies, this TMDL may apply if, after listing the waters for mercury impairment and taking into account all relevant comments submitted on the Impaired Waters List, the Department determines, with EPA approval of the list, that this TMDL should apply to future mercury impaired waterbodies. Under these circumstances, the assessment units will be placed on Sublist 4.

The assessment units addressed in this TMDL are listed in Table 1 and depicted in Figure 1. The assessment units encompass 724,236 acres throughout the state.

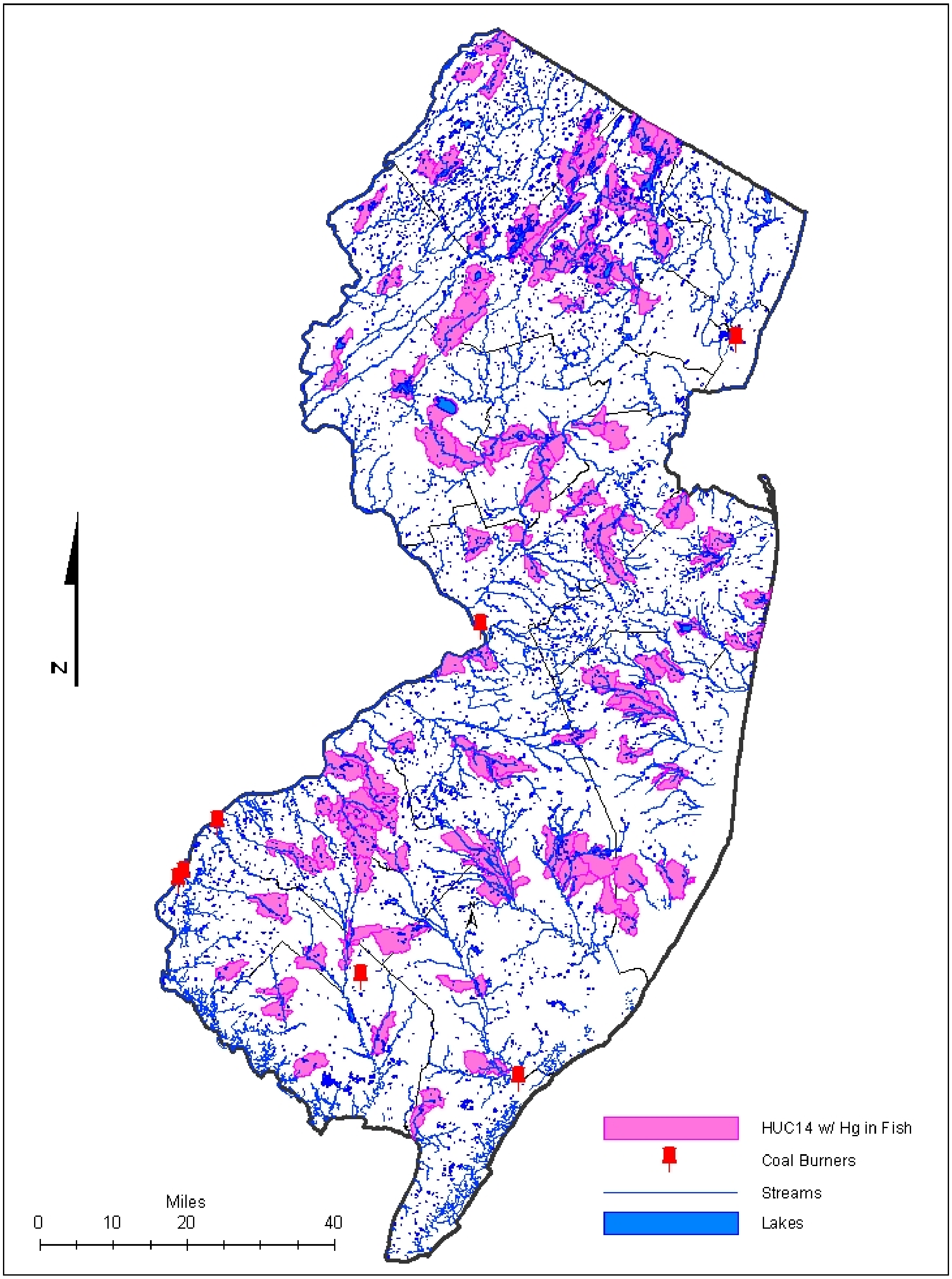


Figure 1. Assessment Units Addressed in this TMDL

3.0. Data Analysis

3.1 Fish Tissue Data

Beginning in 1994, research on freshwater fish found mercury concentrations exceeding the risk-based health advisories established by the State of New Jersey. Additional data were developed and reported in Academy of Natural Sciences, Philadelphia (ANSP) (1999), Ashley and Horwitz (2000), Horwitz et al. (2005) and Horwitz et al. (2006). The Department's Routine Monitoring Program for fish tissue began in 2002. The purpose of this monitoring program is to enhance waterbody assessments; amend existing advisories or, if necessary, develop new advisories; assist the NJDEP in evaluating trends in contaminant concentrations of these selected species; and to determine the need for additional research and monitoring studies. The sampling program is based on a rotating assessment of contamination in five regions of the state on a 5-year cycle. The regions consist of:

1. Passaic River Region;
2. Marine/Estuarine Coastal Region;
3. Raritan River Region;
4. Atlantic Coastal Inland Waterways Region; and
5. Upper and Lower Delaware River Region.

Sampling in the Passaic Region was conducted in 2002-2003 and the Marine/Estuarine Region in 2004-06. The results were reported in Horwitz, et al. (2005 and 2006). In the third year of the cycle, the Raritan River Region was sampled for freshwater fish, blue crabs and marine fish. In 2006-2007, species important to recreational anglers in the Raritan estuaries and adjacent oceanic waters and in two southern New Jersey coastal bays were sampled.

The initial data set consulted included 2,474 samples that had been analyzed for mercury in fish tissue in the waters of New Jersey collected through the above sampling programs and from localized investigations. All fish were analyzed using microwave digestion and cold vapor atomic absorption. Based on an evaluation of data quality, all samples before 1990 were excluded because of issues with background contamination in the labs analyzing samples. A small number of fish tissue samples were derived from whole fish samples. Only samples where the fillets were analyzed were retained to ensure a consistent basis for comparison. Locations with known mercury contamination from other sources were eliminated to avoid influences beyond air deposition (water column exceedances, presence of hazardous sites with mercury, groundwater levels with elevated mercury). All tidal areas were excluded, including those from the areas of on-going or anticipated interstate studies (New York/New Jersey Harbor, Atlantic Ocean and Delaware River and Bay). The final data set used for this TMDL analysis included 1,368 samples from 26 different species (see Appendix B).

This TMDL is based on the linear relationship between mercury levels in the air and water and that a BAF can relate fish tissue concentration to water column concentration. This means that if the existing load is responsible for the observed mercury levels in fish, then one can calculate the load that will result in the target concentration in fish and the associated water column concentration using the BAF, to ensure the SWQS are attained. The steady state bioaccumulation equation is:

$$C_{fish\ t1} = BAF * C_{water\ t1}$$

where:
$C_{fish\ t1}$ and $C_{water\ t1}$ represent methyl mercury concentration in fish and water at time t_1, respectively;
BAF represents the bioaccumulation factor, which is constant for a given age and length fish in a specific water body.

For a future time, t_2, when mercury concentrations have changed, but all other parameters remain constant, the following equation applies:

$$C_{fish\ t2} = BAF * C_{water\ t2}.$$

Combining both equations produces the following:

$$C_{fish\ t1}/C_{fish\ t2} = C_{water\ t1}/C_{water\ t2}.$$

Then, with methyl mercury water column concentrations being proportional to mercury air deposition load, therefore:

$$C_{fish\ t1}/C_{fish\ t2} = L_{air\ t1}/L_{air\ t2}$$

where:
$L_{air\ t1}$ and $L_{air\ t2}$ represent mercury loads from the air deposition at time 1 and time 2.

Mercury concentration in fish increases with both age and length (see Figure 2). In order to derive a representative existing fish tissue concentration as a basis to calculate the load reduction required to achieve the target concentration, it is necessary to statistically standardize the data. The fish tissue mercury concentrations were statistically adjusted to a "standard-length fish". Because many fish are larger than the standard length and therefore higher in mercury, the TMDL analysis targets the 90^{th} percentile mercury tissue concentration of the distribution of all length-standardized fish evaluated. This will provide an implicit margin of safety and be more protective than using a mean or median concentration value. In addition, because growth rates and levels of mercury accumulation will vary between waterbodies, using the 90^{th} percentile tissue concentration will be protective of waterbodies with higher levels of accumulation.

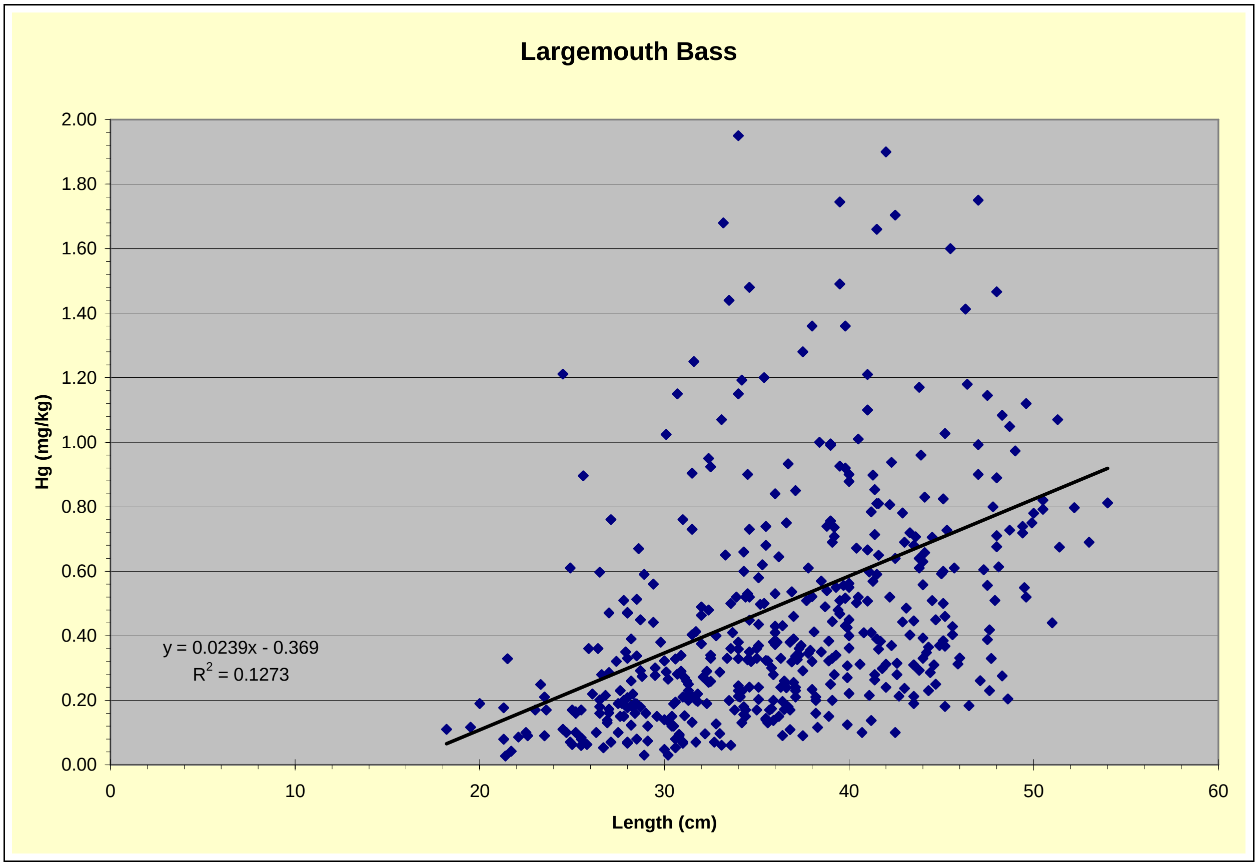


Figure 2. Relationship Between Length and Mercury Concentration in Fish Tissue

The Northeast Regional TMDL analyzed four different species of top trophic level fish, comparing the mean, 80^{th} and 90^{th} percentile concentrations. The authors chose the smallmouth bass (*Micropterous dolomieu*), because of the rate of bioaccumulation of mercury and its ubiquitous distribution throughout the Northeast States. The smallmouth bass is not well distributed throughout New Jersey, therefore it was not an appropriate indicator species for this TMDL. However, the largemouth bass (*Micropterus salmoides*), of the same genus and with the same diet of crayfish, frogs and fish, is well distributed throughout New Jersey. Samples are available from 69% of the listed assessment areas. The chain pickerel was also considered because it is represented by the second largest number of samples in the data set and has a high average mercury concentration (see tables 5 and 6 below). Its diet consists of invertebrates and fish. However, it is not as well distributed throughout New Jersey. Because of the larger sample size and better distribution, the largemouth bass was chosen to be the indicator for this TMDL effort. Using either fish yields a similar reduction factor.

Table 5. Data on Methyl Mercury Concentration in Fish Fillet Samples (n = number of samples, Average = arithmetic mean concentration)

Species List	2000-2007		1990-1999	
	n	Average	n	Average
American Eel	72	0.4	6	0.47
Black Crappie	15	0.15	32	0.19
Bluegill	75	0.14	2	0.03
Bluegill Sunfish	3	0.07	20	0.18
Brown Bullhead	32	0.07	79	0.19
Brown Trout	2	0.08	1	0.2
Chain Pickerel	82	0.658	166	0.685
Channel Catfish	9	0.22	10	0.15
Common Carp	36	0.11	5	0.04
Hybrid Striped Bass	0		6	0.27
Lake Trout	5	0.14	12	0.46
Largemouth Bass	152	0.54	224	0.56
Mud sunfish	0		3	1.01
Northern Pike	6	0.29	6	0.24
Pike	0		3	0.39
Pumpkinseed Sunfish	0		19	0.37
Rainbow Trout	0		6	0.11
Redbreast Sunfish	16	0.16	4	0.24
Rock Bass	19	0.33	4	0.46
Smallmouth Bass	13	0.34	22	0.47
Striped x White Bass Hybrid	5	0.29	0	
Walleye	10	0.4	6	0.74
White Catfish	8	0.19	15	0.27
White perch	12	0.18	22	0.42
White Sucker	3	0.23	0	
Yellow Bullhead	33	0.23	32	0.63
Yellow Perch	27	0.36	28	0.51

An analysis of covariance model was used to estimate the length-adjusted concentrations of mercury in largemouth bass. Scatter plots indicated that a log transformation for mercury would approximately linearize the relationship between mercury and length, so the model used the log to the base 10 of mercury as the dependent variable. The independent variables were length and water body. Water bodies were considered to be fixed effects. The result of this analysis was to create a length-adjusted mercury concentration for each water body.

A model was also run in order to determine whether the length-adjusted concentrations changed over time. In order to do this, an independent variable defining the decade in which the sample was taken (1992 – 1999 vs. 2000 – 2007) was included in the model along with length and water body. This model was significant ($p < 0.001$) with an R-square of 82%. Mercury concentrations varied significantly ($p < 0.001$) with length, waterbody and the decade in which the samples were taken.

Because decade was a significant effect, the two decades were analyzed separately. The adjusted estimates were calculated at the mean length of 35.11cm for data collected from 1992-1999 and 39.78 cm for data collected from 2000-2007.

For the 1992-1999, the data set included 49 water bodies. The number of fish sampled from each water body ranged from 1 to 12. The independent variables included length and water body. This model run was significant ($p < 0.001$) with an R-square of 89%. Mercury concentration varied significantly ($p < 0.001$) with both length and waterbody. The 90th percentile of the length-adjusted mercury concentration is $10^{(0.0448)} = 1.109$ µg/g.

The 2000-2007 dataset included 46 water bodies. The number of fish sampled from each water body ranged from 3 to 5. The independent variables included length and water body. This model run was significant ($p < 0.001$) with an R-square of 85%. Mercury concentration varied significantly ($p < 0.001$) with both length and waterbody. The 90th percentile of the length adjusted mercury concentration is $10^{(0.0607)} = 1.150$ µg/g.

The statistical analyses were performed in SAS version 9.1.3.

Because the mercury concentration varies with the waterbody, the 90th percentile fish tissue concentration is used to calculate the reduction factor. This will be protective of all the waterbodies, even those with higher fish tissue mercury concentrations.

Table 6. Mercury Concentrations Related to Fish Length for 2000-2007 Data

Species	Standard Length (cm)	Mean Hg Concentration (ppm) at Standard Length	80th percentile Hg Concentration (ppm) at Standard Length	90th percentile Hg Concentration (ppm) at Standard Length
Largemouth bass	35.11	0.531	0.64	1.15
Chain pickerel	41.61	0.59	1.26	1.29

Figure 3 shows the distribution of methyl mercury concentrations in all species in the 2000–2007 data set and concentrations in the largemouth bass for the same period. The graph shows that targeting the 90th percentile concentration in largemouth bass corresponds to the 93rd percentile concentration for all fish species. Therefore, targeting the concentration of 90th percentile for largemouth bass, means that approximately 93% of all fish populations tested will comply with the TMDL target concentration. There is much environmental variability. Some lakes will show decreases in mercury more quickly, some more slowly. Both the Minnesota and the Northeast States regional TMDLs were based on the 90th percentile concentration. Therefore the 90th percentile target is in keeping with mercury TMDLs EPA has previously approved.

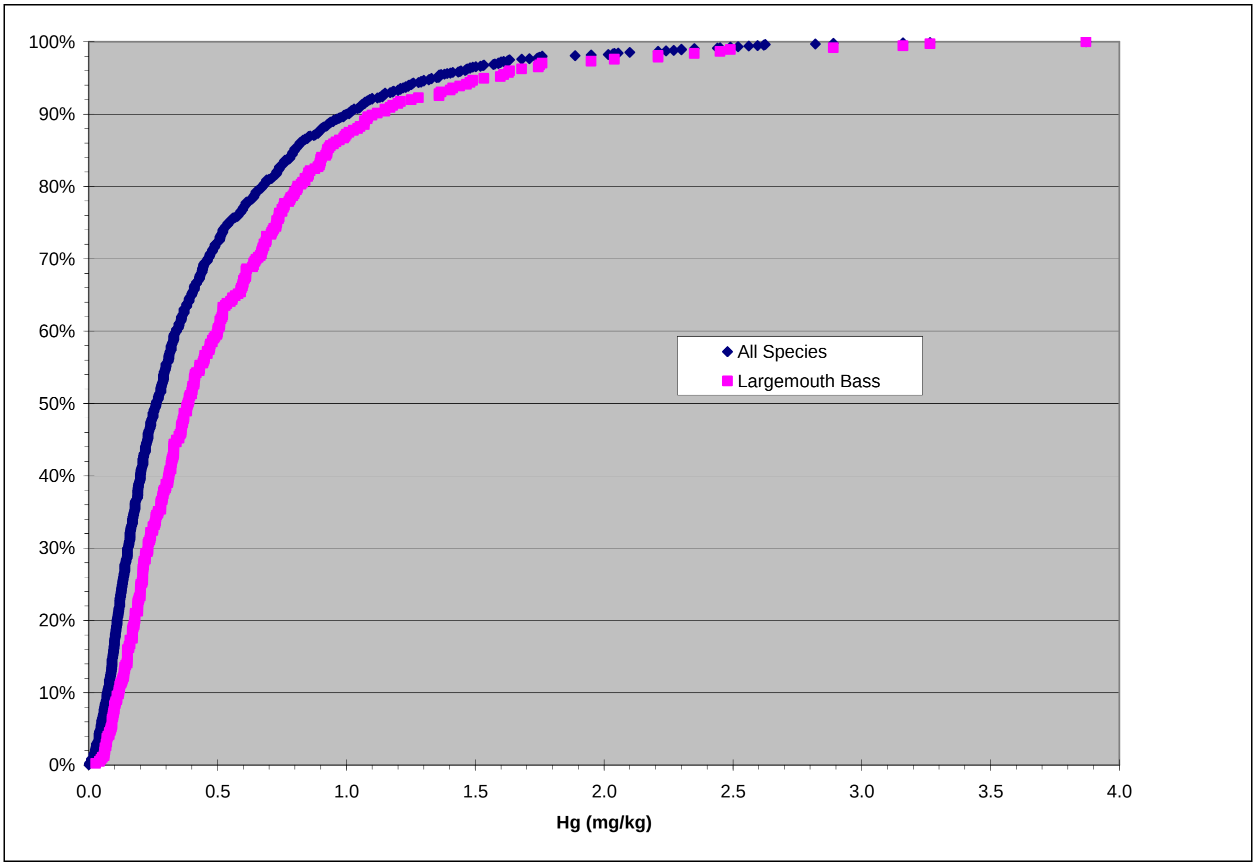


Figure 3. Cumulative Distribution of Mercury Concentrations in Fish Tissues

Based on the linear relationship premise, a Reduction Factor (RF) based on the existing and target fish tissue concentrations is calculated as follows:

RF= (EFMC-TFMC)/EFMC

where:
EFMC = the existing fish mercury concentration for the selected fish species.
TFMC = target fish mercury concentration

or:
0.84 = (1.15 µg/g-0.18 µg/g) /1.15 µg/g

As discussed above, the EFCM for this study is 1.15 µg/g, which represents the 90th percentile concentration based on standard length for largemouth bass. The target fish tissue concentration is 0.18 µg/g, which will allow a consumption rate of 1 meal per week for the high risk population. For unlimited consumption of fish for the high risk population, the reduction factor would need to be 0.94. As discussed below, natural sources of mercury, which cannot be reduced, make this reduction factor unattainable. However, the TMDL calculation includes an implicit margin of safety based on a number of conservative assumptions. Therefore, it is possible that unlimited consumption for the high risk population may be attainable if the identified anthropogenic reductions are achieved. In any case, although this TMDL target will not allow unlimited consumption of top trophic level fish for high risk groups using the multiple conservative assumptions in this analysis, mercury will be reduced at all trophic levels, allowing greater options for safe consumption of fish at the lower trophic levels and one meal per week of the top trophic levels by the high risk population.

4.0. Source Assessment

In order to evaluate and characterize mercury loadings on a statewide basis source assessments are critical. Source assessments include identifying the types of sources and their relative contributions to mercury loadings and are necessary to develop proper management responses to reduce loadings and attain water quality targets.

Air deposition is the primary source of the mercury impairments addressed in this TMDL. A recent study was undertaken in partnership with the states and USEPA Regional Air and Water Offices to use atmospheric deposition modeling to quantify contributions of specific sources and source categories to mercury deposition within each of the lower 48 states (ICF, 2008). The annual simulation was performed based on data that represented late 90's emission profiles for most source categories. The primary modeling system used for this study is the Regional Modeling System for Aerosols and Deposition (REMSAD). REMSAD is a three-dimensional grid model designed to calculate the concentrations of pollutants by simulating the physical and chemical processes in the atmosphere that affect pollutant concentrations. REMSAD simulates both wet and dry deposition of mercury. REMSAD also includes algorithms for the reemission of previously deposited mercury (originating from anthropogenic and natural sources) into the atmosphere from land and water surfaces. The Particle and Precursor Tagging Methodology (PPTM) feature allows the user to tag or track emissions from selected sources or groups of sources, and quantify their contribution to mercury deposition throughout the modeling domain and simulation period. Results from the Community Multiscale Air Quality (CMAQ) modeling system were used to enhance the analysis of the effects of global background on mercury deposition. The outputs from three global models were used to specify the boundary conditions for both REMSAD and CMAQ and thus represent a plausible range of global background contributions based on current scientific understanding.

Preparation and quality assurance of the mercury emissions inventory were critical for the air deposition load modeling. Based on the emissions data utilized by USEPA in the Clean Air Mercury Rule (CAMR) modeling, detailed summaries of the top emitters in the CAMR mercury inventory for each state were prepared and provided to the appropriate EPA regional offices and state agencies for review. An effort was made to update emissions to the 2001 timeframe in addition to the general QA/QC that performed by the states and EPA regions. Then based on the state's input, any errors in the data were corrected. Table 7 lists New Jersey's emission inventory as it was used in the model. This inventory was developed based on the Department's 2001 mercury emission estimates (ICF, 2008). For the total of the three forms of mercury emission load, approximately 60% was due to air point sources and 40% from air nonpoint sources. Air point sources include fuel combustion-electric utilities, industrial facilities and other combustion facilities. Air nonpoint sources include human cremation, fluorescent lamp breakage, miscellaneous volatilization and other non-stationary sources.

Table 7. Summary of Emissions Inventory of New Jersey in Tons per Year (tpy) (ICF, 2008)

Facility Name	HG0* (tpy)	HG2* (tpy)	HGP* (tpy)	Total (tpy)
B.L. England	0.094	0.016	0.004	0.114
Hudson*	0.011	0.028	0.003	0.041
Mercer	0.030	0.015	0.011	0.057
Deepwater	0.002	0.004	0.000	0.006
Logan Generating Company - L.P.	0.001	0.000	0.000	0.002
Chambers Cogeneration - L.P.	0.010	0.006	0.004	0.021
Co Steel Raritan	0.090	0.011	0.011	0.112
Atlantics States Cast Iron Pipe	0.033	0.004	0.004	0.041
U.S. Pipe & Fndy. Co	0.019	0.011	0.000	0.030
Co Steel Sayreville*	0.178	0.022	0.022	0.222
Essex County RRF*	0.047	0.123	0.042	0.212
Camden RRF*	0.011	0.029	0.010	0.050
Union County RRF	0.003	0.008	0.003	0.014
Gloucester County	0.002	0.005	0.002	0.009
Warren Energy RF	0.001	0.001	0.001	0.003
Howarddown	0.002	0.001	0.001	0.004
Hoeganese	0.005	0.003	0.002	0.010
Camden County Muassi	0.005	0.003	0.002	0.010
Stony Brook Regional Sewerage Authority	0.011	0.007	0.005	0.023
Bayshore Regional Sewerage Authority	0.004	0.002	0.002	0.008
Somerset Raritan Valley Sewerage Authority	0.007	0.004	0.003	0.014
Northwest Bergen County Utilities Authority	0.005	0.003	0.002	0.010
Parsippany – Troy Hills Township WWTP	0.004	0.003	0.002	0.009
Atlantic County Utilities Authority	0.003	0.002	0.001	0.006
Gloucester County Utilities Authority	0.001	0.001	0.000	0.002
Point Source Total	0.579	0.312	0.137	1.030
Non-point Source	0.464	0.096	0.055	0.613
Total	1.043	0.408	0.192	1.643

*HG0 - elemental mercury vapor; HG2 - divalent mercury compounds in gas phase; HGP - divalent mercury compounds in particulate phase.

As summarized in Table 8 below, a total of 594 kg of annual mercury load due to air deposition was estimated for New Jersey. “Background” refers to the effects of initial and boundary concentrations and embodies the effects of global emissions, altogether, about 52% of the total load. Emissions from New Jersey are contributing 12.5% of the total load. The emissions from five surrounding states contribute 26% of the total load.

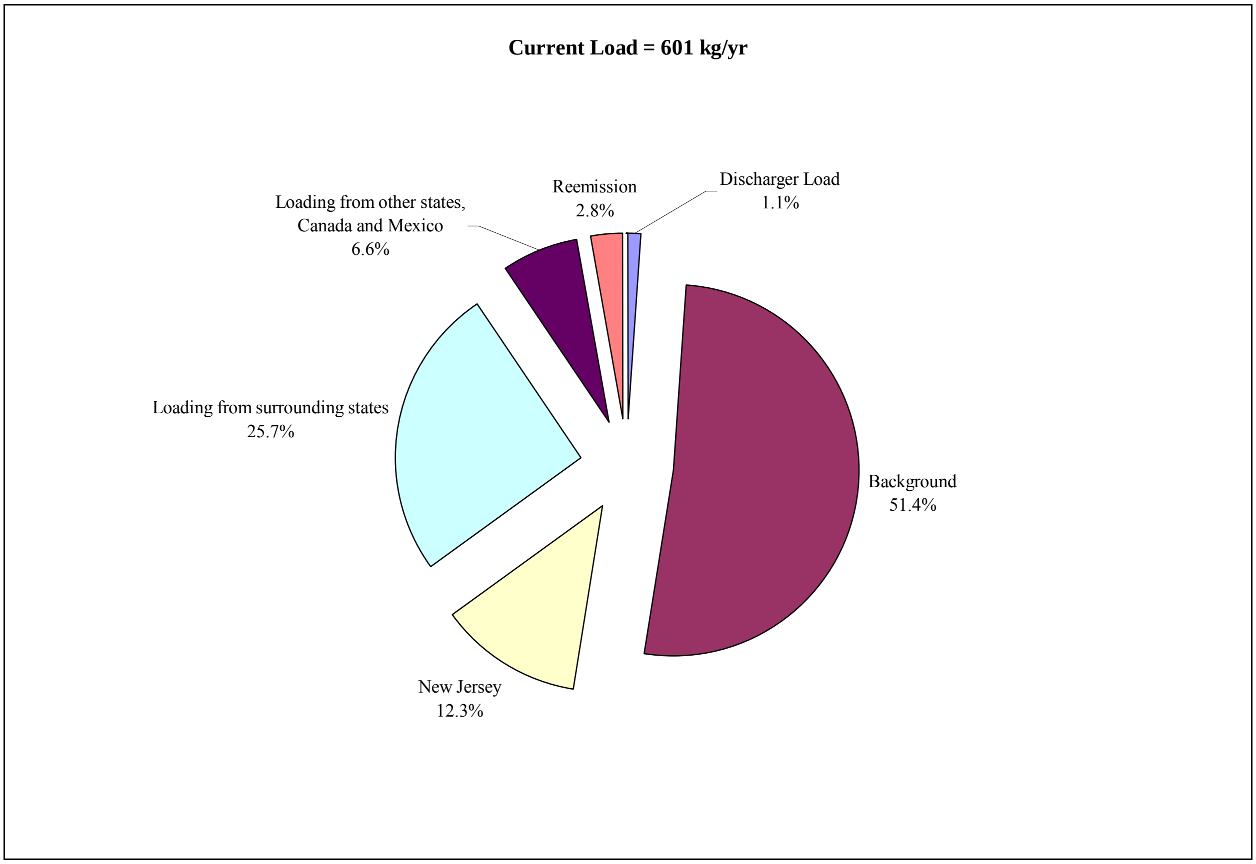
Table 8. Mercury Air Deposition Load for New Jersey (pers. com. D. Atkinson, March 26, 2009, see Appendix D)

Category	Load (kg/yr)	Percent of Total Load
Background	309.0	52.0%
Background-reemission	16.9	2.8%
New Jersey	74.1	12.5%
Loading from the surrounding state (Total)	154.6	26.0%
Pennsylvania	102.8	17.3%
Maryland	25.1	4.2%
New York	13.7	2.3%
Delaware	11.1	1.9%
Connecticut	1.8	0.3%
Loading from other states, Canada and Mexico	39.6	6.7%
Total	594.2	100%

Under the Clean Water Act (CWA), air deposition is a nonpoint source of mercury. Mercury deposited from air sources reaches the surface water as the result of direct deposition on the water surface and through stormwater runoff. Under the CWA, stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES) are a point source. In New Jersey, this includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces are nonpoint sources. Stormwater point sources derive their pollutant load from runoff from land surfaces and the necessary load reduction for this TMDL will be accomplished in the same way as for stormwater that is a nonpoint source, that is by reducing the air deposition load. The distinction is that, under the Clean Water Act stormwater point sources are assigned a WLA while nonpoint sources are assigned a LA. For this TMDL, the proportion of the air deposition loading attributed to stormwater point sources has been estimated by determining the amount of urban land located within Tier A municipalities. Based on NJDEP's 2002 land use coverage, the area of urban land use within the Tier A municipalities is about 25.6% of the entire state. Applying this percentage to the entire load due to air deposition is the best approximation of the air deposition load subject to stormwater regulation and this proportion of the air deposition load will be assigned a WLA.

Surface water discharges of sanitary and industrial wastewater that have the potential to discharge mercury are the other potential point source category which must be assigned a WLA. The Department reviewed over 240 existing major and minor municipal surface water discharge locations. Industrial surface water dischargers with mercury limits in their permits regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) were also included as the potential point sources for this TMDL. Since this TMDL is limited to non-tidal water, facilities discharging to coastal water were excluded. By examining the locations of the outfall pipes, approximately two-thirds of initially identified municipal and industrial surface water discharge facilities were used to estimate the point source loading from them.

Various sources of data were assessed in order to estimate an appropriate loading to attribute to discharge facilities. Due to the high detection limit of the standard method for analyzing the samples collected from the dischargers, mercury concentrations reported to date were generally listed as non-detected in the Monitoring Report Forms. Dental facilities are believed to be the largest source of mercury reaching wastewater treatment plants. Through the recently adopted New Jersey Pollutant Discharge Elimination System, Requirements for Indirect Users – Dental Facilities rules, N.J.A.C. 7:14A-21.12, dental facilities that generate amalgam waste are required to comply with best management practices and install amalgam separators. The amalgam separators will allow the mercury containing amalgam to be collected and recycled, thereby reducing the amount entering the environment through sludge incineration. The Department required major wastewater treatment facilities to carryout baseline monitoring of their effluent to determine mercury levels prior to implementation of the new dental requirements. However, the data from this monitoring effort are not yet available for use in this TMDL. As part of the New York-New Jersey Harbor TMDL development, in 2000 and 2001 a total of 30 samples were collected from 11 Publicly Owned Treatment Works (POTWs) in New Jersey which discharge to the Harbor (GLEC, 2008). Total recoverable mercury concentrations ranged from 8.32 to 74.9 ng/L, with a mean of 30.09 ng/L and a median of 19.75 ng/L. The Department believes that the mercury effluent concentrations found in these facilities will serve as an appropriate representation of effluent quality in the state. Therefore, the median concentration of 19.75 ng/L was used as a typical mercury concentration for treatment facilities. The total permitted flows for selected facilities is about 250 MGD. Using that flow and the selected median concentration, the total mercury load from these facilities is estimated to be 6.8 kg/year. This loading (6.8 kg/yr) is also a conservative assumption of the existing point source load since the permitted flow was used instead of the actual flow. The loading attributed to discharge facilities is insignificant at approximately 1% of the total load. Figure 4 shows the distribution of the current total load of mercury.



Note: Load from stormwater is not distinguished because it is derived from and is a subset of the air deposition load from the different air sources identified.

Figure 4. Distribution of the Current Mercury Load

5.0. TMDL Calculation

Methods similar to those used in the *Northeast Regional TMDL* (2007) are employed below to calculate the TMDL. A total source load (TSL), described in Section 4, and reduction factor (RF), as described in Section 3, are used to define the TMDL by applying the reduction factor to the total source load, as shown in Equation 1 below.

$$TMDL = TSL \times (1-RF)$$

where:

- TMDL is the total maximum daily load (kg/yr) that is expected to result in attainment of the target fish tissue mercury concentration.
- TSL is the existing total source load (kg/yr), and is equal to the sum of the existing point source load and the existing nonpoint source load
- RF is the reduction factor required to achieve the target fish mercury concentration.

To allow a consumption rate for the high risk population of one meal per week, the required reduction is 84.3 % (1 - 0.18/1.15 = 84.3%). The total existing loading from air deposition and the treatment facilities discharging into non-tidal waters is 601.kg/yr. In this load, 6.8 kg/yr (about 1%) comes from NJPDES regulated facilities with discharges to surface water in non-tidal waters. Due to the insignificant percentage contribution from this source category, reductions from this source category are not required in this TMDL. Therefore, individual WLAs are not being assigned to the various facilities through this TMDL. Individual facilities have been and will continue to be assessed to determine if a water quality based effluent limit should be assigned to prevent localized exceedances of SWQS and to ensure that the aggregate WLA is not exceeded. As discussed above and in the Reasonable Assurance section below, the recently implemented dental amalgam rules are expected to significantly reduce the amounts of mercury entering wastewater treatment facilities. At this time, it is not known what effect this will have on effluent concentrations. The post-implementation monitoring will be assessed to determine the effect of best management practices (BMPs) for the handling of dental amalgam waste and installation and proper operation of amalgam separators and the need for adaptive management with regard to this source in air deposition impacted waterbodies. Waterbodies that may be impacted by NJPDES regulated facilities with discharges to surface water (those with water column exceedances of the SWQS) have been excluded from the TMDL and will be addressed individually at a later date.

Based on results of several paleolimnological studies (NEIWPCC, et.al. 2007) in the Northeast, the natural mercury deposition is estimated to range between 15 % and 25 % of deposition fluxes for circa 2000. Natural sources cannot be controlled and are expected to remain at the same long-term average. It is assumed, in this study, that 25% of the background and background reemission is due to natural sources and can not be reduced (Ruth Chemerys and John Graham Pers. Comm. April 28, 2009). Twenty-five percent of the background and background reemission load is about 81.5 kg/yr, which is 13.6% of the total existing load. Including the load of 6.8 kg/yr attributed to surface water dischargers, the portion of the existing load that is not expected to be reduced is about 14.7%. If 0.07 ug/g (the fish concentration for unlimited consumption by the high risk population) were used as the TMDL target, the required reduction would be 93.9% of the existing load, which is greater than the entire anthropogenic load of 85.3% (1-14.7%) and clearly unattainable. For this reason, the concentration level (0.18 ug/g) that allows the high risk population to consume fish once per week was used as the target for this TMDL and will also be used as the threshold in future assessments of impairment. In order to achieve the overall 84.3% reduction of the existing load to attain the target of 0.18 mg/kg in fish tissue, a reduction of 98.8% of the anthropogenic source load would be needed. An implicit margin of safety (MOS) is used in this study, therefore, the MOS term of the TMDL equation is set to zero. Figure 5 presents the distribution of the TMDL to achieve the target concentration that will allow one meal per week by the high risk population.

Table 9. Mercury TMDL for One Meal per Week by High Risk Population

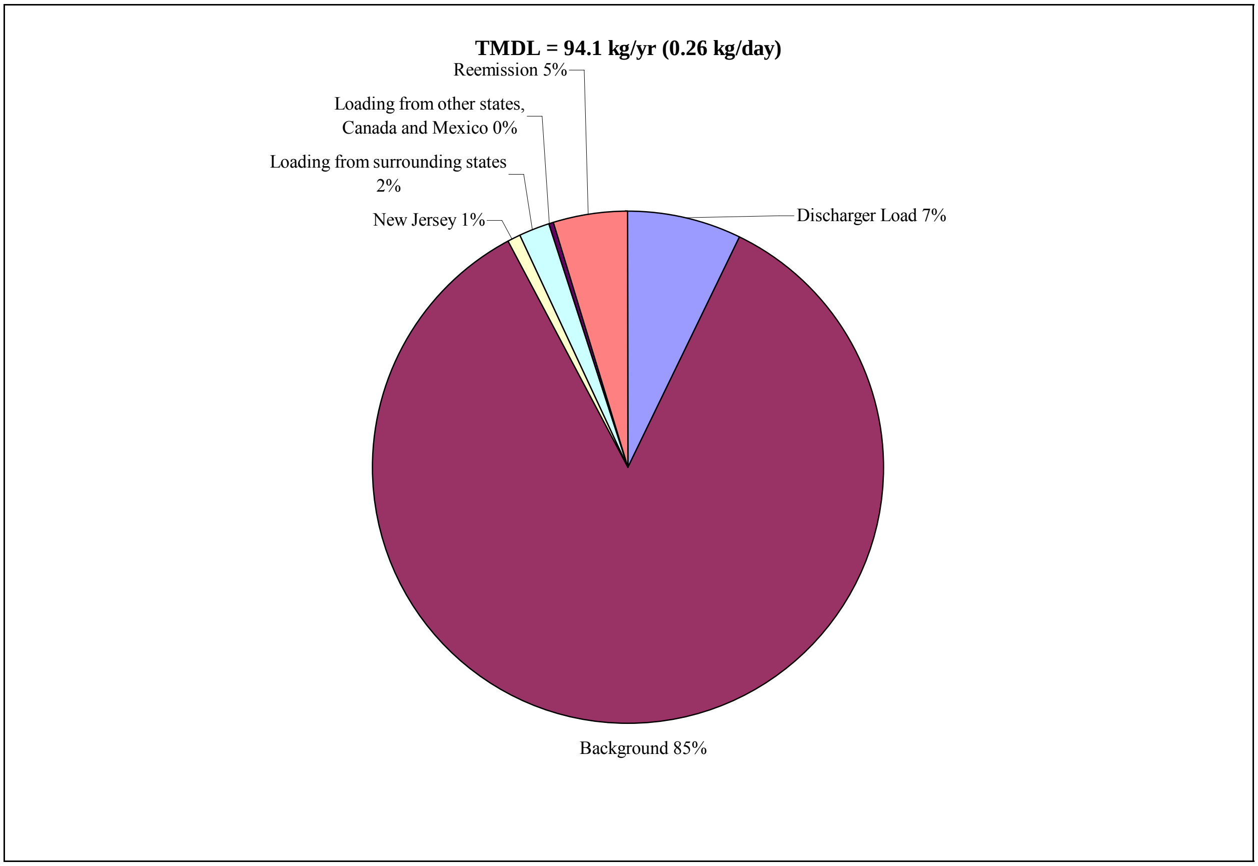
Category	Existing Load (kg/yr)	TMDL Load		Percent Reduction
		kg/yr	kg/day	
Total Annual Load	**601.0**	**94.1**	**0.26**	**84.3%**
Discharger Load (WLA)	6.8	6.8	0.02	-
Air Deposition Load (LA/WLA)	594.2	87.3	0.24	85.3%
Background due to natural source	77.3	77.3	0.21	-
Background due to anthropogenic sources	231.8	2.6	0.01	98.9%
New Jersey	74.1	0.8	0.002	98.9%
Loading from surrounding states	154.6	1.8	0.005	98.9%
Loading from other states, Canada and Mexico	39.6	0.4	0.001	98.9%
reemission due to natural source	4.2	4.2	0.01	-
Reemission due to anthropogenic source	12.7	0.1	0.0004	98.9%

Note: The TMDL loadings presented in the above table were rounded to 0.1 kg/yr. Percents of required reductions were calculated based on values with more significant digits. Using the values from the table to calculate the percent reduction may generate inaccurate results.

Table 10. Distribution of Air Deposition Load between LA and WLA under the TMDL Condition

Air Deposition Load	Annual Load (kg/yr)	Daily Load (kg/day)	Percent of Loading Capacity
Total	87.3	0.24	92.8%
WLA	22.3	0.06	23.7%
LA	65.0	0.18	69.1%

The urban storm water WLA portion of the air deposition load is derived by applying the percentage of urban land within Tier A municipalities (25.6%) to the overall air deposition load (87.3 kg/yr) based on the assumption that this load reaches the water bodies through regulated stormwater sources (see discussion in Section 4). Thus, under the TMDL conditions the WLA has been approximated to be 22.3 kg/yr (87.3 * 0.256), equivalent to 0.06 kg/day (Table 10). The air deposition rate under the TMDL condition is not available to conduct a more precise calculation of the stormwater WLA. More accuracy in developing this WLA is not necessary because the major source of mercury in stormwater is air deposition. Mercury in stormwater must be reduced by reducing air deposition and not through the usual stormwater measures. Therefore a WLA that represents an approximation of the total stormwater load is sufficient for the purposes of this TMDL. Individual stormwater WLAs would not change the response.



Note: Load from stormwater is not distinguished because it is derived from and is a subset of the air deposition load from the different air sources identified.

Figure 5. Distribution of TMDL for One Meal per Week by High Risk Population

As discussed in Section 5.2, multiple conservative assumptions have been made so that the calculated TMDL includes an implicit Margin of Safety (MOS). Therefore, the MOS term of the TMDL equation is set equal to zero. As explained above, a reduction of 85.3% (1-88.3/601) is the highest possible overall reduction that can be expected. The required reduction to achieve unlimited consumption for the high risk population is higher, (1 – 0.07/1.15 = 93.9%). Nevertheless, given the multiple conservative assumptions, this reduction may be achievable. Data gathered following implementation of the TMDL will be used to evaluate success in achieving goals.

5.1. Seasonal Variation/Critical Conditions

40 CFR 130.7(c)(1) requires that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations". Calculated TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters."

The relative contribution of local, regional, and long-range sources of mercury to fish tissue levels in a waterbody are affected by the speciation of natural and anthropogenic emission sources. The amount of bioavailable methyl mercury in water and sediments is a function of the relative rates of mercury methylation and demethylation. Factors such as pH, length of the aquatic food chain, temperature and dissolved organic carbon can affect bioaccumulation. (EPA, 2009). These factors influence the extent to which mercury bioaccumulates in fish and may vary seasonally and spatially. However, mercury concentrations in fish tissue represent accumulation of the life span of a fish. Use of a fish tissue target integrates spatial and temporal variability, making seasonal variation and critical conditions less significant. In addition, the TMDL fish target value is human health-based, reflecting a longer- term exposure.

In New Jersey, data show levels of mercury in some species of fish in the Pinelands sampling region are generally higher compared to fish in other sampling regions of the state. The reductions called for in this TMDL will attain the target fish tissue concentration in the Pinelands, thereby ensuring that the target is met statewide, within the areas addressed by the TMDL.

5.2. Margin of Safety

A TMDL must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA 303(d)(1)(C), 40C.F.R.130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described.

The MOS included in this TMDL is implicit because of the following conservative assumptions:

- The 90th percentile fish mercury concentration based on the largemouth bass, *Micropterus salmoides*. This species of fish has the highest concentration of the species that are ubiquitous throughout the state
- The percent reduction does not account for additional reductions in methyl mercury that may occur as a result of the implementation of ongoing state and federal programs to reduce sulfur emissions. Reductions in sulfur deposition and sulfate-reducing bacterial activity will decrease the rate of mercury methylation. This TMDL does not account for potential mercury reductions associated with decreased sulfur deposition.

6.0. Monitoring

The Department has engaged in various monitoring efforts that have provided significant insight into mercury contamination issues, some of which are described below. In order to effectively assess progress toward achieving mercury reduction objectives, several monitoring programs are recommended, including:

- A primary monitoring strategy for measuring the levels of mercury and calculating trends is the previously mentioned Routine Fish Monitoring Program for Toxics in Fish. This comprehensive program divides the State's waters into five regions that are sampled on a rotating basis for contaminants in fish. Since mercury is persistent in the environment, accumulates in biological tissue, and biomagnifies in the food chain, adverse impacts to non-aquatic, piscivorous (fish eating) organisms may arise from very low surface water concentrations. Fish tissue sampling provides a cost-effective measure to understanding the effects of mercury in the food chain and the environment.

- A mercury water monitoring program is needed to understand the extent and magnitude of the State's mercury contamination and its effect on aquatic organisms. Such a program must have a comprehensive scope and long-term sampling period. Recent mercury studies from the United State Geological Survey (USGS) have suggested the use of screening tools to target areas where elevated concentrations of mercury may occur. These studies have suggested looking at the presence of wetlands within watersheds, dissolved organic carbon and suspended sediment concentrations, and stream flow. High dissolved oxygen content (DOC) and suspended sediment concentrations, increased stream flow, and larger wetland areas may point to elevated mercury concentrations. The sampling requirements would consist of total and methyl mercury in the water column as well as methyl mercury in fish tissue. The locations would extend to all regions of the state such as the Pinelands, Northern New Jersey, Delaware Estuary, and Atlantic Estuary. Each region would have at least five randomized sampling locations as well as a reference site, which are small undeveloped watersheds with no known sources of mercury contamination other than air deposition. This sampling is not needed on a yearly basis, but quarterly sampling once every 2-5 years is appropriate. An ongoing project, that is targeting local air source reduction by sampling for mercury in fish, water column, and leaves at four locations from 2007 to 2013, is expected to impact the development of the statewide mercury monitoring program by refining sampling frequencies, protocols, and objectives. In addition, an ongoing study in collaboration with USGS involves establishing a baseline for natural background levels for mercury in surface waters to discern the location of impairments that may have anthropogenic sources in addition to atmospheric deposition e.g. mercurial pesticides on orchard, crops and golf courses and which may have other natural sources, e.g. geologic. This evaluative monitoring has been completed in the Inner and Outer Coastal Plain, Raritan River Basin, Papakating and Wallkill River Watersheds. The investigation is ongoing in the Millstone River Basin, Crosswicks Creek Watershed and Passaic River Basin.

- One hundred POTWs in New Jersey submitted baseline data on mercury concentrations in their treatment plant effluent. These samples were analyzed using the most sensitive analytical method for mercury in wastewater, Method 1631E. This baseline data will be used to determine the effectiveness of the implementation of the dental BMPs and the installation of the amalgam separators. These POTWs are required to conduct additional mercury sampling and analyses, using the same analytical method, after amalgam separator installation.

- In-stream monitoring to evaluate effectiveness of the dental amalgam rule is required at target locations upstream and downstream of the POTW discharge. The monitoring sites will be sampled semi-annually to evaluate ambient water quality before and after the rule's implementation to observe the significance of the reductions. Currently, only one site has been targeted. This project needs to expand by selecting suitable locations based on reviewing the POTW effluent data.

- Air sampling under the National Mercury Monitoring Deposition Network is required to continue to monitor long-term loadings and trends from atmospheric deposition. This program currently has only one site in the New Brunswick area. Additional sites in southern and northern portions of the state this network are needed to improve knowledge of depositional rates for different regions of the state and assist in atmospheric deposition source track down.

Monitoring studies already carried out have provided the following information:

- The Department's Air Program has collected speciated ambient mercury concentration data from several Tekran units that can be used to estimate dry deposition. To date, over two years' data from units at two locations, Elizabeth and New Brunswick have been checked for quality and are in the process of being evaluated. Data on wet deposition is being collected in New Brunswick and is analyzed by the National Mercury Deposition Network.

- Water monitoring data collected by NJDEP/USGS in the Ambient and Supplemental Surface Water Networks show that of the 1,752 results since 1997, nearly 67% had concentrations less than the detection levels. None of the total mercury values exceeded the current acute freshwater aquatic life criterion for dissolved mercury of 1.4 microgram per liter (ug/l) or the chronic criterion of 0.77 ug/l, but 3% of the samples exceeded the human health criterion of 0.05 ug/l. Other mercury studies and projects by NJDEP and USGS over the years show similar results, the majority of mercury concentrations are below detection levels. Detection levels have improved since 1997 with detection levels between 0.04 and 0.1 ug/l to detection levels between 0.01 and 0.02 ug/l since 2004.

- In response to the need for detection of low levels of mercury, the Department initiated a preliminary study of low level mercury occurrence in surface waters. Using EPA's method 1631E, the project consisted of 33 filtered samples with accompanying field blanks at 23 unique stations across the state. The detection level at the Wisconsin laboratory being used was 0.04 ppt. Results did not exceed any of the existing surface water quality criteria. Mercury concentrations did not appear to be influenced by land use, but did appear to increase with stream flow. The findings suggest that air deposition is a major influence on in-stream mercury concentrations. In 2007, the Department conducted a follow-up study to determine seasonal variability in total and methyl mercury concentrations at 7 reference stations, small undeveloped watersheds with no known sources of mercury contamination other than air deposition. Although total mercury showed no seasonal patterns, methyl mercury had elevated levels during the summer due to higher methylation rates during the warmer months. In addition, the project verified new sampling protocols that allow one person to conduct low level mercury sampling, thereby reducing manpower requirements and allowing this sampling to be incorporated into an ambient or routine program.

- A 150 well, statewide, shallow Ground Water Quality Monitoring Network, which was stratified as a function of land use, has been established and is sampled on a 5 year cycle for mercury and other contaminants. During the first 5 year sampling cycle from 1999 to 2004, mercury concentrations were found to range from <0.01 to 1.7 ug/L in ground water from 148 wells and only 5 of those were detectable above the laboratory reporting limits. In addition, other ground water data has been collected under the Private Well Testing Act that required private wells in 9 Southern New Jersey counties to test for mercury. A total of 25,270 wells were tested with a concentration range of 114.2 ug/l to "not detected". Approximately 1% had concentrations above the drinking water maximum contaminate level (MCL) of 2 ug/l. An analysis of the data showed no obvious geographic or land use patterns for the elevated mercury results.

7.0. Reasonable Assurance

New Jersey has a long history of working toward the reduction of mercury contamination within the state and working with interstate organizations to reduce the mercury both coming into and leaving the state. Much progress has been made. Because of New Jersey's past successes in the reduction of mercury, the actions New Jersey has underway and its commitment to implementing further actions as necessary, including working with neighboring states to reduce sources originating from outside the state, there is reasonable assurance that the goals of the TMDL will be met.

New Jersey began working to reduce mercury releases to the environment in 1992 with the formation of a Mercury Task Force. That Task Force examined the many routes and sources of mercury exposure and found air emissions to be the number one source of mercury contamination in New Jersey. The Task Force identified the largest source of mercury air emissions in New Jersey as Municipal Solid Waste (MSW) Incinerators. The Task Force recommended a statewide mercury emission standard for MSW Incinerators, which was implemented in 1996. In addition to the MSW incinerator standards, New Jersey passed the "Dry Cell Battery Management Act" in 1992, banning the use of mercury in certain batteries. These two efforts reduced MSW incinerator mercury emissions by 97% between 1992 and 2006.

In 1998, New Jersey convened a second Mercury Task Force. The second Task Force consisted of representatives from government, emission sources, public interest groups, academia, and fishing organizations. This Task Force was charged with reviewing the current science on mercury impacts on human health and ecosystems, inventorying and assessing mercury sources, and developing a comprehensive mercury reduction plan for NJ. The "New Jersey Mercury Task Force Report" published in December 2001 established a goal of the virtual elimination of anthropogenic sources of mercury and provided recommendations and targets for further reducing mercury emissions in New Jersey. The Task Force Report is available at http://www.nj.gov/dep/dsr/mercury_task_force.htm

In 2007 the Department's Mercury Workgroup evaluated New Jersey's progress towards meeting the goals and recommendations of the Task Force and began putting together a Mercury Reduction Plan to identify the necessary additional actions to continue to reduce mercury emissions in New Jersey. The reduction plan will serve as the implementation plan for these TMDLs.

Below is a summary of actions that have been taken to reduce New Jersey's mercury loadings.

- To participate in and support regional, national, and global efforts to reduce mercury uses, releases, and exposures New Jersey is a member of the Interstate Mercury Education and Reduction Clearinghouse (IMERC), a member of the Northeast Waste Management Officials Association (NEWMOA), the Quicksilver Caucus, Northeast States for Consolidated Air Use Management (NESCAUM), Environmental Council of the States (ECOS), and Toxics in Packaging.

.

- In conjunction with NEWMOA, informational brochures were developed for tanning salons and property managers concerning the management of mercury containing fluorescent lamps. The brochures were sent to every tanning salon and property management company in the state.

- New Jersey works with interstate organizations to assist in the development of federal legislation that minimizes the use of mercury in products. The Department is a member of and works with the Northeast Waste Management Officials Association (NEWMOA) on mercury issues. The Department will participate in any effort conducted by NEWMOA or other interstate organization to develop federal legislation to minimize the use of mercury in products.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for coal-fired boilers, in order to decrease emissions of mercury. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for iron or steel melters in order to decrease emissions of mercury. The Department provided three years to reduce mercury contamination of scrap through elimination and separation measures. If the source reduction measures do not achieve emission reduction, the rule requires the installation and operation of mercury air pollution control and requires achieving mercury standard starting 1/2010. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for Hospital/medical/infectious waste (HMIW) incinerators in order to prevent or decrease emissions of mercury by ensuring that the mercury emissions from HMIW incinerators will be maintained at low levels. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- The Department has closely monitored mercury sewage sludge levels and has taken action where existing authority would allow the imposition of a sewage sludge limit or a discharge limitation. For example, the POTW with the highest sewage sludge mercury concentrations was identified and the industry responsible voluntarily agreed to shut down all production of mercury-containing diagnostic kits. Increased focus on removing mercury from products, as well as the proposed dental rule noted above, should continue the decreasing trend of detectable concentrations of mercury found in sewage sludge.

- On December 6, 2004, New Jersey adopted revised regulations to establish new requirements for municipal solid waste (MSW) incinerators in order to prevent or decrease emissions of mercury by requiring MSW incinerators to further reduce their mercury emissions. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- The Department has included all mercury containing products in the Universal Waste Rule which allows generators of waste mercury containing products to manage the waste under less stringent regulations than the Hazardous Waste Regulations. In addition, every county in the state holds at least one household hazardous waste (HHW) collection per year. Most counties hold multiple collections and 3 counties (Burlington, Monmouth, and Morris) have permanent collection sites. Households generating mercury containing products can properly dispose of the items at their county's collection.

- Legislation banning the sale of mercury thermometers was passed in April 2005.

- The New Jersey Legislature passed the Mercury Switch Removal Act of 2005 requiring automobile recycling facilities to remove mercury auto switches from vehicles prior to sending the vehicles for recycling. Automobile recyclers located in New Jersey were required to begin removing the mercury auto switches in May 2006. Manufacturers have stopped using mercury switches in convenience lighting.

- The Department adopted new rules on October 1, 2007 to curtail the release of mercury from dental facilities into the environment. The new rules, under most circumstances, exempt a dental facility from the requirement to obtain an individual permit for its discharge to a POTW, if it implements best management practices (BMPs) for the handling of dental amalgam waste and installs and properly operates an amalgam separator. Dental facilities were required to implement the BMPs by October 1, 2008 and must install and operate an amalgam separator by October 1, 2009. These measures are expected to prevent at least 95 percent of the mercury wastes from being sent to the

POTW and result in approximately 2,550 pounds of mercury removed from the environment each year.

- The Department participated in the Quicksilver Caucus, which developed methods for the retirement and sequestering of mercury.

The out of state contributions to the depositional load of mercury are too great for New Jersey to eliminate mercury contamination of fish tissue by reducing sources originating within its borders alone. New Jersey will work with EPA and other states to eliminate mercury sources nationwide. EPAs efforts to issue MACT (Maximum Achievable Control Technology) standards for utilities to reduce the depositional load of mercury are supported by New Jersey. In October 2008, the New England Interstate Water Pollution Control Commission (NEIWPCC), on behalf of seven states, submitted a petition under the Clean Water Act Section 319(g) requesting EPA to convene an interstate conference to address mercury deposition to the Northeast from upwind states. The petition builds on the Northeast States' regional mercury TMDL (approved by EPA in 2007), which indicates that reductions in mercury deposition from outside the region are needed to meet water quality standards. New Jersey will participate actively in this conference when it is held.

8.0. Implementation Plan

The implementation actions below are the recommendations of the Department's Mercury Task Force (NJDEP, 2009) intended to reduce anthropogenic sources of mercury:

1) Consider developing legislation that reflects the provisions of the Mercury Education and Reduction Model Act prepared by the Northeast Waste Management Officials' Association (NEWMOA), as part of the New England Governors' Mercury Action Plan. This plan addresses mercury-containing products and limits the sale of mercury for approved purposes. Provisions of the model legislation have been adopted by 16 states, including all of the New England states.

2) Continue monitoring of mercury in environmental media. Needed follow-up monitoring is described in Section 6 and is essential for determining the effectiveness of the mercury Total Maximum Daily Load (TMDL).

3) New Jersey contributes only 12.5% to the state mercury deposition; 52% is background deposition (natural and anthropogenic) and the remaining percentage comes from surrounding states, Mexico, and Canada. Reductions required in this TMDL can not be achieved from the New Jersey anthropogenic air sources alone. Mercury reductions on the nationwide and global scales are necessary to meet the TMDL targets set up above.

4) The Department plans to update its mercury water quality criteria based upon the EPA recommended Clean Water Act Section 304(a) for methyl mercury in fish tissue. This criterion requires the development of regional bioaccumulation factors (BAFs) to address differences in the rate of methylation based on other water quality parameters such as pH and

dissolved organic carbon. While the EPA's recommended Clean Water Act Section 304(a) water quality criterion is based on a methyl mercury fish tissue concentration value of 0.3 mg/kg, New Jersey plans to develop criteria based upon a methyl mercury fish tissue concentration of 0.18 mg/kg which is based upon consumption of 1 meal per week by high risk individuals. Updating the mercury criteria based on EPA's recommendation will require calculating BAFs for New Jersey that involves additional surface water and fish tissue sampling. This information will also be used to reevaluate the previously proposed wildlife mercury criteria using updated regional BAFs. The revised mercury criteria will be used to develop TMDLs for areas of the State not covered by the Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition. In calculating an updated, revised mercury SWQS for human health and wildlife, the Department will divide the state into four regional waters: Pinelands, Non-Pinelands, Delaware Estuary tidal waters, and Atlantic tidal waters. Surface water and fish tissue data will be collected and used to develop new BAFs for each region of the state. The data results will then be applied in calculating the mercury criteria for each region. In 2009, the Department expects to begin data collection in the Pinelands region with plans to continue collection in non-Pinelands water the following year. The next action is to collect data for the Delaware Estuary and Atlantic tidal waters.

5) The existing regulations concerning mercury will continue to be implemented, enforced, and evaluated for effectiveness. This includes the regulations on mercury emissions from air sources, the removal of automobile mercury switches and the dental amalgam regulations.

9.0. Public Participation

There have been various efforts to inform and educate the general public as well as the regulated community about the effects of mercury and the need to reduce anthropogenic sources. The regulatory controls regarding mercury are described in Section 7 and some of the outreach to the general public are noted below.

Over the years the Department, in cooperation with the Department of Health and Senior Services has conducted a great deal of public outreach to the fishing community to inform them of the fish consumption advisories. Surveys were done to determine how best to reach the public. As a result the fish advisories are posted in both Spanish and English. Brochures have been developed and are distributed to doctors and WIC (the federal Women, Infants and Children nutrition program) centers. The Department of Health seafood inspectors distribute and check for postings as part of their inspections.

Currently the Department's Urban Fishing Program educates children from the Newark Bay Complex and throughout New Jersey about their local watershed. Children learn about how people's actions affect the water and human health, and what they can do to help. The NJDEP's Divisions of Watershed Management and Science, Research and Technology in conjunction with the Division of Fish and Wildlife, the Hackensack RiverKeeper, the City of Bayonne and the Municipal Utilities Authority of Bayonne have offered the program for over 10 years. The first several years of the Urban Watershed Program were conducted only in the Newark Bay

Complex. The program has now expanded to other urban areas around the state. Trenton and Camden have participated over the last three years, and we hope to add several more cities in the future.

In conjunction with NEWMOA, informational brochures were developed for tanning salons and property managers concerning the management of mercury containing fluorescent lamps. The brochures were sent to every tanning salon and property management company in the state.

There has been additional public outreach and opportunity for comment for the TMDL itself. In accordance with N.J.A.C. 7:15–7.2(g), this TMDL was proposed by the Department as an amendment to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans.

Notice proposing this TMDL was published on June 15, 2009 in the New Jersey Register and in newspapers of general circulation in the affected area in order to notify the public of the opportunity to review the TMDL and submit comments. In addition, an informational presentation followed by a public hearing for the proposed TMDL was held on July 15, 2009. Notice of the proposal and the hearing was also provided to affected Designated Planning Agencies and dischargers in the affected watersheds. One member of the public attended the hearing and declined to comment. No comments were submitted during the public comment period. Various minor edits to the proposal document have been made for clarification.

10.0. Data Sources

Geographic Information System (GIS) data from the Department was used extensively to describe the areas addressed in this document.

- State Boundary of New Jersey, Published by New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS), May 20, 2008. On line at: https://njgin.state.nj.us/NJ_NJGINExplorer/jviewer.jsp?pg=DataDownloads

- Watersheds (Subwatersheds by name - DEPHUC14), Drainage basins are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles. The delineations have been developed for general purpose use by USGS District staff over the past 20 years. Arc and polygon attributes have been included in the coverage with basin names and ranks of divides, and 14-digit hydrologic unit codes. *Originator:* U.S. Geological Survey, William H. Ellis, Jr. *Publication_Date:* 19991222 http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- NJDEP 2002 Waters of New Jersey (Lakes and Ponds), *Edition* 2008-05-01. The data was created by extracting water polygons which represented lakes and ponds from the 2002 land use/land cover (LU/LC) layer from NJ DEP's geographical information systems (GIS) database http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njwaterbody.zip

- NJDEP 2002 Waters of New Jersey (Rivers, Bays and Oceans), *Version* 20080501; *Edition:* 20080501. The data was created by extracting water polygons which represented Rivers, Bays and Oceans from the 2002 land use/land cover (LU/LC) layer from NJ DEP's geographical information systems (GIS) database. *Online Linkage* http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njarea.zip

- NJPDES Surface Water Discharges in New Jersey, (1:12,000), Version 20090126, *Edition:* 2009-01-26. This is a 2009 update of the 2002 data. New Jersey Pollutant Discharge Elimination System (NJPDES) surface water discharge pipe GIS point coverage compiled from GPSed locations, NJPDES databases, and permit applications. This coverage contains the surface water discharge points and the receiving waters coordinates for the active as well as terminated pipes. *Online Linkeage*: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njpdesswd.zip

- NJDEP Surface Water Quality Standards of New Jersey *Edition:* 200812. This data is a digital representation of New Jersey's Surface Water Quality Standards in accordance with "Surface Water Quality Standards for New Jersey Waters" as designated in N.J.A.C. 7:9 B. The Surface Water Quality Standards (SWQS) establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. These are reflected in use classifications assigned to specific waters. When interpreting the stream classifications and anti-degradation designations, the descriptions specified in the SWQS at N.J.A.C. 7:9B-1.15 always take precedence. The GIS layer reflects the stream classifications and anti-degradation designations adopted as of June 16, 2008, and it is only supplemental to SWQS and is not legally binding. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swqs.zip

- "Water Management Areas", created 03/2002 by NJDEP, Division of Watershed Management, the last update January, 2009. *Online Linkage*. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/depwmas.zip

- NJDEP Known Contaminated Site List for New Jersey, 2005, *Edition:* 200602; The Known Contaminated Sites List for New Jersey 2005 are those sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have been, a discharge of contamination. This list of Known Contaminated Sites may include sites where remediation is either currently under way, required but not yet initiated or has been completed. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/kcsl.zip

- Groundwater Contamination Areas (CKE); this data layer contains information about areas in the state which are specified as the Currently Known Extent (CKE) of ground water pollution. CKE areas are geographically defined areas within which the local ground water resources are known to be compromised because the water quality exceeds drinking water and ground water quality standards for specific contaminants. NJDEP Currently Known Extent of Groundwater Contamination (CKE) for New Jersey, 2007. *Edition:* 200703. *Online Linkage*: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/cke.zip

11.0. References

Academy of Natural Sciences of Philadelphia (ANSP). 1994. Preliminary Assessment of Total Mercury Concentrations in fishes from rivers, lakes and reservoirs of New Jersey. Report 93-15F; Submitted to New Jersey Department of Environmental Protection and Energy, Division of Science and Research. Contract P-35272. 92 pp.

Academy of Natural Sciences of Philadelphia (ANSP). 1999. Phase II Assessment of total mercury concentrations in fishes from rivers, lakes and reservoirs of New Jersey. Report 99-7. Submitted to New Jersey Department of Environmental Protection and Energy, Division of Science and Research. 155 pp.

Academy of Natural Sciences of Philadelphia (ANSP). 2007. Quality Assurance and Quality Control Plan: Routine Monitoring for Toxics in New Jersey Fish: Year 3, Raritan River Region. Contract # SR06-008. Academy Reference No. 464. Submitted to New Jersey Department of Environmental Protection, Division of Science, Research and Technology.
http://www.state.nj.us/dep/dsr/njmainfish.htm

Ashley, J. And R. Horwitz. 2000. Assessment of PCBs, selected organic pesticides and mercury in fishes from New Jersey: 1998-1999 Monitoring Program, Academy of Natural Sciences; Report No. 00-20F. 112 pp.

Chemerys, R. and Graham, J. E-mail to Helen Pang dated April 28, 2009.

GLEC. 2008. New York-New Jersey Harbor Estuary Program, New Jersey Toxics Reduction Work Plan, Study I-G Project Report. Great Lakes Environment Center, Traverse City, MI. 350 pp. http://www.state.nj.us/dep/dsr/njtrwp/njtrwp-study-i-g.pdf

Hooks, Craig, Director, Office of Wetlands, Oceans and Watersheds, September 29, 2008."Elements of Mercury TMDLs Where Mercury Loadings are Predominantly from Air Deposition" http://www.epa.gov/owow/tmdl/pdf/cover_memo_mercury_tmdl_elements.pdf
http://www.epa.gov/owow/tmdl/pdf/document_mercury_tmdl_elements.pdf

Horwitz, R.J., J. Ashley, P. Overbeck and D. Velinsky. 2005. Final Report: Routine Monitoring Program for Toxics in Fish. Contract SR02-064. ANS Report No. 04-06. April 12, 2005. 175 pp.

Horwitz, R. J., P. Overbeck, J. Ashley, D. Velinsky and L. Zadoudeh. 2006. Final Report: Monitoring Program for Chemical Contaminants in Fish from the State of New Jersey. Contract SR04-073. ANS Report No. 06-04F. August 17, 2006. 77pp.

ICF International San Rafael, CA 2008. Model-Based Analysis and Tracking of Airborne Mercury Emissions to Assist in Watershed Planning Revised Final Report, Prepared for U.S. EPA Office of Water Washington, D.C.

Korn, L. R., e-mail to Anne Witt, dated April 16, 2009.

New England Interstate Water Pollution Control Commission, New Hampshire Department of Environmental Services, New York State Department of Environmental Conservation, Rhode Island Department of Environmental Management, Vermont Department of Environmental Conservation, Connecticut Department of Environmental Protection, Maine Department of Environmental Protection, Massachusetts Department of Environmental Protection
October 24, 2007, Northeast Regional Mercury Total Maximum Daily Load.
http://www.neiwpcc.org/mercury/mercury-docs/FINAL Northeast Regional Mercury TMDL.pdf

NJDEP, 2001 New Jersey's Mercury Task Force Final Report Volume I: Executive Summary and Recommendations, Volume II: Exposure and Impacts, Volume III: Sources of Mercury to New Jersey's Environment. http://www.nj.gov/dep/dsr/mercury_task_force.htm

NJDEP, 2009 New Jersey Mercury Reduction Plan, Mercury Work Group, Unpublished

NJDEP 2008 NJ Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)). Water Assessment Team. NJDEP.
www.state.nj.us/dep/wms/bwqsa/integratedlist2008Report.html.

Toxics in Biota Committee, 1994, Mercury Contamination in New Jersey Freshwater Fish,. NJDEP, NJDHOH, NJDA. 88 pp.

Sutfin, 2002, Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992" USEPA

USEPA. 1997. Mercury Study Report to Congress. Volume III: Fate and Transport of Mercury in the Environment. EPA 452/R-97-005. Washington, DC.
www.epa.gov/ttn/oarpg/t3/reports/volume3.pdf

Appendix A

Listed Assessment units that were excluded from the Statewide TMDL

Waterbody	Name	Reason for Exclusion from TMDL
02030103120070-01	Passaic River Lwr (Fair Lawn Ave to Goffle)	Mercury in surface water
02030103120080-01	Passaic River Lwr (Dundee Dam to F.L. Ave)	Mercury in surface water
02030103120090-01	Passaic River Lwr (Saddle R to Dundee Dam)	Mercury in surface water
02030103150030-01	Passaic River Lwr (Second R to Saddle R)	Mercury in surface water
02030103150040-01	Passaic River Lwr (4th St br to Second R)	Mercury in surface water
02030103150050-01	Passaic River Lwr (Nwk Bay to 4th St brdg)	Mercury in surface water
02030103170030-01	Hackensack River (above Old Tappan gage)	Mercury in surface water
02030103170060-01	Hackensack River (Oradell to Old Tappan gage)	Mercury in surface water
02030103180030-01	Hackensack River (Ft Lee Rd to Oradell gage)	Mercury in surface water
02030103180080-01	Hackensack River (Rt 3 to Bellmans Ck)	Mercury in surface water
02030103180090-01	Hackensack River (Amtrak bridge to Rt 3)	Mercury in surface water
02030103180100-01	Hackensack River (below Amtrak bridge)	Mercury in surface water
02030104010020-01	Kill Van Kull West	Mercury in surface water
02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	Mercury in surface water
02030104010030-01	Kill Van Kull East	Mercury in surface water
02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	Mercury in surface water
02030104020030-01	Arthur Kill North	Mercury in surface water
02030104030010-01	Arthur Kill South	Mercury in surface water
02030104050120-01	Arthur Kill waterfront (below Grasselli)	Mercury in surface water
02040105210060-01	Jacobs Creek (above Woolsey Brook)	Mercury in surface water
02040105230050-01	Assunpink Creek (Shipetaukin to Trenton Rd)	Mercury in surface water
02040201050040-01	Crosswicks Creek (Walnford to Lahaway Ck)	Mercury in surface water
02040201050050-01	Crosswicks Creek (Ellisdale trib - Walnford)	Mercury in surface water
02040201050070-01	Crosswicks Creek (Doctors Ck-Ellisdale trib)	Mercury in surface water
02040206140040-01	Blackwater Branch (above/incl Pine Br)	Mercury in surface water
02040206140050-01	Blackwater Branch (below Pine Branch)	Mercury in surface water
02040206200010-01	Middle Branch / Slab Branch	Mercury in surface water
02040206200020-01	Muskee Creek	Mercury in surface water
02040301020040-01	Muddy Ford Brook	Mercury in surface water
02040301070080-01	Manapaqua Brook	Mercury in surface water
02040301170010-01	Hammonton Creek (above 74d43m)	Mercury in surface water
02040301170020-01	Hammonton Creek (Columbia Rd to 74d43m)	Mercury in surface water
02040302020020-01	Absecon Creek SB	Mercury in surface water
02040302020030-01	Absecon Creek (AC Reserviors) (gage to SB)	Mercury in surface water
02030103010180-01	Passaic River Upr (Pine Bk br to Rockaway)	Mercury in surface water
02030103040010-01	Passaic River Upr (Pompton R to Pine Bk)	Mercury in surface water
02030103120100-01	Passaic River Lwr (Goffle Bk to Pompton R)	Mercury in surface water
02030103180060-01	Berrys Creek (above Paterson Ave)	Mercury in surface water
02030103180070-01	Berrys Creek (below Paterson Ave)	Mercury in surface water
02030105160070-01	South River (below Duhernal Lake)	Mercury in surface water
02040202020030-01	Rancocas Creek NB (incl Mirror Lk-Gaunts Bk)	Mercury in surface water
02040202020040-01	Rancocas Creek NB (NL dam to Mirror Lk)	Mercury in surface water
02040202100060-01	Pennsauken Creek (below NB / SB)	Mercury in surface water
02040301020050-01	Metedeconk River NB (confluence to Rt 9)	Mercury in surface water
02040301040020-01	Metedeconk River (Beaverdam Ck to confl)	Mercury in surface water
02040302050060-01	Great Egg Harbor River (Miry Run to Lake Lenape)	Mercury in surface water

02040302050130-01	Great Egg Harbor River (GEH Bay to Miry Run)	Mercury in surface water
Delaware River 1	Delaware River 1C2	Mercury in surface water
Delaware River 2	Delaware River 1C3	Mercury in surface water
Delaware River 3	Delaware River 1C4	Mercury in surface water
Delaware River 4	Delaware River 1D1	Mercury in surface water
Delaware River 5	Delaware River 1D2	Mercury in surface water
Delaware River 6	Delaware River 1D3	Mercury in surface water
Delaware River 7	Delaware River 1D4	Mercury in surface water
Delaware River 8	Delaware River 1D5	Mercury in surface water
Delaware River 9	Delaware River 1D6	Mercury in surface water
Delaware River 10	Delaware River 1E1	Mercury in surface water
Delaware River 11	Delaware River 1E2	Mercury in surface water
Delaware River 12	Delaware River 1E3	Mercury in surface water
Delaware River 13	Delaware River 1E4	Mercury in surface water
Delaware River 14	Delaware River 1E5	Mercury in surface water
Delaware River 15	Delaware River 2	Mercury in surface water
Delaware River 16	Delaware River 3	Mercury in surface water
Delaware River 17	Delaware River 4	DRBC
Delaware River 18	Delaware River 5A	DRBC
Delaware River 19	Delaware River 5B	DRBC
Delaware River 20	Delaware River 5C	DRBC
02040204910010-02	Delaware Bay (Cape May Pt to Dennis Ck) offshore	DRBC
02040204910010-01	Delaware Bay (CapeMay Pt to Dennis Ck) inshore	DRBC
02040204910040-01	Delaware Bay (Cohansey R to FishingCk)	DRBC
02040204910020-02	Delaware Bay (Dennis Ck to Egg Islnd Pt) offshore	DRBC
02040204910020-01	Delaware Bay (DennisCk to Egg Islnd Pt) inshore	DRBC
02040301200030-02	Wading River (below Rt 542)	Tidal
02040301200080-02	Mullica River (GSP bridge to Turtle Ck)	Tidal
02040301210010-02	Mullica River (below GSP bridge)	Tidal
02030104020030-02	Elizabeth River (below Elizabeth CORP BDY)	Tidal
02030104030010-02	Morses Creek / Piles Creek	Tidal
02030104080040-01	Shrewsbury River (above Navesink River)	Tidal
02030104090040-01	Shark River (above Remsen Mill gage)	Tidal
02030104090060-01	Shark River (below Remsen Mill gage)	Tidal
02030104910020-01	Sandy Hook Bay (east of Thorns Ck)	Tidal
02040201030010-01	Duck Creek and UDRV to Assunpink Ck	Tidal
02030104060010-01	Cheesequake Creek / Whale Creek	Tidal
02030104070110-01	Navesink River (below Rt 35) / Lower Shrewsbury	Tidal
02040301080060-01	Toms River Lwr (Rt 166 to Oak Ridge Pkwy)	Tidal
02030104070110-01	Navesink River (below Rt 35) / Lower Shrewsbury	Tidal
02030104060060-01	Pews Creek to Shrewsbury River	Tidal
02040301080060-01	Toms River Lwr (Rt 166 to Oak Ridge Pkwy)	Tidal
02040301200030-02	Wading River (below Rt 542)	Tidal
02030104080010-01	Little Silver Creek / Town Neck Creek	Tidal
02040301200080-02	Mullica River (GSP bridge to Turtle Ck)	Tidal
02040301210010-02	Mullica River (below GSP bridge)	Tidal
02040302020010-01	Absecon Creek NB	Tidal
02040302020040-01	Absecon Creek (below gage)	Tidal

02030104080010-01	Little Silver Creek / Town Neck Creek	Tidal
02030104080020-01	Parkers Creek / Oceanport Creek	Tidal
02030104080030-01	Branchport Creek	Tidal
02040201070030-01	Shady Brook / Spring Lake / Rowan Lake	Tidal
02040202120080-01	Big Timber Creek (below NB/SB confl)	Tidal
02040202130040-01	Mantua Creek (Edwards Run to rd to Sewell)	Tidal
02040202140040-01	Moss Branch / Little Timber Creek (Repaupo)	Tidal
02040202140050-01	Repaupo Creek (below Tomlin Sta Rd) / Cedar Swamp	Tidal
02040202160020-01	Oldmans Creek (Rt 45 to Commissioners Rd)	Tidal
02040206090080-01	Cohansey River (Greenwich to 75d17m50s)	Tidal
02040206090100-01	Cohansey River (below Greenwich)	Tidal
02030104010010-01	Newark Airport Peripheral Ditch	Tidal
02040206100040-01	Cedar Creek (above Rt 553)	Tidal
02040206160030-01	Maurice River (Union Lake to Sherman Ave)	Other sources of Hg
02030103030070-01	Rockaway River (74d 33m 30s to Stephens Bk)	Other sources of Hg
02030103100070-01	Ramapo River (below Crystal Lake bridge)	Other sources of Hg
02040201050060-01	Ellisdale Trib (Crosswicks Creek)	Other sources of Hg
02040201070020-01	Crosswicks Creek (below Doctors Creek)	Other sources of Hg
02030103100060-01	Crystal Lake / Pond Brook	Other sources of Hg
02030104060040-01	Chingarora Creek to Thorns Creek	Other sources of Hg
02030104060050-01	Waackaack Creek	Other sources of Hg
02030105160090-01	Red Root Creek / Crows Mill Creek	Hg in groundwater
02030105160100-01	Raritan River Lwr (below Lawrence Bk)	Hg in groundwater
02040105230020-01	Assunpink Creek (New Sharon Br to/incl Lake)	Hg in groundwater
02040105230030-01	New Sharon Branch (Assunpink Creek)	Hg in groundwater
02040105230040-01	Assunpink Creek (Trenton Rd to New Sharon Br)	Hg in groundwater
02040105240010-01	Shabakunk Creek	Hg in groundwater
02040105240050-01	Assunpink Creek (below Shipetaukin Ck)	Hg in groundwater
02040201030010-01	Duck Creek and UDRV to Assunpink Ck	Hg in groundwater
02040201040040-01	Jumping Brook (Monmouth Co)	Hg in groundwater
02040301160020-01	Mullica River (above Jackson Road)	Hg in groundwater
02040301170040-01	Mullica River (Batsto R to Pleasant Mills)	Hg in groundwater
02040301170060-01	Mullica River (Rt 563 to Batsto River)	Hg in groundwater
02040301170080-01	Mullica River (Lower Bank Rd to Rt 563)	Hg in groundwater
02040301170130-01	Mullica River (Turtle Ck to Lower Bank Rd)	Hg in groundwater
02040301190050-01	Wading River WB (Jenkins Rd to Rt 563)	Hg in groundwater
02040301200020-01	Wading River (Rt 542 to Oswego River)	Hg in groundwater
02030103180040-01	Overpeck Creek	HEP
02030103180050-01	Hackensack River (Bellmans Ck to Ft Lee Rd)	HEP
02030104050060-01	Rahway River (Robinsons Br to Kenilworth Blvd)	HEP
02030104050100-01	Rahway River (below Robinsons Branch)	HEP
02030105120170-01	Raritan River Lwr (Lawrence Bk to Mile Run)	HEP
02030105160100-01	Raritan River Lwr (below Lawrence Bk)	HEP
02040302940010-01	Atlantic Ocean (34th St to Corson Inl) inshore	Tidal
02040302940010-02	Atlantic Ocean (34th St to Corson Inl) offshore	Tidal
02040302920010-01	Atlantic Ocean (Absecon In to Ventnor) inshore	Tidal
02040302920010-02	Atlantic Ocean (Absecon In to Ventnor) offshore	Tidal
02040301920010-02	Atlantic Ocean (Barnegat to Surf City) offshore	Tidal
02040301920010-01	Atlantic Ocean (Barnegat to Surf City)inshore	Tidal

02040302940050-01	Atlantic Ocean (CM Inlet to Cape May Pt) inshore	Tidal
02040302940050-02	Atlantic Ocean (CM Inlet to Cape May Pt) offshore	Tidal
02030902940020-01	Atlantic Ocean (Corson to Townsends Inl) inshore	Tidal
02030902940020-02	Atlantic Ocean (Corson to Townsends Inl) offshore	Tidal
02040302930010-01	Atlantic Ocean (Great Egg to 34th St) inshore	Tidal
02040302930010-02	Atlantic Ocean (Great Egg to 34th St) offshore	Tidal
02040301920030-01	Atlantic Ocean (Haven Bch to Lit Egg) inshore	Tidal
02040301920030-02	Atlantic Ocean (Haven Bch to Lit Egg) offshore	Tidal
02040302940040-01	Atlantic Ocean (Hereford to Cape May In) inshore	Tidal
02040302940040-02	Atlantic Ocean (Hereford to Cape May In) offshore	Tidal
02040301910020-01	Atlantic Ocean (Herring Is to Rt 37) inshore	Tidal
02040301910020-02	Atlantic Ocean (Herring Is to Rt 37) offshore	Tidal
02040302910010-01	Atlantic Ocean (Ltl Egg to Absecon In) inshore	Tidal
02040302910010-02	Atlantic Ocean (Ltl Egg to Absecon In) offshore	Tidal
02040301910010-01	Atlantic Ocean (Manasquan/Herring Is) inshore	Tidal
02040301910010-02	Atlantic Ocean (Manasquan/Herring Is) offshore	Tidal
02030104920020-01	Atlantic Ocean (Navesink R to Whale Pond) inshore	Tidal
02030104920020-02	Atlantic Ocean (Navesink R to Whale Pond) offshore	Tidal
02040301910030-01	Atlantic Ocean (Rt 37 to Barnegat Inlet) inshore	Tidal
02040301910030-02	Atlantic Ocean (Rt 37 to Barnegat Inlet) offshore	Tidal
02030104920010-01	Atlantic Ocean (Sandy H to Navesink R) inshore	Tidal
02030104920010-02	Atlantic Ocean (Sandy H to Navesink R) offshore	Tidal
02030104930020-01	Atlantic Ocean (Shark R to Manasquan) inshore	Tidal
02030104930020-02	Atlantic Ocean (Shark R to Manasquan) offshore	Tidal
02040301920020-01	Atlantic Ocean (Surf City to Haven Be) inshore	Tidal
02040301920020-02	Atlantic Ocean (Surf City to Haven Be) offshore	Tidal
02030902940030-01	Atlantic Ocean (Townsends to Hereford In) inshore	Tidal
02030902940030-02	Atlantic Ocean (Townsends to Hereford In) offshore	Tidal
02040302920020-01	Atlantic Ocean (Ventnor to Great Egg) inshore	Tidal
02040302920020-02	Atlantic Ocean (Ventnor to Great Egg) offshore	Tidal
02030104930010-01	Atlantic Ocean (Whale Pond to Shark R) inshore	Tidal

Appendix B

Fish Tissue Data

Location	Species	Field (or lab) Total Length (cm)	Hg (mg/kg) ug/g wet wt	Year
Alcyon Lake	Largemouth Bass	28.6	0.67	1992
Alcyon Lake	Largemouth Bass	33.7	0.41	1992
Batsto Lake	Yellow Bullhead	23.7	0.23	1992
Batsto Lake	Brown Bullhead	26.5	0.18	1992
Batsto Lake	Chain Pickerel	57.3	1.06	1992
Batsto Lake	Largemouth Bass	27.1	0.76	1992
Batsto Lake	Largemouth Bass	35.4	1.20	1992
Batsto Lake	Largemouth Bass	37.5	1.28	1992
Big Timber Creek	Black Crappie	15.5	0.07	1992
Big Timber Creek	Brown Bullhead	29.4	0.05	1992
Big Timber Creek	Brown Bullhead	31	0.06	1992
Big Timber Creek	Channel Catfish	42.3	0.09	1992
Big Timber Creek	White Catfish	33.4	0.08	1992
Big Timber Creek	White Catfish	29.6	0.09	1992
Big Timber Creek	Largemouth Bass	33.0	0.10	1992
Big Timber Creek	Largemouth Bass	28.2	0.12	1992
Big Timber Creek	Largemouth Bass	25.5	0.06	1992
Clementon Lake	Chain Pickerel	35.5	0.14	1992
Clementon Lake	Chain Pickerel	33	0.16	1992
Clementon Lake	Chain Pickerel	40	0.16	1992
Clementon Lake	Chain Pickerel	50.5	0.32	1992
Clementon Lake	Chain Pickerel	48.6	0.37	1992
Clementon Lake	Chain Pickerel	47.6	0.38	1992
Clementon Lake	Largemouth Bass	35.9	0.28	1992
Clementon Lake	Largemouth Bass	38.7	0.49	1992
Clinton Reservoir	Largemouth Bass	28.2	0.39	1992
Clinton Reservoir	Largemouth Bass	34.3	0.60	1992
Clinton Reservoir	Largemouth Bass	34.6	0.73	1992
Clinton Reservoir	Largemouth Bass	44.1	0.83	1992
Clinton Reservoir	Largemouth Bass	36.0	0.84	1992
Clinton Reservoir	Largemouth Bass	37.1	0.85	1992
Cooper River Park Lake	Black Crappie	16.7	0.04	1992
Cooper River Park Lake	Black Crappie	18.1	0.10	1992
Cooper River Park Lake	Black Crappie	18.4	0.12	1992
Cooper River Park Lake	Largemouth Bass	19.5	0.12	1992
Cooper River Park Lake	Largemouth Bass	21.4	0.03	1992
Cooper River Park Lake	Largemouth Bass	21.7	0.04	1992
Cooper River Park Lake	Largemouth Bass	25.5	0.08	1992
Cooper River Park Lake	Largemouth Bass	28	0.07	1992
Cooper River Park Lake	Largemouth Bass	30.8	0.09	1992

Cooper River Park Lake	Largemouth Bass	32.2	0.10	1992
Cooper River Park Lake	Largemouth Bass	32.8	0.13	1992
Cooper River Park Lake	Largemouth Bass	35.5	0.14	1992
Cooper River Park Lake	Largemouth Bass	43.5	0.31	1992
Cooper River Park Lake	Largemouth Bass	44	0.56	1992
Cooper River Park Lake	Largemouth Bass	22.1	0.09	1992
Cooper River Park Lake	Largemouth Bass	25.5	0.08	1992
Cooper River Park Lake	Largemouth Bass	28	0.07	1992
Cooper River Park Lake	Largemouth Bass	30.8	0.09	1992
Cooper River Park Lake	Largemouth Bass	35.5	0.14	1992
Cooper River Park Lake	Largemouth Bass	43.5	0.31	1992
Cranberry Lake	Chain Pickerel	42.4	0.27	1992
Cranberry Lake	Chain Pickerel	56.9	0.37	1992
Cranberry Lake	Chain Pickerel	55.5	0.37	1992
Cranberry Lake	Hybrid Striped Bass	38.2	0.29	1992
Cranberry Lake	Hybrid Striped Bass	37	0.31	1992
Cranberry Lake	Hybrid Striped Bass	52	0.43	1992
Crystal Lake	Brown Bullhead	19.8	0.02	1992
Crystal Lake	Brown Bullhead	20	0.05	1992
Dundee Lake	Brown Bullhead	27.1	0.19	1992
Dundee Lake	Brown Bullhead	29.3	0.20	1992
East Creek Lake	Chain Pickerel	31.5	0.79	1992
East Creek Lake	Chain Pickerel	34..5	1.03	1992
East Creek Lake	Chain Pickerel	41.4	1.33	1992
East Creek Lake	Chain Pickerel	39	1.33	1992
East Creek Lake	Chain Pickerel	51	1.59	1992
East Creek Lake	Chain Pickerel	40	1.76	1992
East Creek Lake	Chain Pickerel	50	2.30	1992
East Creek Lake	Chain Pickerel	46.2	2.44	1992
East Creek Lake	Chain Pickerel	52.5	2.82	1992
East Creek Lake	Yellow Bullhead	26.8	1.29	1992
East Creek Lake	Yellow Bullhead	27.4	1.47	1992
Evans Lake	Largemouth Bass	27.8	0.15	1992
Evans Lake	Largemouth Bass	21.5	0.33	1992
Harrisville Lake	Chain Pickerel	40	0.99	1992
Harrisville Lake	Chain Pickerel	33.5	1.21	1992
Harrisville Lake	Chain Pickerel	28.3	1.71	1992
Harrisville Lake	Chain Pickerel	45.7	1.74	1992
Harrisville Lake	Chain Pickerel	51.4	2.10	1992
Harrisville Lake	Yellow Bullhead	27.5	1.36	1992
Lake Carasaljo	Chain Pickerel	34.9	0.28	1992
Lake Hopatcong	Chain Pickerel	35.1	0.19	1992
Lake Hopatcong	Chain Pickerel	48	0.22	1992
Lake Hopatcong	Chain Pickerel	47.3	0.35	1992
Lake Hopatcong	Chain Pickerel	45	0.37	1992
Lake Hopatcong	Chain Pickerel	53	0.64	1992
Lake Hopatcong	Largemouth Bass	39.9	0.27	1992
Lake Hopatcong	Largemouth Bass	41.4	0.28	1992
Lake Hopatcong	Largemouth Bass	29.5	0.30	1992

Lake Nummy	Chain Pickerel	35	1.36	1992
Lake Nummy	Yellow Bullhead	26.7	0.32	1992
Lake Nummy	Yellow Bullhead	27.8	0.32	1992
Lake Nummy	Yellow Bullhead	28.1	0.32	1992
Lenape Lake	Chain Pickerel	35.5	0.25	1992
Lenape Lake	Chain Pickerel	44.8	0.54	1992
Lenape Lake	Chain Pickerel	49.7	0.89	1992
Marlton Lake	Largemouth Bass	38	1.36	1992
Maskells Mill Lake	Chain Pickerel	28	0.37	1992
Merrill Creek	Rainbow Trout	25.3	0.04	1992
Merrill Creek	Rainbow Trout	24.7	0.08	1992
Merrill Creek Reservoir	Rainbow Trout	32.1	0.14	1992
Merrill Creek Reservoir	Rainbow Trout	37.5	0.14	1992
Merrill Creek Reservoir	Rainbow Trout	38.6	0.24	1992
Merrill Creek Reservoir	Lake Trout	51.3	0.44	1992
Merrill Creek Reservoir	Lake Trout	51.6	0.77	1992
Merrill Creek Reservoir	Lake Trout	53.2	0.79	1992
Merrill Creek Reservoir	Lake Trout	56.4	0.69	1992
Merrill Creek Reservoir	Largemouth Bass	30.9	0.29	1992
Merrill Creek Reservoir	Largemouth Bass	43.9	0.96	1992
Merrill Creek Reservoir	Largemouth Bass	41.0	1.21	1992
Monksville Reservoir	Chain Pickerel	39.3	0.21	1992
Monksville Reservoir	Chain Pickerel	42.4	0.36	1992
Monksville Reservoir	Chain Pickerel	64	1.14	1992
Monksville Reservoir	Largemouth Bass	28.7	0.45	1992
Monksville Reservoir	Largemouth Bass	33.9	0.52	1992
Monksville Reservoir	Largemouth Bass	38.4	1.00	1992
Mountain Lake	Largemouth Bass	31.8	0.22	1992
Mountain Lake	Largemouth Bass	37.4	0.37	1992
Mountain Lake	Largemouth Bass	47.0	0.90	1992
New Brooklyn Lake	Chain Pickerel	18.7	0.10	1992
New Brooklyn Lake	Chain Pickerel	37.7	0.23	1992
New Brooklyn Lake	Chain Pickerel	46.6	0.79	1992
Newton Creek, North	Brown Bullhead	29	0.02	1992
Newton Creek, North	Brown Bullhead	34.4	0.03	1992
Newton Creek, North	Brown Bullhead	32.3	0.03	1992
Newton Creek, North	Brown Bullhead	32.4	0.03	1992
Newton Creek, North	Channel Catfish	36.5	0.08	1992
Newton Creek, North	Channel Catfish	47.1	0.12	1992
Newton Creek, South	Brown Bullhead	25.9	0.04	1992
Newton Creek, South	Brown Bullhead	26.1	0.06	1992
Newton Creek, South	Brown Bullhead	29.5	0.18	1992
Newton Creek, South	Chain Pickerel	25.3	0.10	1992
Newton Creek, South	Largemouth Bass	37.1	0.23	1992
Newton Creek, South	Largemouth Bass	36.6	0.24	1992
Newton Creek, South	Largemouth Bass	30.7	1.15	1992
Newton Lake	Black Crappie	18.4	0.09	1992
Newton Lake	Black Crappie	19.4	0.11	1992
Newton Lake	Black Crappie	20.4	0.13	1992

Newton Lake	Largemouth Bass	30	0.05	1992
Newton Lake	Largemouth Bass	30.6	0.05	1992
Newton Lake	Largemouth Bass	33.6	0.06	1992
Newton Lake	Largemouth Bass	33.1	0.06	1992
Newton Lake	Largemouth Bass	25.8	0.06	1992
Newton Lake	Largemouth Bass	25.0	0.06	1992
Newton Lake	Largemouth Bass	31.0	0.07	1992
Newton Lake	Largemouth Bass	31.0	0.07	1992
Newton Lake	Largemouth Bass	29.1	0.07	1992
Newton Lake	Largemouth Bass	45.2	0.18	1992
Newton Lake	Largemouth Bass	41.1	0.22	1992
Newton Lake	Largemouth Bass	45.6	0.40	1992
Rancocas Creek	Channel Catfish	45.6	0.11	1992
Rockaway River	Brown Bullhead	31	0.12	1992
Rockaway River	Chain Pickerel	34	0.15	1992
Rockaway River	Chain Pickerel	30.6	0.15	1992
Rockaway River	Chain Pickerel	38.8	0.25	1992
Rockaway River	Chain Pickerel	40.7	0.29	1992
Rockaway River	Chain Pickerel	44.7	0.31	1992
Rockaway River	Rainbow Trout	53.6	0.04	1992
Rockaway River	Yellow Bullhead	21.2	0.15	1992
Rockaway River near Whippany	Largemouth Bass	26.4	0.36	1992
Rockaway River near Whippany	Largemouth Bass	28.9	0.59	1992
Rockaway River near Whippany	Largemouth Bass	31.5	0.73	1992
Round Valley Reservoir	Lake Trout	40	0.06	1992
Round Valley Reservoir	Lake Trout	54.4	0.14	1992
Round Valley Reservoir	Lake Trout	75.5	0.14	1992
Saw Mill Lake	Brown Bullhead	36.5	0.05	1992
Saw Mill Lake	Brown Bullhead	33.1	0.06	1992
Saw Mill Lake	Brown Bullhead	39.5	0.07	1992
Saw Mill Lake	Brown Bullhead	37.9	0.07	1992
Saw Mill Lake	Northern Pike	53.4	0.27	1992
Shadow Lake	Largemouth Bass	29.1	0.12	1992
Shadow Lake	Largemouth Bass	30.4	0.15	1992
Shadow Lake	Largemouth Bass	36.7	0.18	1992
Shadow Lake	Largemouth Bass	31.2	0.26	1992
Spring Lake	Largemouth Bass	37.1	0.21	1992
Spring Lake	Largemouth Bass	49.9	0.75	1992
Spring Lake	Largemouth Bass	47.8	0.80	1992
Spruce Run Reservoir	Hybrid Striped Bass	33.1	0.17	1992
Spruce Run Reservoir	Hybrid Striped Bass	37.1	0.19	1992
Spruce Run Reservoir	Hybrid Striped Bass	38.2	0.22	1992
Spruce Run Reservoir	Largemouth Bass	25.2	0.10	1992
Spruce Run Reservoir	Largemouth Bass	28.4	0.19	1992
Spruce Run Reservoir	Largemouth Bass	41.2	0.41	1992
Spruce Run Reservoir	Largemouth Bass	43.8	0.64	1992
Stafford Forge Main Line	Chain Pickerel	26.6	0.59	1992
Stafford Forge Main Line	Chain Pickerel	27.7	0.63	1992
Stafford Forge Main Line	Chain Pickerel	29.9	0.85	1992

Strawbridge Lake	Black Crappie	15.3	0.13	1992
Strawbridge Lake	Black Crappie	14.8	0.24	1992
Strawbridge Lake	Black Crappie	14.3	0.24	1992
Swartswood Lake	Chain Pickerel	39.6	0.09	1992
Swartswood Lake	Chain Pickerel	43.3	0.10	1992
Swartswood Lake	Chain Pickerel	42.3	0.12	1992
Swartswood Lake	Smallmouth Bass	30.8	0.12	1992
Swartswood Lake	Smallmouth Bass	35.5	0.18	1992
Swartswood Lake	Smallmouth Bass	37.5	0.29	1992
Wading River	Chain Pickerel	39.4	0.66	1992
Wading River	Chain Pickerel	40.8	0.68	1992
Wading River	Chain Pickerel	34.3	0.82	1992
Wading River	Chain Pickerel	37.3	1.09	1992
Wading River	Chain Pickerel	43.6	1.23	1992
Wanaque Reservoir	Chain Pickerel	38.7	0.33	1992
Wanaque Reservoir	Chain Pickerel	55.5	0.93	1992
Wanaque Reservoir	Smallmouth Bass	27.5	0.34	1992
Wanaque Reservoir	Smallmouth Bass	37.9	0.51	1992
Wanaque Reservoir	Largemouth Bass	32.8	0.40	1992
Wanaque Reservoir	Largemouth Bass	37.8	0.61	1992
Wanaque Reservoir	Largemouth Bass	36.6	0.75	1992
Wanaque Reservoir	Largemouth Bass	40.5	1.01	1992
Wanaque Reservoir	Largemouth Bass	43.8	1.17	1992
Wanaque Reservoir	Largemouth Bass	46.4	1.18	1992
Wilson Lake	Chain Pickerel	37.8	0.24	1992
Wilson Lake	Chain Pickerel	36.3	0.38	1992
Wilson Lake	Chain Pickerel	50.6	1.06	1992
Wilson Lake	Chain Pickerel	34.4	1.53	1992
Woodstown Memorial Lake	Black Crappie	17.5	0.08	1992
Woodstown Memorial Lake	Largemouth Bass	24.5	0.11	1992
Woodstown Memorial Lake	Largemouth Bass	27.8	0.20	1992
Woodstown Memorial Lake	Largemouth Bass	27.6	0.23	1992
Woodstown Memorial Lake	Largemouth Bass	39.3	0.34	1992
Woodstown Memorial Lake	Largemouth Bass	45.1	0.50	1992
Big Timber Creek	Channel Catfish	42.3	0.09	1993
Budd Lake	White Catfish	33.8	0.17	1993
Budd Lake	Northern Pike	54.8	0.11	1993
Budd Lake	Northern Pike	64	0.11	1993
Budd Lake	Northern Pike	68.5	0.14	1993
Canistear Reservoir	Largemouth Bass	36	0.41	1993
Canistear Reservoir	Largemouth Bass	42.2	0.52	1993
Canistear Reservoir	Largemouth Bass	40	0.55	1993
Canistear Reservoir	Largemouth Bass	45.7	0.61	1993
Canistear Reservoir	Largemouth Bass	43.5	0.68	1993
Canistear Reservoir	Largemouth Bass	39.1	0.69	1993
Canistear Reservoir	Largemouth Bass	38.8	0.74	1993
Carnegie Lake	Largemouth Bass	39.1	0.20	1993
Carnegie Lake	Largemouth Bass	32.3	0.29	1993
Carnegie Lake	Largemouth Bass	35.1	0.37	1993

Carnegie Lake	Largemouth Bass	44.7	0.45	1993
Carnegie Lake	Largemouth Bass	35.1	0.58	1993
Carnegie Lake	Largemouth Bass	51.3	1.07	1993
Corbin City Impoundment #3	Brown Bullhead	26.7	0.07	1993
Crystal Lake	Black Crappie	19.1	0.04	1993
Crystal Lake	Black Crappie	20.7	0.18	1993
Crystal Lake	Largemouth Bass	23.5	0.09	1993
Crystal Lake	Largemouth Bass	30.0	0.14	1993
Crystal Lake	Largemouth Bass	42.6	0.28	1993
Manasquan Reservoir	Largemouth Bass	31	0.76	1993
Manasquan Reservoir	Largemouth Bass	38.9	2.35	1993
Manasquan Reservoir	Largemouth Bass	36.4	2.45	1993
Manasquan Reservoir	Largemouth Bass	40	2.49	1993
Manasquan Reservoir	Largemouth Bass	38	2.89	1993
Manasquan Reservoir	Largemouth Bass	41.1	3.16	1993
Manasquan Reservoir	Largemouth Bass	40.3	3.87	1993
Maskells Mill Lake	Black Crappie	20.8	0.20	1993
Maskells Mill Lake	Black Crappie	26.3	0.29	1993
Maskells Mill Lake	Brown Bullhead	25.4	0.23	1993
Maskells Mill Lake	Brown Bullhead	28.9	0.31	1993
Maskells Mill Lake	Brown Bullhead	28.9	0.47	1993
Maskells Mill Lake	Largemouth Bass	25.9	0.36	1993
Maskells Mill Lake	Largemouth Bass	32.4	0.48	1993
Mullica River	Chain Pickerel	40.7	1.21	1993
New Brooklyn Lake	Chain Pickerel	46.2	0.82	1993
New Brooklyn Lake	Chain Pickerel	59.7	1.30	1993
Round Valley Reservoir	Largemouth Bass	25.2	0.16	1993
Round Valley Reservoir	Largemouth Bass	37.1	0.24	1993
Round Valley Reservoir	Largemouth Bass	35.1	0.24	1993
Spruce Run Reservoir	Northern Pike	63.2	0.41	1993
Spruce Run Reservoir	Northern Pike	64.2	0.39	1993
Woodstown Memorial Lake	Black Crappie	19.5	0.10	1993
Woodstown Memorial Lake	Black Crappie	37.3	0.22	1993
Batsto Lake	Bluegill sunfish	18.5	0.31	1994
Batsto Lake	Bluegill sunfish	22	0.33	1994
Batsto Lake	Bluegill sunfish	20	0.56	1994
Batsto Lake	Brown bullhead	30.5	0.16	1994
Batsto Lake	Brown bullhead	30	0.16	1994
Batsto Lake	Brown bullhead	28	0.16	1994
Batsto Lake	Brown bullhead	30	0.21	1994
Batsto Lake	Brown bullhead	30	0.25	1994
Batsto Lake	Chain pickerel	29	0.38	1994
Batsto Lake	Chain pickerel	29.5	0.43	1994
Batsto Lake	Chain pickerel	28.5	0.44	1994
Batsto Lake	Chain pickerel	30	0.44	1994
Batsto Lake	Chain pickerel	38	0.79	1994
Batsto Lake	Largemouth bass	27	0.47	1994
Batsto Lake	Largemouth bass	26.5	0.60	1994
Batsto Lake	Largemouth bass	31.5	0.90	1994

Batsto Lake	Largemouth bass	32.5	0.92	1994
Batsto Lake	Largemouth bass	34	1.15	1994
Carnegie Lake	Bluegill sunfish	16.2	0.06	1994
Carnegie Lake	Bluegill sunfish	16.8	0.02	1994
Carnegie Lake	Bluegill sunfish	17.5	0.05	1994
Carnegie Lake	White perch	20	0.13	1994
Carnegie Lake	White perch	20.5	0.19	1994
Carnegie Lake	White perch	21.1	0.11	1994
Carnegie Lake	White perch	21.2	0.20	1994
Carnegie Lake	White perch	21.4	0.19	1994
Carnegie Lake	Largemouth bass	43.0	0.24	1994
Carnegie Lake	Largemouth bass	45.2	0.37	1994
Carnegie Lake	Largemouth bass	43.5	0.45	1994
Carnegie Lake	Largemouth bass	48.0	0.68	1994
Carnegie Lake	Largemouth bass	54.0	0.81	1994
Merrill Creek Reservoir	Largemouth bass	41.0	0.67	1994
Merrill Creek Reservoir	Largemouth bass	39.5	0.93	1994
Merrill Creek Reservoir	Largemouth bass	36.7	0.93	1994
Merrill Creek Reservoir	Largemouth bass	41.0	1.10	1994
Merrill Creek Reservoir	Largemouth bass	49.6	1.12	1994
Monksville Reservoir	Largemouth bass	31.3	0.20	1994
Monksville Reservoir	Largemouth bass	31.2	0.21	1994
Monksville Reservoir	Largemouth bass	28.5	0.51	1994
Monksville Reservoir	Largemouth bass	41.2	0.78	1994
Monksville Reservoir	Largemouth bass	39	1.00	1994
Wilson Lake	Pumpkinseed sunfish	20.4	0.26	1994
Wilson Lake	Pumpkinseed sunfish	18.5	0.60	1994
Wilson Lake	Pumpkinseed sunfish	18.2	1.52	1994
Wilson Lake	Yellow perch	22	0.48	1994
Wilson Lake	Yellow perch	24.5	0.65	1994
Wilson Lake	Yellow perch	26.1	0.72	1994
Wilson Lake	Yellow perch	30	1.08	1994
Wilson Lake	Yellow perch	2.95	1.23	1994
Wilson Lake	Largemouth bass	35.5	0.74	1994
Wilson Lake	Largemouth bass	40.0	0.88	1994
Wilson Lake	Largemouth bass	25.6	0.90	1994
Wilson Lake	Largemouth bass	34.5	0.90	1994
Wilson Lake	Largemouth bass	47.0	1.75	1994
Carnegie Lake	Brown bullhead	30.1	0.03	1995
Carnegie Lake	Brown bullhead	31.1	0.05	1995
Carnegie Lake	Brown bullhead	28.2	0.06	1995
Carnegie Lake	Brown bullhead	28.5	0.10	1995
Carnegie Lake	Brown bullhead	29.4	0.12	1995
Carnegie Lake	Channel catfish	56.6	0.12	1995
Carnegie Lake	Channel catfish	61.8	0.16	1995
Carnegie Lake	Channel catfish	56.2	0.18	1995

Carnegie Lake	Channel catfish	41.2	0.44	1995
East Creek Lake	Brown bullhead	33.2	2.62	1995
East Creek Lake	Chain pickerel	31.2	0.65	1995
East Creek Lake	Chain pickerel	33.5	0.78	1995
East Creek Lake	Chain pickerel	35	0.99	1995
East Creek Lake	Chain pickerel	33.3	1.14	1995
East Creek Lake	Chain pickerel	33.7	1.35	1995
East Creek Lake	Pumpkinseed sunfish	11.3	0.35	1995
East Creek Lake	Pumpkinseed sunfish	11.4	0.43	1995
East Creek Lake	Pumpkinseed sunfish	11.4	0.53	1995
East Creek Lake	Yellow bullhead	11.7	0.30	1995
East Creek Lake	Yellow bullhead	22.3	0.73	1995
East Creek Lake	Yellow perch	18	0.67	1995
East Creek Lake	Yellow perch	20	0.82	1995
East Creek Lake	Yellow perch	22	0.90	1995
East Creek Lake	Yellow perch	24	0.95	1995
East Creek Lake	Yellow perch	20.1	1.01	1995
East Creek Lake	Largemouth bass	33.1	1.07	1995
East Creek Lake	Largemouth bass	33.5	1.44	1995
East Creek Lake	Largemouth bass	34	1.95	1995
East Creek Lake	Largemouth bass	38	2.04	1995
East Creek Lake	Largemouth bass	42	2.21	1995
Harrisville Lake	Chain pickerel	27.5	0.90	1995
Harrisville Lake	Chain pickerel	24.5	0.94	1995
Harrisville Lake	Chain pickerel	25	1.20	1995
Harrisville Lake	Chain pickerel	33.5	1.48	1995
Harrisville Lake	Chain pickerel	45	2.27	1995
Harrisville Lake	mud sunfish	11.1	0.76	1995
Harrisville Lake	mud sunfish	17.5	0.95	1995
Harrisville Lake	mud sunfish	18.5	1.32	1995
Harrisville Lake	Yellow bullhead	15.5	0.96	1995
Harrisville Lake	Yellow bullhead	32.5	2.52	1995
Lake Nummy	Chain pickerel	33.3	0.47	1995
Lake Nummy	Chain pickerel	33.3	0.49	1995
Lake Nummy	Chain pickerel	33.6	0.60	1995
Lake Nummy	Chain pickerel	33.7	0.63	1995
Lake Nummy	Chain pickerel	33.2	0.64	1995
Lake Nummy	Yellow bullhead	25.7	0.21	1995
Lake Nummy	Yellow bullhead	11	0.23	1995
Lake Nummy	Yellow bullhead	25.5	0.31	1995
Lake Nummy	Yellow bullhead	25.1	0.34	1995
Lake Nummy	Yellow perch	22.3	0.52	1995
Lake Nummy	Yellow perch	20	0.53	1995
Lake Nummy	Yellow perch	22.3	0.53	1995
Lake Nummy	Yellow perch	22.3	0.54	1995
Lake Nummy	Yellow perch	22.1	0.59	1995

Manasquan Reservoir	Black crappie	17.5	0.35	1995
Manasquan Reservoir	Black crappie	16.5	0.51	1995
Manasquan Reservoir	Black crappie	16.5	0.53	1995
Manasquan Reservoir	Bluegill sunfish	15	0.16	1995
Manasquan Reservoir	Bluegill sunfish	15.5	0.22	1995
Manasquan Reservoir	Bluegill sunfish	16.8	0.22	1995
Manasquan Reservoir	Bluegill sunfish	16.5	0.31	1995
Manasquan Reservoir	Bluegill sunfish	16.5	0.37	1995
Manasquan Reservoir	Brown bullhead	24	0.06	1995
Manasquan Reservoir	Brown bullhead	21.5	0.11	1995
Manasquan Reservoir	Brown bullhead	22	0.12	1995
Manasquan Reservoir	Brown bullhead	26	0.15	1995
Manasquan Reservoir	Brown bullhead	24	0.16	1995
Manasquan Reservoir	Chain pickerel	21.6	0.08	1995
Manasquan Reservoir	Chain pickerel	20	0.13	1995
Manasquan Reservoir	Chain pickerel	24.1	0.15	1995
Manasquan Reservoir	Chain pickerel	39.8	0.48	1995
Manasquan Reservoir	Yellow perch	19.5	0.11	1995
Manasquan Reservoir	Yellow perch	18	0.12	1995
Manasquan Reservoir	Yellow perch	21	0.17	1995
Manasquan Reservoir	Largemouth bass	27	0.29	1995
Manasquan Reservoir	Largemouth bass	28	0.47	1995
Manasquan Reservoir	Largemouth bass	39.5	1.49	1995
Manasquan Reservoir	Largemouth bass	39.5	1.75	1995
Manasquan Reservoir	Largemouth bass	44.5	2.21	1995
Merrill Creek Reservoir	Black crappie	25.3	0.09	1995
Merrill Creek Reservoir	Black crappie	26.1	0.12	1995
Merrill Creek Reservoir	Bluegill sunfish	14.6	0.05	1995
Merrill Creek Reservoir	Bluegill sunfish	172	0.09	1995
Merrill Creek Reservoir	Bluegill sunfish	25.4	0.16	1995
Merrill Creek Reservoir	Brown bullhead	26	0.12	1995
Merrill Creek Reservoir	Brown bullhead	27.9	0.14	1995
Merrill Creek Reservoir	Brown bullhead	29.5	0.14	1995
Merrill Creek Reservoir	Brown bullhead	25.4	0.16	1995
Merrill Creek Reservoir	Brown bullhead	25.1	0.17	1995
Merrill Creek Reservoir	Lake trout	56.7	0.38	1995
Merrill Creek Reservoir	Lake trout	56.5	0.44	1995
Merrill Creek Reservoir	Lake trout	60	0.46	1995
Merrill Creek Reservoir	Lake trout	58.6	0.51	1995
Merrill Creek Reservoir	Lake trout	64	0.73	1995
Merrill Creek Reservoir	Smallmouth bass	38.5	0.44	1995
Merrill Creek Reservoir	Smallmouth bass	40.1	0.44	1995
Merrill Creek Reservoir	Smallmouth bass	42.5	0.49	1995
Merrill Creek Reservoir	Smallmouth bass	39.3	0.63	1995
Merrill Creek Reservoir	Smallmouth bass	43.3	0.68	1995
Merrill Creek Reservoir	Yellow perch	31.2	0.20	1995
Merrill Creek Reservoir	Yellow perch	30.1	0.22	1995
Merrill Creek Reservoir	Yellow perch	34	0.32	1995
Monksville Reservoir	Brown bullhead	31.8	0.04	1995

Monksville Reservoir	Brown bullhead	31	0.06	1995
Monksville Reservoir	Brown bullhead	29	0.06	1995
Monksville Reservoir	Brown bullhead	28.5	0.09	1995
Monksville Reservoir	Brown bullhead	29.2	0.13	1995
Monksville Reservoir	Brown trout	45	0.20	1995
Monksville Reservoir	Pumpkinseed sunfish	19.2	0.09	1995
Monksville Reservoir	Pumpkinseed sunfish	18.1	0.14	1995
Monksville Reservoir	Pumpkinseed sunfish	18	0.25	1995
Monksville Reservoir	Smallmouth bass	31.6	0.26	1995
Monksville Reservoir	Smallmouth bass	27	0.28	1995
Monksville Reservoir	Smallmouth bass	37	0.33	1995
Monksville Reservoir	Walleye	35.5	0.30	1995
Monksville Reservoir	Walleye	41.4	0.42	1995
Monksville Reservoir	Walleye	42	0.48	1995
Monksville Reservoir	Walleye	47.6	0.80	1995
Monksville Reservoir	Walleye	45.9	0.98	1995
Monksville Reservoir	Walleye	52.2	1.44	1995
Monksville Reservoir	White perch	24.5	0.19	1995
Monksville Reservoir	White perch	26.8	0.55	1995
Monksville Reservoir	White perch	27	0.58	1995
Monksville Reservoir	White perch	28.5	0.74	1995
Monksville Reservoir	White perch	32.1	0.79	1995
Mullica River	Brown bullhead	25.5	0.26	1995
Mullica River	Brown bullhead	24.5	0.28	1995
Mullica River	Brown bullhead	22	0.40	1995
Mullica River	Chain pickerel	23.5	0.25	1995
Mullica River	Chain pickerel	30	0.45	1995
Mullica River	Chain pickerel	33.2	0.49	1995
Mullica River	Chain pickerel	46	0.62	1995
Mullica River	Chain pickerel	50.5	0.92	1995
Mullica River	Pumpkinseed sunfish	13	0.12	1995
Mullica River	Pumpkinseed sunfish	13	0.21	1995
Mullica River	Pumpkinseed sunfish	17	0.52	1995
Mullica River	White catfish	29.6	0.23	1995
Mullica River	White catfish	29	0.25	1995
Mullica River	White catfish	29	0.35	1995
Mullica River	White perch	18.3	0.34	1995
Mullica River	White perch	17.4	0.35	1995
Mullica River	White perch	20	0.36	1995
Mullica River	White perch	19	0.36	1995
Mullica River	White perch	21	0.51	1995
New Brooklyn Lake	Black crappie	21	0.08	1995
New Brooklyn Lake	Black crappie	21.8	0.16	1995
New Brooklyn Lake	Black crappie	21.5	0.19	1995

New Brooklyn Lake	Chain pickerel	20.5	0.13	1995
New Brooklyn Lake	Chain pickerel	29.7	0.20	1995
New Brooklyn Lake	Chain pickerel	34	0.25	1995
New Brooklyn Lake	Chain pickerel	43.9	0.48	1995
New Brooklyn Lake	Chain pickerel	32.5	0.64	1995
New Brooklyn Lake	Pumpkinseed sunfish	15.4	0.22	1995
New Brooklyn Lake	Pumpkinseed sunfish	16	0.28	1995
New Brooklyn Lake	Pumpkinseed sunfish	16.5	0.30	1995
New Brooklyn Lake	Yellow bullhead	20	0.05	1995
New Brooklyn Lake	Yellow bullhead	24.1	0.06	1995
New Brooklyn Lake	Yellow bullhead	23,8	0.08	1995
New Brooklyn Lake	Yellow bullhead	25.9	0.09	1995
New Brooklyn Lake	Yellow bullhead	26.9	0.20	1995
New Brooklyn Lake	Largemouth bass	23.3	0.25	1995
New Brooklyn Lake	Largemouth bass	27.4	0.32	1995
New Brooklyn Lake	Largemouth bass	31.7	0.41	1995
Wading River	Brown bullhead	31.5	0.62	1995
Wading River	Chain pickerel	42.5	0.46	1995
Wading River	Chain pickerel	35.1	0.49	1995
Wading River	Chain pickerel	28.5	0.55	1995
Wading River	Chain pickerel	22.3	0.55	1995
Wading River	Chain pickerel	32	0.71	1995
Wading River	White catfish	30.3	0.49	1995
Wading River	White catfish	30	0.60	1995
Wading River	Yellow bullhead	20.2	1.01	1995
Wading River	Yellow bullhead	30.3	1.59	1995
Wanaque Reservoir	Bluegill sunfish	17.2	0.07	1995
Wanaque Reservoir	Brown bullhead	35.8	0.01	1995
Wanaque Reservoir	Brown bullhead	36.2	0.03	1995
Wanaque Reservoir	Brown bullhead	34	0.07	1995
Wanaque Reservoir	Chain pickerel	51	0.12	1995
Wanaque Reservoir	Chain pickerel	47.5	0.18	1995
Wanaque Reservoir	Chain pickerel	50.5	0.37	1995
Wanaque Reservoir	Chain pickerel	47	0.41	1995
Wanaque Reservoir	Chain pickerel	50.6	0.43	1995
Wanaque Reservoir	Chain pickerel	56	0.73	1995
Wanaque Reservoir	Smallmouth bass	38.5	0.27	1995
Wanaque Reservoir	Smallmouth bass	29.6	0.29	1995
Wanaque Reservoir	Smallmouth bass	46.2	0.36	1995
Wanaque Reservoir	White catfish	41.5	0.12	1995
Wanaque Reservoir	White catfish	40.5	0.17	1995
Wanaque Reservoir	White catfish	37.1	0.17	1995
Wanaque Reservoir	White catfish	37.7	0.28	1995
Wanaque Reservoir	White catfish	42.9	0.33	1995
Wanaque Reservoir	White perch	27.2	0.35	1995
Wanaque Reservoir	White perch	30.7	0.63	1995

Wanaque Reservoir	White perch	36.8	0.65	1995
Wanaque Reservoir	White perch	32.1	0.75	1995
Wanaque Reservoir	White perch	33.9	1.18	1995
Wanaque Reservoir	Yellow bullhead	23.9	0.03	1995
Wanaque Reservoir	Largemouth bass	37.9	0.36	1995
Wanaque Reservoir	Largemouth bass	34.6	0.45	1995
Wanaque Reservoir	Largemouth bass	39.5	0.51	1995
Wanaque Reservoir	Largemouth bass	41.4	0.71	1995
Wanaque Reservoir	Largemouth bass	41.4	0.85	1995
Wilson Lake	Chain pickerel	29.5	0.66	1995
Wilson Lake	Chain pickerel	30.5	0.88	1995
Wilson Lake	Chain pickerel	25.7	0.91	1995
Wilson Lake	Chain pickerel	47	1.14	1995
Wilson Lake	Chain pickerel	47	1.30	1995
Boonton Reservoir	Brown Bullhead	30.5	0.01	1996
Boonton Reservoir	Brown Bullhead	32.8	0.02	1996
Boonton Reservoir	White Catfish	40	0.54	1996
Boonton Reservoir	Largemouth Bass	35	0.33	1996
Boonton Reservoir	Largemouth Bass	45.1	0.60	1996
Boonton Reservoir	Largemouth Bass	41.6	0.81	1996
Butterfly Bogs	Brown Bullhead	30.6	0.08	1996
Butterfly Bogs	Chain Pickerel	33.9	0.78	1996
Cedar Lake	Brown Bullhead	31.5	0.06	1996
Cedar Lake	Chain Pickerel	47.9	0.24	1996
Cedar Lake	Chain Pickerel	49.6	0.31	1996
Cedar Lake	Chain Pickerel	64.7	0.76	1996
Cedar Lake	Largemouth Bass	39	0.25	1996
Cedar Lake	Largemouth Bass	41.5	0.59	1996
Cedar Lake	Largemouth Bass	43.8	0.61	1996
Crater Lake	Brown Bullhead	30	0.39	1996
Crater Lake	Yellow Perch	21.6	0.29	1996
Crater Lake	Yellow Perch	19.9	0.43	1996
Crater Lake	Yellow Perch	27.9	0.58	1996
DeVoe Lake	Brown Bullhead	27	0.09	1996
DeVoe Lake	Chain Pickerel	41.5	0.14	1996
DeVoe Lake	Chain Pickerel	43	0.25	1996
DeVoe Lake	Chain Pickerel	48.5	0.27	1996
DeVoe Lake	Largemouth Bass	31.7	0.07	1996
DeVoe Lake	Largemouth Bass	34.1	0.21	1996
DeVoe Lake	Largemouth Bass	36.5	0.26	1996
Double Trouble Lake	Chain Pickerel	18.1	0.74	1996
Double Trouble Lake	Chain Pickerel	37.7	1.24	1996
Double Trouble Lake	Chain Pickerel	46.7	1.60	1996
Double Trouble Lake	Chain Pickerel	52.4	2.24	1996
Double Trouble Lake	Chain Pickerel	57.6	2.30	1996
Double Trouble Lake	Yellow Bullhead	26.1	0.82	1996
Double Trouble Lake	Yellow Bullhead	28.3	1.09	1996
Double Trouble Lake	Yellow Bullhead	26.6	1.18	1996
Echo Lake Reservoir	Largemouth Bass	30.4	0.12	1996

Echo Lake Reservoir	Largemouth Bass	34.4	0.15	1996
Echo Lake Reservoir	Largemouth Bass	29	0.16	1996
Echo Lake Reservoir	Largemouth Bass	35	0.17	1996
Green Turtle Lake	Chain Pickerel	28.1	0.11	1996
Green Turtle Lake	Chain Pickerel	44.7	0.14	1996
Green Turtle Lake	Chain Pickerel	44.6	0.15	1996
Green Turtle Lake	Yellow Perch	20.8	0.09	1996
Green Turtle Lake	Yellow Perch	24.6	0.10	1996
Green Turtle Lake	Largemouth Bass	23.6	0.17	1996
Green Turtle Lake	Largemouth Bass	26.1	0.22	1996
Green Turtle Lake	Largemouth Bass	34.7	0.32	1996
Greenwood Lake	White perch	18.3	0.00	1996
Greenwood Lake	White perch	19.2	0.02	1996
Greenwood Lake	Largemouth Bass	36.2	0.15	1996
Greenwood Lake	Largemouth Bass	34.3	0.18	1996
Greenwood Lake	Largemouth Bass	31.4	0.21	1996
Greenwood Lake	Largemouth Bass	36.3	0.24	1996
Greenwood Lake	Largemouth Bass	40	0.40	1996
Grovers Mill Pond	Brown Bullhead	33	0.08	1996
Grovers Mill Pond	Brown Bullhead	32.2	0.40	1996
Grovers Mill Pond	Chain Pickerel	35.3	0.12	1996
Grovers Mill Pond	Chain Pickerel	35.2	0.16	1996
Grovers Mill Pond	Chain Pickerel	37.2	0.16	1996
Grovers Mill Pond	Chain Pickerel	36.5	0.18	1996
Grovers Mill Pond	Largemouth Bass	31.3	0.25	1996
Grovers Mill Pond	Largemouth Bass	35.8	0.30	1996
Grovers Mill Pond	Largemouth Bass	35	0.36	1996
Grovers Mill Pond	Largemouth Bass	41.5	0.39	1996
Grovers Mill Pond	Largemouth Bass	28	0.47	1996
Hainesville Pond	Chain Pickerel	39.3	0.14	1996
Hainesville Pond	Chain Pickerel	36.6	0.14	1996
Hainesville Pond	Chain Pickerel	36.5	0.15	1996
Hainesville Pond	Largemouth Bass	30.3	0.13	1996
Hainesville Pond	Largemouth Bass	31.0	0.21	1996
Hainesville Pond	Largemouth Bass	31.3	0.23	1996
Malaga Lake	Chain Pickerel	32	0.73	1996
Malaga Lake	Chain Pickerel	29.3	0.88	1996
Malaga Lake	Chain Pickerel	36.2	0.97	1996
Malaga Lake	Chain Pickerel	31	0.99	1996
Malaga Lake	Chain Pickerel	34	1.38	1996
Malaga Lake	Largemouth Bass	32.4	0.95	1996
Passaic River at Hatfield Swamp	Pumpkinseed Sunfish	12.4	0.08	1996
Passaic River at Hatfield Swamp	Pumpkinseed Sunfish	12.6	0.09	1996
Passaic River at Hatfield Swamp	Black Crappie	18.1	0.30	1996
Passaic River at Hatfield Swamp	Black Crappie	18.9	0.32	1996
Passaic River at Hatfield Swamp	Bluegill Sunfish	18.9	0.19	1996
Passaic River at Hatfield Swamp	Black Crappie	20	0.21	1996

Passaic River at Hatfield Swamp	Black Crappie	20	0.22	1996
Passaic River at Hatfield Swamp	Yellow Bullhead	21.4	0.11	1996
Passaic River at Hatfield Swamp	Largemouth Bass	23	0.17	1996
Passaic River at Hatfield Swamp	Largemouth Bass	23.5	0.21	1996
Passaic River at Hatfield Swamp	Largemouth Bass	36	0.53	1996
Pompton River at Lincoln Park	Pike	27.8	0.17	1996
Pompton River at Lincoln Park	Pike	42	0.41	1996
Pompton River at Lincoln Park	Pike	66.6	0.59	1996
Pompton River at Lincoln Park	Yellow Perch	21	0.21	1996
Pompton River at Lincoln Park	Yellow Perch	24	0.26	1996
Pompton River at Lincoln Park	Largemouth Bass	35.4	0.50	1996
Pompton River at Lincoln Park	Largemouth Bass	35.5	0.68	1996
Raritan River at Millstone River	Brown Bullhead	25.4	0.06	1996
Raritan River at Millstone River	Brown Bullhead	27.5	0.07	1996
Raritan River at Millstone River	Channel Catfish	39.8	0.15	1996
Raritan River at Millstone River	Largemouth Bass	32.5	0.33	1996
Raritan River at Millstone River	Largemouth Bass	36.3	0.33	1996
Raritan River at Millstone River	Largemouth Bass	44.9	0.37	1996
Raritan River at Millstone River	Largemouth Bass	37	0.46	1996
Ridgeway Branch of Tom's River	Brown Bullhead	26.4	0.17	1996
Ridgeway Branch of Tom's River	Brown Bullhead	27	0.44	1996
Ridgeway Branch of Tom's River	Brown Bullhead	22.8	1.15	1996
Ridgeway Branch of Tom's River	Brown Bullhead	25.6	1.57	1996
Ridgeway Branch of Tom's River	Chain Pickerel	36	1.22	1996
Rockaway River near Whippany	Black Crappie	17.9	0.21	1996
Rockaway River near Whippany	Bluegill Sunfish	14.5	0.12	1996
Rockaway River near Whippany	Largemouth Bass	39.8	0.92	1996
South Branch Raritan River at Neshanic Station	Brown Bullhead	17.2	0.08	1996
South Branch Raritan River at Neshanic Station	Redbreast Sunfish	15.7	0.09	1996
South Branch Raritan River at Neshanic Station	Redbreast Sunfish	15.9	0.15	1996
South Branch Raritan River at Neshanic Station	Rock Bass	15	0.09	1996
South Branch Raritan River at Neshanic Station	Smallmouth Bass	20.7	0.18	1996
South Branch Raritan River at Neshanic Station	Largemouth Bass	18.2	0.11	1996
Speedwell Lake	Bluegill Sunfish	18.3	0.12	1996
Speedwell Lake	Bluegill Sunfish	19.7	0.13	1996
Speedwell Lake	Brown Bullhead	21	0.01	1996
Speedwell Lake	Largemouth Bass	27.5	0.10	1996
Speedwell Lake	Largemouth Bass	32.5	0.34	1996
Speedwell Lake	Largemouth Bass	36.1	0.38	1996
Steenykill Lake	Largemouth Bass	26.5	0.16	1996
Steenykill Lake	Largemouth Bass	27.5	0.19	1996
Steenykill Lake	Largemouth Bass	27.7	0.19	1996
Steenykill Lake	Largemouth Bass	27.8	0.15	1996
Steenykill Lake	Largemouth Bass	28.3	0.22	1996

Steenykill Lake	Largemouth Bass	29.6	0.15	1996
Sunset Lake	Bluegill Sunfish	11.2	0.05	1996
Sunset Lake	Chain Pickerel	30.7	0.09	1996
Sunset Lake	Largemouth Bass	22.5	0.10	1996
Sunset Lake	Largemouth Bass	33.8	0.17	1996
Sunset Lake	Largemouth Bass	38.2	0.21	1996
Sunset Lake	Largemouth Bass	38.5	0.35	1996
Sunset Lake	Largemouth Bass	53	0.69	1996
Wawayanda Lake	Chain Pickerel	35	0.25	1996
Wawayanda Lake	Chain Pickerel	39.5	0.28	1996
Wawayanda Lake	Chain Pickerel	40.5	0.29	1996
Wawayanda Lake	Chain Pickerel	37.9	0.31	1996
Wawayanda Lake	Chain Pickerel	42	0.34	1996
Wawayanda Lake	Chain Pickerel	42.4	0.44	1996
Oak Ridge Reservoir	Yellow Bullhead	24.5	0.25	1997
Oak Ridge Reservoir	Chain Pickerel	25	0.24	1997
Oak Ridge Reservoir	Chain Pickerel	28	0.29	1997
Oak Ridge Reservoir	Chain Pickerel	30.6	0.30	1997
Oak Ridge Reservoir	Brown Bullhead	33	0.02	1997
Oak Ridge Reservoir	Brown Bullhead	34.5	0.02	1997
Oak Ridge Reservoir	Smallmouth Bass	40.2	0.49	1997
Oak Ridge Reservoir	Chain Pickerel	58	0.30	1997
Oak Ridge Reservoir	Largemouth Bass	36.8	0.38	1997
Oak Ridge Reservoir	Largemouth Bass	42.5	0.64	1997
Oak Ridge Reservoir	Largemouth Bass	48	0.71	1997
Oak Ridge Reservoir	Largemouth Bass	48	0.89	1997
Pompton River at Pequannock River	Black Crappie	19.3	0.24	1997
Pompton River at Pequannock River	Pumpkinseed Sunfish	14.5	0.35	1997
Pompton River at Pequannock River	Pumpkinseed Sunfish	14.1	0.78	1997
Pompton River at Pequannock River	Redbreast Sunfish	13.7	0.32	1997
Pompton River at Pequannock River	Redbreast Sunfish	15.8	0.41	1997
Pompton River at Pequannock River	Rock Bass	19.2	0.54	1997
Pompton River at Pequannock River	Rock Bass	21.1	0.54	1997
Pompton River at Pequannock River	Rock Bass	22	0.68	1997
Pompton River at Pequannock River	Smallmouth Bass	29.6	0.57	1997
Pompton River at Pequannock River	Smallmouth Bass	36.8	1.02	1997
Pompton River at Pequannock River	Smallmouth Bass	25.4	1.10	1997
Pompton River at Pequannock River	Smallmouth Bass	27.8	1.14	1997
Pompton River at Pequannock River	Yellow Bullhead	26.2	0.80	1997
Pompton River at Pequannock River	Largemouth Bass	39	0.99	1997
Pompton River at Pequannock River	Largemouth Bass	39.8	1.36	1997
Whitesbog Pond	Chain Pickerel	23	0.43	1997
Whitesbog Pond	Chain Pickerel	31.5	0.58	1997
Whitesbog Pond	Chain Pickerel	34.3	0.74	1997
Whitesbog Pond	Chain Pickerel	32.5	0.76	1997
Whitesbog Pond	Chain Pickerel	39.6	1.02	1997
Willow Grove Lake	Brown Bullhead	33	0.23	1997

Willow Grove Lake	Brown Bullhead	32.4	0.28	1997
Willow Grove Lake	Chain Pickerel	31	0.76	1997
Willow Grove Lake	Chain Pickerel	48.1	1.03	1997
Willow Grove Lake	Chain Pickerel	36.5	1.13	1997
Willow Grove Lake	Chain Pickerel	45.2	1.26	1997
Willow Grove Lake	Chain Pickerel	53	1.29	1997
Willow Grove Lake	White Catfish	43	0.17	1997
Willow Grove Lake	Yellow Bullhead	28	0.82	1997
Willow Grove Lake	Yellow Bullhead	30.5	0.91	1997
Willow Grove Lake	Largemouth Bass	33.2	1.68	1997
Mullica River @ Green Bank	American Eel	45.7	0.51	1999
Mullica River @ Green Bank	American Eel	69	0.49	1999
Mullica River @ New Gretna	American Eel	42.5	0.3	1999
Mullica River, below dam @ Batsto Village	American Eel	29.7	0.65	1999
Mullica River, below dam @ Batsto Village	American Eel	39.5	0.04	1999
Mullica River, below dam @ Batsto Village	American Eel	46.3	0.8	1999
Stewart Lake (Woodbury)	Bluegill	15.9	0.03	1999
Stewart Lake (Woodbury)	Bluegill	16.4	0.03	1999
Stewart Lake (Woodbury)	Black Crappie	18.3	0.1	1999
Stewart Lake (Woodbury)	Brown Bullhead	25.4	0.01	1999
Stewart Lake (Woodbury)	Brown Bullhead	27.3	0.01	1999
Stewart Lake (Woodbury)	Brown Bullhead	31.1	0.04	1999
Stewart Lake (Woodbury)	Common Carp	43.8	0.01	1999
Stewart Lake (Woodbury)	Common Carp	49.3	0.04	1999
Stewart Lake (Woodbury)	Common Carp	54.5	0.08	1999
Stewart Lake (Woodbury)	Common Carp	59.8	0.03	1999
Stewart Lake (Woodbury)	Common Carp	65.8	0.03	1999
Stewart Lake (Woodbury)	Largemouth Bass	35.9	0.2	1999
Stewart Lake (Woodbury)	Largemouth Bass	38.9	0.15	1999
Stewart Lake (Woodbury)	Largemouth Bass	43.5	0.19	1999
Boonton Reservoir	rock bass	20.7	0.13	2002
Boonton Reservoir	rock bass	22.2	0.27	2002
Boonton Reservoir	rock bass	22.3	0.22	2002
Boonton Reservoir	rock bass	22.3	0.26	2002
Boonton Reservoir	smallmouth bass	38.9	0.39	2002
Boonton Reservoir	smallmouth bass	41.0	0.39	2002
Boonton Reservoir	smallmouth bass	43.4	0.52	2002
Boonton Reservoir	smallmouth bass	48.4	0.75	2002
Boonton Reservoir	largemouth bass	41.6	0.36	2002
Boonton Reservoir	largemouth bass	45.0	0.59	2002
Boonton Reservoir	largemouth bass	48.3	1.08	2002
Boonton Reservoir	largemouth bass	48.7	0.73	2002
Boonton Reservoir	largemouth bass	52.2	0.80	2002
Branch Brook Park	bluegill	14.5	0.16	2002
Branch Brook Park	bluegill	15.3	0.15	2002
Branch Brook Park	bluegill	15.5	0.24	2002

Branch Brook Park	common carp	60.5	0.10	2002
Branch Brook Park	common carp	69.0	0.19	2002
Branch Brook Park	common carp	69.5	0.19	2002
Branch Brook Park	common carp	72.5	0.07	2002
Canistear Reservoir	bluegill	18.5	0.11	2002
Canistear Reservoir	yellow perch	20.5	0.29	2002
Canistear Reservoir	bluegill	21.0	0.10	2002
Canistear Reservoir	bluegill	21.8	0.11	2002
Canistear Reservoir	yellow bullhead	24.5	0.12	2002
Canistear Reservoir	yellow bullhead	25.1	0.17	2002
Canistear Reservoir	yellow perch	25.3	0.18	2002
Canistear Reservoir	yellow perch	27.5	0.22	2002
Canistear Reservoir	yellow bullhead	27.6	0.16	2002
Canistear Reservoir	yellow bullhead	28.6	0.19	2002
Canistear Reservoir	chain pickerel	41.5	0.19	2002
Canistear Reservoir	chain pickerel	41.8	0.25	2002
Canistear Reservoir	chain pickerel	44.0	0.14	2002
Canistear Reservoir	chain pickerel	47.2	0.16	2002
Canistear Reservoir	bluegill	21.2	0.23	2002
Canistear Reservoir	largemouth bass	41.7	0.38	2002
Canistear Reservoir	largemouth bass	43.8	0.29	2002
Canistear Reservoir	largemouth bass	44.5	0.51	2002
Canistear Reservoir	largemouth bass	51.4	0.67	2002
Clinton Reservoir	redbreast sunfish	12.7	0.25	2002
Clinton Reservoir	redbreast sunfish	13.2	0.19	2002
Clinton Reservoir	redbreast sunfish	13.8	0.16	2002
Clinton Reservoir	redbreast sunfish	14.1	0.16	2002
Clinton Reservoir	rock bass	15.8	0.18	2002
Clinton Reservoir	rock bass	15.9	0.19	2002
Clinton Reservoir	rock bass	18.2	0.65	2002
Clinton Reservoir	yellow bullhead	28.2	0.43	2002
Clinton Reservoir	yellow bullhead	28.3	0.74	2002
Clinton Reservoir	yellow bullhead	28.4	0.44	2002
Clinton Reservoir	yellow bullhead	29.7	0.45	2002
Clinton Reservoir	white sucker	44.5	0.25	2002
Clinton Reservoir	chain pickerel	45.2	0.61	2002
Clinton Reservoir	white sucker	45.5	0.19	2002
Clinton Reservoir	white sucker	46.8	0.24	2002
Clinton Reservoir	chain pickerel	53.0	0.43	2002
Echo Lake Reservoir	bluegill	16.4	0.10	2002
Echo Lake Reservoir	bluegill	17.9	0.06	2002
Echo Lake Reservoir	bluegill	18.5	0.11	2002
Echo Lake Reservoir	bluegill	19.0	0.11	2002
Echo Lake Reservoir	yellow bullhead	22.4	0.09	2002
Echo Lake Reservoir	yellow bullhead	22.9	0.14	2002
Echo Lake Reservoir	yellow bullhead	26.4	0.16	2002
Echo Lake Reservoir	yellow bullhead	28.6	0.07	2002
Echo Lake Reservoir	chain pickerel	43.5	0.20	2002
Echo Lake Reservoir	chain pickerel	45.6	0.27	2002

Echo Lake Reservoir	chain pickerel	62.8	0.37	2002
Echo Lake Reservoir	largemouth bass	45.6	0.43	2002
Echo Lake Reservoir	largemouth bass	48.1	0.61	2002
Echo Lake Reservoir	largemouth bass	49.4	0.72	2002
Echo Lake Reservoir	largemouth bass	50.5	0.79	2002
Green Turtle Lake	bluegill	17.7	0.07	2002
Green Turtle Lake	bluegill	17.9	0.09	2002
Green Turtle Lake	bluegill	18.6	0.14	2002
Green Turtle Lake	bluegill	19.9	0.58	2002
Green Turtle Lake	largemouth bass	31.7	0.20	2002
Green Turtle Lake	largemouth bass	32.5	0.26	2002
Green Turtle Lake	largemouth bass	38.9	0.32	2002
Green Turtle Lake	largemouth bass	40.0	0.36	2002
Green Turtle Lake	largemouth bass	49.4	0.74	2002
Greenwood Lake	bluegill	19.0	0.08	2002
Greenwood Lake	bluegill	19.1	0.13	2002
Greenwood Lake	bluegill	19.2	0.07	2002
Greenwood Lake	bluegill	20.1	0.09	2002
Greenwood Lake	yellow bullhead	21.4	0.06	2002
Greenwood Lake	yellow bullhead	23.6	0.09	2002
Greenwood Lake	yellow bullhead	23.7	0.07	2002
Greenwood Lake	yellow bullhead	23.8	0.11	2002
Greenwood Lake	walleye		0.18	2002
Greenwood Lake	walleye		0.28	2002
Greenwood Lake	walleye		0.28	2002
Greenwood Lake	walleye		0.30	2002
Greenwood Lake	walleye		0.47	2002
Greenwood Lake	largemouth bass	39.9	0.31	2002
Greenwood Lake	largemouth bass	42.0	0.31	2002
Greenwood Lake	largemouth bass	42.6	0.31	2002
Greenwood Lake	largemouth bass	42.7	0.21	2002
Greenwood Lake	largemouth bass	44.4	0.29	2002
Monksville reservoir	bluegill	17.8	0.11	2002
Monksville reservoir	bluegill	18.5	0.08	2002
Monksville reservoir	yellow bullhead	19.4	0.11	2002
Monksville reservoir	bluegill	19.8	0.17	2002
Monksville reservoir	bluegill	19.9	0.13	2002
Monksville reservoir	yellow bullhead	23.0	0.13	2002
Monksville reservoir	yellow perch	27.6	0.17	2002
Monksville reservoir	yellow perch	34.9	0.17	2002
Monksville reservoir	chain pickerel	35.5	0.15	2002
Monksville reservoir	chain pickerel	38.4	0.19	2002
Monksville reservoir	walleye	44.4	0.44	2002
Monksville reservoir	walleye	47.8	0.55	2002
Monksville reservoir	chain pickerel	51.1	0.31	2002
Monksville reservoir	walleye	51.6	0.42	2002
Monksville reservoir	walleye	54.0	0.35	2002
Monksville reservoir	walleye	59.8	0.78	2002
Monksville Reservoir	Largemouth bass	26.5	0.20	2002

Monksville Reservoir	Largemouth bass	28.0	0.18	2002
Monksville Reservoir	Largemouth bass	31.5	0.13	2002
Monksville Reservoir	Largemouth bass	36.9	0.32	2002
Monksville Reservoir	Largemouth bass	44.0	0.39	2002
Oak Ridge Reservoir	bluegill	17.5	0.15	2002
Oak Ridge Reservoir	bluegill	18.1	0.11	2002
Oak Ridge Reservoir	bluegill	19.9	0.24	2002
Oak Ridge Reservoir	bluegill	20.0	0.28	2002
Oak Ridge Reservoir	yellow bullhead	23.8	0.10	2002
Oak Ridge Reservoir	yellow bullhead	28.5	0.23	2002
Oak Ridge Reservoir	largemouth bass	41.3	0.90	2002
Oak Ridge Reservoir	largemouth bass	41.6	0.65	2002
Oak Ridge Reservoir	largemouth bass	42.2	0.81	2002
Oak Ridge Reservoir	largemouth bass	45.1	0.82	2002
Pompton River at Lincoln Park	black crappie	17.5	0.19	2002
Pompton River at Lincoln Park	black crappie	20.3	0.29	2002
Pompton River at Lincoln Park	rock bass	20.8	0.64	2002
Pompton River at Lincoln Park	black crappie	21.4	0.15	2002
Pompton River at Lincoln Park	rock bass	21.5	0.60	2002
Pompton River at Lincoln Park	rock bass	23.7	0.83	2002
Pompton River at Lincoln Park	common carp	49.5	0.22	2002
Pompton River at Lincoln Park	common carp	49.9	0.47	2002
Pompton River at Lincoln Park	common carp	57.5	0.28	2002
Pompton River at Lincoln Park	common carp	58.7	0.39	2002
Pompton River at Lincoln Park	largemouth bass	34.6	0.35	2002
Pompton River at Lincoln Park	largemouth bass	35.2	0.50	2002
Pompton River at Lincoln Park	largemouth bass	39.2	0.74	2002
Rockaway River at Powerville	bluegill	15.8	0.11	2002
Rockaway River at Powerville	bluegill	16.0	0.11	2002
Rockaway River at Powerville	bluegill	16.1	0.13	2002
Rockaway River at Powerville	yellow bullhead	16.6	0.10	2002
Rockaway River at Powerville	yellow bullhead	22.5	0.28	2002
Rockaway River at Powerville	rock bass	23.3	0.29	2002
Rockaway River at Powerville	yellow bullhead	23.5	0.14	2002
Rockaway River at Powerville	rock bass	23.9	0.41	2002
Rockaway River at Powerville	rock bass	24.1	0.34	2002
Rockaway River at Powerville	rock bass	24.5	0.32	2002
Shepherds lake	redbreast sunfish	14.6	0.19	2002
Shepherds lake	rock bass	15.3	0.20	2002
Shepherds lake	redbreast sunfish	15.6	0.18	2002
Shepherds lake	redbreast sunfish	15.9	0.20	2002
Shepherds lake	rock bass	20.9	0.15	2002
Shepherds lake	brown bullhead	28.9	0.06	2002
Shepherds lake	brown bullhead	29.5	0.13	2002
Shepherds lake	brown bullhead	36.1	0.07	2002
Shepherds lake	largemouth bass	39.0	0.76	2002
Shepherds Lake	largemouth bass	39.2	0.71	2002
Shepherds Lake	largemouth bass	39.7	0.56	2002
Shepherds Lake	largemouth bass	40.4	0.67	2002

Shepherds Lake	largemouth bass	41.1	0.60	2002
Speedwell Lake	bluegill	15.4	0.10	2002
Speedwell Lake	bluegill	15.8	0.10	2002
Speedwell Lake	bluegill	18.6	0.13	2002
Speedwell Lake	bluegill	20.5	0.16	2002
Speedwell Lake	chain pickerel	25.9	0.09	2002
Speedwell Lake	chain pickerel	31.8	0.11	2002
Speedwell Lake	common carp	57.7	0.13	2002
Speedwell Lake	chain pickerel	59.6	0.26	2002
Speedwell Lake	common carp	61.7	0.10	2002
Speedwell Lake	common carp	62.5	0.14	2002
Speedwell Lake	common carp	63.6	0.05	2002
Split Rock Reservoir	bluegill	21.2	0.13	2002
Split Rock Reservoir	bluegill	21.4	0.21	2002
Split Rock Reservoir	bluegill	22.0	0.10	2002
Split Rock Reservoir	bluegill	22.6	0.12	2002
Split Rock Reservoir	yellow perch	26.2	0.10	2002
Split Rock Reservoir	yellow perch	29.5	0.15	2002
Split Rock Reservoir	yellow perch	30.0	0.13	2002
Split Rock Reservoir	yellow perch	30.0	0.34	2002
Split Rock Reservoir	brown bullhead	30.7	0.04	2002
Split Rock Reservoir	brown bullhead	39.0	0.04	2002
Split Rock Reservoir	chain pickerel	46.8	0.30	2002
Split Rock Reservoir	chain pickerel	49.0	0.32	2002
Split Rock Reservoir	chain pickerel	54.5	0.30	2002
Split Rock Reservoir	chain pickerel	57.0	0.32	2002
Split Rock Reservoir	chain pickerel	61.0	0.26	2002
Split Rock Reservoir	largemouth bass	35.5	0.32	2002
Split Rock Reservoir	largemouth bass	35.9	0.38	2002
Split Rock Reservoir	largemouth bass	38.0	0.32	2002
Split Rock Reservoir	largemouth bass	39.4	0.48	2002
Split Rock Reservoir	largemouth bass	40.5	0.52	2002
Wanaque Reservoir	yellow bullhead	18.8	0.10	2002
Wanaque Reservoir	yellow bullhead	19.9	0.08	2002
Wanaque Reservoir	bluegill	20.2	0.22	2002
Wanaque Reservoir	bluegill	20.4	0.23	2002
Wanaque Reservoir	bluegill	20.6	0.27	2002
Wanaque Reservoir	bluegill	21.2	0.41	2002
Wanaque Reservoir	yellow bullhead	22.2	0.16	2002
Wanaque Reservoir	yellow bullhead	22.9	0.17	2002
Wanaque Reservoir	largemouth bass	30.7	0.28	2002
Wanaque Reservoir	largemouth bass	34.2	0.23	2002
Wanaque Reservoir	largemouth bass	45.2	1.03	2002
Wanaque Reservoir	largemouth bass	48.0	1.47	2002
Wawayanda Lake	bluegill	17.9	0.14	2002
Wawayanda Lake	bluegill	18.2	0.21	2002
Wawayanda Lake	bluegill	18.3	0.21	2002
Wawayanda Lake	chain pickerel	26.4	0.23	2002
Wawayanda Lake	chain pickerel	27.1	0.23	2002
Wawayanda Lake	yellow bullhead	27.1	0.30	2002

Wawayanda Lake	chain pickerel	28.0	0.23	2002
Wawayanda Lake	yellow bullhead	28.3	0.45	2002
Wawayanda Lake	yellow bullhead	29.9	0.36	2002
Wawayanda Lake	chain pickerel	33.9	0.50	2002
Wawayanda Lake	chain pickerel	44.5	0.44	2002
Wawayanda Lake	largemouth bass	33.0	0.29	2002
Wawayanda Lake	largemouth bass	33.4	0.33	2002
Wawayanda Lake	largemouth bass	42.9	0.78	2002
Wawayanda Lake	largemouth bass	44.1	0.66	2002
Wawayanda Lake	largemouth bass	45.3	0.73	2002
Weequachic Lake	bluegill	16.4	0.12	2002
Weequachic Lake	bluegill	17.3	0.15	2002
Weequachic Lake	bluegill	17.4	0.09	2002
Weequachic Lake	white perch	17.7	0.10	2002
Weequachic Lake	white perch	17.9	0.08	2002
Weequachic Lake	white perch	18.0	0.09	2002
Weequachic Lake	brown bullhead	27.2	0.03	2002
Weequachic Lake	brown bullhead	30.0	0.03	2002
Weequachic Lake	brown bullhead	31.0	0.03	2002
Weequachic Lake	common carp	50.5	0.04	2002
Weequachic Lake	common carp	56.2	0.08	2002
Weequachic Lake	common carp	71.0	0.10	2002
Weequachic Lake	largemouth bass	34.0	0.21	2002
Weequachic Lake	largemouth bass	35.1	0.20	2002
Weequachic Lake	largemouth bass	45.9	0.31	2002
Weequachic Lake	largemouth bass	47.5	0.39	2002
Mullica River	American Eel	49.5	0.29	2004
Mullica River	American Eel	63.5	0.33	2004
Mullica River	American Eel	64.9	0.18	2004
Mullica River	American Eel	73.2	0.2	2004
Mullica River	American Eel	77	0.2	2004
Below New Market Pond Dam	American eel	68.2	0.08673	2006
Below New Market Pond Dam	American eel	69.9	0.11418	2006
Bound Brook @ Shepard Rd.	American eel	51.3	0.08569	2006
Bound Brook @ Shepard Rd.	American eel	54.3	0.08921	2006
Bound Brook @ Shepard Rd.	American eel	61.3	0.20208	2006
Budd Lake	bluegill	17.8	0.09949	2006
Budd Lake	bluegill	18.2	0.1561	2006
Budd Lake	bluegill	18.8	0.12716	2006
Budd Lake	brown bullhead	25.6	0.02337	2006
Budd Lake	brown bullhead	27.2	0.0193	2006
Budd Lake	brown bullhead	31.5	0.01034	2006
Budd Lake	white catfish	34.3	0.18067	2006
Budd Lake	white catfish	35.6	0.21846	2006
Budd Lake	white catfish	42.1	0.27947	2006
Budd Lake	northern pike	74.1	0.30651	2006
Budd Lake	northern pike	78.4	0.45883	2006
Budd Lake	northern pike	81	0.19917	2006
Budd Lake	largemouth bass	35.7	0.16964	2006
Budd Lake	largemouth bass	36.4	0.43134	2006

Budd Lake	largemouth bass	36.9	0.53606	2006
Budd Lake	largemouth bass	43.1	0.48615	2006
Budd Lake	largemouth bass	47.6	0.41803	2006
Carnegie Lake	Bluegill sunfish	16.7	0.06306	2006
Carnegie Lake	Bluegill sunfish	17.9	0.05655	2006
Carnegie Lake	Bluegill sunfish	19	0.10097	2006
Carnegie Lake	white perch	20.8	0.23403	2006
Carnegie Lake	white perch	20.8	0.14171	2006
Carnegie Lake	white perch	21	0.16152	2006
Carnegie Lake	largemouth bass	34.3	0.15636	2006
Carnegie Lake	largemouth bass	38.3	0.11614	2006
Carnegie Lake	largemouth bass	43.3	0.40243	2006
Carnegie Lake	largemouth bass	44.3	0.36529	2006
Carnegie Lake	largemouth bass	49.6	0.51996	2006
Davidson Mill Pond	bluegill	18.1	0.18292	2006
Davidson Mill Pond	bluegill	19	0.0504	2006
Davidson Mill Pond	bluegill	20.3	0.14941	2006
Davidson Mill Pond	chain pickerel	43.5	0.27161	2006
Davidson Mill Pond	chain pickerel	43.9	0.24405	2006
Davidson Mill Pond	chain pickerel	48.3	0.35285	2006
Davidson Mill Pond	American eel	75.2	0.20145	2006
Davidson Mill Pond	American eel	79	0.20049	2006
Davidson Mill Pond	largemouth bass	37.7	0.5091	2006
Davidson Mill Pond	largemouth bass	40.4	0.50194	2006
Davidson Mill Pond	largemouth bass	41.3	0.56886	2006
DeVoe Lake	brown bullhead	30.9	0.07703	2006
DeVoe Lake	brown bullhead	32.5	0.12689	2006
DeVoe Lake	brown bullhead	35.7	0.16058	2006
DeVoe Lake	chain pickerel	45.8	0.26277	2006
DeVoe Lake	chain pickerel	50	0.38873	2006
DeVoe Lake	chain pickerel	50.5	0.50737	2006
Duhernal Lake	bluegill	18.4	0.04042	2006
Duhernal Lake	bluegill	20.2	0.07774	2006
Duhernal Lake	bluegill	22.3	0.16006	2006
Duhernal Lake	brown bullhead	31.6	0.03663	2006
Duhernal Lake	brown bullhead	33.5	0.02588	2006
Duhernal Lake	brown bullhead	34.5	0.05482	2006
Duhernal Lake	largemouth bass	36.4	0.19646	2006
Duhernal Lake	largemouth bass	36.5	0.1712	2006
Duhernal Lake	largemouth bass	39.2	0.2798	2006
Farrington Lake	bluegill	17.2	0.09828	2006
Farrington Lake	bluegill	17.8	0.1512	2006
Farrington Lake	bluegill	18.7	0.11982	2006
Farrington Lake	yellow perch	20.6	0.17985	2006
Farrington Lake	yellow perch	20.7	0.22166	2006
Farrington Lake	yellow perch	25.7	0.41141	2006
Farrington Lake	brown bullhead	29.8	0.03402	2006
Farrington Lake	brown bullhead	34.7	0.04048	2006
Farrington Lake	brown bullhead	36.5	0.01656	2006
Farrington Lake	chain pickerel	43.2	0.19105	2006

Farrington Lake	chain pickerel	45.8	0.20378	2006
Farrington Lake	chain pickerel	48.8	0.48139	2006
Farrington Lake	largemouth bass	39.8	0.51737	2006
Farrington Lake	largemouth bass	41	0.50762	2006
Farrington Lake	largemouth bass	42.3	0.93764	2006
Farrington Lake	largemouth bass	46.3	1.41272	2006
Farrington Lake	largemouth bass	49	0.97277	2006
Lamington River @ Lamington	redbreast sunfish	15.8	0.12666	2006
Lamington River @ Lamington	redbreast sunfish	16.1	0.16744	2006
Lamington River @ Lamington	redbreast sunfish	16.6	0.14858	2006
Lamington River @ Lamington	smallmouth bass	18.6	0.13566	2006
Lamington River @ Lamington	smallmouth bass	20.6	0.18452	2006
Lamington River @ Lamington	smallmouth bass	22	0.12535	2006
Lamington River @ Lamington	brown trout	23.7	0.07503	2006
Lamington River @ Lamington	brown trout	26.1	0.08884	2006
Lamington River @ Lamington	American eel	53.7	0.18808	2006
Lamington River @ Lamington	American eel	60.2	0.39376	2006
Lamington River @ Lamington	American eel	63.2	0.24738	2006
Manalapan Lake	bluegill	18.4	0.04791	2006
Manalapan Lake	bluegill	18.4	0.07113	2006
Manalapan Lake	bluegill	18.6	0.04947	2006
Manalapan Lake	black crappie	21	0.09823	2006
Manalapan Lake	black crappie	21.4	0.10733	2006
Manalapan Lake	black crappie	22.8	0.14389	2006
Manalapan Lake	American eel	49.5	0.07662	2006
Manalapan Lake	American eel	53.4	0.12536	2006
Manalapan Lake	American eel	59.7	0.17554	2006
Manalapan Lake	largemouth bass	38	0.23315	2006
Manalapan Lake	largemouth bass	39.1	0.32996	2006
Manalapan Lake	largemouth bass	40.8	0.40945	2006
New Market Pond	bluegill	16.5	0.06683	2006
New Market Pond	bluegill	17	0.06511	2006
New Market Pond	bluegill	17.3	0.0888	2006
New Market Pond	black crappie	20.6	0.05647	2006
New Market Pond	black crappie	22.5	0.08984	2006
New Market Pond	black crappie	24.1	0.05213	2006
New Market Pond	brown bullhead	33.3	0.02354	2006
New Market Pond	brown bullhead	33.5	0.00063	2006
New Market Pond	American eel	34	0.02819	2006
New Market Pond	brown bullhead	34.5	0.00419	2006
New Market Pond	American eel	46.6	0.04004	2006
New Market Pond	American eel	48.5	0.10651	2006
New Market Pond	common carp	50.7	0.04819	2006
New Market Pond	common carp	52.7	0.05352	2006
New Market Pond	common carp	53	0.03293	2006
New Market Pond	largemouth bass	35.9	0.13736	2006
New Market Pond	largemouth bass	36.8	0.10944	2006
New Market Pond	largemouth bass	41.4	0.26315	2006
Raritan River @ Millstone River	redbreast sunfish	18.2	0.13396	2006
Raritan River @ Millstone River	redbreast sunfish	18.2	0.16323	2006

Raritan River @ Millstone River	redbreast sunfish	19.3	0.10685	2006
Raritan River @ Millstone River	smallmouth bass	30.9	0.29331	2006
Raritan River @ Millstone River	smallmouth bass	31	0.33445	2006
Raritan River @ Millstone River	white catfish	32.6	0.20333	2006
Raritan River @ Millstone River	white catfish	35.7	0.21395	2006
Raritan River @ Millstone River	smallmouth bass	37.3	0.26906	2006
Raritan River @ Millstone River	white catfish	40.1	0.23869	2006
Raritan River @ Millstone River	channel catfish	48.7	0.35862	2006
Raritan River @ Millstone River	channel catfish	53	0.17138	2006
Raritan River @ Millstone River	American eel	57.6	0.10876	2006
Raritan River @ Millstone River	common carp	57.9	0.12682	2006
Raritan River @ Millstone River	common carp	59.7	0.15017	2006
Raritan River @ Millstone River	channel catfish	63.7	0.16402	2006
Raritan River @ Millstone River	common carp	65.9	0.00431	2006
Raritan River @ Millstone River	American eel	70.6	0.24336	2006
Raritan River @ Millstone River	American eel	71	0.29174	2006
Raritan River at Millstone River	largemouth bass	32.4	0.25569	2006
Raritan River at Millstone River	largemouth bass	37.2	0.32619	2006
Raritan River at Millstone River	largemouth bass	43	0.6896	2006
Rosedale Lake in Pennington	bluegill	18.4	0.05062	2006
Rosedale Lake in Pennington	bluegill	18.7	0.06377	2006
Rosedale Lake in Pennington	bluegill	20.2	0.10783	2006
Rosedale Lake in Pennington	black crappie	24.1	0.10195	2006
Rosedale Lake in Pennington	black crappie	25.7	0.11855	2006
Rosedale Lake in Pennington	black crappie	30.8	0.12335	2006
Rosedale Lake in Pennington	common carp	62.2	0.11683	2006
Rosedale Lake in Pennington	common carp	64.1	0.10668	2006
Rosedale Lake in Pennington	common carp	66.8	0.10278	2006
Rosedale Lake in Pennington	largemouth bass	40	0.22114	2006
Rosedale Lake in Pennington	largemouth bass	47.6	0.22991	2006
Rosedale Lake in Pennington	largemouth bass	47.7	0.3298	2006
Round Valley Reservoir	bluegill	21.5	0.11044	2006
Round Valley Reservoir	bluegill	21.9	0.11996	2006
Round Valley Reservoir	bluegill	22	0.09508	2006
Round Valley Reservoir	white catfish	36.8	0.08206	2006
Round Valley Reservoir	white catfish	40	0.0991	2006
Round Valley Reservoir	lake trout	43.9	0.08773	2006
Round Valley Reservoir	channel catfish	50.2	0.11492	2006
Round Valley Reservoir	lake trout	52.2	0.10409	2006
Round Valley Reservoir	lake trout	53.7	0.2057	2006
Round Valley Reservoir	lake trout	54.9	0.12745	2006
Round Valley Reservoir	channel catfish	58.7	0.4599	2006
Round Valley Reservoir	channel catfish	61.8	0.06823	2006
Round Valley Reservoir	lake trout	66.5	0.18896	2006
Round Valley Reservoir	largemouth bass	30.6	0.19463	2006
Round Valley Reservoir	largemouth bass	41.8	0.2981	2006
Round Valley Reservoir	largemouth bass	45.1	0.38514	2006
South Branch Raritan River at Neshanic Station	redbreast sunfish	16.9	0.10381	2006

South Branch Raritan River at Neshanic Station	redbreast sunfish	17.7	0.09302	2006
South Branch Raritan River at Neshanic Station	redbreast sunfish	17.9	0.12138	2006
South Branch Raritan River at Neshanic Station	rock bass	20.4	0.24498	2006
South Branch Raritan River at Neshanic Station	rock bass	20.6	0.16647	2006
South Branch Raritan River at Neshanic Station	rock bass	21.1	0.2056	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	34.9	0.31523	2006
South Branch Raritan River at Neshanic Station	common carp	37.2	0.05298	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	41.1	0.38035	2006
South Branch Raritan River at Neshanic Station	common carp	42.7	0.05706	2006
South Branch Raritan River at Neshanic Station	common carp	46.1	0.04491	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	49.9	0.39461	2006
South Branch Raritan River at Neshanic Station	American eel	63	0.29096	2006
South Branch Raritan River at Neshanic Station	American eel	69.9	0.22739	2006
South Branch Raritan River at Neshanic Station	American eel	72.5	0.25548	2006
South Branch Raritan River at Neshanic Station	largemouth bass	20	0.18969	2006
South Branch Raritan River at Neshanic Station	largemouth bass	21.3	0.17653	2006
South Branch Raritan River at Neshanic Station	largemouth bass	26.9	0.1382	2006
Spring Lake	common carp	48.3	0.04448	2006
Spring Lake	common carp	54.5	0.00202	2006
Spring Lake	common carp	64.6	0.0799	2006
Spruce Run Reservoir	channel catfish	41	0.06091	2006
Spruce Run Reservoir	striped x white bass hybrid	42.4	0.14346	2006
Spruce Run Reservoir	striped x white bass hybrid	48	0.18523	2006
Spruce Run Reservoir	striped x white bass hybrid	49.2	0.22875	2006
Spruce Run Reservoir	striped x white bass hybrid	53.6	0.39913	2006
Spruce Run Reservoir	striped x white bass hybrid	54.3	0.51704	2006
Spruce Run Reservoir	channel catfish	55.6	0.22611	2006
Spruce Run Reservoir	channel catfish	56.3	0.32477	2006
Spruce Run Reservoir	common carp	57.8	0.12598	2006
Spruce Run Reservoir	common carp	58.1	0.12418	2006
Spruce Run Reservoir	common carp	58.3	0.13401	2006
Spruce Run Reservoir	northern pike	65.5	0.31375	2006

Spruce Run Reservoir	northern pike	68.5	0.24939	2006
Spruce Run Reservoir	northern pike	76.8	0.20958	2006
Spruce Run Reservoir	largemouth bass	28.7	0.17957	2006
Spruce Run Reservoir	largemouth bass	35.8	0.17422	2006
Spruce Run Reservoir	largemouth bass	39.8	0.43026	2006
Spruce Run Reservoir	largemouth bass	42.9	0.44294	2006
Spruce Run Reservoir	largemouth bass	47.3	0.60489	2006
Weston Mill Pond	bluegill	17.7	0.06793	2006
Weston Mill Pond	bluegill	18.6	0.11264	2006
Weston Mill Pond	bluegill	18.9	0.2196	2006
Weston Mill Pond	yellow perch	25.3	0.27386	2006
Weston Mill Pond	black crappie	25.8	0.19928	2006
Weston Mill Pond	yellow perch	26.3	0.14497	2006
Weston Mill Pond	black crappie	26.9	0.28312	2006
Weston Mill Pond	black crappie	26.9	0.22769	2006
Weston Mill Pond	brown bullhead	27.1	0.01612	2006
Weston Mill Pond	brown bullhead	28.2	0.05252	2006
Weston Mill Pond	yellow perch	29.3	0.39874	2006
Weston Mill Pond	brown bullhead	35.7	0.0256	2006
Weston Mill Pond	chain pickerel	38.9	0.16182	2006
Weston Mill Pond	chain pickerel	45.9	0.28877	2006
Weston Mill Pond	chain pickerel	48	0.48049	2006
Weston Mill Pond	American eel	49.8	0.10278	2006
Weston Mill Pond	American eel	50.2	0.11332	2006
Weston Mill Pond	American eel	55.1	0.13674	2006
Weston Mill Pond	largemouth bass	38	0.52104	2006
Weston Mill Pond	largemouth bass	38.1	0.41189	2006
Weston Mill Pond	largemouth bass	39.5	0.46808	2006
Atsion Lake	American eel	31.2	0.33	2007
Atsion Lake	American eel	32.1	0.27	2007
Atsion Lake	American eel	51.7	0.52	2007
Atsion Lake	chain pickerel	33.2	0.47	2007
Atsion Lake	chain pickerel	39.6	0.69	2007
Atsion Lake	chain pickerel	44.7	0.82	2007
Batsto Lake	brown bullhead	32.9	0.29	2007
Batsto Lake	brown bullhead	33.4	0.22	2007
Batsto Lake	brown bullhead	36.18	0.16	2007
Batsto Lake	chain pickerel	23.7	0.30	2007
Batsto Lake	chain pickerel	35	0.78	2007
Batsto Lake	chain pickerel	35.5	0.85	2007
Batsto Lake	chain pickerel	35.9	0.44	2007
Batsto Lake	largemouth bass	35.5	1.25	2007
Batsto Lake	largemouth bass	35.6	1.07	2007
Batsto Lake	largemouth bass	36.7	0.85	2007
Batsto Lake	largemouth bass	37.2	0.10	2007
Cedar Lake	American eel	48.7	0.16	2007
Cedar Lake	American eel	54.2	0.18	2007
Cedar Lake	American eel	63.9	0.22	2007
Cedar Lake	largemouth bass	32.8	0.18	2007
Cedar Lake	largemouth bass	38.8	0.31	2007

Cedar Lake	largemouth bass	47	1.63	2007
Cedar Lake	white perch	30.7	0.33	2007
Cedar Lake	white perch	31.8	0.22	2007
Cedar Lake	white perch	37.4	0.51	2007
Cedarville Ponds	chain pickerel	30.6	0.65	2007
Cedarville Ponds	chain pickerel	32.5	0.46	2007
Cedarville Ponds	chain pickerel	34.4	0.53	2007
Cedarville Ponds	chain pickerel	35.4	0.54	2007
Cedarville Ponds	chain pickerel	43.1	0.69	2007
Cedarville Ponds	yellow perch	28	0.31	2007
Cedarville Ponds	yellow perch	28.8	0.33	2007
Cedarville Ponds	yellow perch	29.8	0.35	2007
Deal Lake	American eel	31	0.30	2007
Deal Lake	American eel	60	0.05	2007
Deal Lake	largemouth bass	38	0.09	2007
Deal Lake	largemouth bass	39.8	0.12	2007
Deal Lake	largemouth bass	40.2	0.14	2007
Deal Lake	white perch	16.3	0.02	2007
Deal Lake	white perch	18.1	0.04	2007
Deal Lake	white perch	20.2	0.18	2007
East Creek Lake	American eel	43.2	1.05	2007
East Creek Lake	American eel	51.8	1.02	2007
East Creek Lake	American eel	53.9	1.24	2007
East Creek Lake	chain pickerel	33.6	1.14	2007
East Creek Lake	chain pickerel	41.1	1.46	2007
East Creek Lake	chain pickerel	42.9	1.05	2007
East Creek Lake	largemouth bass	30.5	1.05	2007
East Creek Lake	largemouth bass	39.4	1.40	2007
East Creek Lake	largemouth bass	44.6	1.37	2007
Harrisville Lake	American eel	27.4	0.47	2007
Harrisville Lake	American eel	40.5	0.58	2007
Harrisville Lake	American eel	54.1	0.73	2007
Harrisville Lake	chain pickerel	27.6	1.05	2007
Harrisville Lake	chain pickerel	29.4	0.61	2007
Harrisville Lake	chain pickerel	30.4	0.91	2007
Harrisville Lake	chain pickerel	31.3	1.05	2007
Lake Absegami	American eel	31.6	0.36	2007
Lake Absegami	American eel	32.7	0.29	2007
Lake Absegami	American eel	47.5	0.80	2007
Lake Absegami	chain pickerel	35.3	1.32	2007
Lake Absegami	chain pickerel	35.4	1.26	2007
Lake Absegami	chain pickerel	43.5	1.24	2007
Lake Absegami	chain pickerel	47.6	1.62	2007
Lake Absegami	chain pickerel	58.7	1.39	2007
Lake Manahawkin	American eel	46.3	1.50	2007
Lake Manahawkin	American eel	56.1	1.43	2007
Lake Manahawkin	American eel	79.6	1.89	2007
Lake Manahawkin	largemouth bass	33.6	1.08	2007
Lake Manahawkin	largemouth bass	35.2	0.93	2007

Lake Manahawkin	largemouth bass	45.1	1.76	2007
Lake Nummy	yellow bullhead	29.2	0.44	2007
Lake Nummy	yellow bullhead	29.7	0.26	2007
Lake Nummy	yellow bullhead	33.4	0.79	2007
Lake Nummy	chain pickerel	46.2	1.07	2007
Lake Nummy	chain pickerel	56	2.56	2007
Lake Oswego	American eel	49.6	0.70	2007
Lake Oswego	American eel	60.5	0.46	2007
Lake Oswego	chain pickerel	26.6	0.82	2007
Lake Oswego	chain pickerel	27.7	0.76	2007
Lake Oswego	chain pickerel	42.1	0.42	2007
Lake Oswego	chain pickerel	46.8	2.05	2007
Lefferts Lake	brown bullhead	27.8	0.07	2007
Lefferts Lake	brown bullhead	28.8	0.10	2007
Lefferts Lake	brown bullhead	29.1	0.10	2007
Lefferts Lake	chain pickerel	43.9	0.11	2007
Lefferts Lake	chain pickerel	44.7	0.19	2007
Lefferts Lake	chain pickerel	46.7	0.21	2007
Lefferts Lake	yellow perch	23.8	0.10	2007
Lefferts Lake	yellow perch	24.4	0.12	2007
Lefferts Lake	yellow perch	25.3	0.09	2007
Lenape Lake	American eel	53	0.42	2007
Lenape Lake	American eel	58.7	1.06	2007
Lenape Lake	American eel	62.4	0.89	2007
Lenape Lake	largemouth bass	40	1.60	2007
Lenape Lake	largemouth bass	44.6	1.04	2007
Lenape Lake	largemouth bass	45.9	1.61	2007
Manasquan Reservoir	American eel	54.2	0.08	2007
Manasquan Reservoir	American eel	58	0.05	2007
Manasquan Reservoir	American eel	82.4	0.17	2007
Manasquan Reservoir	largemouth bass	40.1	0.10	2007
Manasquan Reservoir	largemouth bass	44.5	0.21	2007
Manasquan Reservoir	largemouth bass	49.2	0.40	2007
Maple Lake	American eel	44.1	0.81	2007
Maple Lake	American eel	48.6	0.81	2007
Maple Lake	American eel	53.6	1.02	2007
Maple Lake	largemouth bass	33.1	0.43	2007
Maple Lake	largemouth bass	33.7	0.84	2007
Maple Lake	largemouth bass	34.7	0.86	2007
Maple Lake	largemouth bass	38	1.48	2007
Marlu Lake	common carp	64.4	0.04	2007
Marlu Lake	common carp	66.6	0.04	2007
Marlu Lake	common carp	67.9	0.04	2007
Marlu Lake	largemouth bass	34.5	0.08	2007
Marlu Lake	largemouth bass	41.4	0.09	2007
Marlu Lake	largemouth bass	44.2	0.14	2007
Parvin Lake	American eel	63.1	0.12	2007
Parvin Lake	American eel	64.9	0.12	2007
Parvin Lake	chain pickerel	45.7	0.24	2007
Parvin Lake	chain pickerel	47.7	0.21	2007

Parvin Lake	chain pickerel	51.4	0.19	2007
Parvin Lake	largemouth bass	35.9	0.16	2007
Parvin Lake	largemouth bass	39.5	0.21	2007
Parvin Lake	largemouth bass	43.3	0.26	2007
Parvin Lake	largemouth bass	44.6	0.19	2007
Parvin Lake	largemouth bass	49	0.27	2007
Pohatcong Lake	American eel	44.3	0.44	2007
Pohatcong Lake	American eel	45.3	0.95	2007
Pohatcong Lake	American eel	66.2	0.72	2007
Pohatcong Lake	largemouth bass	41.7	0.78	2007
Pohatcong Lake	largemouth bass	41.7	0.69	2007
Pohatcong Lake	largemouth bass	42.7	0.61	2007
Pohatcong Lake	largemouth bass	43	0.64	2007
Pohatcong Lake	yellow perch	26.5	0.14	2007
Pohatcong Lake	yellow perch	31.2	0.36	2007
Pohatcong Lake	yellow perch	34.6	0.83	2007
Shenandoah Lake	American eel	46.8	0.42	2007
Shenandoah Lake	American eel	47.9	0.24	2007
Shenandoah Lake	American eel	75.5	0.42	2007
Shenandoah Lake	chain pickerel	35.3	0.34	2007
Shenandoah Lake	chain pickerel	41.2	0.23	2007
Shenandoah Lake	chain pickerel	41.4	0.32	2007
Shenandoah Lake	largemouth bass	40.5	0.37	2007
Shenandoah Lake	largemouth bass	41.6	0.46	2007
Shenandoah Lake	largemouth bass	43.2	0.65	2007
Swimming River Reservoir	American eel	42.2	0.04	2007
Swimming River Reservoir	American eel	66.1	0.07	2007
Swimming River Reservoir	American eel	68.9	0.08	2007
Swimming River Reservoir	largemouth bass	40	0.09	2007
Swimming River Reservoir	largemouth bass	42.7	0.09	2007
Swimming River Reservoir	largemouth bass	50.1	0.15	2007
Wading River	chain pickerel	36.3	2.60	2007
Wading River	chain pickerel	37.5	2.63	2007
Wading River	chain pickerel	40.7	2.03	2007
Wilson Lake	chain pickerel	34.7	1.58	2007
Wilson Lake	chain pickerel	37	1.36	2007
Wilson Lake	chain pickerel	54.7	2.02	2007
Wilson Lake	largemouth bass	35.4	1.53	2007
Wilson Lake	largemouth bass	38.9	1.63	2007
Wilson Lake	largemouth bass	40.9	3.27	2007
Wilson Lake	yellow perch	28	1.25	2007
Wilson Lake	yellow perch	28	1.46	2007
Wilson Lake	yellow perch	30	0.87	2007

Appendix C

Non-Tidal Surface Water NJPDES Facility List to Quantify Potential Hg Load

NJPDES Permit Number	Facility Name	Permitted Flow	Description
NJ0000876	HERCULES INC - KENVIL	0.7	Industrial
NJ0020036	DEPT OF VETERANS AFFAIRS	0.08	Municipal minor
NJ0020184	NEWTOWN WASTEWATER TREATMENT PLANT	1.4	Municipal major
NJ0020206	ALLENTOWN BORO WWTP	0.238	Municipal minor
NJ0020281	CHATHAM HILL STP	0.03	Municipal minor
NJ0020290	CHATHAM TWP MAIN STP	1	Municipal minor
NJ0020354	BRANCHBURG NESHANIC STP	0.055	Municipal minor
NJ0020389	CLINTON TOWN WWTP	2.03	Municipal major
NJ0020419	LONG POND SCHOOL WTP	0.01	Municipal minor
NJ0020427	CALDWELL WASTEWATER TREATMENT PLANT	4.5	Municipal major
NJ0020532	HARRISON TOWNSHIP TREATMENT PLANT	0.8	Municipal minor
NJ0020605	ALLAMUCHY SEWERAGE TREATMENT PLANT	0.6	Municipal minor
NJ0020711	WARREN CO TECHNICAL SCHOOL STP	0.012	Municipal minor
NJ0021083	VETERANS AFFAIRS NJ HEALTH CARE SYSTEM-LYONS	0.4	Municipal minor
NJ0021091	JEFFERSON TWP HIGH-MIDDLE SCHOOL	0.0275	Municipal minor
NJ0021105	ARTHUR STANLICK SCHOOL	0.013	Municipal minor
NJ0021113	WASHINGTON BORO WWTP	1.5	Municipal major
NJ0021253	INDIAN HILLS HIGH SCHOOL	0.0336	Municipal minor
NJ0021326	MEDFORD LAKES BOROUGH STP	0.55	Municipal minor
NJ0021334	MENDHAM BORO	0.45	Municipal minor
NJ0021342	SKYVIEW/HIBROOK WTP	0.023	Municipal minor
NJ0021369	HACKETTSTOWN MUA	3.48	Municipal major
NJ0021571	SPRINGFIELD TWP ELEM SCH STP	0.0075	Municipal minor
NJ0021636	NEW PROVIDENCE WWTP	1.5	Municipal major
NJ0021717	BUENA BOROUGH MUA	0.4	Municipal major
NJ0021865	FIDDLER'S ELBOW CTRY CLUB WWTP	0.03	Municipal minor
NJ0021890	MILFORD SEWER UTILITY	0.4	Municipal minor
NJ0021954	CLOVERHILL STP	0.5	Municipal minor
NJ0022047	RARITAN TOWNSHIP MUA STP	3.8	Municipal major
NJ0022063	SUSSEX COUNTY HOMESTEAD WTP	0.05	Municipal minor
NJ0022101	BLAIR ACADEMY	0.05	Municipal minor
NJ0022110	EDUCATIONAL TESTING SERVICE	0.08	Municipal minor
NJ0022144	HAGEDORN PSYCHIATRIC HOSPITAL	0.052	Municipal minor
NJ0022250	WOODSTOWN WASTEWATER TREATMENT PLANT	0.53	Municipal minor
NJ0022276	STONYBROOK SCHOOL	0.01	Municipal minor
NJ0022349	ROCKAWAY VALLEY REG SA	12	Municipal major
NJ0022381	NORTHERN BURLINGTON COUNTY	0.0135	Municipal minor
NJ0022390	NPDC SEWAGE TREATMENT PLANT	0.5	Municipal minor
NJ0022438	HELEN A FORT MIDDLE SCHOOL	0.05	Municipal minor

NJ0022489	WARREN TWP SEWERAGE AUTH STAGE I-II STP	0.47	Municipal minor
NJ0022497	WARREN STAGE IV STP	0.8	Municipal minor
NJ0022586	MARLBORO PSYCHIATRIC HOSP STP	1	Municipal major
NJ0022675	ROXBURY TOWNSHIP	2	Municipal major
NJ0022764	RIVER ROAD STP	0.1172	Municipal minor
NJ0022781	POTTERSVILLE STP	0.048	Municipal minor
NJ0022845	HARRISON BROOK STP	2.5	Municipal major
NJ0022918	ROOSEVELT BORO WTP	0.25	Municipal minor
NJ0022985	WRIGHTSTOWN BOROUGH STP	0.337	Municipal minor
NJ0023001	SALVATION ARMY CAMP TECUMSEH	0.018	Municipal minor
NJ0023124	MONTGOMERY HIGH SCHOOL STP	0.035	Municipal minor
NJ0023175	ROUND VALLEY MIDDLE SCHOOL	0.009	Municipal minor
NJ0023311	KINGWOOD TWP SCHOOL	0.0048	Municipal minor
NJ0023493	WASHINGTON TOWNSHIP MUA WTP	0.5	Municipal minor
NJ0023540	NAVAL WEAPONS STATION EARLE	0.37	Municipal minor
NJ0023663	CARRIER FOUNDATION WTP	0.04	Municipal minor
NJ0023698	POMPTON LAKES BORO MUA	1.2	Municipal major
NJ0023728	PINE BROOK STP	8.8	Municipal major
NJ0023736	PINELANDS WASTEWATER COMPANY	0.5	Municipal minor
NJ0023787	EAST WINDSOR WATER POLLUTION CONTROL PLANT	4.5	Municipal major
NJ0023841	LOUNSBERRY HOLLOW MIDDLE SCH STP	0.032	Municipal minor
NJ0023949	LEGENDS RESORT & COUNTRY CLUB	0.35	Municipal minor
NJ0024031	ELMWOOD WTP	2.978	Municipal major
NJ0024040	WOODSTREAM STP	1.7	Municipal major
NJ0024091	UNION TWP ELEMENTARY SCHOOL	0.011	Municipal minor
NJ0024104	UNITED WATER PRINCETON MEADOWS	1.64	Municipal major
NJ0024163	BIG `N` SHOPPING CENTER STP	0.02	Municipal minor
NJ0024414	WEST MILFORD SHOPPING CENTER STP	0.02	Municipal minor
NJ0024457	OUR LADY OF THE MAGNIFICAT	0.0012	Municipal minor
NJ0024465	LONG HILL TOWNSHIP OF STP	0.9	Municipal minor
NJ0024490	VERONA TWP WTP	4.1	Municipal major
NJ0024511	LIVINGSTON WATER POLLUTION CONTROL FACILITY	4.6	Municipal major
NJ0024716	PHILLIPSBURG TOWN STP	3.5	Municipal major
NJ0024759	EWING-LAWRENCE SA WTP	16	Municipal major
NJ0024791	RIDGEWOOD VILLAGE WPC FACILITY	5	Municipal major
NJ0024813	NORTHWEST BERGEN CNTY UA	16.8	Municipal major
NJ0024821	PEMBERTON TOWNSHIP MUA STP	2.5	Municipal major
NJ0024864	SOMERSET RARITAN VALLEY SA	21.3	Municipal major
NJ0024902	HANOVER SEWERAGE AUTHORITY	4.61	Municipal major
NJ0024911	BUTTERWORTH WATER POLLUTION CONTROL UTILITY	3.3	Municipal major
NJ0024929	WOODLAND WATER POLLUTION CONTROL UTILITY(WPCU	2	Municipal major
NJ0024937	MOLITOR WATER POLLUTION CONTROL FACILITY	5	Municipal major
NJ0024970	PARSIPPANY TROY HILLS	16	Municipal major
NJ0025160	HAMMONTON WTPF	1.6	Municipal major
NJ0025330	CEDAR GROVE STP	2	Municipal major

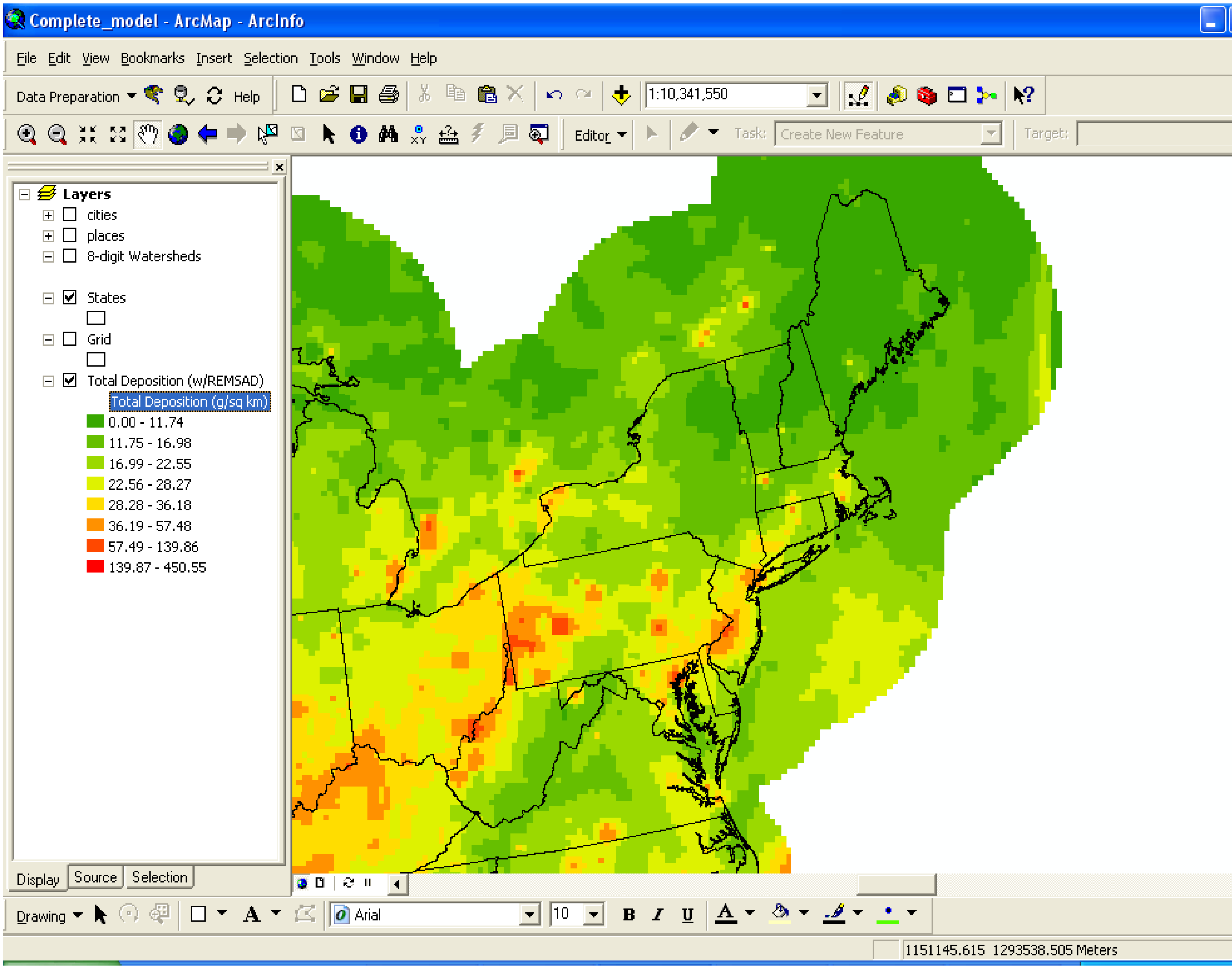
NJ0025496	MORRISTOWN SEWER UTILITY	6.3	Municipal major
NJ0025518	FLORHAM PARK SEWERAGE AUTH	1.4	Municipal major
NJ0026174	CRESCENT PARK STP	0.064	Municipal minor
NJ0026387	BERNARDSVILLE STP	0.8	Municipal minor
NJ0026689	GREYSTONE PARK PSYCH HOSPITAL	0.4	Municipal minor
NJ0026697	READINGTON TWP PUBLIC SCHOOL	0.017	Municipal minor
NJ0026719	ALBERT C WAGNER YOUTH CORRECTIONAL FACILITY	1.3	Municipal minor
NJ0026727	COLORADO CAFE WTP	0.0175	Municipal minor
NJ0026824	CHESTER SHOPPING CENTER	0.011	Municipal minor
NJ0026832	MEDFORD TWP WASTEWATER TREATMENT PLANT	1.75	Municipal major
NJ0026867	WHITE ROCK STP	0.1295	Municipal minor
NJ0026891	BURNT HILL TREATMENT PLANT #1	0.0153	Municipal minor
NJ0026905	STAGE II TREATMENT PLANT	0.48	Municipal minor
NJ0027006	RINGWOOD ACRES TREATMENT PLANT	0.036	Municipal minor
NJ0027031	HOLMDEL BD OF ED VILLAGE SCHOOL STP	0.01	Municipal minor
NJ0027049	POPE JOHN XXIII HIGH SCH WTP	0.022	Municipal minor
NJ0027057	SPARTA PLAZA WTP	0.05	Municipal minor
NJ0027065	SPARTA ALPINE SCHOOL	0.025	Municipal minor
NJ0027227	TRUMP NATIONAL GOLF COURSE	0.0005	Municipal minor
NJ0027464	HANOVER MOBILE VILLAGE ASSOC	0.02	Municipal minor
NJ0027511	CALIFORNIA VILLAGE SEWER PLANT	0.032	Municipal minor
NJ0027529	CAREONE @HOLMDEL	0.025	Municipal minor
NJ0027553	LESTER D. WILSON ELEM SCHOOL	0.0075	Municipal minor
NJ0027561	DELAWARE TOWNSHIP MUA	0.065	Municipal minor
NJ0027596	SPARTAN VILLAGE MOBILE HOME PK	0.038	Municipal minor
NJ0027669	AWOSTING STP	0.045	Municipal minor
NJ0027677	OLDE MILFORD ESTATES STP	0.172	Municipal minor
NJ0027685	HIGHVIEW ACRES STP	0.2	Municipal minor
NJ0027715	MERCER CO CORRECTION CTR STP	0.09	Municipal minor
NJ0027731	PRINCETON HEALTHCARE SYSTEM	0.296	Industrial
NJ0027774	OAKWOOD KNOLLS WWTP	0.035	Municipal minor
NJ0027821	MUSCONETCONG SEWERAGE AUTHORITY	5.79	Municipal major
NJ0027961	BERKELEY HEIGHTS WPCF	3.1	Municipal major
NJ0028002	MOUNTAIN VIEW STP	13.5	Municipal major
NJ0028304	QUALITY INN OF LEDGEWOOD	0.04	Municipal minor
NJ0028436	RARITAN TWP MUA-FLEMINGTON	2.35	Municipal major
NJ0028479	NJ TRAINING SCHOOL FOR BOYS	0.15	Municipal minor
NJ0028487	MOUNTAINVIEW CORRECTIONAL INSTITUTION	0.26	Municipal minor
NJ0028541	BIRCH HILL PARK STP	0.02	Municipal minor
NJ0028665	MOBILE ESTATES OF SOUTHAMPTON INC	0.06	Municipal minor
NJ0028894	KITTATINNY REG HS BD OF ED	0.045	Municipal minor
NJ0029041	REGENCY @ SUSSEX APT	0.08	Municipal minor
NJ0029386	TWO BRIDGES WASTEWATER TREATMENT PLANT	10	Municipal major
NJ0029432	ROBERT ERSKINE SCHOOL STP	0.008	Municipal minor
NJ0029475	HIGHTSTOWN BORO AWWTP	1	Municipal major

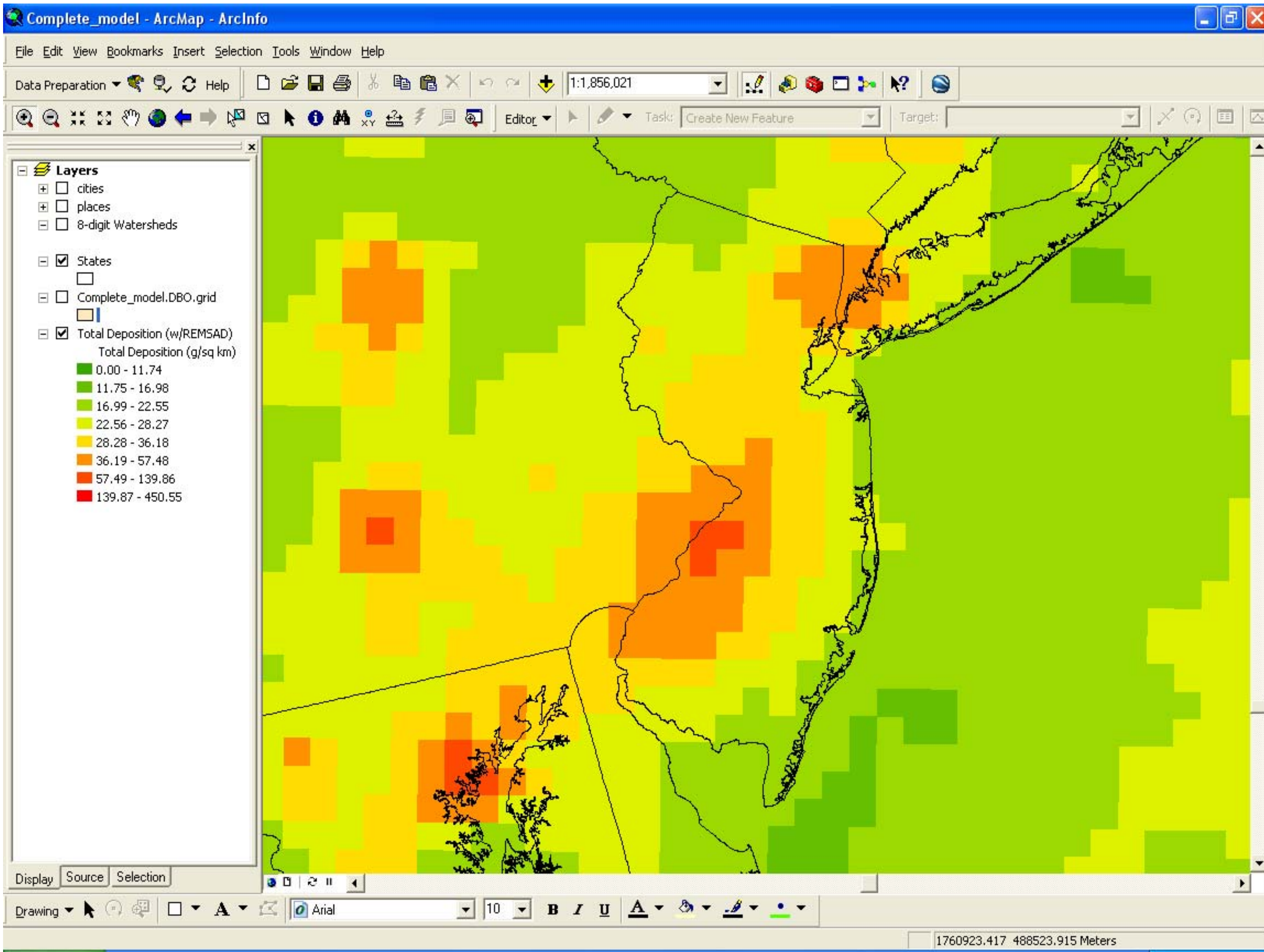
NJ0029831	FRENCHTOWN WASTEWATER TREATMENT PLANT	0.15	Municipal minor
NJ0029858	OAKLAND CARE CENTER INC	0.03	Municipal minor
NJ0031046	NORTH WARREN REG SCH DIST WTF	0.02	Municipal minor
NJ0031119	STONY BROOK RSA- RIVER ROAD STP	13.06	Municipal major
NJ0031585	HIGH POINT REGIONAL HS	0.03	Municipal minor
NJ0031615	CAMDEN COUNTY VOC & TECH SCHOOL	0.058	Municipal minor
NJ0031674	REMINGTON'S RESTAURANT	0.028	Municipal minor
NJ0031771	COLTS NECK INN HOTEL	0.006	Municipal minor
NJ0032395	RINGWOOD PLAZA STP	0.01168	Municipal minor
NJ0033995	ENVIRONMENTAL DISPOSAL CORP	2.1	Municipal major
NJ0035084	EXXONMOBIL RESEARCH & ENGINEERING CO	0.22	Industrial
NJ0035114	BELVIDERE AREA WWTF	0.5	Municipal minor
NJ0035301	STONY BROOK RGNL SEWERAGE AUTH	0.3	Municipal minor
NJ0035319	STONY BROOK RSA	0.3	Municipal minor
NJ0035483	OXFORD AREA WTF	0.5	Municipal minor
NJ0035670	ALEXANDRIA MIDDLE SCHOOL	0.011	Municipal minor
NJ0035718	HOLMDEL WASTEWATER TREATMENT FACILITY	0.04	Municipal minor
NJ0050130	RIVERSIDE FARMS STP	0.145	Municipal minor
NJ0050369	WARREN STAGE V STP	0.38	Municipal minor
NJ0050580	HAMPTON COMMONS WASTEWATER FACILITY	0.05	Municipal minor
NJ0052256	CHATHAM GLEN STP	0.155	Municipal minor
NJ0053112	CHAPEL HILL ESTATES STP	0.01	Municipal minor
NJ0053350	SUSSEX CNTY MUA UPPER WALLKILL FACILITY	3	Municipal major
NJ0053759	WANAQUE VALLEY REGIONAL SEWERAGE AUTHORITY	1.25	Municipal major
NJ0055395	BURLINGTON CNTY RESOURCE RECOVERY COMPLEX	2.075	Industrial
NJ0060038	PIKE BROOK STP	0.67	Municipal minor
NJ0067733	OXBRIDGE WASTEWATER TREATMENT PLANT	0.16	Municipal minor
NJ0069523	CHERRY VALLEY STP	0.286	Municipal minor
NJ0080811	RAMAPO RIVER RESERVE WWTP	0.1137	Municipal minor
NJ0098663	HOMESTEAD TREATMENT UTILITY	0.25	Municipal minor
NJ0098922	READINGTON-LEBANON SA	0.8	Municipal minor
NJ0100528	GLEN MEADOWS/TWIN OAKS STP	0.025	Municipal minor
NJ0102270	EVOINK DEGUSSA CORP	0.015	Industrial
NJ0102563	ROUTE 78 OFFICE AREA WWTF	0.09653	Municipal minor
NJ0109061	LONG VALLEY VILLAGE WTP	0.244	Municipal minor
NJ0136603	MORRIS LAKE WTP	0.2	Municipal minor
NJG0005134	HERCULES GROUNDWATER TREATMT AT GEO SPEC CHEM	0.432	Industrial

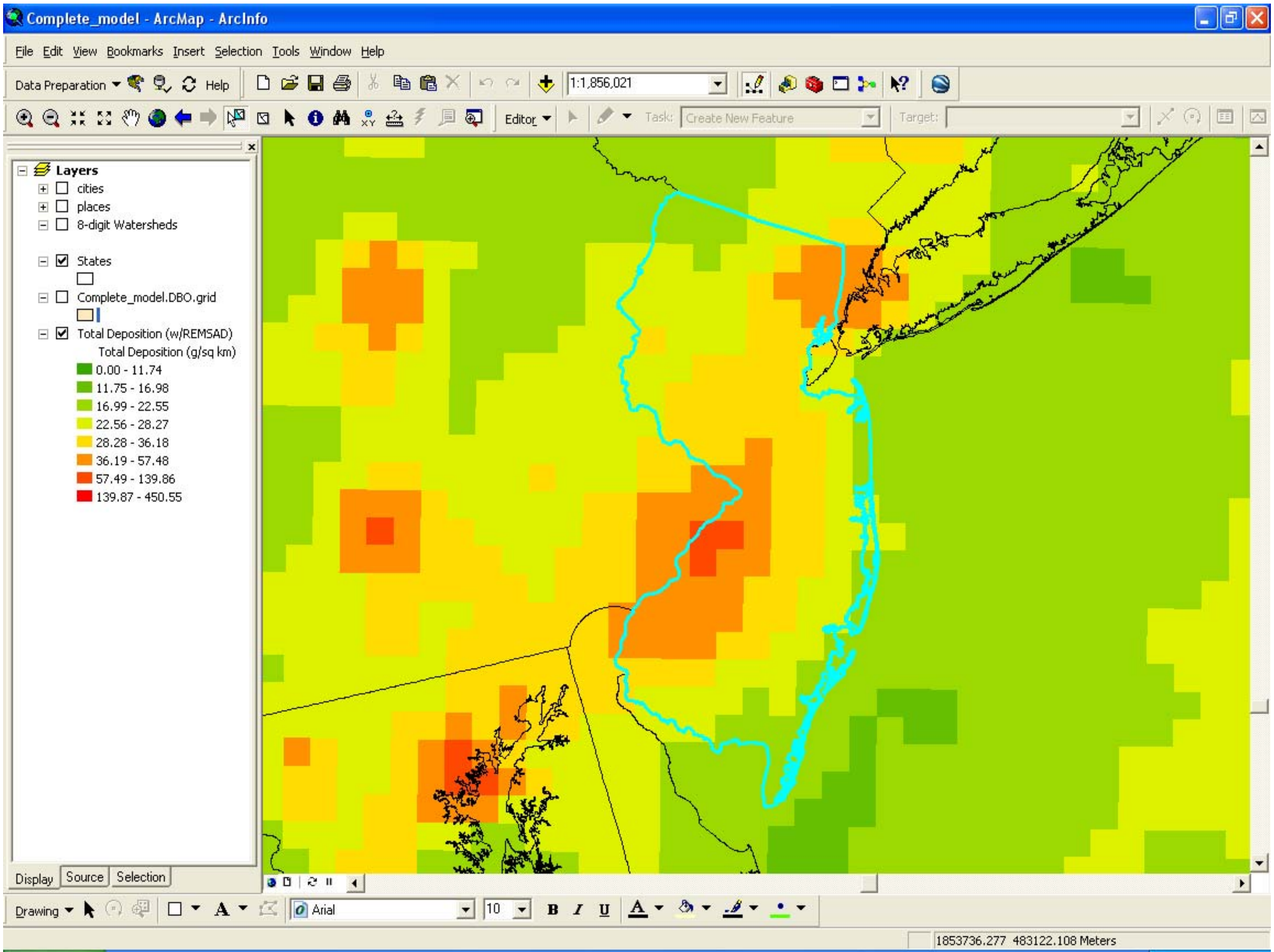
Footnote: TMDL Section 4.0 - Source Assessment describes list construction.

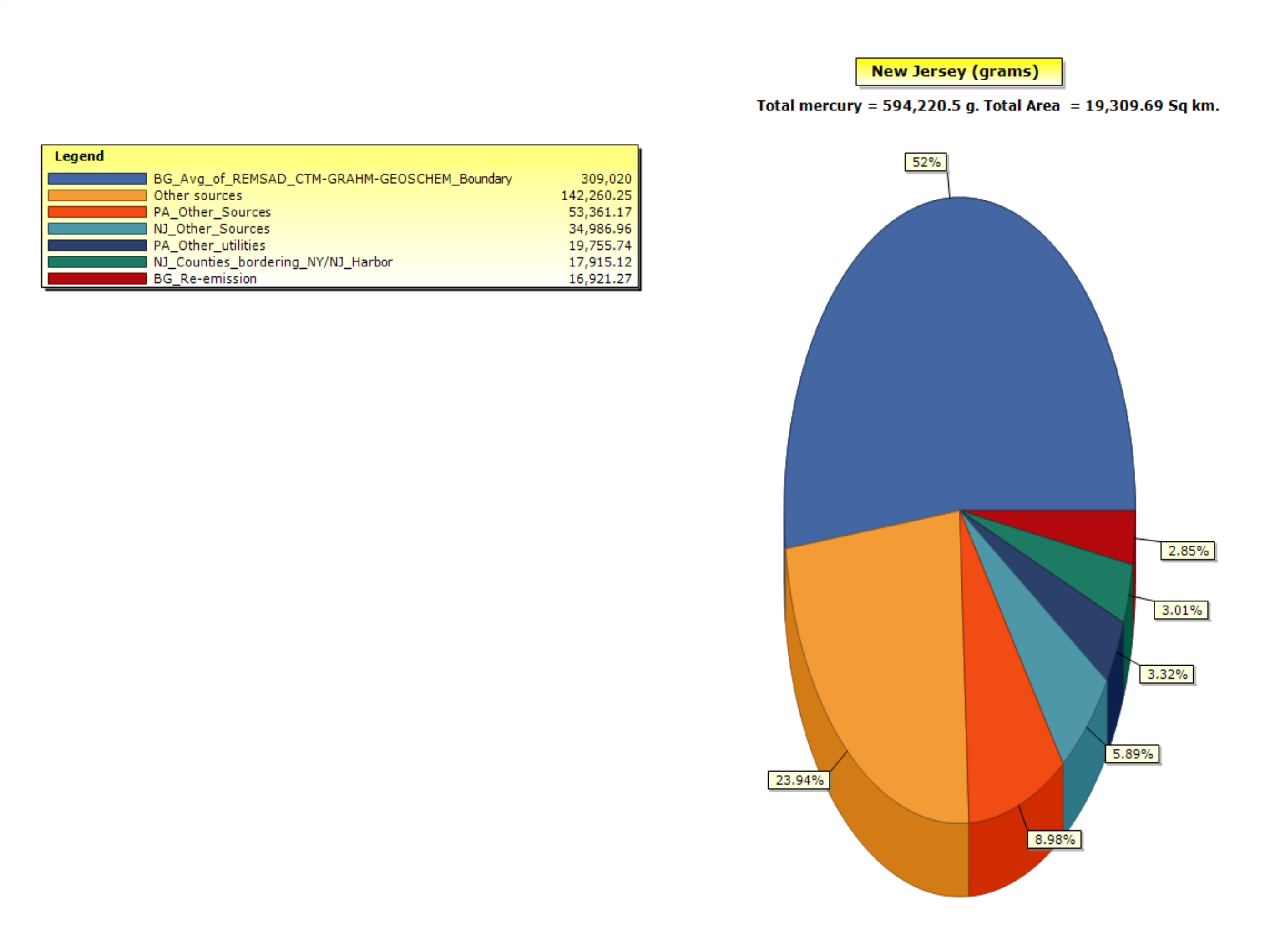
Appendix D

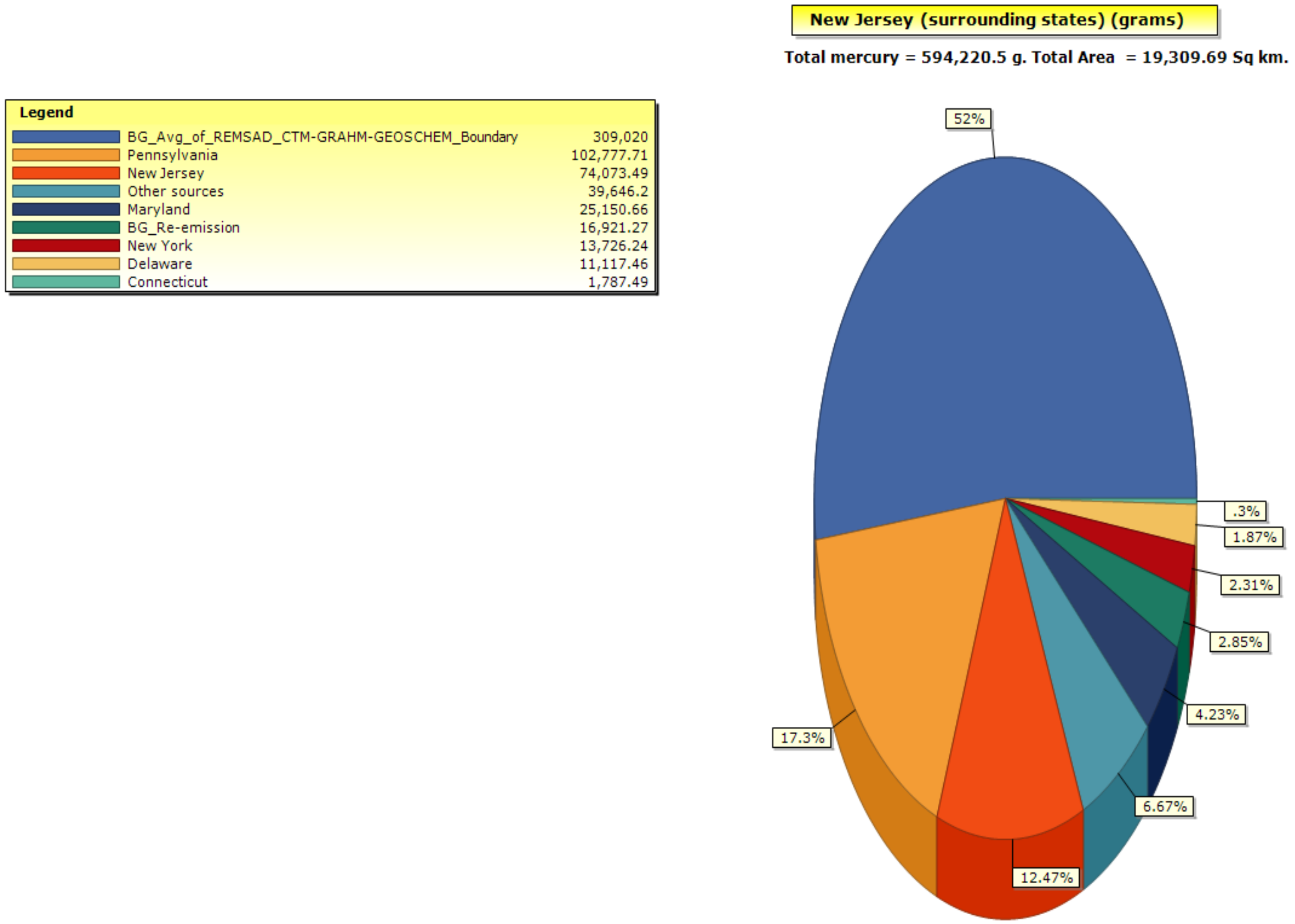
Mercury Air Deposition Load for New Jersey (provided by Mr. Dwight Atkinson of EPA)

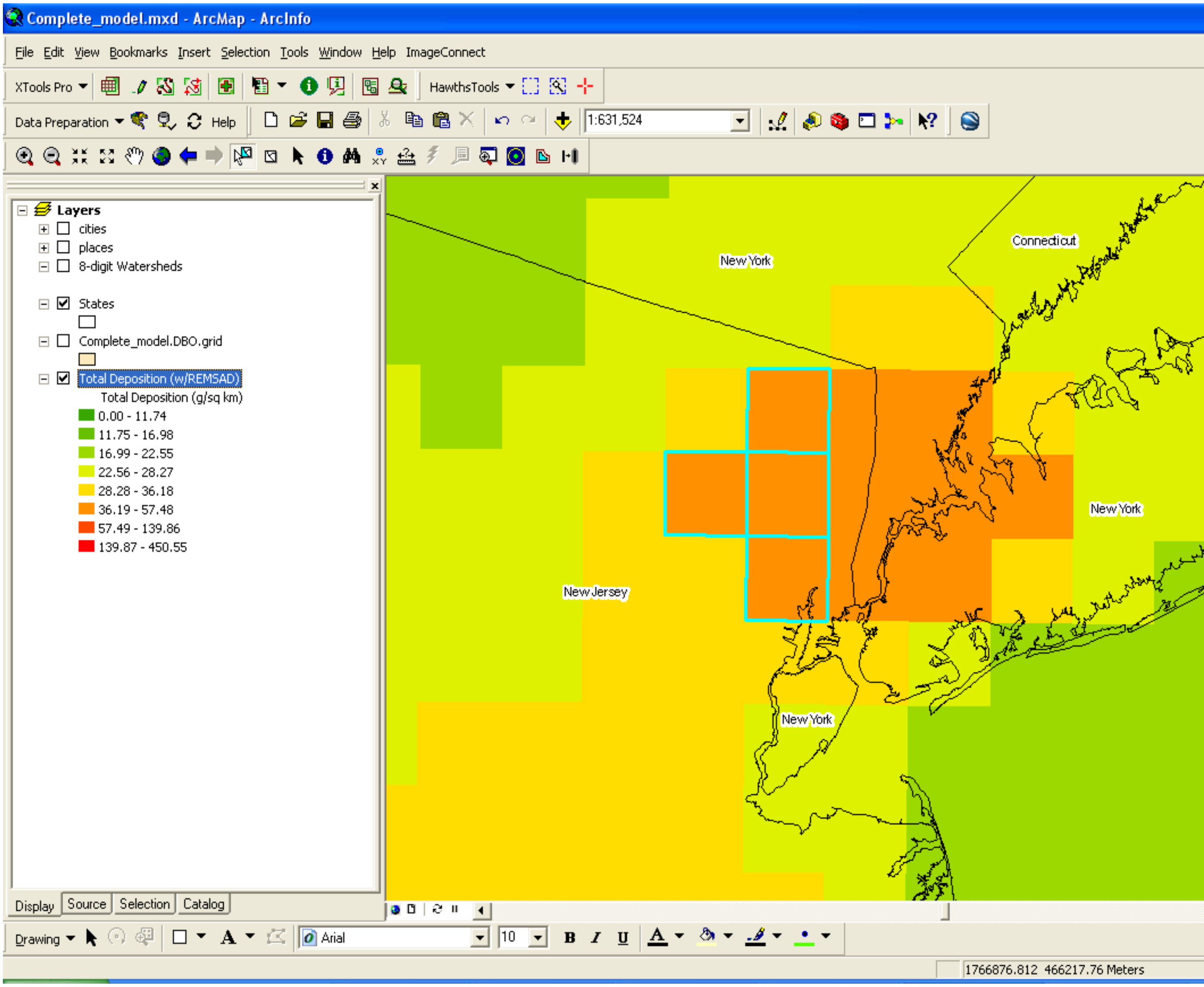


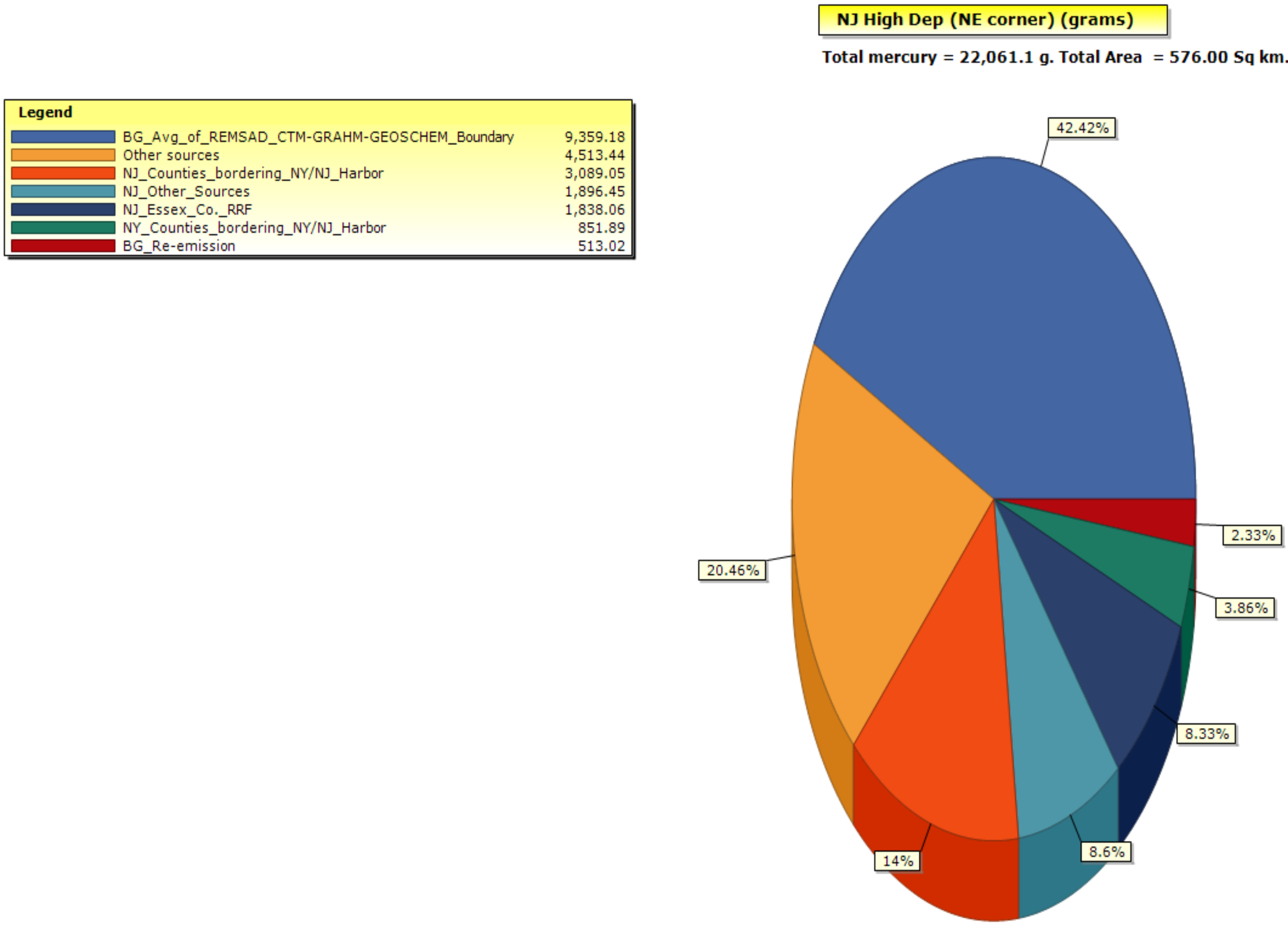

Complete_model - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help
Data Preparation
Help
1:1,856,021
Editor
Task: Create New Feature
Target:
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display
Source
Selection
Drawing
Arial
10
1760923.417 488523.915 Meters

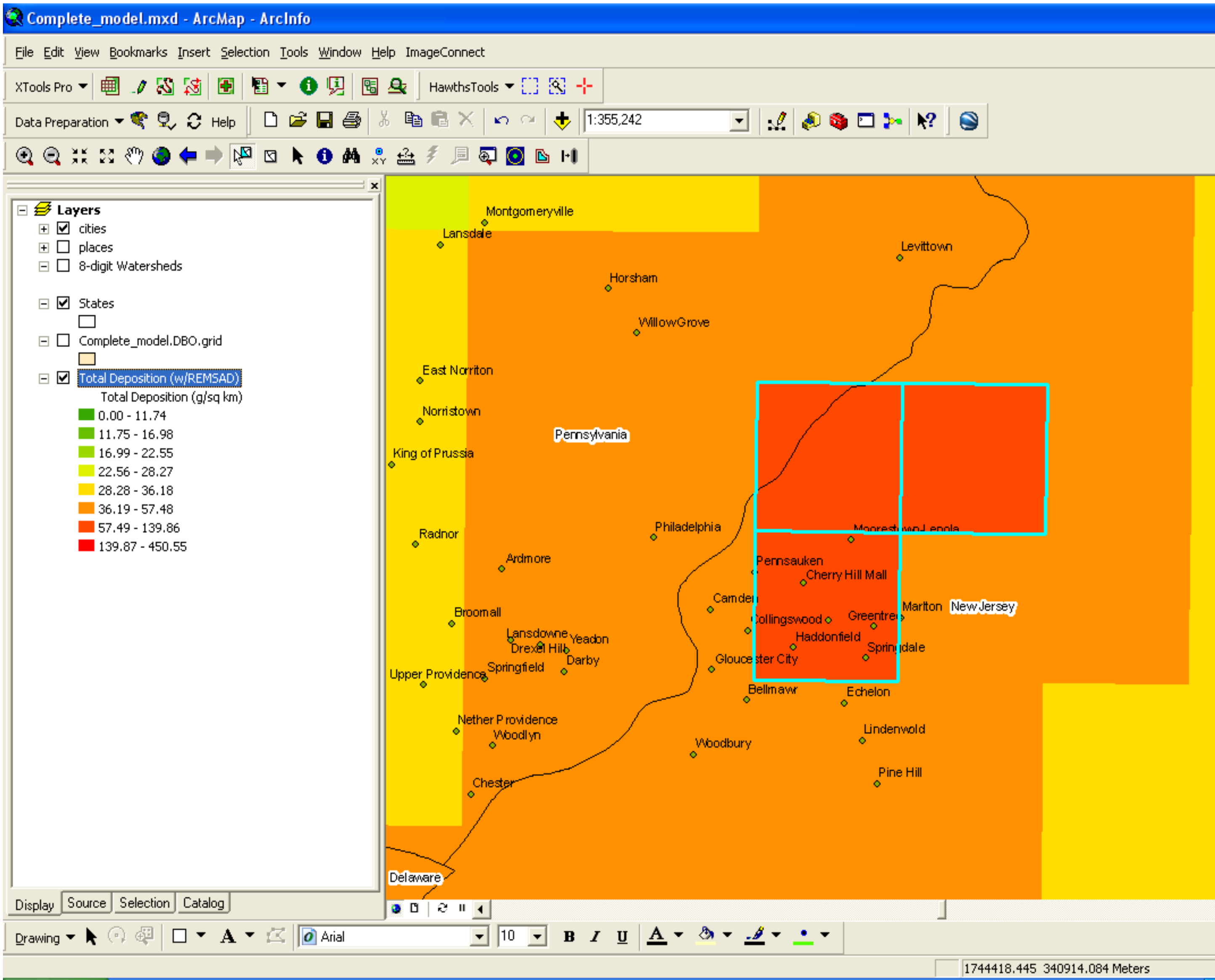

Complete_model - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help
Data Preparation
Help
1:1,856,021
Editor
Task: Create New Feature
Target:
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display
Source
Selection
Drawing
Arial
10
1853736.277 483122.108 Meters

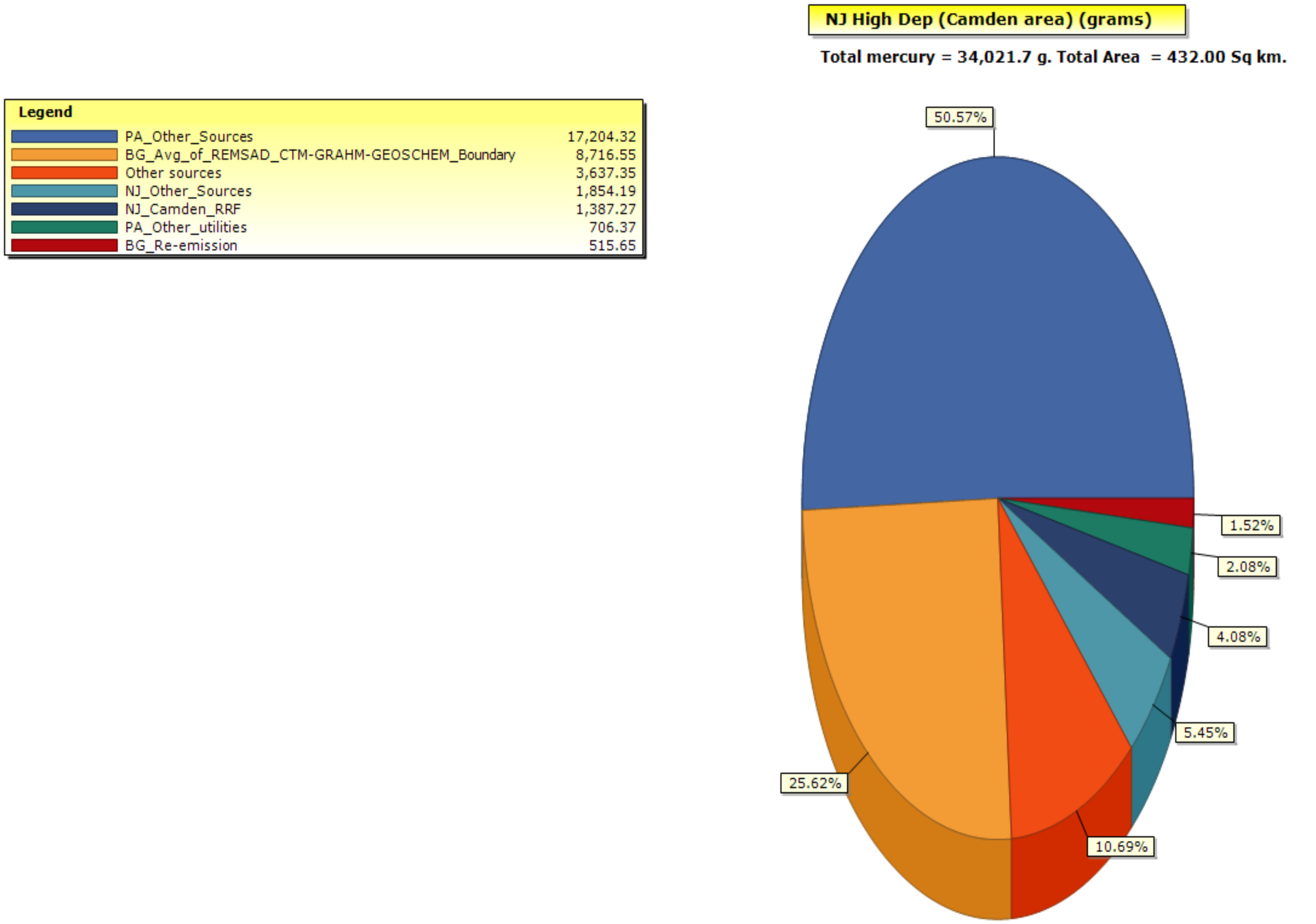

New Jersey (grams)
Total mercury = 594,220.5 g. Total Area = 19,309.69 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 309,020
Other sources 142,260.25
PA_Other_Sources 53,361.17
NJ_Other_Sources 34,986.96
PA_Other_utilities 19,755.74
NJ_Counties_bordering_NY/NJ_Harbor 17,915.12
BG_Re-emission 16,921.27
52%
2.85%
3.01%
3.32%
5.89%
8.98%
23.94%


New Jersey (surrounding states) (grams)
Total mercury = 594,220.5 g. Total Area = 19,309.69 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 309,020
Pennsylvania 102,777.71
New Jersey 74,073.49
Other sources 39,646.2
Maryland 25,150.66
BG_Re-emission 16,921.27
New York 13,726.24
Delaware 11,117.46
Connecticut 1,787.49
52%
.3%
1.87%
2.31%
2.85%
4.23%
6.67%
12.47%
17.3%


Complete_model.mxd - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help ImageConnect
XTools Pro
HawthsTools
Data Preparation
Help
1:631,524
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display
Source
Selection
Catalog
New York
Connecticut
New York
New Jersey
New York
Drawing
Arial
10
1766876.812 466217.76 Meters


NJ High Dep (NE corner) (grams)
Total mercury = 22,061.1 g. Total Area = 576.00 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 9,359.18
Other sources 4,513.44
NJ_Counties_bordering_NY/NJ_Harbor 3,089.05
NJ_Other_Sources 1,896.45
NJ_Essex_Co._RRF 1,838.06
NY_Counties_bordering_NY/NJ_Harbor 851.89
BG_Re-emission 513.02
42.42%
20.46%
14%
8.6%
8.33%
3.86%
2.33%


Complete_model.mxd - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help ImageConnect
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Montgomeryville
Lansdale
Levittown
Horsham
Willow Grove
East Norriton
Norristown
Pennsylvania
King of Prussia
Philadelphia
Radnor
Ardmore
Pennsauken
Cherry Hill Mall
Camden
Marlton
New Jersey
Broomall
Lansdowne
Yeadon
Drexel Hill
Darby
Springfield
Upper Providence
Haddonfield
Echelon
Bellmawr
Nether Providence
Woodlyn
Woodbury
Lindenwold
Pine Hill
Chester
Delaware
1744418.445 340914.084 Meters


NJ High Dep (Camden area) (grams)
Total mercury = 34,021.7 g. Total Area = 432.00 Sq km.
Legend
PA_Other_Sources 17,204.32
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 8,716.55
Other sources 3,637.35
NJ_Other_Sources 1,854.19
NJ_Camden_RRF 1,387.27
PA_Other_utilities 706.37
BG_Re-emission 515.65
50.57%
1.52%
2.08%
4.08%
5.45%
10.69%
25.62%