CITY OF BALTIMORE
DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER AND WASTEWATER
SURFACE WATER MANAGEMENT DIVISION

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May 27, 2010

Preface

This report describes activities done by the City of Baltimore during 2009 in association with its National Pollutant Discharge Elimination System municipal separate storm sewer system discharge permit (Permit Number: MD0068292). This permit expired January 3, 2010. As of the writing of this report, the State has not yet sent the City a draft of the next permit.

On April 7-9, 2009, the EPA conducted an inspection of the City's permit program. The inspection team issued their report on September 24, 2009. The inspection team found several deficiencies, and these are discussed in the various sections of the City's annual report. On September 30, 2009, the EPA issued to the City its Findings of Violation and Order for Compliance (docket number CWA-03-2009-0312DN). Since that time, the City has been addressing the problems detailed by the EPA and reporting to the EPA its progress. The City's Water and Wastewater Bureau Chief last updated the EPA by telephone on May 14, 2010. The corrective actions taken and planned for the near future are discussed in the various sections of the City's annual report.

In July 2009 the responsibilities to review plans and conduct inspections for sediment and erosion controls and stormwater best management practices (BMPs) was moved to the Surface Water Management Division. In this re-organization, two engineers, one inspection supervisor and two inspectors were transferred to the Surface Water Management Division. It was soon learned that the plan review workload was too great for just the two engineers, and the Surface Water Management Division had to pay a consulting firm to supply a person to help with the reviews. The inspection supervisor had to retire in the fall 2009 because of illness. One inspector was assigned to conduct all the inspections of active construction sites. This inspector has several years experience in these duties, but had always had other inspectors to share the work load. The other inspector was assigned to conduct maintenance inspections of existing stormwater BMPs. Although this inspector has many years of service, he has very little experience inspecting stormwater management facilities. At the time of the writing of this report, his supervisor is lining up training for him. Once properly trained, he can resume stormwater BMP maintenance inspections. The City has not conducted stormwater BMP maintenance inspections since 2007. As the delegated erosion and sediment control enforcement authority for the State, the City is responsible for conducting a maintenance inspection of each stormwater BMP facility at least once every three years.

The Maryland Department of the Environment (MDE) conducted a review of the City's application for continued delegation of erosion and sediment control enforcement authority in October and November 2009. This review involved the inspection of ten active construction sites to check for the implementation of adequate erosion and sediment controls. The MDE inspector found inadequate controls at eight of ten sites during his initial inspection. Ultimately, after his follow-up visits, the MDE inspector found that only five of the ten sites had adequate maintenance, and that enforcement action was unsuccessful for five sites. MDE scheduled another review for May 2010.

The City completed construction of three watershed restoration projects during 2009:

- Stream restoration and wetlands creation on Maidens Choice Run near Beechfield Elementary School (2,700 feet of stream restored);
- Stream restoration of the Lower Stony Run from Coldspring Lane to just below University Parkway (project length 4,300 feet);
- Installation of six ultra-urban Best Management Practices (BMPs) in Catchment "O" of Watershed 263 (combined treatment volume of 0.039 acre-feet to treat 0.44 acres of impervious surface area).

The City completed watershed studies of Gwynns Falls in 2004, and Jones Falls and Herring Run in 2008. In the Direct Harbor watershed, the City has only completed a plan for the small 900-acre Watershed 263. Consequently, the City has not met the requirement listed in Section F1 of its permit. The City has hired consultants to assess the existing watershed plans to determine updates needed to be in compliance with current and anticipated requirements. With this analysis, the City has started the preparation to meet the anticipated requirements for management plans in the City's next MS4 permit.

The permit required the City to restore or treat 20% of the City's impervious area, which amounts to 4,675 of a total of 23,373 acres. As a means of measuring how well the practices implemented under the permit- street sweeping and inlet cleaning; volume control BMPs; and stream restoration- have met the goal of treating 20% of the impervious area, the City has chosen to estimate the amount of phosphorus annually retained or removed by their practices, and compare that amount to the estimated phosphorus load that 23,373 acres of impervious area would annually generate, which is 51,650 pounds of phosphorus (assuming each acre generates an annual load of 2.21 pounds of phosphorus). The total estimated annual amount of phosphorus retained by the City's practices is 3,352 pounds. This represents 6% of the expected annual load from the City's impervious surfaces.

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Appendix D1a.1 As-Built Drawings of 12 Stormwater Management BMPs

List of Files on CD-ROM Accompanying Report

2009 Annual Report for City of Baltimore MS4 Permit.pdf
This is a copy of this report in an Acrobat file.

Baltimore City MS4 Inspection April 2009 Final Report.pdf
This Acrobat file contains a copy of the compliance inspection report issued by the EPA's Office of Compliance and Enforcement on September 24, 2009. This report is mentioned in the Preface and Section D4.

EPA Administrative Order CWA-03-2009-0312DN.pdf
This Acrobat file contains a copy of the cover letter and Findings of Violation and Order for Compliance (docket number CWA-03-2009-0312DN) from Jon M. Capacasa, the Director of EPA's Water Protection Division, to the Mayor of Baltimore on September 30, 2009. This order is mentioned in the Preface and Section D4.

City Response to EPA Order CWA-03-2009-0312DN Nov52009.pdf
This Acrobat file contains a copy of the report the City prepared on November 5, 2009, in response to the EPA's Findings of Violation and Order for Compliance (docket number CWA-03-2009-0312DN). This report is mentioned in the Preface.

MDE Delegation Review Letter January 2010.pdf and MDE Delegation Review Report January 2010.pdf
These two Acrobat files contain the cover letter and evaluation report from the Maryland Department of the Environment (MDE) for their review in October and November 2009 of the delegation of erosion and sediment control enforcement authority to the City. These files are mentioned in the Preface and in Section D2.

City of Baltimore Response to MDE Delegation Review Jan 2010.pdf
This is an Acrobat file containing a letter from the City to MDE in response to their delegation of authority review. This file is mentioned in Section D2.

Monitoring_Site_Locations_2009.shx, .dbf, .prj, .sbn, .sbx, .shp, .shp.xml
This set of seven files comprises the GIS coverage of the City's chemical and biological monitoring locations that are referred to in Section C4.

SWM & ESC Tables 2009.xls

Urban BMP Mgt Practices

This is the first tab of the Excel file. It contains the records of management practices approved during 2009 that are referred to in Section D1a.

NPDES Construction General Perm

This is the second tab of the Excel file. It contains the records of plans for earth disturbances greater than one acre which were approved during 2009. This table is referred to in Section D2b.

Baltimore City NPDES Stormwater Permit Data 2009.mdb

Baltimore City Responsible Personnel Certification Info 2009

This is an Access table with information on the people who attended this training during 2009 that is referred to in Section D2a.

Baltimore City Monitoring Sample Results 2009

This is an Access table with the 2009 sample results from: stream impact sampling (SIS); ammonia screening (AS); baseline and discrete stormwater samples from Moores Run monitoring at Hamilton Avenue and Radecke Avenue stations; and restoration monitoring for Biddison Run, Stony Run, Powder Mill Run and Watershed 263. This table is referred to in Sections D3a, F2a, F2b, F2c and G1a.

Baltimore City Chemical Monitoring 2009

This is an Access table that contains the 2009 results for stormwater EMCs and baseline discrete samples for monitoring in Moores Run at the Hamilton Avenue and Radecke Avenue stations; and restoration monitoring for Biddison Run, Stony Run, Powder Mill Run and Watershed 263. It is referred to in Sections D3a, F2a, F2b, F2c and G1a.

Private Properties Believed to Be Illicitly Discharging Sewage.pdf

This is an Acrobat file containing a letter on September 9, 2009, from Wazir Qadri of the Bureau of Water and Wastewater to Eric Uttenreither, Superintendent of Plumbing & Building Inspections in the Department of Housing and Community Development, in which there is a list of private properties believed to be illicitly discharging sewage. It is mentioned in Section D3a.

City Streams Dry Weather Time Concentration Graphs

This is a folder that contains 16 Excel files: each file has a set of concentration over time scatterplots for each of the 35 monitoring stations for a given parameter. These graphs have been updated since the set that was sent with the 2008 Annual Report to include sample results through December 2009. These graphs are referred to in Sections D3a, D5c, F2a, and G1a.

Back River WWTP SWPPP Inspection December 2009.pdf

This is an Acrobat file containing a memo from Rayford McEachern to Nick Francos detailing his observations on December 15, 2009, during his inspection of the grounds at the Back River Wastewater Treatment Plant. This inspection is

done as part of the stormwater pollution prevention plan. This file is mentioned in Section D4a.

Patapsco WWTP SWPPP Inspection June 2009.pdf

This is an Acrobat file containing a memo from John Martin to Gary Wagner detailing his observations on June 12, 2009, during his inspection of the grounds at the Patapsco Wastewater Treatment Plant. This inspection is done as part of the stormwater pollution prevention plan. This file is mentioned in Section D4a.

City Landfill 2009 Inspection Reports

This is a folder that contains 7 Acrobat files. Each file contains an inspection report for one of the City's landfills. The inspections were done in December 2009. These inspect reports are referred to in Section D4b.

Stormwater Pollution Prevention Plans for City Properties

This is a folder that contains 8 Acrobat files. Each Acrobat file contains the stormwater pollution prevention plan (SWPPP) for one City facility. There are SWPPPs for the 7 sub-stations and one for the Northwest Transfer Station.

Parsons Brinckerhoff Summary of Environmental Requirements Applicable to Watershed Plans.pdf

This Acrobat file contains a list of criteria to assess existing watershed plans to determine updates needed to be in compliance with current and anticipated requirements based on EPA, City, and region-specific provisions. It is mentioned in Section E1.

Macroinvertebrate Sample Results 2002 through 2009.xls

This is an Excel file that contains a record for each one of the 255 macroinvertebrate samples collected at fixed and random sites from 2002 through 2009. Each record has the benthic IBI score calculated for the sample using the method endorsed by the Maryland Biological Stream Survey (MBSS) in their October 2005 report, "New Biological Indicators to Better Assess the Condition of Maryland Streams". These samples are discussed in Sections E3, F2a and G1bi.

2009 Macroinvertebrate Counts Sheets for Individual Stations.xls

This is an Excel file containing the count sheets for the ten benthic macroinvertebrate samples collected during 2009 (at five random stations in the Gwynns Falls watershed; one fixed station in the Gwynns Falls watershed; one fixed station on Stony Run; one fixed stations on Biddison Run; and two fixed stations on Moores Run). It is mentioned in Sections E3, F2a and G1bi.

Fish Sample Results 2002 through 2009.xls

This is an Excel file that contains a record for each of the 174 fish samples collected at fixed and random sites from 2002 through 2009. All of the records have the fish IBI score calculated for the sample using the method endorsed by

the Maryland Biological Stream Survey (MBSS) in their October 2005 report, "New Biological Indicators to Better Assess the Condition of Maryland Streams". Fish samples are discussed in Sections E3, F2a and G1bii.

Watershed 263 Time Graphs.xls

This is an Excel file that contains concentration over time graphs of the dry weather (baseline) and storm composite concentrations for Baltimore St. and Lanvale St. from September 2004 through March 2010. These graphs are referred to in Section F2b.

Moores Run Watershed SWMM Model 2009 Annual Report.doc

This is a Word document that contains the report from EA Engineering, Science & Technology, Inc., on the SWMM model loads estimated for 2009. This report is referred to in Section G1a.

Hamilton & Radecke Stm EMC Time Graphs.xls

This is an Excel file that contains the storm event mean concentrations (EMCs) over time scatterplots for Hamilton Avenue and Radecke Avenue. These graphs have been updated since the set that was sent with the 2008 Annual Report to include storm EMCs through the storm on October 15, 2009. These graphs are referred to in Section G1a.

Moores Run Habitat Assessments 2005 through 2010 Graphs.xls

This is an Excel file that contains bar graphs depicting the scores from the Moores Run habitat assessment conducted from 2005 through 2010. There is one bar graph for each segment for each parameter. There are a total of 144 graphs. These graphs are referred to in Section G1c.

Fiscal Analyses Table.xls

This is an Excel file that contains the Fiscal Analyses table that is referred to in Section H.

A. Permit Administration

Ralph Cullison has replaced William P. Stack as the liaison with the Maryland Department of the Environment (MDE). Mr. Cullison's address is 3001 Druid Park Dr., Baltimore, MD, 21215. His phone number is (410) 396-0539. His e-mail address is Ralph.Cullison@baltimorecity.gov.

B. Legal Authority

The City maintained adequate legal authority in accordance with NPDES regulations 40 CFR 122.26(d)(2)(i) during 2009.

C. Source Identification- GIS Data

1. Storm Drain System

This information was provided with the 2004 Annual Report.

2. Urban Best Management Practices (BMP)

The Surface Water Management Division is working with consultants to build a new database system to better manage records of existing BMPs, and have a place where records can be created as new BMPs are built. The City anticipates the design of the database to be completed in May 2010.

3. Impervious Surfaces

This information was provided with the 2004 Annual Report.

4. Monitoring Locations

A set of seven GIS files (with files names beginning "Monitoring_Site_Locations_2009") containing this information can be found on the CD-ROM accompanying this report. The GIS coverage made up by these files gives the location for each of the City's chemical and biological monitoring stations including: the stations associated with the long-term discharge characterization in Moores Run; the monitoring associated with the restoration projects in Biddison Run, Stony Run and Watershed 263; chemical monitoring stations that are a part of the Stream Impact Surveys (SIS) and ammonia screening surveys; the fixed biological monitoring sites; and the random biological monitoring sites. This GIS coverage does not include the locations of physical monitoring stations associated with the long-term discharge characterization in Moores Run, or the restoration projects in Biddison Run or Stony Run. These files are an update of the ones sent with the 2008 Annual Report, and include the location of the KENNISON stormwater monitoring station in the Powder Mill watershed, and the new fixed biomonitoring stations added in maidens Choice Run and Stony Run.

5. Watershed Restoration

Surface Water Management Division staff could not finish updating this set of GIS files in time to be sent with this report. These files will be sent to the State at a later time.

D. Management Programs

1. **Stormwater Management**
   In July 2009 the responsibility to maintain programmatic and implementation information according to the requirements established as part of MDE's triennial stormwater program review was moved to the Surface Water Management Division. During 2009 there were 223 stormwater exemptions issued. There were 10 fees-in-lieu approved that resulted in a total of $247,639.80 in fees collected.

   a. **New BMPs**
   There were twelve stormwater management BMPs for which the as-built drawings were approved during 2009. Here is a list of the project names, street addresses and dates the as-built drawings were approved:
   - **Pompeian Inc.**: 4201 Pulaski Highway; approved 3/16/2009
   - **L. Fishman and Son**: 6301 E. Lombard Street; approved 3/23/2009
   - **Roland Park Country School Athletics**: 5204 Roland Avenue; approved 3/11/2009
   - **Crystal Clear Car Wash**: 5936 Belair Road; submitted for approval 1/7/2009
   - **Congregation Ohr Hamizrach**: 6813 Park Heights Avenue; approved 2/9/2009
   - **Archbishop Curley High School Roadway & Parking Improvements**: 3701 Sinclair Lane; approved 3/18/2009
   - **1301 Covington Street**: 1301 Covington Street; approved 4/6/2009
   - **6000 Chemical Road**: 6000 Chemical Road; approved 2/4/2009
   - **Steamship Trade Association**: 1901 Portal Street; approved 2/2/2009
   - **Jackson Station 3 Story Townhomes**: 1834 and 1841-47 Jackson Street; approved 4/22/2009
   - **Johns Hopkins University San Martins Center**: Johns Hopkins University
   - **1401-1421 Richardson Street**: 1401-1421 Richardson Street

   Appendix D1a.1 contains a copy of the as-built drawing for each of these projects. This appendix is a folder separate from the bound copy of this report.

   A table of the 60 BMP plans that were approved during 2009 can be found in the tab labeled "Urban BMP Mgt Practices" in the Excel file "SWM & ESC Tables 2009.xls" on the CD-ROM accompanying this report.

b. **Maintenance Inspections**
The City did not conduct any maintenance inspections during 2009. The one inspector whom the City has available for maintenance inspections will receive training in June 2010. The City anticipates that maintenance inspections will resume in the summer 2010.

2. **Erosion and Sediment Control**
In July 2009 the responsibility for the erosion and sediment control program was moved to the Surface Water Management Division.

The Maryland Department of the Environment (MDE) conducted a review of the City's application for continued delegation of erosion and sediment control enforcement authority in October and November 2009. This review involved the inspection of ten active construction sites to check for the implementation of adequate erosion and sediment controls. The MDE inspector found inadequate controls at eight of ten sites during his initial inspection. Ultimately, after his follow-up visits, the MDE inspector found that only five of the ten sites had adequate maintenance, and that enforcement action was unsuccessful for five sites. A copy of MDE's cover letter and evaluation can be found in the Acrobat files "MDE Delegation Review Letter January 2010.pdf" and "MDE Delegation Review Report January 2010.pdf" on the CD-ROM accompanying this report. A copy of the City's response to MDE is contained in the Acrobat file "City of Baltimore Response to MDE Delegation Review Jan 2010.pdf" on the CD-ROM accompanying this report. A copy of the letter that the City wrote in response to MDE is contained in the Acrobat file "City of Baltimore Response to MDE Delegation Review Jan 2010.pdf" on the CD-ROM accompanying this report. MDE scheduled another review for May 2010.

a. **Responsible Personnel**
The City conducted one "responsible personnel" certification class on February 24, 2009. Fourteen people attended and earned a green card. Tracy Moffatt was the instructor for the class. Information on those who attended can be found in table "Baltimore City Responsible Personnel Certification Info 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report.

b. **Grading (Earth Disturbances) Permits**
A table listing information about the plans involving earth disturbances greater than one acre which were approved during 2009 can be found in the tab labeled "NPDES Construction General Perm" in the Excel file "SWM & ESC Tables 2009.xls" on the CD-ROM accompanying this report. The total area of disturbance for these 32 approved projects is 6,878,292 square feet (158 acres).

3. **Illicit Discharge**

a. **Pollution Source Tracking (PST)**

The City relies on ammonia screening (AS) and stream impact sampling (SIS), two water quality monitoring programs run by the Water Quality Monitoring and Inspection Section, to initiate PSTs. The monitoring results from the surveys for the AS and SIS programs for 2009 are listed within table "Baltimore City Monitoring Sample Results 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report. The breakdown by program and major watershed for the number of station visits and water quality analyses performed during 2009 is listed in Table D3a.1. The count for Herring Run SIS does not include the samples collected for the Biddison Run restoration project monitoring (see Section F2a) or the Moores Run long-term discharge characterization monitoring (see Section G1a). The count for Jones Falls SIS does not include the samples collected at the Linkwood station on Stony Run (see Section F2c).

Table D3a.1 Monitoring Associated with Illicit Discharge Detection During 2009

Program	Number of Surveys	Number of Stations Visited	Number of Water Quality Analyses Performed
Herring Run SIS	12	96	1,814
Jones Falls SIS	12	48	897
Gwynns Falls SIS	12	108	2,084
Harbor SIS	12	95	1,900
Quality Control Replicates	48	48	454
Quality Control Blanks for Harbor SIS Enterococci	9	9	9
Herring Run Ammonia Screening	28	365	2,152
Jones Falls Ammonia Screening	30	331	1,965
Gwynns Falls Ammonia Screening	32	366	2,168
Harbor Ammonia Screening	34	283	1,638
Quality Control Replicates for Harbor Ammonia Screening Enterococci	9	9	9
Quality Control Blanks for Harbor Ammonia Screening Enterococci	9	9	9
Total	172	1,692	15,099

The dates for surveys during 2009 in each major watershed are listed in Table D3a.2.

Table D3a.2 Dates for Ammonia Screening and Stream Impact Sampling Surveys During 2009 in Each Major Watershed

Herring Run		Jones Falls		Gwynns Falls		Harbor	
Date	Type	Date	Type	Date	Type	Date	Type
1/14/2009	AS	1/12/2009	SIS	1/5/2009	SIS	1/9/2009	AS
1/22/2009	AS	1/22/2009	AS	1/13/2009	AS	1/13/2009	AS
1/26/2009	SIS	2/6/2009	AS	1/22/2009	AS	1/20/2009	SIS
2/3/2009	AS	2/9/2009	SIS	1/27/2009	AS	1/27/2009	AS
2/11/2009	AS	2/20/2009	AS	2/2/2009	SIS	2/3/2009	AS
2/19/2009	AS	2/25/2009	AS	2/10/2009	AS	2/11/2009	AS
2/23/2009	SIS	3/5/2009	AS	2/20/2009	AS	2/17/2009	SIS
3/6/2009	AS	3/11/2009	AS	2/24/2009	AS	2/25/2009	AS
3/11/2009	AS	3/16/2009	SIS	3/5/2009	AS	3/5/2009	AS
3/18/2009	AS	3/23/2009	AS	3/9/2009	SIS	3/11/2009	AS
3/24/2009	AS	3/31/2009	AS	3/24/2009	AS	3/17/2009	AS
3/30/2009	SIS	4/8/2009	AS	4/6/2009	SIS	3/23/2009	SIS
4/22/2009	AS	4/13/2009	SIS	4/23/2009	AS	4/1/2009	AS+E
4/27/2009	SIS	4/16/2009	AS	5/4/2009	SIS	4/21/2009	SIS
5/6/2009	AS	4/22/2009	AS	5/12/2009	AS	5/5/2009	AS+E
5/13/2009	AS	4/28/2009	AS	5/20/2009	AS	5/12/2009	AS
5/18/2009	SIS	5/5/2009	AS	6/1/2009	SIS	5/21/2009	AS
5/29/2009	AS	5/11/2009	SIS	6/9/2009	AS	5/27/2009	SIS
6/11/2009	AS	5/20/2009	AS	6/16/2009	AS	6/2/2009	AS
6/16/2009	AS	6/2/2009	AS	6/24/2009	AS	6/9/2009	AS
6/22/2009	SIS	6/8/2009	SIS	7/6/2009	SIS	6/15/2009	SIS
6/30/2009	AS	6/15/2009	AS	7/14/2009	AS	6/23/2009	AS
7/7/2009	AS	7/9/2009	AS	7/22/2009	AS	6/29/2009	AS+E
7/17/2009	AS	7/13/2009	SIS	7/29/2009	AS	7/9/2009	AS+E
7/21/2009	AS	7/23/2009	AS	8/3/2009	SIS	7/14/2009	AS
7/27/2009	SIS	8/10/2009	SIS	8/11/2009	AS	7/20/2009	SIS
8/4/2009	AS	8/17/2009	AS	8/18/2009	AS	7/31/2009	AS
8/13/2009	AS	8/25/2009	AS	8/25/2009	AS	8/6/2009	AS+E
8/18/2009	AS	9/1/2009	AS	8/31/2009	SIS	8/17/2009	SIS
8/24/2009	SIS	9/14/2009	SIS	9/1/2009	AS	8/27/2009	AS
9/15/2009	AS	9/21/2009	AS	9/2/2009	AS	9/2/2009	AS
9/28/2009	SIS	9/29/2009	AS	9/15/2009	AS	9/10/2009	AS+E
10/6/2009	AS	10/14/2009	AS	9/17/2009	AS	9/16/2009	AS
10/22/2009	AS	10/19/2009	SIS	9/23/2009	AS	9/21/2009	SIS
10/26/2009	SIS	10/28/2009	AS	9/30/2009	AS	10/2/2009	AS+E
11/3/2009	AS	11/3/2009	AS	10/5/2009	SIS	10/7/2009	AS
11/16/2009	SIS	11/9/2009	SIS	10/20/2009	AS	10/13/2009	SIS
12/1/2009	AS	11/17/2009	AS	10/30/2009	AS	10/22/2009	AS
12/10/2009	AS	11/23/2009	AS	11/2/2009	SIS	10/28/2009	AS
12/14/2009	SIS	11/30/2009	AS	11/10/2009	AS	11/4/2009	AS+E
		12/8/2009	SIS	11/17/2009	AS	11/10/2009	AS
		12/16/2009	AS	11/30/2009	AS	11/19/2009	SIS
				12/7/2009	SIS	11/24/2009	AS
				12/16/2009	AS	12/2/2009	AS+E
						12/10/2009	AS
						12/15/2009	SIS

Gray highlight indicates that the survey was done during, or just after, a precipitation event.
AS+E means that samples were collected for enterococci MPN counts during the ammonia screening survey.

Table D3a.3 shows a comparison of the number of sites visited and the number of water quality analyses performed for ammonia surveys for each major watershed for each year from 2003 through 2009.

Table D3a.3 Compare Number of Ammonia Screenings Surveys 2003-2009			
Program	Number of Surveys	Number of Stations Visited	Number of Water Quality Analyses Performed
2003 Herring Run Ammonia Screening	23	287	1,682
2004 Herring Run Ammonia Screening	32	370	1,999
2005 Herring Run Ammonia Screening	37	485	1,884
2006 Herring Run Ammonia Screening	45	530	1,116
2007 Herring Run Ammonia Screening	34	453	2,242
2008 Herring Run Ammonia Screening	34	454	2,442
2009 Herring Run Ammonia Screening	28	365	2,152
2003 Jones Falls Ammonia Screening	25	220	1,290
2004 Jones Falls Ammonia Screening	33	345	1,866
2005 Jones Falls Ammonia Screening	33	333	1,832
2006 Jones Falls Ammonia Screening	32	326	1,554
2007 Jones Falls Ammonia Screening	39	409	2,091
2008 Jones Falls Ammonia Screening	34	366	2,105
2009 Jones Falls Ammonia Screening	30	331	1,965
2003 Gwynns Falls Ammonia Screening	32	366	2,102
2004 Gwynns Falls Ammonia Screening	36	403	2,228
2005 Gwynns Falls Ammonia Screening	32	381	2,256
2006 Gwynns Falls Ammonia Screening	32	382	1,878
2007 Gwynns Falls Ammonia Screening	32	405	2,049
2008 Gwynns Falls Ammonia Screening	33	422	2,449
2009 Gwynns Falls Ammonia Screening	32	366	2,168
2003 Harbor Ammonia Screening	24	189	1,090
2004 Harbor Ammonia Screening	38	306	1,685
2005 Harbor Ammonia Screening	33	259	1,461
2006 Harbor Ammonia Screening	32	250	1,332
2007 Harbor Ammonia Screening	34	267	1,269
2008 Harbor Ammonia Screening	33	261	1,479
2009 Harbor Ammonia Screening	34	283	1,638

In February 2008, the Bureau of Water and Wastewater formed an inter-agency group to address sanitary sewer inputs to the storm drain system. This group meets monthly to discuss progress and develop plans to resolve ongoing and newly discovered illicit discharges of sanitary sewage. The Department of Housing and Community Development is the agency vested with the authority to force private property owners to remove their illicit connections. On September 9, 2009, Wazir Qadri, from the Bureau of Water and Wastewater, sent a letter to Eric Uttenreither, Superintendent of Plumbing & Building

Inspections in the Department of Housing and Community Development, listing nineteen private properties that are linked by investigations to illicit sewage discharge. Mr. Qadri asked that seven property owners on the 2400 block of Maryland Avenue be notified that the City wants to enter their properties to conduct dye testing, which is used to determine if a property has an illicit connection. He also asked that a violation notice be issued to each of six property owners whose properties have an illicit connection. He also asked that a violation notice be issued to two property owners on the 4000 block of Fairview Avenue whose connections to the sanitary sewer were leaking. A copy of this letter can be found in the Acrobat file "Private Properties Believed to Be Illicitly Discharging Sewage.pdf" on the CD-ROM accompanying this report. At the time of the writing of this report in May 2010, all of the property owners listed in Mr. Qadri's letter have been notified by the Department of Housing and Community Development. The owner of 2901 Chestnut Avenue has disconnected his sewer from the storm drain system- this has been verified by City staff by dye testing. None of the other problems have yet been addressed by the owners. The owners of the seven properties on Maryland Avenue have not yet set up appointments with the City so that the City can conduct dye testing on their properties.

Most PSTs are initiated when staff who are out doing surveys get unusually high readings from the field measurements. However, staff also can use the accumulated history of field and lab water quality data for a given station to decide to initiate a PST. On the CD-ROM accompanying this report, there is a folder entitled "City Streams Dry Weather Time Concentration Graphs". This folder contains 16 Excel files: each file has a set of concentration over time scatterplots for each of the 35 monitoring stations for a given parameter. The parameters graphed are: ammonia nitrogen (lab measurement), ammonia nitrogen (field measurements- this file has graphs for an additional 14 stations that are only visited during ammonia screening surveys), BOD, chlorides, COD, conductivity (measured in the lab), total copper, fecal coliform counts, fluoride, nitrate+nitrite nitrogen, sodium (only 4 stations), suspended solids, TKN, total nitrogen (estimated by adding together nitrate+nitrite nitrogen and TKN), total phosphorus, and total zinc. Please see Section E2, "Watershed Assessment from Chemical Monitoring", for more discussion about these time graphs.

Figure D3a.3 shows the number of PSTs initiated each year from 1997 through 2009 for each watershed. During 2009 there were 67 PSTs initiated. Table D3a.4 lists the number of PSTs initiated from 2004 through 2009, as well as a current breakdown of the counts of those PSTs for each status category. Figure D3a.4 presents a stacked-bar graph representation of the data in Table D3a.4.

Figure D3a.3 Number of PSTs Initiated in Each Watershed in Each Year 1997-2009

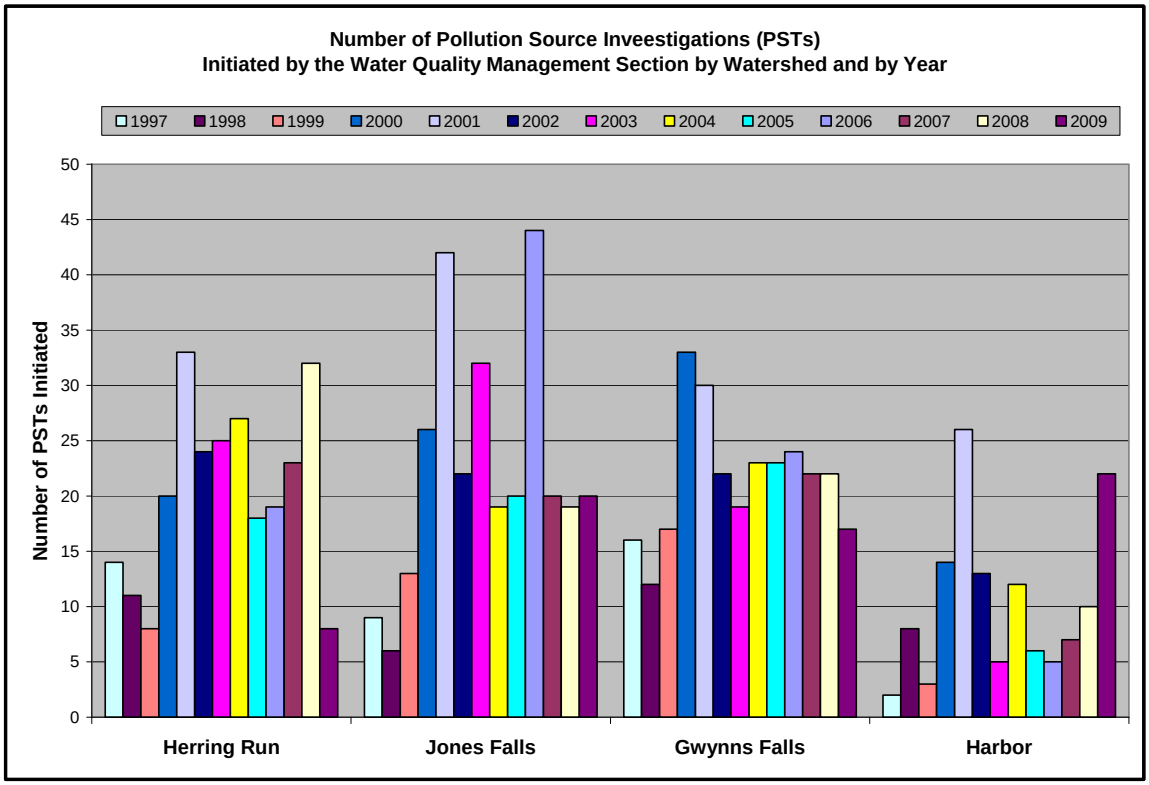
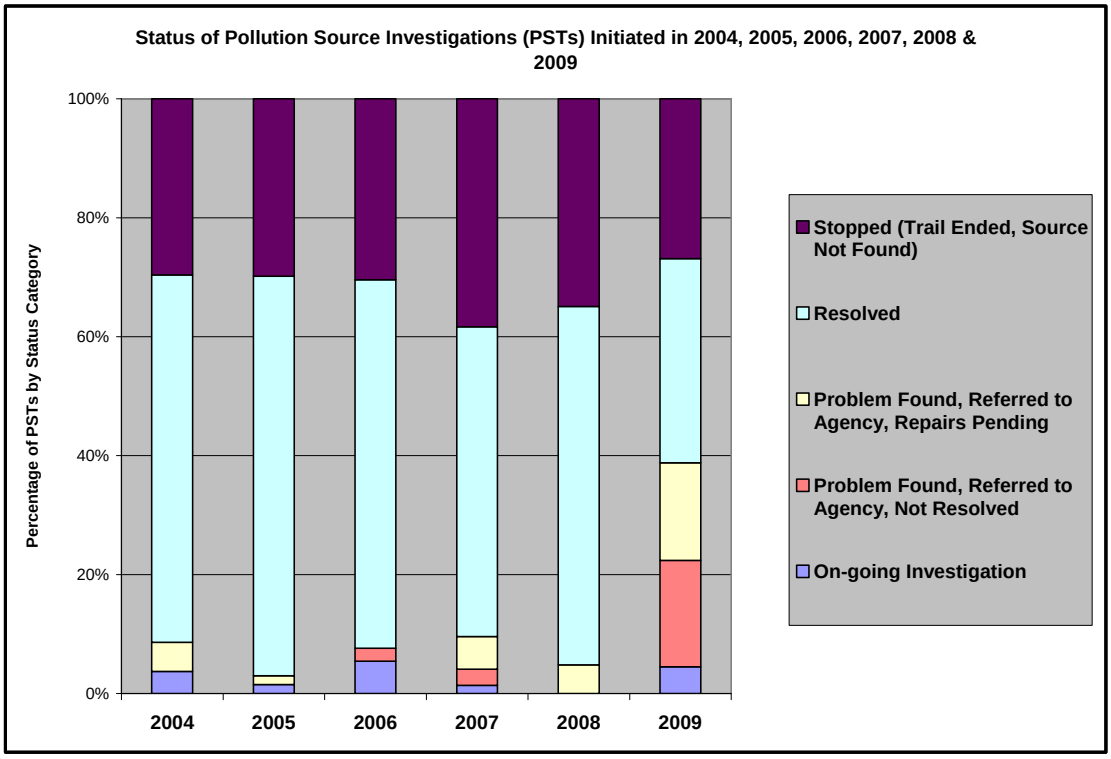


Table D3a.4 PST Counts by Status Code by Year

Status Code	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
On-going Investigation	3	1	5	1	0	3
Problem Found, Referred to Agency, Not Resolved	0	0	2	2	0	12
Problem Found, Referred to Agency, Repairs Pending	4	1	0	4	4	11
Resolved	50	45	57	38	50	23
Stopped (Trail Ended, Source Not Found)	24	20	28	28	29	18
Total Number of PSTs Initiated	**81**	**67**	**92**	**73**	**83**	**67**

Figure D3a.4 100% Stacked Bar Graph Comparing Percentages of PSTs by Status Category for 2004 through 2009



Waterview Avenue Chromium PST

The Waterview Avenue SIS station has a history of total chromium values that are usually very much higher than those at other SIS stations. Figure D3a.5 shows the total chromium concentrations for Waterview Avenue over the period of monitoring. In the 2005 Annual Report, the City reported on its unsuccessful efforts to find the source of the high total chromium readings at the Waterview Avenue station. Since then, staff have continued to collect monthly samples at the Waterview Avenue SIS station. The total chromium concentration for the July 20, 2009 sample was so much greater than that for the previous sample (see Table D3a.6); and the dissolved chromium concentration was far and away the highest level yet recorded at the station (see Table D3a.7). The decision was made to have the lab analyze each Waterview Avenue sample from September 2009 onward for dissolved metals concentrations- previous to that only one out of four monthly samples had been analyzed for dissolved metals concentrations. The concentrations of total and dissolved chromium have greatly fallen since October 2009.

Figure D3a.5 Total Chromium Concentrations for Waterview Avenue SIS Station
March 28, 2000 through January 19, 2010

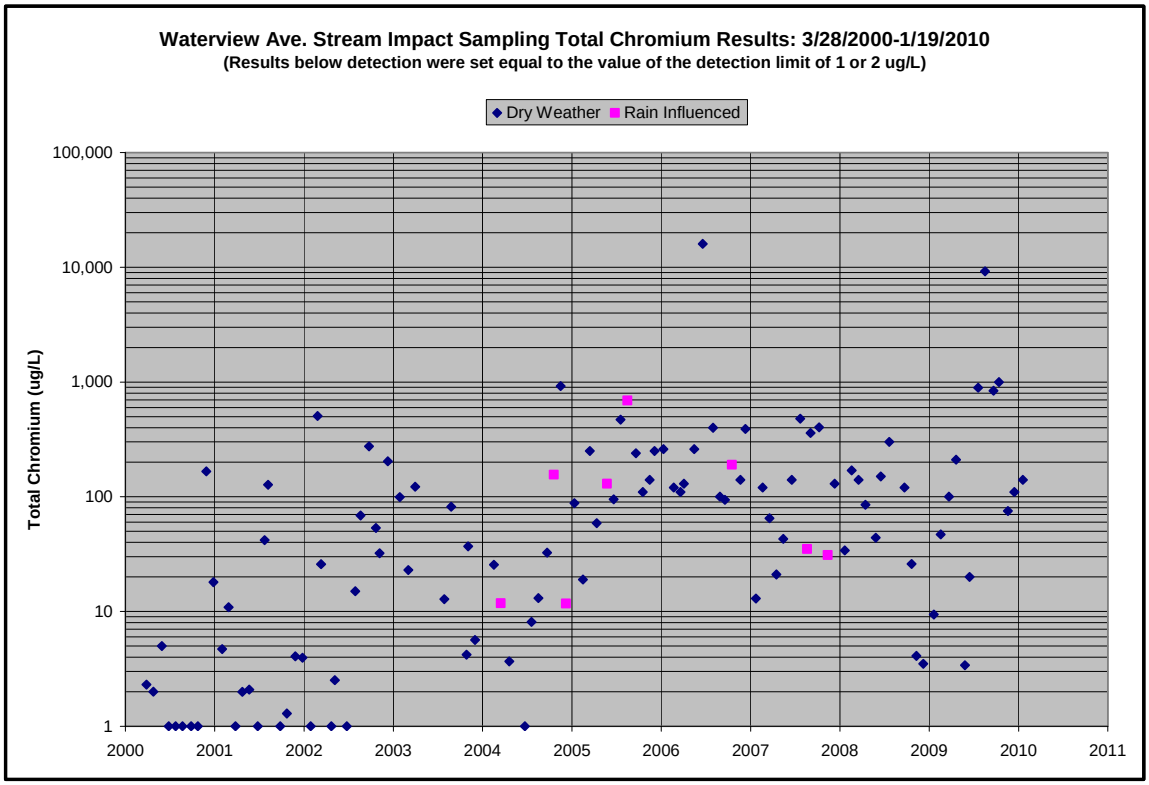


Table D3a.6 Waterview Avenue Metals Results Dry Weather Screening During 2009

Date	Total Chromium (ug/L)	Dissolved Chromium (ug/L)	Total Copper (ug/L)	Dissolved Copper (ug/L)	Total Lead (ug/L)	Dissolved Lead (ug/L)	Total Zinc (ug/L)	Dissolved Zinc (ug/L)	Total Hardness (mg/L)
1/20/2009	9		2.3		<2		46		
2/17/2009	47		7.4		5.00		70		
3/23/2009	100	<2	52.0	15.0	1.60	<0.05	64	54	
4/21/2009	210		13.0		2.90		82		
5/27/2009	3		4.0		0.78		62		
6/15/2009	20		6.7		<2		56		
7/20/2009	890	1,000	18.0	5.6	3.40	0.07	200	66	300
8/17/2009	9,200		3.4		0.47		55		
9/21/2009	840	200	49.0	4.7	4.80	<2	83	16	320
10/13/2009	1,000	680	22.0	4.8	2.30	<2	56	26	320
11/19/2009	75	<2	9.1	2.1	2.20	0.06	55	22	310
12/15/2009	110	2	8.1	2.2	<2	<2	68	32	300

Table D3a.7 Waterview Avenue: Compare Total & Dissolved Chromium Concentrations		
Date	Total Chromium (ug/L)	Dissolved Chromium (ug/L)
4/25/2000	2	<2
5/30/2000	<5	<5
4/24/2001	1.99	<1
10/23/2001	1.29	<1
11/27/2001	4.06	<1
12/26/2001	3.96	1.27
1/29/2002	<1	<1
3/12/2002	25.9	6.64
7/30/2002	15	<1
9/24/2002	275	3.22
12/10/2002	204	31.2
1/28/2003	99.2	29.6
11/4/2003	37	<2
9/21/2004	32.6	16.4
2/15/2005	19	<2
5/24/2005	130	<2
9/20/2005	240	2.8
1/10/2006	260	<2
5/16/2006	260	4
1/23/2007	13	<2
5/15/2007	43	<2
9/4/2007	360	2.1
1/22/2008	34	<2
5/27/2008	44	2.2
10/21/2008	26	<2
3/23/2009	100	<2
7/20/2009	890	1000
9/21/2009	840	200
10/13/2009	1000	680
11/19/2009	75	<2
12/15/2009	110	2.2
1/19/2010	140	<2
Gray highlight indicates that it rained during the survey done that day.		
Light yellow highlight indicates that the dissolved chromium concentration reported by the lab was greater than the total chromium concentration.		

b. **Exterior Lead Paint Removal Waste Control Program**
Special Projects of the Pollution Control Section of the Environmental Services Division administers this program. Table D3b.1 and Figure D3b.1 give annual statistics from this program for 2001 through 2009.

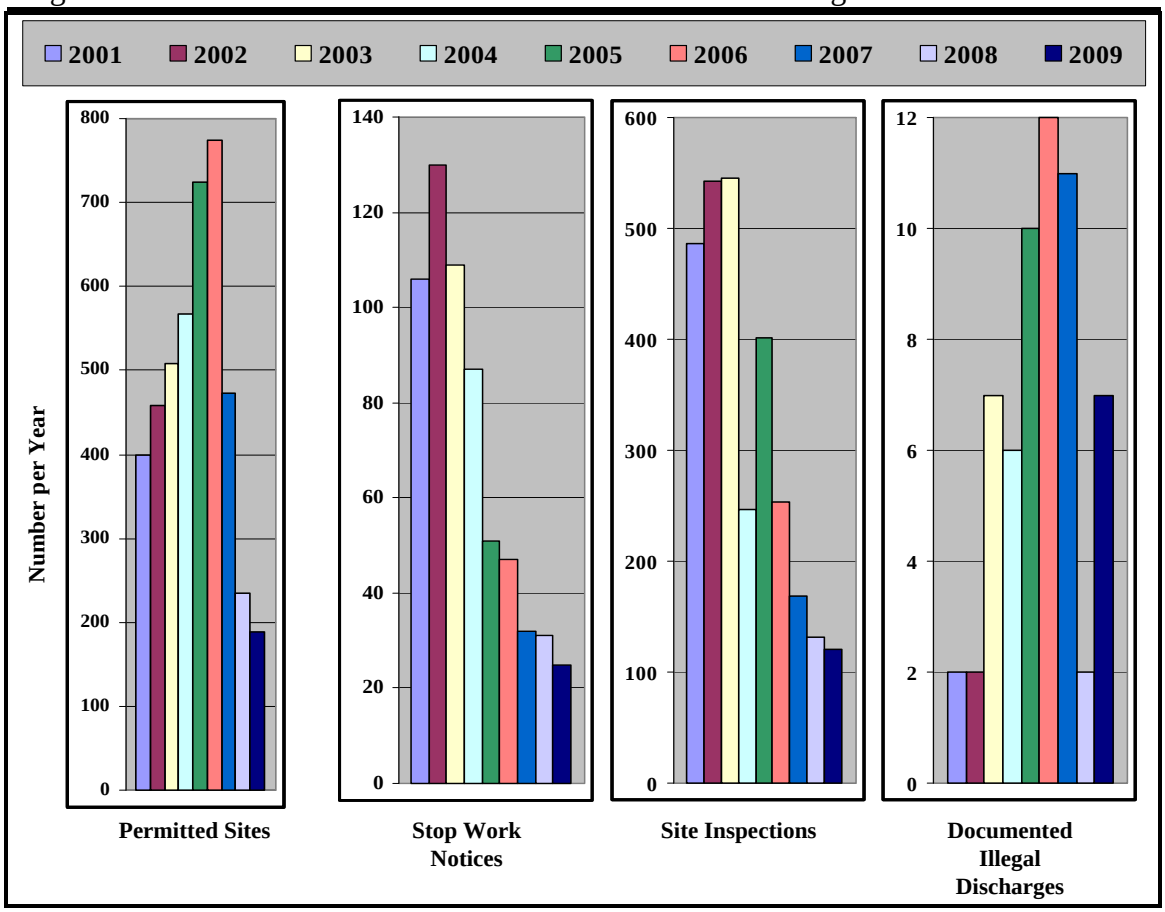
During 2009, Special Projects documented seven direct discharges of lead paint wastes to the storm drain system. Under the Enforcement Response Plan guidelines, sufficient grounds were established to warrant the assessment of civil penalties to separate companies in three of the incidents. In the remaining cases the companies were issued a notice of violation requiring a response that detailed corrective actions to be taken to avoid future violations.

In an update on the conclusion of a case that began in 2006, New Faces Masonry was found guilty of water pollution in District Court on February 27, 2009. The company owner was sentenced to thirty days of home confinement, fined $7,500 and given five years probation. Special Projects had conducted the investigation and presented the case to the Environmental Crimes Unit of the Attorney General's Office.

Table D3b.1 Exterior Lead Paint Removal Waste Control Program Statistics

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Number of permitted sites	400	459	509	568	724	774	473	234	189
Number of stop work notices	106	130	109	87	51	47	32	31	25
Number of site inspections	486	542	545	246	402	254	168	131	120
Number of documented illegal discharges to the storm drain system	2	2	7	6	10	12	11	2	7

Figure D3b.1 Exterior Lead Paint Removal Waste Control Program 2001-2009



4. **City Property Management**

a. **Wastewater Treatment Plants**

i. **Back River Wastewater Treatment Plant**

There is a pollution prevention plan that requires an annual walk-through inspection. A copy of the results of the walk-through inspection conducted on December 15, 2009, is provided in the Acrobat file "Back River WWTP SWPPP Inspection December 2009.pdf" on the CD-ROM accompanying this report. The inspector concluded that in general the plant was clean and well maintained- that good housekeeping measures are in place to keep trash to a minimum. The inspector stated that no reportable spills had occurred during 2009. The inspector noted these problems:

- The protective silt and wooden wall barrier surrounding the ferric tanks need repair.
- Lime storage area at the old centrifuge building has open bags of lime that need to be cleaned.

- An alternative D.A.F. polymer that was set up for easier truck delivery of polymer to the building is dripping polymer on the ground at the connection location. The area supervisor was notified of this problem.

Each of these problems was subsequently addressed by the plant's maintenance staff.

ii. **Patapsco Wastewater Treatment Plant (02SW0629)**
There is a pollution prevention plan that requires an annual walk-through inspection. A copy of the results of the walk-through inspection conducted on June 12, 2009, is provided in the Acrobat file "Patapsco WWTP SWPPP Inspection June 2009.pdf" on the CD-ROM accompanying this report. The inspectors listed 18 problems that they observed, and provided a table listing the work order numbers assigned to get each problem resolved. The inspectors stated that the majority of the problems had to do with trash and standing water; and that most areas that in the past had problems where oil, sewage, sludge or chemicals had spilled, were clean and free of pollutants during this inspection.

b. **Landfills**
The Bureau of Solid Waste has the responsibility to administer the pollution prevention plans for the City's seven landfills. The Quarantine Road Landfill is the only one that is currently active; the others have been closed (Reedbird in 1976, Cold Spring Lane in 1980, Monument Street in 1980, Pennington Avenue in 1981 and Bowley's Lane in 1985). The Bureau of Solid Waste conducted the annual inspections of the landfills in December 2009. Copies of the reports in Acrobat files can be found in the folder "City Landfill 2009 Inspection Reports" on the CD-ROM accompanying this report. Below are notes of the actions the City has taken or the plans the City has to resolve the problems observed by the inspector:

<u>Quarantine Road Landfill</u>
- Studies are currently being performed to improve the vegetative cover and thus decrease potential erosion
- In the fall, the Bureau of Solid Waste will study all landfills for the amount of sediment in the sediment basins and will make plans to remove sediment from basins as appropriate.

<u>Millennium Stockpile</u>
- Housekeeping completed

- Erosion was identified as an issue: it has been difficult to get grass to keep in the soil. The City has contracted KCI to look into how soil can be amended for growth.

Reedbird Landfill
- Housekeeping issues addressed

Monument Street Landfill
- Maintenance of the swales was addressed
- Housekeeping was addressed.

Bowley's Lane Landfill
- Housekeeping was addressed
- Trash was removed

Coldspring Landfill
- Some of the land of what used to be the Coldspring Landfill is now owned by Loyola Trust. In May 2010, an engineer from the Surface Water Management Division helped go through land records to help the Bureau of Solid Waste in the determination of whom –between the City and Loyola Trust- will be responsible for correcting the erosion problems described in the inspection report.

c. **Sub-stations**

Sub-stations are where vehicles owned by the City are maintained and fueled. Road salt is stored at some of the facilities. The Department of General Services has the responsibility to administer the stormwater pollution prevention plans (SWPPPs) for the City's sub-stations.

The EPA chose to inspect George L. Winfield Central Repair Garage at 3800 Biddle Street during their April 7-9, 2009, compliance inspection of the City's MS4 permit program. The inspection team found that the facility, which was already in operation, was not covered under a stormwater discharge permit and did not have a SWPPP. The City submitted a Notice of Intent (NOI) to have the George L. Winfield Central Repair Garage at 3800 Biddle Street covered under the general permit for stormwater discharges on April 14, 2009. MDE acknowledged the NOI in a letter to the Director of Public Works on May 15, 2009, and assigned this facility registration number 02SW2123. A copy of the NOI and the State's letter can be found in Appendix A of the Acrobat file "City Response to EPA Order CWA-03-2009-0312DN Nov52009.pdf" on the CD-ROM accompanying this report. The City completed a SWPPP for this facility- a copy can be found in the Acrobat file "George L. Winfield Central Repair Garage SWPPP.pdf" in the folder "Stormwater

Pollution Prevention Plans for City Properties" on the CD-ROM accompanying this report.

On April 17, 2009, the City submitted a Notice to Terminate (NOT) coverage under the general stormwater discharge permit for the following shops (listed with their registration numbers):

- Central Garage - 101 Dickman Street - 02SW1018
- Eastern Substation - 6700 Pulaski Highway - 02SW0706
- Fire Maintenance - 1407 Key Highway - 02SW0709.

A copy of the NOT can be found in Appendix B of the Acrobat file "City Response to EPA Order CWA-03-2009-0312DN Nov52009.pdf" on the CD-ROM accompanying this report.

The six facilities listed below (with their respective registration numbers) remain permitted under the General Discharge Permit for Stormwater Associated with Industrial Activities, Permit Number 02-SW. The SWPPPs for each of these facilities was updated in May 2010, and a copy of each SWPPP can be found in an Acrobat file in the folder "Stormwater Pollution Prevention Plans for City Properties" on the CD-ROM accompanying this report.

List of Facilities Registered Under the General Discharge Permit 02-SW:

- Midtown Fueling Station – 410 Front St. – 02SW0704
  Main fueling facility for the entire City, open 24 hours. Replenish fluids for vehicles.
- Fallsway Substation – 201 Fallsway – 02SW0707
  Open 16 hours (2 shifts). Provide preventive maintenance services of vehicles located in the downtown area. Conduct moderate repair for vehicles, motorcycle shop, carwash and towing.
- Northeastern Substation – 4325 York Road – 02SW0702
  Open 16 hours (2 shifts). Fueling station, provide moderate repairs on vehicles and houses the Department of Transportations' salt dome and towing.
- Mechanic Shop – 6400 Pulaski Highway – 02SW0708
  Open 8 hours. Repair mowing and complex equipment; towing.
- Western Substation – 239 North Calverton Street – 02SW0703
  Open 16 hours (2 shifts). Provide preventive maintenance for City vehicles, moderate repair and towing.
- Northwestern Substation – 4410 Lewin Avenue – 02SW0705
  Open 16 hours (2 shifts). Fueling station, provide moderate repairs on vehicles and houses the Department of Transportation's salt dome and towing.

d. **Northwest Transfer Station (02SW1307)**

The EPA chose to inspect this site during their April 2009 compliance inspection of the City's MS4 permit program. At that time, the City did not have a stormwater pollution prevent plan (SWPPP) for this site. The City completed a SWPPP in January 2010. The SWPPP describes the stormwater drainage system; details baseline and activity-specific BMPs employed at the facility; provides standardized reporting forms; and establishes a module for employee training. Baseline and activity-specific BMPs have been reaffirmed with employees and appropriate spill response materials were furnished throughout the facility. A copy of the SWPPP can be found in the Acrobat file "Northwest Transfer Station SWPPP.pdf" in the folder "Stormwater Pollution Prevention Plans for City Properties" on the CD-ROM accompanying this report.

The EPA Inspection Team noted several physical deficiencies throughout the facility (see page 16 of "Baltimore City MS4 Inspection April 2009 Final Report.pdf" on the CD-ROM accompanying this report). To address some of these deficiencies, the City is planning the following site improvements to be completed in July 2010:

- Replace the existing grate inlet at the end of the trench inlet with a sump inlet and "SNOUT" (or equivalent) oil/water/debris separators.
- At the other inlets, install catch basin inserts to collect debris, sediment and petroleum products discharging to the existing inlets.
- Remove rip rap and concrete from the channel along the sweeper pads. Amend soil with permanent seeding and check dams to provide potential treatment.
- Move electronics and waste oil above ground storage tanks (ASTs) to the sweeper pad, which is a lighter traffic area. Install a roof/cover over the container and tanks. Reduce the number of ASTs and replace ASTs with secondary containment tanks.

In addition, the City is planning these building modifications: replace the missing grates on the interior trench drain, and construct awnings at the compaction area. These improvements are considered "capital improvements", and consequently it will take more time to fund them. The City anticipates completing these improvements by October 2011.

5. **Road Construction and Maintenance**

a. **Street Sweeping and Storm Drain Cleaning**

Street Sweeping

Table D5a.1 and Figure D5a.1 present the number of road miles swept and amount of debris collected each year from 1999 through 2009 by the street sweepers operated by the Bureau of Solid Waste. Figure D5a.2 shows the relationship between miles of roads swept and amount of debris removed using the data from Table D5a.1. It is obvious what benefit would be derived from increasing the productivity of the street sweeping fleet back to the levels of production accomplished during 1999-2001. To provide some sense of the benefit of street sweeping and how it relates to the City's impervious area goal, see the discussion under "Street Sweeping and Inlet Cleaning" in Section F3, "Annual Reporting".

D5a.1 Street Sweeping Statistics 1999-2009

Year	Roads Swept (miles)	Debris Removed (tons)
1999	93,600	16,000
2000	145,600	16,897
2001	102,500	15,569
2002	74,400	14,437
2003	75,098	11,347
2004	42,098	8,686
2005	47,050	6,208
2006	80,000	7,261
2007	82,481	7,800
2008	79,075	9,308
2009	70,143	8,186

Figure D5a.1 Street Sweeping Statistics 1999-2009

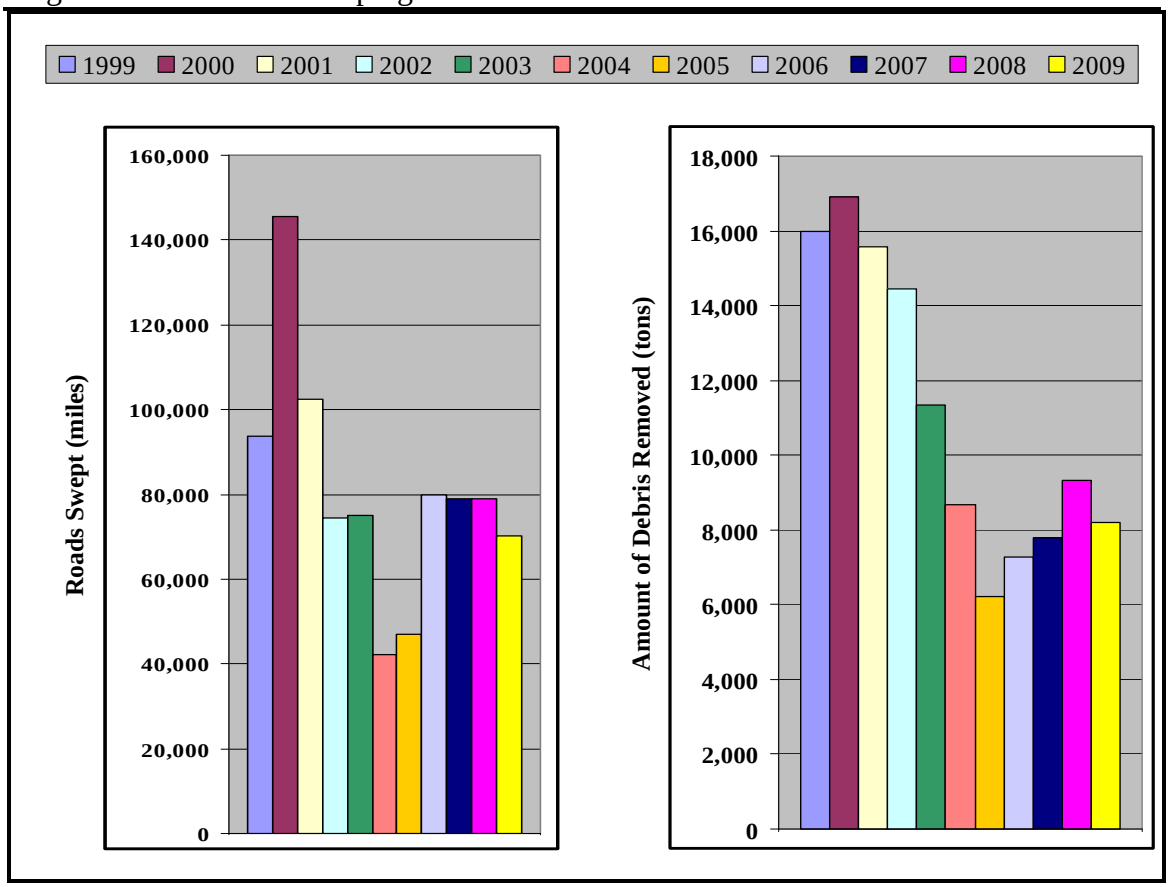
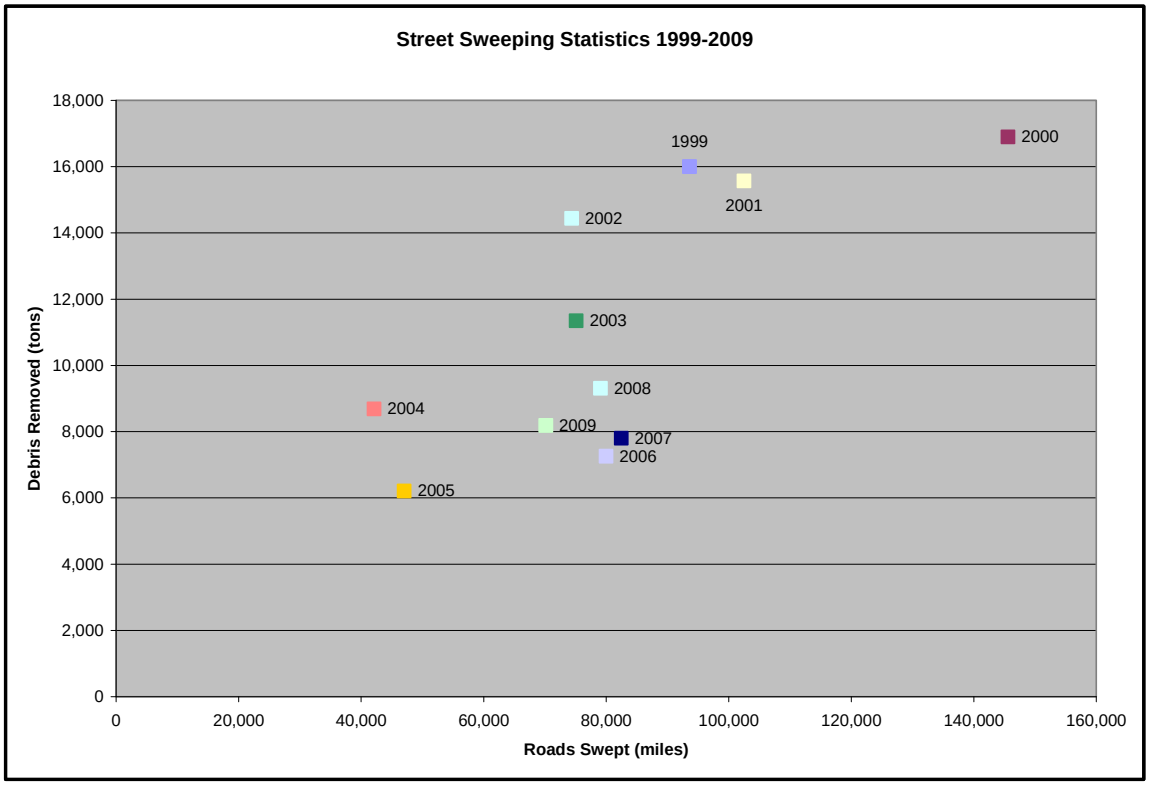


Figure D5a.2 Relationship Between Miles of Roads Swept and Amount of Debris Removed (Using 1999-2009 Statistics)



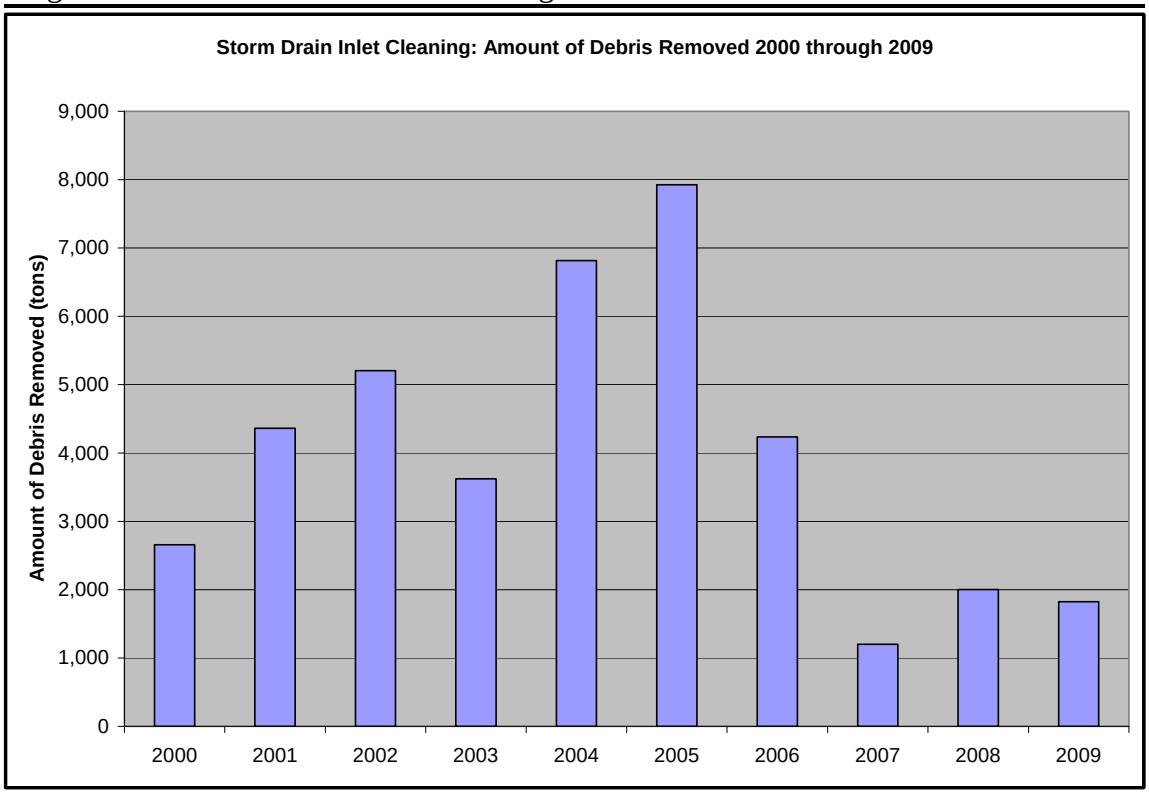
Storm Drain Cleaning

Table D5a.2 and Figure D5a.3 present the amount of debris removed by storm drain and inlet maintenance activities by the Water and Wastewater Maintenance Division from 2000 through 2009. During 2009 staff cleaned 2,783 inlets in response to complaints that they were choked, and cleaned another 3,619 inlets as part of the routine, pro-active maintenance plan. That total of 6,402 inlets cleaned for 2009 was an increase of 8% over the number of inlets cleaned during 2008. However, the amount of debris removed decreased for 2009 compared to 2008 by 9%.

Table D5a.2 Storm Drain and Inlet Cleaning Amount of Debris Removed 2000 through 2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Debris Removed (tons)	2,658	4,362	5,204	3,624	6,817	7,925	4,234	1,202	2,001	1,824

Figure D5a.3 Storm Drain Inlet Cleaning: Amount of Debris Removed 2000-2009



To provide some sense of the benefit of inlet cleaning and how it relates to the City's impervious area goal, see the discussion under "Street Sweeping and Inlet Cleaning" in Section F3, "Annual Reporting".

b. **Integrated Pest Management**

Table D5b.1 lists the type and amount of pesticide, herbicide and fertilizer used by the Department of Transportation each year for 1999 through 2009.

Table D5b.1 Bureau of Highways Pesticide, Herbicide and Fertilizer Usage

Product	**Unit**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Snapshot 2.5 TG	lb	150	150	0	0	0	0	0	0	0	0	0
Brushmaster	gal	18	15	0	10	3	40	60	120	100	135	125
Lesco Three Way	gal	78	33	0	70	0	0	0	0	0	0	0
Oust	gal	69	0	0	0	0	0	0	0	0	0	0
Round-up Pro	gal	171	145	256	160	120	120	125	175	125	140	135
Proxy	gal	20	10.5	14	14	5	0	0	0	0	0	0
Lesco Professional Turf Fertilizer	lb	1000	0	0	0	0	0	0	0	0	0	0
Scythe	gal	0	28	0	0	0	0	0	0	0	0	0
Sahara Herbicide	gal	0	0	0	20	0	0	0	0	0	0	0
Sahara Herbicide	lb	0	0	0	0	7	20	16	20	0	0	0

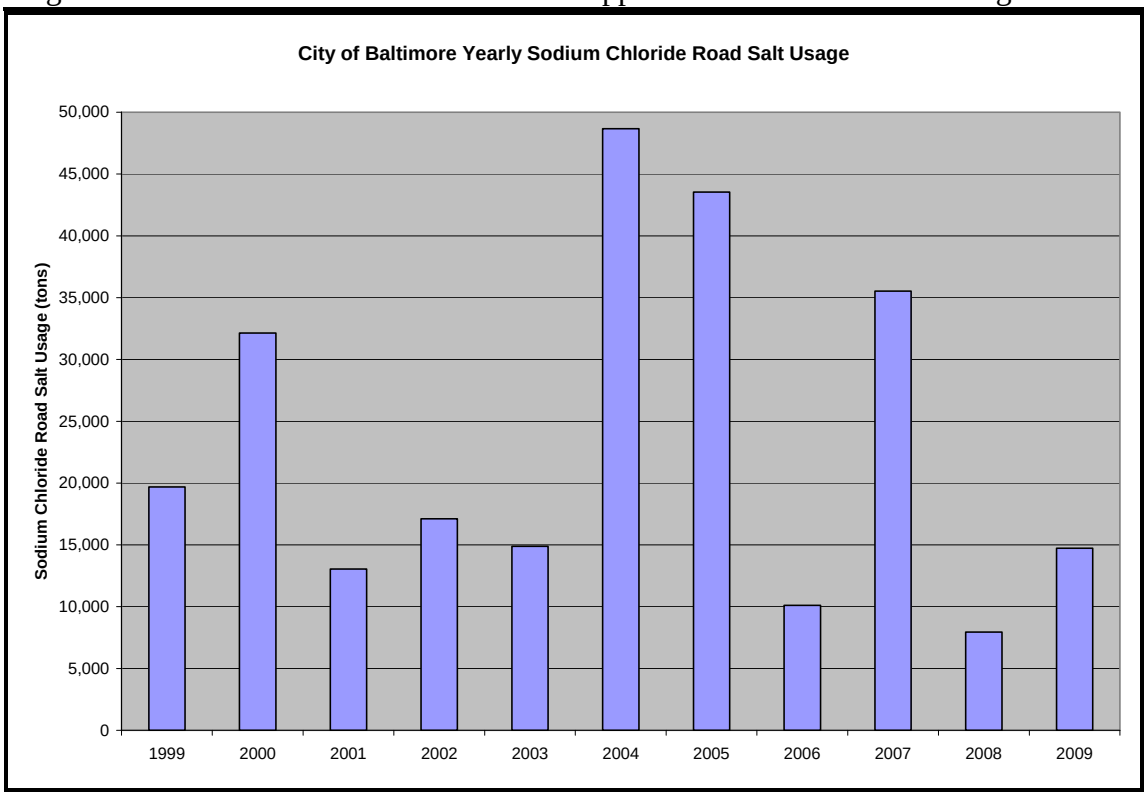
c. **Deicing Materials**

Table D5c.1 contains the amounts of deicing materials that the Department of Transportation applied each year for 1999 through 2009. Figure D5c.1 displays the amount of sodium chloride applied by year for 1999 through 2009.

Table D5c.1 Bureau of Highways De-icing Material Applied Data

Year	Sodium Chloride (tons)	Magnesium Chloride Flakes (tons)	Liquid Calcium Chloride (gal)	Calcium Chloride (tons)	Ice-Ban (gal)	Number of Snow Events	Snow Fall (in.)
1999	19,697	0	0	0	0	not known	12.2
2000	32,135	6.1	0	5	2,005	not known	35.0
2001	13,036	0	0	1	10,200	not known	6.0
2002	17,108	0	0	5	0	not known	3.5
2003	14,883	1	0	0	0	not known	56.5
2004	48,660	6	0	0	0	5	not known
2005	43,550	0	0	0	0	9	18.5
2006	10,106	0	0	0	0	1	13.0
2007	35,533	0	0	0	0	8	15.8
2008	7,944	0	0	0	0	4	4.3
2009	14,734	0	0	0	0	3	28.6

Figure D5c.1 Amount of Sodium Chloride Applied to Roads for 1999 through 2009



6. **Public Education**

Public outreach and education are at the foremost importance to environmentally sound stormwater management. They raise the level of awareness of the public about existing stormwater problems and environmentally friendly solutions. The primary goal of public outreach and education is pollution prevention. An aware resident will most likely change pollution-causing behaviors and seek to alleviate environmental problems.

<u>Water Quality Monitoring and Inspection Section Presentations</u>

Pollution Control Analysts from the Water Quality Monitoring and Inspection Section made presentations at the following venues:

- April 25, 2009, at the "Beyond the Board Walk" event sponsored by the Baltimore National Aquarium, staff presented an automated storm drain display and other displays that summarized the section's water quality monitoring and pollution tracking programs.
- At the Baltimore National Aquarium's anniversary in 2009, staff presented an automated storm drain display and other displays that summarized the section's water quality monitoring and pollution tracking programs.
- May 8, 2009, staff attended the career day festival at Lakeland Elementary and Middle School, and presented an automated storm drain display, water quality testing equipment and preserved macroinvertebrates collected from streams in the City.

Stormwater Public Education and Citizen Involvement Overview

The City's Department of Public Works (DPW), Bureau of Water and Wastewater and sister agencies led by Mayor Stephanie Rawlings Blake, believe that education is one of the least costly ways of improving the City's waterways. In this regard, education is the purest form of implementing citywide water quality improvements. Throughout 2009 and early 2010, we estimate that we presented to over 5,000 citizens about stormwater and water quality issues. Below is a sample of meetings in which stormwater was presented before groups of up to 100+ attendees by DPW staff in 2009-2010:

- DPW Discussions – 6 meetings
- Home Builders Association of Maryland-development community & Shari Wilson, MDE Secretary
- Environmental Roundtables- attended by over a dozen different environmental organizations. At the roundtables, DPW presented information about several projects and provided updates on activities such as the Total Maximum Daily Loads, MS4 permit status, stormwater management regulations and sanitary sewer overflows.
- Baltimore City Schools- Chief Facilities Manager
- Cherry Hill Community Stakeholders Meeting
- Surface Water Management- Community Relations Council meetings (9)
- Project BLUE (Baltimore Lessons in Urban Ecosystems): Project BLUE immerses students in the worlds of watersheds and ecosystems through engaging lessons and hands-on activities. During the program, students actively participate in experiences centered on how watersheds and ecosystems function and how they can become stewards for their environment.
- Blue Alleys Proposal with Jones Falls Watershed
- American Society of Civil Engineers- Stormwater Management Committee
- Franklin Square Elementary/Middle School students
- Baltimore Industrial Group- included Port Deputy Director
- Department of Housing and Community Development staff education
- Department of Transportation staff
- Department of Health staff
- Main Street Managers
- Baltimore Development Corporation staff

Legislation: 2010 Stormwater Ordinance

DPW staff met with a key group of stakeholders to develop a new Stormwater Ordinance for the City as mandated by Maryland's 2007 Stormwater Law. The group consisted of developers, attorneys, City staff and key consultants and met over eight months. The bill was heard in the Planning Commission (four hearings) and in the City Council and committees three times. These

hearings provided a forum for educating citizens not just about the bill, but the need for such a bill. Speakers about water quality were predominately in support of the bill. Stakeholders- including representatives from the watershed groups and the Baltimore Harbor Waterkeeper- provided testimony and amendments to the bill. This was a successful partnership of government and the citizens. The bill passed by the State deadline of May 4, 2010.

TreeBaltimore

TreeBaltimore is an effort to double the City's tree canopy by 2030. Their web address is http://www.baltimorecity.gov/Government/AgenciesDepartments/RecreationandParks/TreeBaltimore.aspx. This site has a link to the Tree Benefit Calculator, which allows anyone to make a simple estimation of the benefits individual street-side trees provide. This tool is based on i-Tree's (from the USDA Forest Service) street tree assessment tool called STRATUM. With inputs of location, species and tree size, users will get an understanding of the environmental and economic value trees provide on an annual basis.

Watershed Groups

The City has partnered with volunteers from the Jones Falls Watershed Association in a plan to place storm drain markers on 1,500 storm drains within the Jones Falls watershed.

Cleaner Greener Baltimore Campaign

The City started the Cleaner Greener Baltimore program in 2007. The program has continuously expanded as a partnership with the DPW Office of Communications, the Office of the Watershed Liaison, other agencies and the watershed associations. The campaign educates the public on stormwater issues. An integral part of this outreach includes how to address stormwater issues at their homes and neighborhoods by planting trees and improving streams and parks. Cleaner Greener Baltimore is also set up to reduce litter and to increase recycling. Over fifty meetings for the One-Plus-One solid waste and recycling campaign were held. More information about this program can be found through the City's website www.cleanergreenerbaltimore.org.

Stormwater Utility

A stormwater utility is proposed by the City to address funding shortfalls of $35-50 million dollars a year to the meet the MS4 permit and TMDLs. DPW has been meeting with key stakeholders and citizens (in over twenty community meetings) to explain the water infrastructure system, and specifically teaching attendees about dog feces, trash, fecal coliform bacteria and especially how they can help in the battle to reduce nutrients and improve water quality. The creation of the utility will go on the ballot in November 2011. DPW staff estimate there will be numerous community meetings to educate folks why the legislation and new fee is needed. The City is very

serious about meeting its permitting obligations and it is our responsibility to get citizens onboard.

Watershed Liaison

DPW has hired a Watershed Liaison, who coordinates communication between watershed groups, key agency personnel and acts as an outreach coordinator to educate the citizens on water quality. Duties include but are not limited to:

- Provide back-up and support for the City's Source Water Protection Plan
- Liaison with watershed associations and tributary strategy teams
- Coordinate and help capital improvements projects (CIP) staff with public outreach for capital projects
- Coordinate with other agencies within the City (Departments of Transportation, Housing and Community Development and Recreation and Parks) to integrate their activities into watershed plans
- Work with community organizations:
  - Jones Falls Watershed Association
  - Herring Run Watershed Association
  - Baltimore Harbor Watershed Association
  - Baltimore Harbor Waterkeeper
  - Gwynns Falls Watershed Association

Public Opinion Surveys

OpinionWorks surveyed four hundred City residents between December 28, 2009 and January 4, 2010, and conducted face-to-face focus groups on February 20, 2010, in order to better understand what the public knew about water quality and how best to reach out to them. OpinionWorks presented their report, "Stormwater: What Does the Public Know? What Are They Willing to Pay?" at the Baltimore City and Baltimore County State of Our Watersheds Conference on March 13, 2010. A copy of their PowerPoint presentation can be found at http://resources.baltimorecountymd.gov/Documents/Environment/Watersheds/bwaopinionworks.pdf. Here are the results of some of the questions asked in the telephone surveys and focus groups:

- Is stormwater treated? 58% were uncertain. However, 62% understand that trash washing down a storm drain ends up in the Harbor.
- Grading the Inner Harbor: D+
- Could we have a Harbor in which we can swim and fish? 70% said the City's streams and Harbor are not safe for swimming; 13% thought the waters are safe. 70% said having a "swimmable, fishable Harbor" is a goal the City should work towards. However, they cannot visualize this; it is a very long-term goal at best. The concept of a healthy Harbor is compelling to many.

- Does the public support a City stormwater fee? 34% were opposed, and 56% were in support.

Key Opinion Conclusions:

- The environment generally and clean water particularly are high priorities of voters.
- We are in a turbulent time politically, with economic uncertainty and little confidence in leaders.
- Stormwater fees met with skepticism, like any other tax or fee.
- When equity concerns are overcome, support grows strongly.
- When tied to health, greening, and jobs, strong support becomes a strong consensus.
- We must share these findings with political leaders to encourage the action the public wants.

<u>CitiTrack Service Request System</u>

The City has an online CitiTrack Service Request System as an alternative to dialing 311. The 311 Call Center is open seven days a week from 6:00 AM through 10:00 PM, including holidays. Citizens can use this service to report such water quality problems as hazardous waste; sewage or sewer investigation; stormwater inlet choked or damaged; dirty alley or street cleaning; or missed mixed refuse pickup. The complainant is given a service request tracking number. The requests feed into a mainframe computer and managers report in weekly meetings how many requests have been addressed with workable solutions. The Jones Falls, Herring Run and Gwynns Falls Watershed Associations have links to use the Baltimore 311 system. The City wants to know immediately about: sewer overflows, when a stream looks like paint or other chemicals have been dumped, fish kills, or any smells of gas or flammable substances. When reporting a sewer overflow, the City has worked with the watershed organizations to instruct complainants to:

- Send your Service Request Number to the watershed organization
- Give detailed directions and location
- If possible, meet in the field to show City staff the location.

<u>Baltimore City/Baltimore County Watershed Agreement (BWA) Status</u>

The City is working with Baltimore County DEPRM to implement the new Watershed Agreement Action Plan. This past year the City and County and other stakeholders have developed an Action Plan, with much community/stakeholder input. The key component is that implementation has discrete deadlines and is tracked by an outside party. Under education, the following tasks are required:

- Establish a BWA web-based program to disseminate and update information;
- Create a branded environmental awareness campaign; and
- Organize, advertise and conduct one-day awareness blitz programs.

Within the school system, the following actions are required:

- Ensure that BWA actions are incorporated into school curriculum;
- Expand water quality education covering the impacts of water quality on public health in school curricula; and
- Increase the number of schools achieving green school status.

City's Internet Pages

In last year's annual report we discussed the multiple sites within the City's web pages that describe the City's Cleaner and Greener Program. These sites not only relay what the City is doing to improve the health of the environment, but inform citizens what they can do as well. These pages are constantly being updated. Here are two other of the City's environmental education web addresses:

http://baltimorecity.gov/Government/AgenciesDepartments/PublicWorks/BureauofWaterWastewater/CustomerCare/WaterSavingTipsTricks.aspx

http://www.baltimorecity.gov/Government/AgenciesDepartments/RecreationandParks.aspx

Watershed 246 Management Plan

The City gave a $24,900 grant to the Baltimore Harbor Watershed Association to develop a watershed management plan for the Harris Creek watershed. DPW staff have been attending community meetings and tours as the process continues into 2010.

Rooftop Disconnection Project

The City is also collaborating with the Herring Run Watershed Association and Center for Watershed Protection in a rooftop disconnection project. 4,000 downspouts will be disconnected at 2,000 homes.

Water Conservation

According to the City's Office of Sustainability's 2009 Annual Report, the Department of General Service was awarded $2.4 million for water conservation projects in City facilities. The funds will be used to install low flow fixtures in over 30 fire stations and more than 20 libraries throughout the City and will save roughly $150,000 a year in water bills. The City government- as guided by the Water Resources Element (part of City's Comprehensive Plan), the Sustainability Plan and the Sustainability Commission- are pushing for water use reductions. The City is working on two key strategies:

- Conduct public education program on reducing water consumption
- Develop programs to inform and educate Baltimore residents about water use for purposes like landscaping, clothes and car washing, and bathing to help promote more sustainable behavior.

More information can be found at http://www.baltimoresustainability.org/conservation/waterUse.aspx.

Trash Water Wheel

In partnership with the Baltimore Harbor Watershed Association, the Bureau of Solid Waste and other partners are using a trash water wheel as a demonstration project to bring trash to the public's attention. Education is an important component in our goal of reducing trash in the Harbor.

Household Hazardous Waste

The City normally schedules and funds ($160,000) two household hazardous waste drop-off events per year. These are free for City residents. A fact sheet is given out for educating the citizenry about the effects of household hazardous waste on surface water. These web pages provide information: http://www.baltimorecity.gov/Government/AgenciesDepartments/PublicWorks/SingleStreamRecycling/HouseholdHazardousWaste.aspx

http://www.baltimorecity.gov/Government/AgenciesDepartments/PublicWorks/SingleStreamRecycling/HouseholdHazardousWaste/CFLFAQs.aspx.

Green Cleaning

GO GREEN CLEANING was introduced as a pilot program in City Hall and several other City buildings. The Department of General Services now uses environmentally friendly cleaning agents that are safer and healthier for the maintenance workers, building occupants, as well as for our planet. There is an online survey for educating citizens and allows them to provide feedback on recycled products, natural hand soap, green toilet cleaners, etc. (http://www.baltimorecity.gov/Government/AgenciesDepartments/GeneralServices/GoGreenCleaning.aspx).

Lawn Care and Landscape Management

What You Can Do:

- Make your lawn Bay-friendly by planting native grasses that do not require watering and reducing or eliminating use of chemicals and pesticides that eventually end up in our waters
- Avoid pouring toxic substances down storm drains that go directly into our streams
- Plant a tree! Trees prevent erosion by holding soil in place with their roots and they help soak up and treat chemicals in our stormwater.
- Conserve water at home by taking shorter showers, washing dishes by hand, and avoid keeping faucets turned on
- Do your part to prevent and clean up litter which can ultimately end up in our water bodies
- Get involved in your local watershed group

Residents are encouraged to bring unused lawn chemicals for Household Hazardous Waste Days. The Department of Recreation and Parks staff has been educated not to use any fertilizer or pesticides on over 6,000 acres of

parkland within the City boundaries (except minor amounts on some ball fields) and none is used on over 17,000 acres the City owns surrounding the three water supply reservoirs in Baltimore and Carroll Counties.

Litter Control, Recycling, and Composting

The staff of the Bureau of Solid Waste Office of Communications has greatly steeped up efforts to provide outreach on litter, trash, recycling, the One-Plus-One Campaign (going to once a week pick-up of trash and recyclables from twice a week). Because of this effort, recycling has increased dramatically. The components of the campaign include: the cost of litter, what the City is doing, and what citizens can do. Over 100 community meetings were held to educate citizens about service changes and effects of trash on streams and streets. It is DPW's responsibility to educate citizens to help in keeping streets and storm drains clean; and to talk about the consequences if they are not. Here is a brief list of the accomplishments related to trash and water quality:

- Increased mechanical sweeping operations to serve more than 1,500 miles of streets each week
- Provided customer service training to Solid Waste crews
- Moved Sanitation Code Enforcement to Housing to increase efficiency of management and service delivery
- Moved Baltimore Housing Cleaning and Boarding to Solid Waste augmenting and complimenting existing cleaning operations
- Scrubbed Solid Waste yards
- Extended citizen drop-off summer hours at all Solid Waste district service centers
- Focused resources and energy on placing and maintaining more public trashcans along gateways and at bus stops across the City with dedicated collection crews to maintain the cans in the most heavily traveled corridors
- Established cleaning of neighborhood parks assigned to Solid Waste as a 7-day operation during the summer months
- Reduced response time for cleaning complaints (dirty alleys, backyards, lots) from 21 to 14 days.

RecycleMORE

RecycleMORE was a citywide neighborhood recycling contest. The goals were to increase community partnerships that promote a cleaner, greener City, increase household recycling through neighborhood-driven outreach and educational efforts, and increase Baltimore's overall recycling tonnage. Jointly sponsored by the Department of Public Works and the Initiative for a Cleaner Greener Baltimore, the contest tracked recycling tonnage from participating communities from January 1 through March 26, 2010. The neighborhood that recycled the most won an appreciation day block party. The winner was announced at the Mayor's Spring Cleanup Kickoff, April 17, 2010.

E. Watershed Assessment and Planning

1. Watershed Management Plans

There are five watersheds at the 8-digit scale into which parts of the City drain. These are listed in Table E1.1. The City completed watershed studies of Gwynns Falls in 2004, and Jones Falls and Herring Run in 2008. At this time, the City only has a plan for the small Watershed 263 within the Baltimore Harbor watershed. The City has not yet commissioned any plan for the very small portion of the City that drains into the Patapsco River (basin 02130906). Consequently, the City has not met the requirement listed in Section F1 of the MS4 permit which expired January 2010. Table E1.2 lists the studies the City has completed to date.

The City has hired Parsons Brinckerhoff to assess existing watershed plans to determine updates needed to be in compliance with current and anticipated requirements based on EPA, City, and region-specific provisions. Parsons Brinckerhoff created a set of criteria listed in the Acrobat file "Parsons Brinckerhoff Summary of Environmental Requirements Applicable to Watershed Plans.pdf" for this process. With this analysis, the City has started the preparation to meet the anticipated requirements for management plans in the City's next MS4 permit.

Table E1.1 Baltimore City Watersheds

Major Watersheds	MDE 8-digit Watershed Number	Subwatersheds
Back River	**2130901**	West Branch Herring Run
		East Branch Herring Run
		Herring Run Mainstem
		Chinquapin Run
		Tiffany Run
		Armistead Run
		Biddison Run
		Moores Run
		Redhouse Run
		Unnamed Tributary
		Stemmers Run
Baltimore Harbor	**2130903**	SW Harbor
		Middle Branch
		Inner Harbor
		East Patapsco
Jones Falls	**2130904**	Western Run
		Stony Run
		Lower Jones Falls
Gwynns Falls	**2130905**	Gwynns Run North
		Gwynns Run South
		Lower Gwynns Falls
		Middle Gwynns Falls
		Dead Run
		Maidens Choice
		Powder Mill
Patapsco River	**2130906**	Lower North Branch

Table E1.2 Baltimore City Watersheds Plans

Planning Area	Major Watershed	Report Title	Year
Upper Back River	Back River	Small Watershed Action Plan	2008
Biddison Run	Back River	Stormwater Improvement Feasibility & Conceptual Design	2006
Herring Run	Back River	Stream Assessment & Restoration Concept Plan	2004
Moores Run	Back River	Watershed Restoration Plan	2001
Watershed 263	Baltimore Harbor	Management Plan	2006
Lower Jones Falls	Jones Falls	Small Watershed Action Plan	2008
Western Run	Jones Falls	Stream Assessment	2004
Stony Run	Jones Falls	Watershed Restoration Plan	2001
Gwynns Falls	Gwynns Falls	Water Quality Management Plan	2004
Powder Mill	Gwynns Falls	Targeted Watershed Assessment	2004
Maidens Choice	Gwynns Falls	Watershed Restoration Plan	2001

2. **Watershed Assessment from Chemical Monitoring**
The folder "City Streams Dry Weather Time Concentration Graphs" on the CD-ROM accompanying this report contains a set of sixteen Excel files. Each Excel file contains a set of concentration versus sampling date time graphs for a given water quality parameter for samples collected during dry weather for all the City's stations, including the two Biddison Run stations (discussed in Section F2a), and the four Moores Run stations (discussed in Section G1a). The parameters that were graphed are (alphabetically by file name): ammonia nitrogen (lab measurement); ammonia nitrogen (field measurement); biological oxygen demand (BOD 5-day); chlorides; chemical oxygen demand (COD); conductivity (lab measurement); total copper; fecal coliform counts; fluoride; nitrate+nitrite nitrogen; sodium (only measured for the stations Powder Mill; Dead Run Dnst.; Maidens Choice and Radecke Ave.); total suspended solids; total Kjeldahl nitrogen (TKN); total nitrogen (estimated by the sum of TKN with nitrate+nitrite nitrogen); total phosphorus; and total zinc. Starting on September 10, 2003, the City's lab analyzing these samples switched to automated technology made by Skalar to measure nitrogen and phosphorus. The City believes that there is a difference in the results comparing the samples before and after this switch. On each graph for nitrogen and phosphorus parameters measured in the City's lab there is a green vertical line marking the date the switch was made. Beginning with samples from January 20, 2009, total phosphorus, TKN and nitrate+nitrite nitrogen were analyzed by a contracted lab because the State de-certified the City's lab for measuring those analytes. On each graph for nitrogen and phosphorus parameters there is a red vertical line marking this date. The concentrations since the switch to the contracted lab appear lower than they were for the period (September 10, 2003 through January 20, 2009) that the City's lab was using the Skalar equipment to measure phosphorus and nitrogen.

Dissolved Metals Analysis

Each year the City analyses three out of twelve batches of monthly SIS samples from each watershed for total hardness and dissolved copper, lead and zinc. This has been the protocol since March 2003. An analysis was done to find out how often the samples exceeded the State's freshwater chronic criteria for these metals. Formulas for adjusting the freshwater criteria for hardness were taken from these reports prepared by MDE: Water Quality Analysis of Copper and Lead for the Jones Falls in Baltimore County and Baltimore City, Maryland and Water Quality Analysis of Zinc Contamination for the Jones Falls Baltimore City and Baltimore County, Maryland.

There were 758 dry weather samples to examine after combining the results from all the SIS stations for samples collected through December 2009. The total hardness results for 77 samples were above 400 mg/L, putting them out of range for this set of adjustment curves. Almost all of these samples were

from stations around the Harbor; one sample was from the Hamilton Avenue station in the Herring Run watershed. One dissolved lead result, reported by the lab as below the reporting limit, could not be used because the hardness-adjusted freshwater chronic criterion for lead for this sample was below the lab's reporting limit for lead for this sample. Out of the remaining samples, 7 of 681 samples (1%) had a dissolved copper concentration that exceeded the hardness-adjusted freshwater chronic criterion; 3 of 680 samples (less than 1%) had a dissolved lead concentration that exceeded the hardness-adjusted freshwater chronic criterion; and none of the 678 samples had a dissolved zinc concentration that exceeded the hardness-adjusted freshwater chronic criterion.

Three of the samples that exceeded the copper freshwater chronic criterion came from the Central & Lancaster station in the Direct Harbor watershed. There were only 9 samples that could be evaluated at this station; thus 33% of the samples from this station exceeded the copper freshwater chronic criterion. Another station in this watershed, Warner & Alluvion, had 2 of 12 (17%) of its dissolved copper samples above the hardness-adjusted freshwater chronic criterion. The Gwynns Falls Pkwy. station in the Gwynns Falls watershed and the Smith Ave. station in the Jones Falls watershed each had 1 of 19 (5%) of their dissolved copper samples above the hardness-adjusted freshwater chronic criterion.

Three stations had one dissolved lead sample exceed the hardness-adjusted freshwater chronic criterion: Stony Run (1 out of 19 samples) in the Jones Falls watershed, and Hamilton Avenue (1 out of 68 samples) and Mary Avenue (1 out of 69 samples) in the Moores Run sub-watershed of the Herring Run watershed. This analysis was also applied to the samples from Watershed 263 (discussed in Section F2b) and Moores Run (discussed in Section G1a.).

E. Coli and Enterococci MPN Count Analysis

After June 2008, the City stopped having the SIS samples examined for fecal coliform MPN counts. Beginning in November 2008, the City began having the samples examined for e. coli MPN counts. Beginning it April 2009, the City switched to having enterococci MPN counts done on the Direct Harbor watershed SIS stations and the Lombard St. station in the Jones Falls watershed- enterococci are considered a better indicator to use for marine waters. Also, beginning in April 2009, the City begin collecting samples for enterococci MPN counts at the marine water SIS stations twice each month.

In 2009, the City formed a sampling partnership with the Baltimore Harbor WATERKEEPER, a volunteer organization. The Baltimore Harbor WATERKEEPER staff were worried about the bacterial contamination of the Harbor, and curious why it was not listed as impaired by bacteria on the State's list. Baltimore Harbor WATERKEEPER staff drew up a plan to

collect samples by boat, and the City agreed to pay the laboratory costs to have enterococci MPN counts done on the samples. Baltimore Harbor WATERKEEPER collected samples at 11 stations in the Middle Branch and 9 stations in Baltimore Harbor. Sampling was done from May through December 2009. During 24 sampling runs, Baltimore Harbor WATERKEEPER staff made 223 station sample visits, and submitted 47 quality control samples- for a total of 270 enterococci MPN counts performed by the contracted laboratory.

Table E2.1 lists the e. coli MPN count geometric mean and the percentage of dry weather samples for which the e. coli MPN count was at below each of the four water contact use categories for each freshwater sampling station. Figure E2.1 depicts the percentage of dry weather samples for which the e. coli MPN count was at below the infrequent full body contact recreation guideline (576 MPN/100 ml) for each freshwater sampling station.

Table E2.2 lists the enterococci MPN count geometric mean and the percentage of dry weather samples for which the enterococci MPN count was at below each of the four water contact use categories for each marine water sampling station sampled by either the Baltimore Harbor WATERKEEPER or City staff. Figure E2.2 depicts the percentage of dry weather samples for which the enterococci MPN count was at below the infrequent full body contact recreation guideline (500 MPN/100 ml) for each marine water sampling station. Between the two groups of stations done by the Baltimore Harbor WATERKEEPER, the Middle Branch stations were better than the Baltimore Harbor stations. The marine water SIS stations sampled by City staff were much worse than either of the two sets of stations sampled by the Baltimore Harbor WATERKEEPER. The City's marine water SIS stations are along the shore: they are next to where large stormwater outfalls discharge. Since the Baltimore Harbor WATERKEEPER sampled from a boat, their samples were away from the shoreline.

Table E2.1 E. Coli MPN Counts: Geometric Means and Comparision to State's Criteria for Frequency of Use (November 2008 through January 2010)

Station	ID	Number of Samples	Geometric Mean	Per Cent At or Below Frequent Full Body Contact Recreation (235 MPN/100 ml)	Per Cent At or Below Moderately Frequent Full Body Contact Recreation (298 MPN/100 ml)	Per Cent At or Below Occasional Full Body Contact Recreation (410 MPN/100 ml)	Per Cent At or Below Infrequent Full Body Contact Recreation (576 MPN/100 ml)	Per Cent Above Infrequent Full Body Contact Recreation (576 MPN/100 ml)
Herring Run Watershed								
PERRING PKWY	HR-1	14	1,390	0%	0%	14%	29%	71%
MT. PLEASANT GC	HR-2	14	2,144	14%	14%	14%	14%	86%
CHINQUAPIN RUN	HR-3	14	798	14%	14%	14%	36%	64%
TIFFANY RUN	HR-4	14	458	29%	29%	50%	71%	29%
HARFORD RD.	HR-5	14	1,112	7%	7%	21%	21%	79%
WRIGHT AVE.	HR-6	14	584	21%	21%	36%	50%	50%
PULASKI HWY.	HR-7	14	851	0%	0%	14%	43%	57%
Moores Run Sub-watershed								
MARY AVE.	MR-1	14	3,952	0%	0%	0%	0%	100%
HAMILTON AVE.	MR-2	14	2,834	0%	7%	7%	7%	93%
RADECKE AVE.	MR-3	14	2,142	0%	0%	21%	21%	79%
BIDDLE ST. & 62ND ST	MR-4	14	968	14%	14%	29%	36%	64%
Biddison Run Sub-watershed								
BIDDISON RUN UPSTRM	BR-1	11	1,108	18%	36%	45%	45%	55%
BIDDISON RUN DWNSTRM	BR-2	11	892	45%	45%	55%	55%	45%
Jones Falls Watershed								
SMITH AVE.	JF-1	15	208	60%	60%	67%	73%	27%
WESTERN RUN	JF-2	15	626	27%	27%	33%	47%	53%
STONY RUN	JF-3	15	123	87%	87%	93%	93%	7%
Gwynns Falls Watershed								
POWDER MILL	GF-1	15	990	7%	7%	33%	33%	67%
PURNELL DR.	GF-2	13	551	23%	23%	38%	69%	31%
DEAD RUN DNST.	GF-3	13	217	46%	54%	77%	77%	23%
GWYNNS FALLS PKWY.	GF-4	13	164	54%	54%	62%	69%	31%
GRUN HILTON ST.	GF-5	13	3,465	0%	0%	0%	0%	100%
GF HILTON ST.	GF-6	13	312	46%	46%	62%	69%	31%
MAIDENS CHOICE	GF-7	13	308	46%	46%	62%	77%	23%
GRUN CARROLL PARK	GF-8	13	16,831	0%	0%	0%	0%	100%
WASHINGTON BLVD.	GF-9	13	1,611	0%	0%	8%	15%	85%

Figure E2.1 Percent E. Coli MPN Counts At or Below the Infrequent Full Body Contact Recreation Guideline (576 MPN/100 ml)

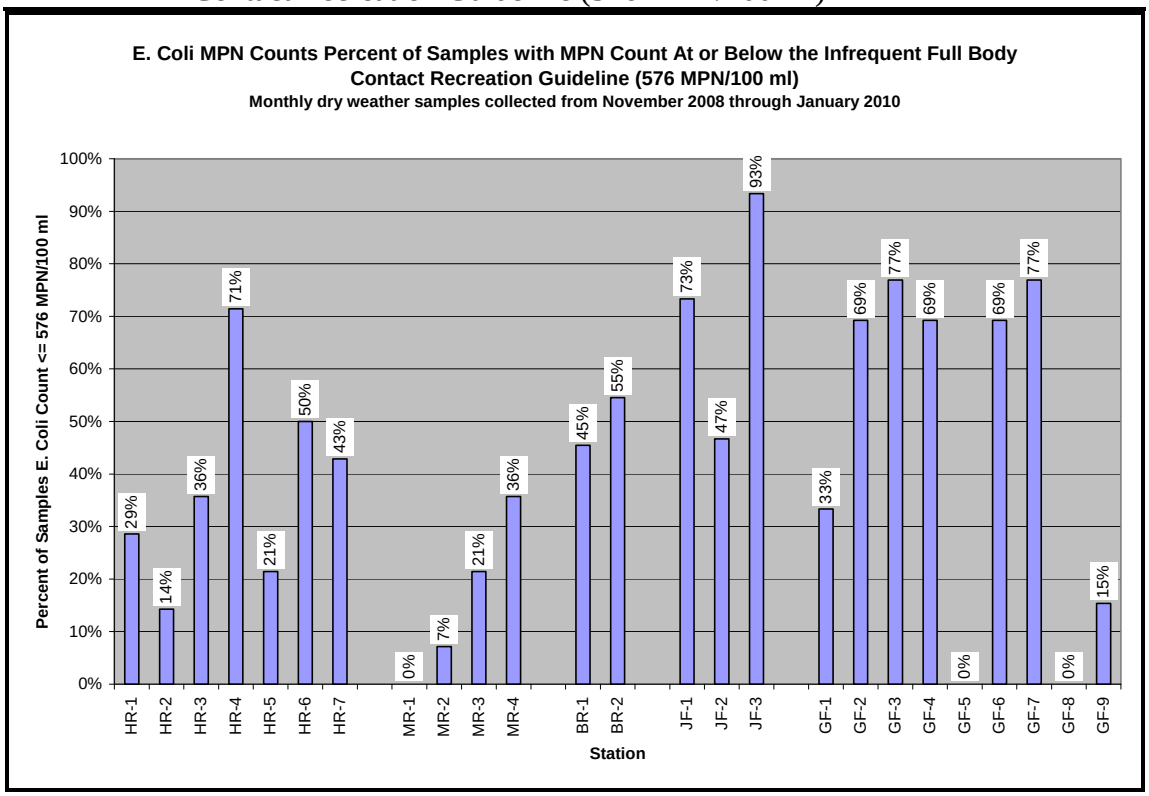
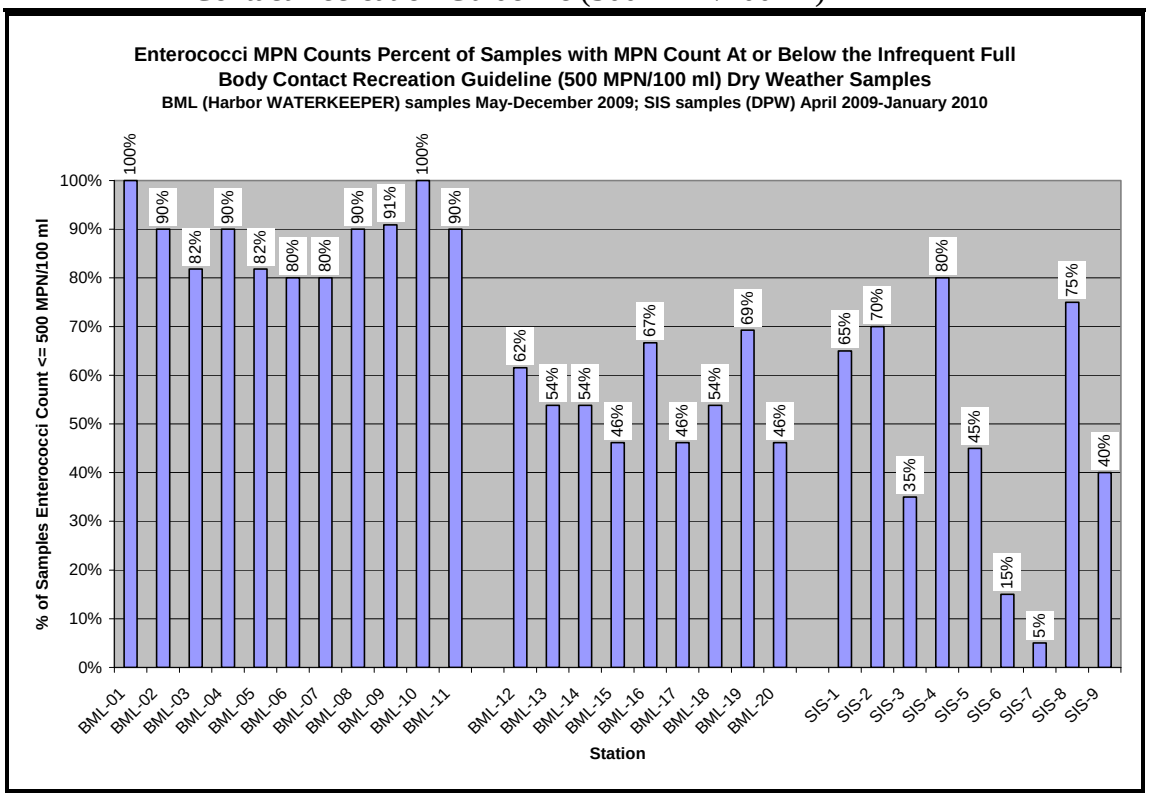


Table E2.2 Enterococci MPN Counts: Geometric Means and Comparision to State's Criteria for Frequency of Use (April 2009 through January 2010)								
Station	Station ID	Number of Samples	Geometric Mean	Per Cent At or Below Frequent Full Body Contact Recreation (104 MPN/100 ml)	Per Cent At or Below Moderately Frequent Full Body Contact Recreation (158 MPN/100 ml)	Per Cent At or Below Occasional Full Body Contact Recreation (275 MPN/100 ml)	Per Cent At or Below Infrequent Full Body Contact Recreation (500 MPN/100 ml)	Per Cent Above Infrequent Full Body Contact Recreation (500 MPN/100 ml)
WATERKEEPER Middle Branch Stations								
BML-01	BML-01	3	14	67%	67%	67%	100%	0%
BML-02	BML-02	10	56	60%	60%	60%	90%	10%
BML-03	BML-03	11	38	64%	73%	82%	82%	18%
BML-04	BML-04	10	26	80%	80%	90%	90%	10%
BML-05	BML-05	11	23	73%	82%	82%	82%	18%
BML-06	BML-06	10	35	70%	70%	80%	80%	20%
BML-07	BML-07	10	56	60%	60%	70%	80%	20%
BML-08	BML-08	10	14	80%	80%	90%	90%	10%
BML-09	BML-09	11	14	82%	82%	91%	91%	9%
BML-10	BML-10	11	6	91%	91%	91%	100%	0%
BML-11	BML-11	10	24	70%	70%	80%	90%	10%
WATERKEEPER Baltimore Harbor Stations								
BML-12	BML-12	13	295	31%	31%	46%	62%	38%
BML-13	BML-13	13	348	31%	31%	54%	54%	46%
BML-14	BML-14	13	485	15%	31%	46%	54%	46%
BML-15	BML-15	13	806	23%	23%	31%	46%	54%
BML-16	BML-16	12	108	42%	58%	67%	67%	33%
BML-17	BML-17	13	2,507	8%	15%	23%	46%	54%
BML-18	BML-18	13	371	38%	46%	46%	54%	46%
BML-19	BML-19	13	258	23%	31%	38%	69%	31%
BML-20	BML-20	13	284	31%	38%	38%	46%	54%
Direct Harbor Watershed SIS Stations								
REEDBIRD AVE.	SIS-1	20	220	40%	45%	55%	65%	35%
WATERVIEW AVE.	SIS-2	20	372	15%	15%	35%	70%	30%
WARNER & ALLUVION	SIS-3	20	814	10%	10%	20%	35%	65%
LIGHT ST.	SIS-4	20	81	50%	50%	55%	80%	20%
CENTRAL & LANCASTER	SIS-5	20	889	10%	15%	30%	45%	55%
LAKEWOOD AVE.	SIS-6	20	2,727	0%	0%	10%	15%	85%
LINWOOD AVE.	SIS-7	20	13,299	0%	0%	0%	5%	95%
JANEY RUN	SIS-8	20	110	55%	55%	60%	75%	25%
LOMBARD ST.	SIS-9	15	947	13%	13%	20%	40%	60%

Figure E2.2 Percent Enterococci MPN Counts At or Below the Infrequent Full Body Contact Recreation Guideline (500 MPN/100 ml)



Total Phosphorus and Total Nitrogen Analyses

The City has always had its stream samples analyzed for total phosphorus, total Kjeldahl nitrogen and nitrate+nitrite nitrogen. From November 1997 through January 12, 2010, the dry weather stream samples were analyzed by one of the City's labs. In early 2010, the State review of this City lab found problems with the lab's abilities to measure phosphorus and nitrogen. Thus, beginning with samples collected on January 20, 2010, the City used a contracted lab with appropriate certification to analyze the samples for phosphorus and nitrogen.

Table E2.3 lists the percentages for each station of the dry weather samples analyzed by the contracted lab which were at or exceeded these nutrient concentration guidelines: total phosphorus at 0.1 mg/L, and total nitrogen (estimated by the sum of total Kjeldahl nitrogen and nitrate+nitrite nitrogen) at 3 mg/L. Following a convention that the State used in its Maryland Water Quality Inventory, 1993-1995, a water quality level was assigned for each station's sample sets: "normal" (shown by light green highlight) if the percentage was less than 11%; "elevated" (shown by light yellow highlight) if it was between 11% and 25%; and "high" (shown by rose highlight) if it was greater than 25%. The Direct Harbor set of stations have the worst problems with phosphorus and nitrogen; the Herring Run watershed stations have the least problems with phosphorus and nitrogen. The worst stations are Linwood

Ave. in the Direct Harbor watershed and GRUN CARROLL PARK in the Gwynns Falls watershed.

Table E2.3 Percent of Dry Weather Samples Exceeding Guidelines for Total Phosphorus or Total Nitrogen (January 20, 2009 through March 16, 2010)

Station	Percent of Samples Total Phosphorus >=0.1 mg/L	Percent of Samples Total Nitrogen >=3 mg/L
Herring Run Watershed		
PERRING PKWY	8%	0%
MT. PLEASANT GC	15%	8%
CHINQUAPIN RUN	8%	8%
TIFFANY RUN	0%	0%
HARFORD RD.	8%	0%
WRIGHT AVE.	8%	8%
PULASKI HWY.	8%	8%
Moores Run Sub-watershed		
MARY AVE.	23%	0%
HAMILTON AVE.	15%	15%
RADECKE AVE.	8%	0%
BIDDLE ST. & 62ND ST.	38%	0%
Biddison Run Sub-watershed		
BIDDISON RUN UPSTRM	18%	0%
BIDDISON RUN DWNSTRM	18%	9%
Jones Falls Watershed		
SMITH AVE.	25%	0%
WESTERN RUN	8%	0%
LINKWOOD	21%	17%
STONY RUN	8%	0%
LOMBARD ST.	46%	0%
Gwynns Falls Watershed		
POWDER MILL	8%	8%
PURNELL DR.	9%	0%
DEAD RUN DNST.	27%	0%
GWYNNS FALLS PKWY.	18%	9%
GRUN HILTON ST.	9%	0%
GF HILTON ST.	18%	0%
MAIDENS CHOICE	9%	9%
GRUN CARROLL PARK	64%	27%
WASHINGTON BLVD.	0%	0%

Key

	Normal: <= 11% of Samples
	Elevated: Between 11-25% of Samples
	High: >25% of Samples

Table E2.3 Percent of Dry Weather Samples Exceeding Guidelines for Total Phosphorus or Total Nitrogen (January 20, 2009 through March 16, 2010) (continued)		
Station	Percent of Samples Total Phosphorus >=0.1 mg/L	Percent of Samples Total Nitrogen >=3 mg/L
Direct Harbor Watershed		
LINWOOD AVE.	85%	46%
LAKEWOOD AVE.	50%	21%
CENTRAL & LANCASTER	50%	7%
LIGHT ST.	29%	14%
WARNER & ALLUVION	21%	0%
WATERVIEW AVE.	14%	7%
REEDBIRD AVE.	43%	14%
JANEY RUN	43%	7%

Key	
	Normal: <= 11% of Samples
	Elevated: Between 11-25% of Samples
	High: >25% of Samples

3. **Watershed Assessment from Biological Monitoring**

The City conducts biological monitoring for benthic macroinvertebrates and fish within three of the four major watersheds- Gwynns Falls, Jones Falls and Herring Run- using a combination of random and fixed site sampling. Each year one major watershed is chosen for the random sampling- in 2009 it was the Gwynns Falls Watershed. During 2009, the City collected benthic macroinvertebrates at 10 stations. A record for each macroinvertebrate sample and its resulting BIBI score can be found in the Excel file "Macroinvertebrate Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report. The count sheets for the benthic macroinvertebrate samples collected during 2009 can be found in the Excel file "2009 Macroinvertebrate Counts Sheets for Individual Stations.xls" on the CD-ROM accompanying this report. Also, during 2009, the City collected fish samples at 7 stations. A record for each fish sample and its resulting IBI score can be found in the Excel file "Fish Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report.

As reported in the 2006 Annual Report, the City hired a consultant to review the City's biomonitoring data from 2002 through 2005 to find out if the number of sites was appropriate to meet its goals for detecting differences between watersheds and detecting trends over time. The consultant concluded that the City could decrease the number of stations and still meet its goals. Table E3.1 gives the number of sites recommended for biomonitoring for a year when the targeted watershed is Gwynns Falls, and the number of sites actually sampled during 2009. The numbers listed in Table E3.1 include any sampling done at the two fixed stations in Biddison Run (Herring Run Watershed) associated with the stream restoration project, and the four fixed

stations in Moores Run (Herring Run Watershed) associated with long-term discharge characterization. Biomonitoring results for the fixed Biddison Run stations are discussed in Section F2a. Macroinvertebrate sampling results for the four fixed Moores Run stations are discussed in Section G1bi; and the fish sampling results are discussed in Section G1bii.

Table E3.1 Number of Biomonitoring Stations to Sample: Recommended for Years When Gwynns Falls Is the Targeted Watershed & Actually Sampled During 2009

Monitoring Type and Watershed	**Recommended (at least)**	**Actually Sampled During 2009**
Benthos, Gwynns Falls, Random	10	5
Benthos, Gwynns Falls, Fixed	1	1
Benthos, Herring Run, Fixed	1	3
Benthos, Jones Falls, Fixed	1	1
Fish, Gwynns Falls, Random	5	3
Fish, Gwynns Falls, Fixed	5	1
Fish, Herring Run, Fixed	5	1
Fish, Jones Falls, Fixed	5	2

The City uses the method for calculating genus IBI scores for benthic macroinvertebrates and fish that the Maryland Biological Stream Survey (MBSS) presented in their October 2005 report, “New Biological Indicators to Better Assess the Condition of Maryland Streams”.

Figure E3.1 presents the genus BIBI scores for the macroinvertebrates collected at the 5 random sites in the Gwynns Falls watershed collected in 2009. All 5 samples were assigned a rating of “very poor”, with scores of 1.3 or 1.7.

Figure E3.2 presents percentile rank versus genus IBI scores for the benthic macroinvertebrate samples from the random sampling stations for 2002 through 2009. Each curve presents the distribution of the scores for a given year. All benthic macroinvertebrate samples were rated in the “very poor” to “poor” range. The Gwynns Falls has been randomly sampled in 2003, 2006 and 2009. The random sets of results from 2006 and 2009 from the Gwynns Falls were similarly very poor, with top scores of only 1.7, and do not compare well to the Gwynns Falls random set of 2003.

Figure E3.1 Benthic Macroinvertebrates Genus BIBI Scores for Gwynns Falls Random Stations Sampled During 2009

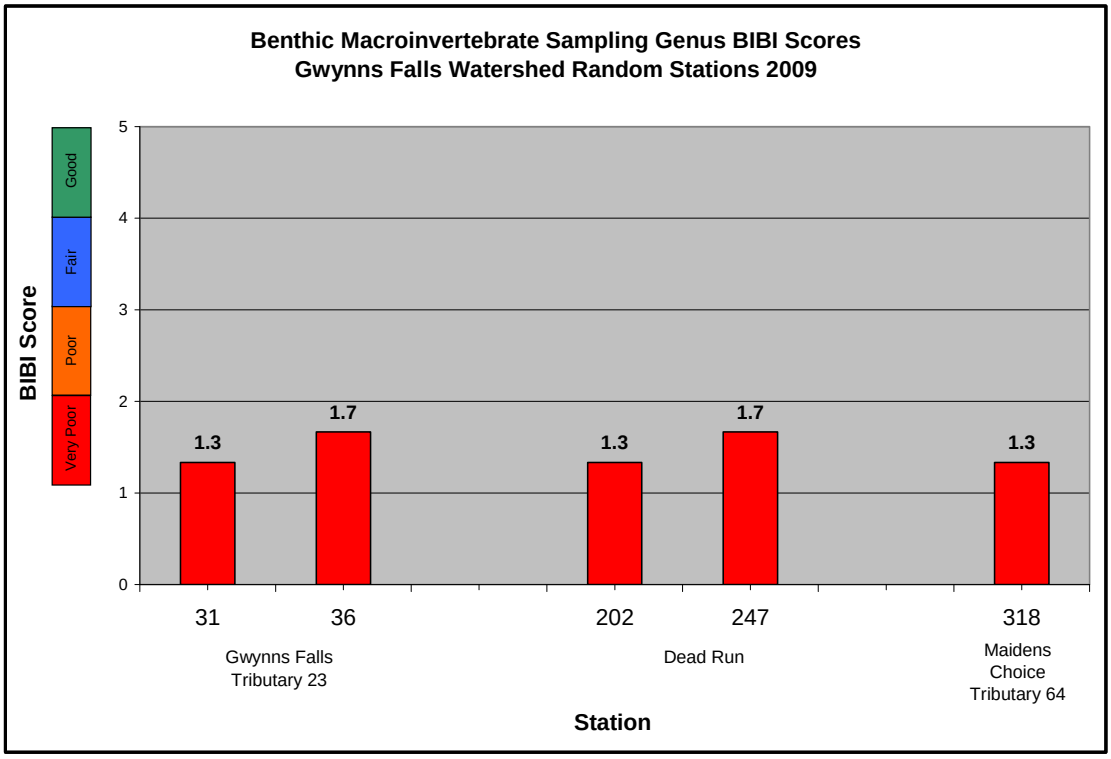


Figure E3.2 Comparison of the Genus BIBI Scores for Macroinvertebrate Samples from Random Stations 2002-2009

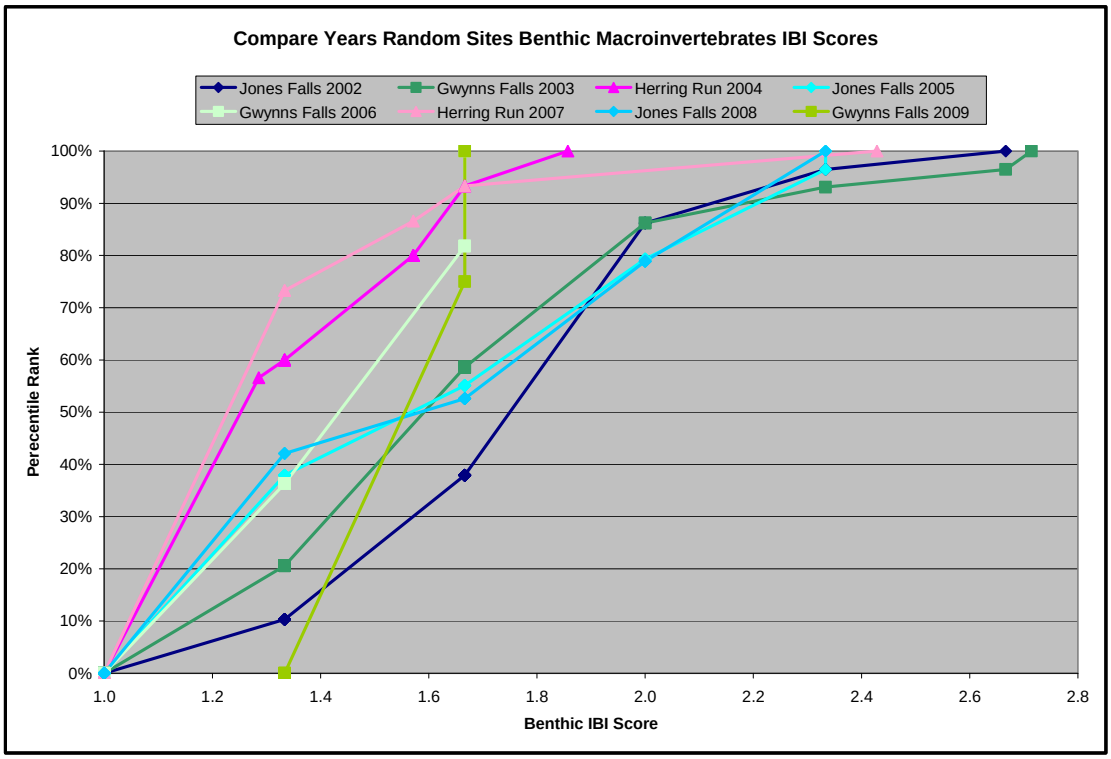


Table E3.2 lists the genus BIBI scores for the fixed site samples from 2002 through 2009. Only two of these stations, BCY115 on Stony Run in the Jones Falls watershed, and DR02 on Dead Run in the Gwynns Falls watershed were sampled during 2009. BCY115 was assigned a score of 1.3, which has a rating of "very poor", and which ties the previous high score for this station. Station DR02 was also assigned a score of 1.3, which is slightly lower than the score of 1.7, which was the score the last time the station was sampled in 2006.

Table E3.2 Comparison of Benthic Macroinvertebrate Results for Samples from the Fixed Stations for 2002-2009

Station	Stream	2002	2003	2004	2005	2006	2007	2008	2009
Gwynns Falls Watershed									
PM03	Powder Mill Run	Not Sampled	Not Sampled	1.3	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY106	Gwynns Falls	1.3	Not Sampled	1.0	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY107	Gwynns Falls	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
DR02 (BCY108)	Dead Run	1.7	1.0	1.0	1.0	1.7	Not Sampled	Not Sampled	1.3
BCY110	Maidens Choice Run	1.3	1.3	1.0	1.3	Not Sampled	Not Sampled	Not Sampled	Not Sampled
Jones Falls Watershed									
BCY112	Western Run	1.3	1.7	Not Sampled	2.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled
JF02	Jones Falls	Not Sampled	Not Sampled	1.0	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY114	Stony Run	1.3	1.3	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY115	Stony Run	1.3	1.0	1.0	1.3	Not Sampled	1.0	1.0	1.3
Herring Run Watershed									
HR06	Herring Run	Not Sampled	Not Sampled	1.0	1.7	Not Sampled	Not Sampled	Not Sampled	Not Sampled
HR07	Herring Run	2.0	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY118	Chinquapin Run	1.0	1.0	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY116	Herring Run	1.3	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY117	Herring Run	1.3	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled

Figure E3.3 presents the fish IBI scores for the samples collected at the 3 random sites in the Gwynns Falls watershed during 2009. Figure E3.4 presents percentile rank versus fish IBI scores from the random sampling stations for 2003 through 2009. Each curve presents the distribution of the scores for a given year. There was no fishing conducted at random sites for 2006, a year that the Gwynns Falls watershed was targeted. The group of Gwynns Falls random samples collected in 2009 scored worse than the group collected during 2003.

Figure E3.3 Fish IBI Scores for Gwynns Falls Random Stations Sampled in 2009

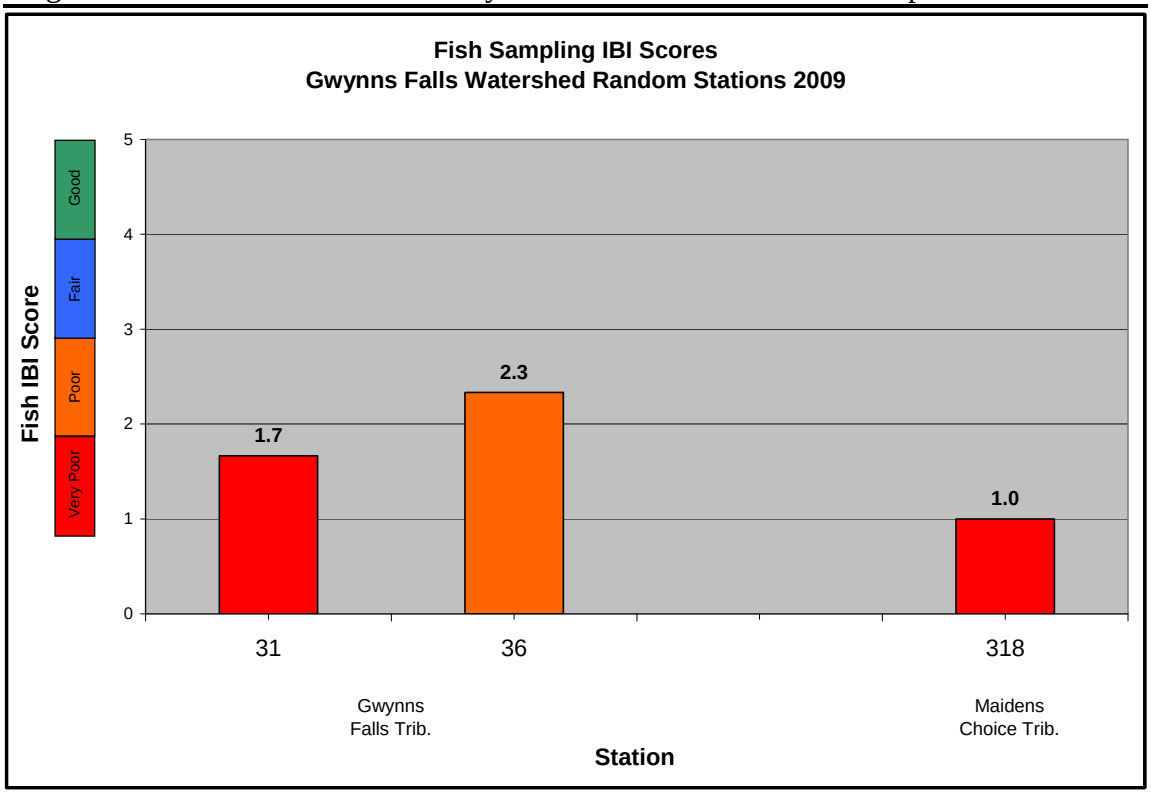


Figure E3.4 Comparison of the Fish IBI Scores from Random Stations 2003-2009

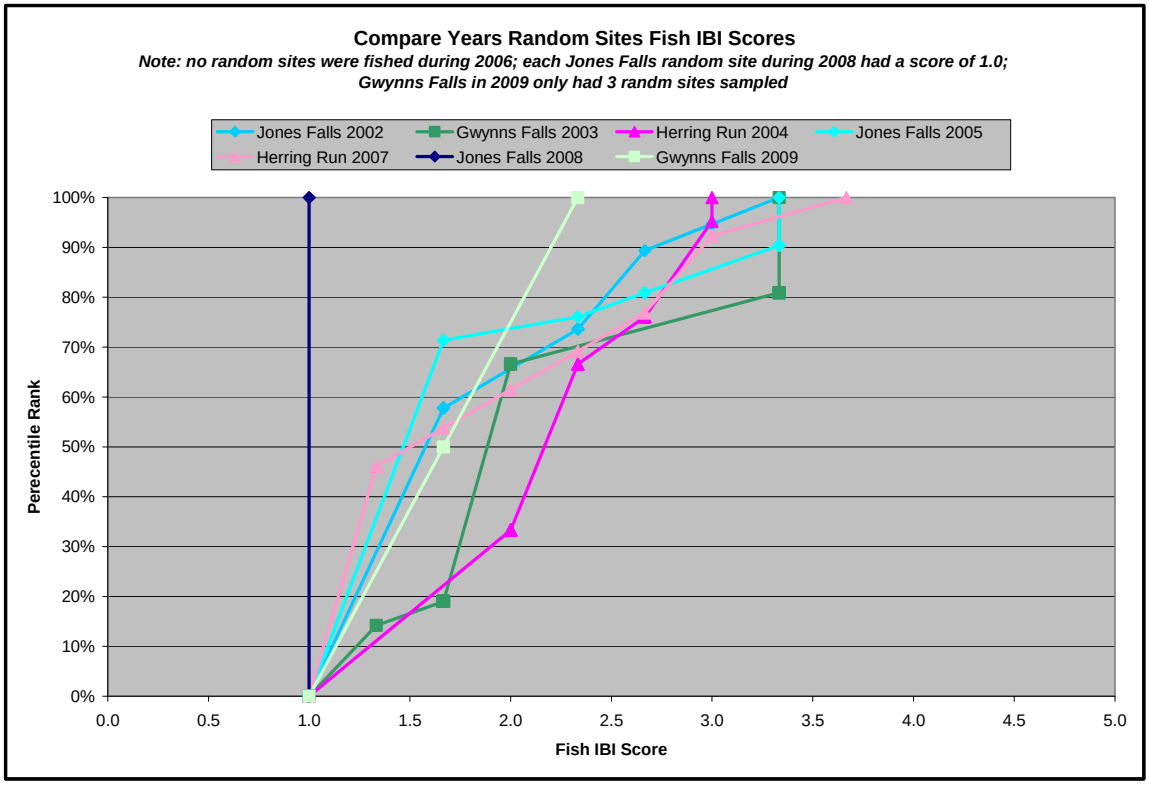


Table E3.3 lists the fish IBI scores for the fixed site samples from 2002 through 2009. Only three of these fixed stations were sampled for fish during 2009. In 2009, the station BCY115 on Stony Run once again had a fish IBI score of 1.0, which is the lowest score possible, and is assigned a rating of "very poor". Station 949, also on Stony Run, improved slightly from 1.0 for 2008 to 1.3 for 2009; however, the rating for this station remains as "very poor". Station 582 on Maidens Choice Run was sampled for the first time in 2009, and achieved a score of 2.0, which has a rating of "poor".

Table E3.3 Comparison of Fish IBI Scores from the Fixed Stations for 2002-2009

Station	Stream	2002	2003	2004	2005	2006	2007	2008	2009
Gwynns Falls Watershed									
PM03	Powder Mill Run	Not Sampled	Not Sampled	Not Sampled	1.7	Not Sampled	Not Sampled	2.3	Not Sampled
DR02	Dead Run	Not Sampled	Not Sampled	1.7	2.0	Not Sampled	2.0	2.3	Not Sampled
BCY110	Maidens Choice Run	1.0	Not Sampled	1.7	1.7	Not Sampled	Not Sampled	Not Sampled	Not Sampled
582	Maidens Choice Run	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	2.0
Jones Falls Watershed									
BCY112	Western Run	Not Sampled	Not Sampled	2.0	2.0	Not Sampled	Not Sampled	2.7	Not Sampled
949	Stony Run	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	1.0	1.3
BCY115	Stony Run	Not Sampled	Not Sampled	1.0	1.0	Not Sampled	1.0	1.0	1.0
Herring Run Watershed									
HR06	Herring Run	Not Sampled	Not Sampled	1.3	1.7	Not Sampled	Not Sampled	Not Sampled	Not Sampled
BCY118	Chinquapin Run	1.0	Not Sampled	1.0	1.0	Not Sampled	Not Sampled	Not Sampled	Not Sampled

F. Watershed Restoration

During 2009, the City completed the stream and wetlands restoration work on Maidens Choice near the Beechfield Elementary School, and the construction of 6 ultra-urban Best Management Practices (BMPs) in Catchment "O" of Watershed 263. By the time of the writing of this report in May 2010, the open channel improvements for Lower Stony Run from Coldspring Lane to Ridgemead Road were completed.

1. Implementation Schedule

This section presents the watershed restoration practices that are under construction, pending construction or were recently completed. It should be kept in mind that the projects reported as "pending" are subject to many unforeseen variables that can result in delays. A description of the delays and a revised schedule for the affected projects is presented below.

Gwynns Falls Watershed Capital Improvements

ER4018 Powder Mill Environmental Restoration Project 1

Design Cost: approximately $478,422
Construction Cost: approximately $2,500,000 (negotiating with Army Corps of Engineers for fund matching)

Status: Completed 60% design in August 2009. Design to 90% is pending the results of the forest stand delineation and subsequent tree mitigation negotiations with the Department of Recreation & Parks. 90% Design completion is currently scheduled for May 21, 2010.

Description: Stream Restoration of 3,900 linear feet of Powder Mill Run, a tributary to the Gwynns Falls. The design does not just restore the current stream channels, but diverts flow to smaller channels to decrease flow rate and decrease sediment transport. The purpose of this project is to create a stream and floodplain corridor that functions as close to the pre-settlement conditions as is feasible in the modern setting; establish a self-sustaining native species riparian wetland floodway system; and stabilize existing infrastructure including storm drain outfalls and other utility encroachments to extent feasible. This project will be used to address impervious area treatment requirements and TMDL loadings of the stormwater NPDES permit. This project will be complemented by Baltimore County's efforts to improve water quality in the west branch of Powder Mill Run. Dr. Art Parola from the University of Louisville will be using dendrochronology to get a better estimate of the amount of fine sediments that have been eroded. Dendochronology is a method that uses the amount of tree root exposure adjacent to stream channels to determine the erosion rates. This, coupled with the installation of a stormwater monitoring station on one of the major outfalls to the stream, will improve our ability to estimate the anticipated sediment and nutrient load reductions from the project.

Gwynns Falls Habitat Improvement: Maidens Choice Stream #1

Design Cost: $154,000
Construction: $1,700,000

Status: Completed in September 2009

Description: This project was done under a joint agreement between the City of Baltimore and the U.S. Army Corps of Engineers. The project site is located near Beechfield Elementary School on the Maidens Choice Run.

The upstream drainage area is 2.9 square miles and the length of stream being restored is 2,700 feet. A wetland was restored next to the school. The wetlands will treat runoff from both the storm drain and the school parking lot nearby. A portion of storm drain was removed to recreate the natural stream.

Jones Falls Watershed Capital Improvements

ER4014 Western Run Stream Restoration Project 1

Design Cost: $235,776
Construction Cost: $422,859 (funded by the Maryland Port Administration (MPA) as mitigation for the Masonville Dredge Spoil site)

Status: Construction of the project is to begin on June 16, 2010

Description: Stabilize approximately 2,100 feet of stream reach on the main stem of Western Run, in the vicinity of Greenspring Avenue and Pimlico Road, and along Cross Country Boulevard. The stream reaches within this project were recommended in the Western Run Assessment Report as some of the highest ranked reaches for stabilization and improvements. Project highlights include: stabilization of severely eroded banks using rock walls, soil lifts, and bioengineering; replacement of failed storm drain outfalls; protection of threatened storm drain outfalls, protection of threatened sanitary sewer lines, protection of Cross County Boulevard, and protection of a private parking lot.

Open Channel Improvements- Lower Stony Run

Design Cost: $210,000
Construction Cost: $900,000

Status: complete

Description: This project begins below the culvert under Coldspring Lane and continues through Linkwood Park down to Ridgemead Road. Work continues just below University Parkway for another 1,400 feet. The project length is approximately 4,300 feet, although a portion of the stream system flows through underground culverts. The upstream drainage area is 2,700 acres. The section immediately below Coldspring Lane is severely entrenched, with limited floodplain area, failing gabions and concrete channels throughout. The natural channel design approach may not be applicable above University Parkway. The project will try to stabilize the substrate and remove potential fish blockages.

Open Channel Improvements- East Stony Run

Design Cost: $400,000
Construction Cost: $660,000

Status: the revised design plans are completed and all easements have been secured; the stream restoration project can proceed after the completion of the Charles Street culvert project; the stream restoration projection is expected to begin in the summer 2010

Description: 800 feet of the East Stony Run will be restored using the principles outlined by the Rosgen (Natural Channel Design) approach where possible to stabilize the stream channel and embankments.

Lower Lower Stony Run Stream Restoration Project (ER4020)

Design Cost: $333,000
Construction Cost: no estimate yet

Status: design 60% completed; the design team is waiting for comments from the permitting agencies before preparing the final design

Description: The Lower Lower Stony Run project involves the restoration of the lowest reach of the Stony Run stream from approximately 1,400 feet below University Parkway until the stream enters a culvert in Wyman Park. The plan is to restore approximately 4,500 linear feet of the stream.

Herring Run Watershed Capital Improvements

Moores Run Wetland

Design Cost: $147,500
Construction Cost: estimated $3,000,000

Status: Design is 95% complete, and is in expedited review for sediment and erosion control and stormwater management. Construction will be delayed as funding is set in place. Construction is anticipated for 2012.

Description: The Moores Run Wetland at Frankford Neighborhood project is located east of Denview Way between Relcrest Road and Force Drive and west of Moores Run. The facility will improve stream water quality by diverting storm flows into the facility, storing this volume for an extended time period before slowly releasing flow back to Moores Run.

The facility is comprised of an excavated pond with a stamped concrete control structure located near the lower end of the pond. A concrete U-shaped stamped concrete channel will be located at the upper end. This channel will divert the first storm flows into the facility while still maintaining a base flow in the stream channel. Trash and debris will be collected by a series of trash collection bags that will be frequently replaced as part of a maintenance program. A portion of the bottom of the facility is designed to contain a pool of water between 6 and 18 inches deep. Wetland plants will be placed within this area. The area adjacent to the pond will be landscaped and a walking path added to the top of the pond. The facility is designed so that high frequency storm events will be diverted into the facility. However, as the storm volume increases, less of the storm flow will be diverted into the facility and more flows will remain in the stream. The less frequent, high volume storms will actually fully fill the facility and overtop the facility along Moores Run. The facility should be able to treat approximately 18-19% of the upstream runoff from the entire (2,800 acres) upstream drainage area.

Yorkwood Elementary School Greening Project

Design Cost: $30,000
Construction Cost: $150,000

Status: Construction is anticipated for the spring or summer of 2010.

Description: The Department of Public Works is working with the Baltimore City Public School System to convert unused impervious surfaces (e.g., asphalt playgrounds and parking areas) into environmentally friendly landscaping areas. Yorkwood Elementary School was selected for greening due to the vast area of asphalt to be removed, and the project's advocacy by the school's administration and its teachers. Approximately ¾ acre of impervious surface will be removed. The City plans to incorporate a soil treatment technique under a research grant with the University of Maryland Baltimore County. The treatment technique is called "deep tilling", and the purpose is to increase the infiltration rate of the soils after the asphalt is removed. Typically, soils under impervious cover are compacted and not conducive to infiltration.

Biddison Run Stream Stabilization (Project ER4023)

Design Cost: $310,474
Construction Cost: not yet determined

Status: Consultant is currently completing geomorphic and sediment studies and has begun preparing preliminary hydrologic and hydraulic analyses. The consultant is scheduled to submit the concept plans and report to the City on April 1, 2010.

Description: Assess, prioritize, and prepare design plans for restoration areas along Biddison Run. This project is part of the Masonville Dredge Spoil mitigation plan. The City is negotiating with the Maryland Port Authority to secure funding for the construction phase of the project. The study reach begins where the Biddison Run open channel emerges at Sipple Avenue and the project reach continues south to Moravia Road. The entire study reach covers approximately 6,900 linear feet of the Biddison Run open channel. The right stream bank of Biddison Run along Moravia Road has been identified as an area in need of emergency stabilization. Erosion along the road at this location is endangering the stability of Moravia Road and potentially creating a public safety issue. A memorandum documented the erosion at this location to be 22 feet high and at the worst location to be 8 feet from the edge of Moravia Road. The estimated rate of erosion along the bank was 1.3 feet per year. The majority of the Biddison Run channel falls within private property. The first challenge for the consultant in the restoration design will be to contact all of the private stakeholders (landowners) and obtain commitments for project buy-in. The consultant is anticipating that the stakeholder buy-in will come in the form of City acquisition of permanent easements from the private property owners encompassing the project area. With complete stakeholder buy-in, the consultant is proposing to address all of the stream instabilities and major sediment sources within Biddison Run. In the event of resistance to the proposed project by individual landowners, the consultant will alter the proposed restoration plans and develop a solution involving locating or designing sediment storage areas for excessive sediment supply.

Harbor Watershed Capital Improvements

Bush Street Trash-Debris Collector

Design Cost: $187,630
Construction Cost: not yet determined

Status: the consultant is progressing towards 30% design; the consultant has developed three debris collection system alternatives for presentation to the City; final design is scheduled for March 2011

Description: The Bush Street storm drain outfall drains the heavily urbanized 930 acre Watershed 263. The previous design was a floating

netting system at the confluence of the Middle Branch and the Bush Street storm drain. An alternate underground system design is needed due to concerns from the development community over the potential unsightliness of a "floating system". This project is a candidate mitigation project that will be funded by MPA.

Watershed 263 Ultra-Urban BMP Pilot and Theme Park

Design Cost: $140,000
Construction Cost: $317,103 (including $232,000 City funds)

Status: Construction was completed in the summer 2009. As of May 2010, the web site is not finished. It should be finished in the summer of 2010.

Description: The Department of Public Works is partnering with the Center for Watershed Protection (CWP) and Parks and People Foundation (PPF) to construct 6 ultra-urban Best Management Practices (BMPs) in Catchment "O" of Watershed 263. The project was awarded a Pioneer Grant of $100,000 by the Chesapeake Bay Trust and a Stormwater Cost-share grant of $75,000 from MDE. The 6 BMPs were identified in the "Stormwater Management Strategy for Catchment O" that was developed by CWP under a Pioneer Grant awarded to the PPF in 2004. The strategy was based on a systematic physical survey of the 38-acre Pioneer drainage area, and includes municipal and community stewardship projects and suggested priorities.

While numerous "small" practices have already been installed under this strategy, the six BMPs under construction will be featured in a web-based "virtual ultra-urban BMP theme park" created and hosted by the CWP. These BMPs will consist of designs that have not been implemented in highly urban watersheds in the Chesapeake Bay region previously, and include: one bio-retention project, three curb extension projects, one Filterra tree pit project, and one impervious removal project. Although the practices are different, there are similarities as to how they function. All of these BMPs slow and treat stormwater runoff. The stormwater is directed into the BMP, and then is treated by various processes. For example, the runoff will go through vegetative plantings/landscaping that will allow for infiltration of pollutants into the soil, causing cleaner water to exit the BMP; flow returns to the gutter that directs it to a nearby inlet, where it enters the storm drain system.

Watershed 263 Ultra-Urban BMP Project (Next Set of 4 BMPs)

Design Cost: $150,000
Construction Cost: $493,025

Status: working on the 30% ESD designs for the four sites

Description: Consultant will provide designs for BMPs for four more sites in Watershed 263 as follows:
Site 1, Open Lot on Fayette Street and Mount Street: bio-retention cell or rain garden cell on corner lot of Mount and Fayette
Site 2, Corner of Fayette and Monroe: corner bump out or Filterra Box
Site 3, Bush Street: bio-retention between bike path and sidewalk; bump outs and trench drains
Site 4, Lanvale and Gilmore: bio-retention cell

2. **Restoration Monitoring**
This section describes the monitoring that the City does to determine the effectiveness of the restoration practices being implemented as per Part III.H of the Permit. The following projects are featured: the long-term discharge characterization monitoring at Hamilton Avenue and Radecke Avenue in the Moores Run watershed; Biddison Run stream restoration; Stony Run stream restoration; and Watershed 263. A discussion of the monitoring activities during 2009 for the Biddison Run, Stony Run and Watershed 263 follows in this section. A discussion on the monitoring activities during 2009 for the Moores Run appears in Section G1.

In June 2009, the City installed a wet weather sampling station at one of the major storm drain outfalls to Powder Mill. This station is called Kennison. Data collected from this station will be compared to the in-stream station on Powder Mill to determine the relative contribution of contaminants from the watershed and stream channel. A more detailed discussion of this monitoring activity will be presented in the next annual report.

a. **Biddison Run**
The stream restoration construction began in the late summer of 2005 and was completed in March 2006. The City established six monumented cross-sections. It was the plan to resurvey these annually. Unfortunately, the City has not yet done any resurveying.

Since October 2002 the City has collected monthly baseline (dry weather) samples at the two Biddison Run stations ("BIDDISON RUN UPSTRM" and "BIDDISON RUN DWNSTRM") that are associated with the restoration. Water quality sample results from 2009 can be found in tables "Baltimore City Chemical Monitoring 2009" and

"Baltimore City Monitoring Sample Results 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report. During 2009, there were 10 sampling events, with a total of 20 samples collected; a total of 15 discharge measurements made using a pygmy meter; and a total of 340 water quality analyses performed on those samples. One sampling event, on March 26th, occurred during rain; the results from that pair of samples are not included in the "Baltimore City Chemical Monitoring 2009" Access table, but are included in the "Baltimore City Monitoring Sample Results 2009" Access table, on the CD-ROM accompanying this report.

Graphs for these two stations of the concentration over time can be found in the Excel files in the folder entitled "City Streams Dry Weather Time Concentration Graphs" on the CD-ROM accompanying this report. Each Excel file has a set of concentration over time scatterplots for each of the 35 monitoring stations for a given parameter. The two Biddison Run stations' graphs are the last in the series and are in tabs with names that begin "BidR Up", and "BidR Dwn". The parameters graphed are: ammonia nitrogen (lab measurement), ammonia nitrogen (field measurements- there are more data for the BIDDISON RUN UPSTRM station because it is also visited during Herring Run ammonia screening surveys), BOD, chlorides, COD, conductivity (lab measurement), total copper, fecal coliform counts, fluoride, nitrate+nitrite nitrogen, total suspended solids, TKN, total nitrogen (estimated by adding together nitrate+nitrite nitrogen and TKN), total phosphorus, and total zinc. Unlike other freshwater stations where the City collects dry weather samples, these stations do not show a long-term increase for chlorides for the period since monitoring began in October 2002.

A summary of the e. coli MPN counts from November 2008 through January 2010 for the two Biddison Run water quality sampling stations is presented in Table E2.1. The geometric mean for the upstream station was 1,108 MPN/100 ml, and 892 MPN/100 ml for the downstream station. The percent of dry weather samples which had an e. coli MPN count at or below the infrequent full body contact recreation criteria (576 MPN/100 ml) was 45% for the upstream station and 55% for the downstream station.

A summary of the total phosphorus and total nitrogen results from January 2009 through January 2010 for the two Biddison Run water quality sampling stations is presented in Table E2.3. Both stations were at or exceeded the total phosphorus guideline of 0.1 mg/L in 18% of the samples. This indicates an "elevated" level for total phosphorus. The upstream station did not have any samples at or

exceeding the total nitrogen guideline of 3 mg/L; the downstream station had 9% of the samples at or exceeding the guideline. Both stations rate in the "normal" range for total nitrogen.

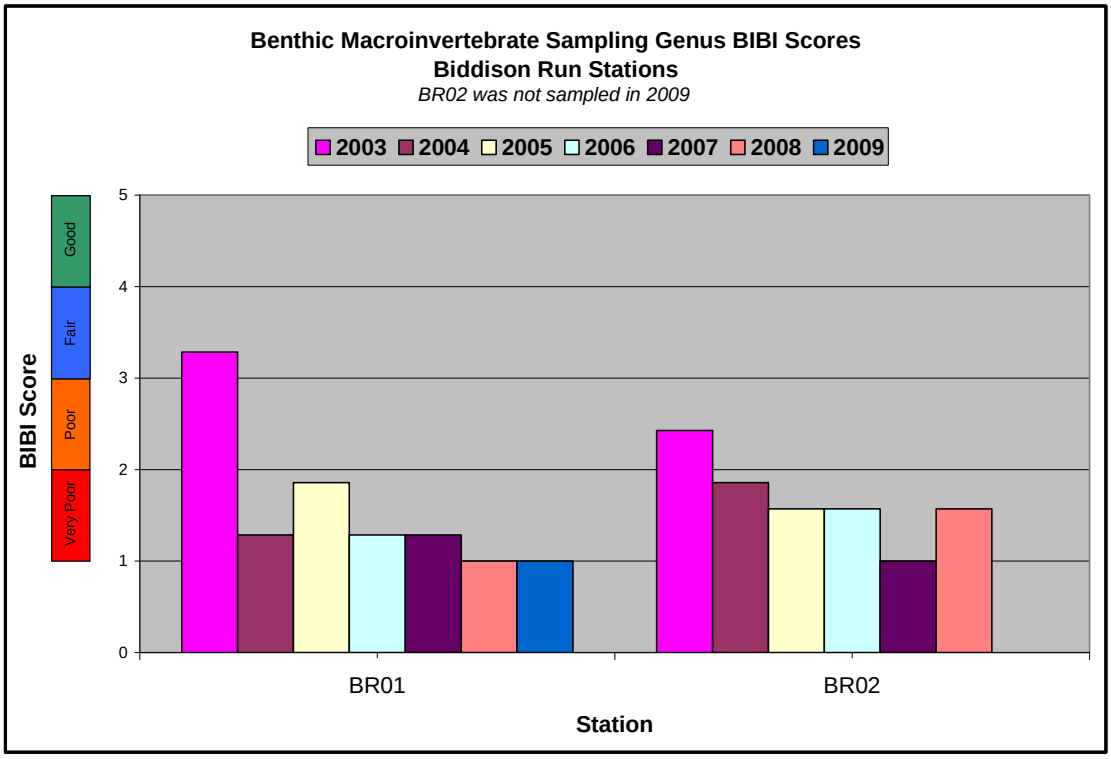
There are two fixed stations on Biddison Run (BR01 and BR02) where the City samples for benthic macroinvertebrates and fish. Benthic macroinvertebrates were first collected at each station in 2003. A record for each macroinvertebrate sample and its resulting BIBI score can be found in the Excel file "Macroinvertebrate Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report. The count sheet for the benthic macroinvertebrate samples collected at station BR01 in 2009 can be found in the Excel file "2009 Macroinvertebrate Counts Sheets for Individual Stations.xls" on the CD-ROM accompanying this report. Fish were first collected at BR01 in 2002 and at BR02 in 2003. Station BR02 was not fished during 2009. A record for each fish sample and its resulting IBI score can be found in the Excel file "Fish Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report. For more information on the City's biological monitoring efforts please see Section E3, "Watershed Assessment from Biological Monitoring".

Table F2a.1 and Figure F2a.1 present the results from benthic macroinvertebrate sampling at the Biddison Run sampling stations for 2003 through 2009. Please note that all of these scores have been computed using the method endorsed by the MBSS in 2005. Both stations have regressed over the years. Station BR01 has gone from a high score of 3.3 (a rating of "fair") in 2003 down to a score of 1.0 (the lowest score possible, with a rating of "very poor") in both 2008 and 2009. Station BR02 went from a score of 2.4 (a rating of "poor") in 2003 down to the lowest possible IBI score of 1.0 in 2007; but then slightly improved in 2008 with a score of 1.6 (a rating of "very poor").

Table F2a.1 Biddison Run Benthic Macroinvertebrate Genus BIBI Scores 2003-2009

Station	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
BR01	3.3	1.3	1.9	1.3	1.3	1.0	1.0
BR02	2.4	1.9	1.6	1.6	1.0	1.6	Not Sampled

Figure F2a.1 Comparison of the Genus BIBI Scores for Benthic Macroinvertebrate Samples from Biddison Run Stations 2003-2009

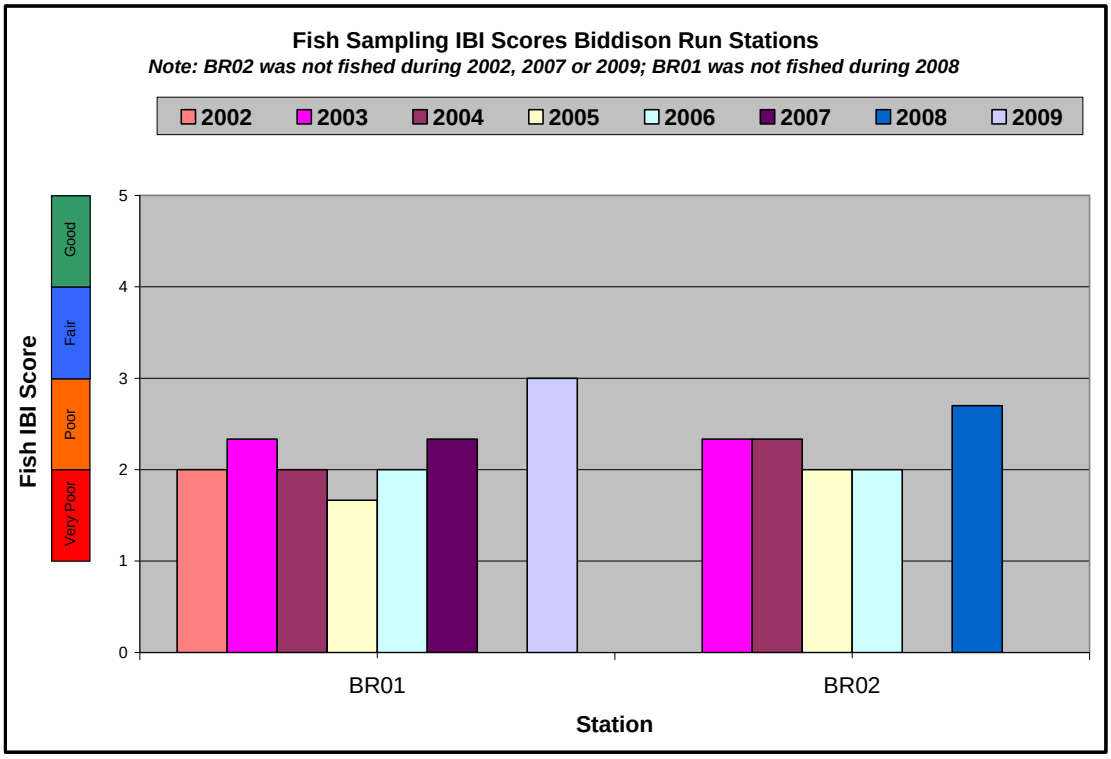


Tables F2a.2 and Figure F2a.2 present the results from fish sampling. For the upstream station (BR01), the FIBI score of 3.0 for 2009 was the highest yet achieved among the seven years; and it is the first time that the station has achieved a "fair" rating. The downstream station (BR02) was not fished during 2009.

Table F2a.2 Biddison Run Fish Sampling IBI Scores 2002-2009

Station	2002	2003	2004	2005	2006	2007	2008	2009
BR01	2.0	2.3	2.0	1.7	2.0	2.3	Not Sampled	3.0
BR02	Not Sampled	2.3	2.3	2.0	2.0	Not Sampled	2.7	Not Sampled

Figure F2a.2 Comparison of the IBI Scores for Fish Samples from Biddison Run Stations 2002-2009



b. **Watershed 263**

Table F2b.1 lists the number of samples collected, and number of water quality analyses performed on those samples, in Watershed 263 during 2009. The results from storm composite samples and dry weather grab samples at the monitoring stations at Baltimore Street (Catchment O) and Lanvale Street (Catchment F) can be found in tables "Baltimore City Chemical Monitoring 2009" and "Baltimore City Monitoring Sample Results 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report. There were only two storms monitored at each of the stations during 2009. The persistent problems with the sampling and flow monitoring equipment being damaged or washed out during intense storms has led staff to decide to abandon storm monitoring at these stations.

The Excel file "Watershed 263 Time Graphs.xls" on the CD-ROM accompanying this report contains concentration over time graphs of the dry weather (baseline) and storm composite concentrations for Baltimore St. and Lanvale St. from September 2004 through March 2010 for the following parameters: BOD, nitrate+nitrite nitrogen, total Kjeldahl nitrogen, total nitrogen, total phosphorus, total suspended solids, total copper, dissolved copper, total lead, dissolved lead, total zinc, dissolved zinc, total hardness, e. coli count, enterococci count

(begun in October 2008), fecal coliform count (ended July 2008) and fluoride (ended April 2008). The green vertical line on each of these graphs demarcates the beginning of street sweeping in mid-January 2006 within Catchment O. Looking at these time graphs, comparing the samples from before and after sweeping began, the baseline nitrate+nitrite nitrogen, total phosphorus and fluoride have decreased for both Baltimore St. and Lanvale St. In addition, the Lanvale St. baseline BOD has decreased.

Table F2b.1 Watershed 263 Monitoring During 2009		
Station and Type	Number of Samples	Number of Water Quality Analyses Performed
Baltimore St. Baseline	21	293
Lanvale St. Baseline	10	139
Quality Control Replicates	18	198
Baltimore St. Storm	2	28
Lanvale St. Storm	2	28
Total		686

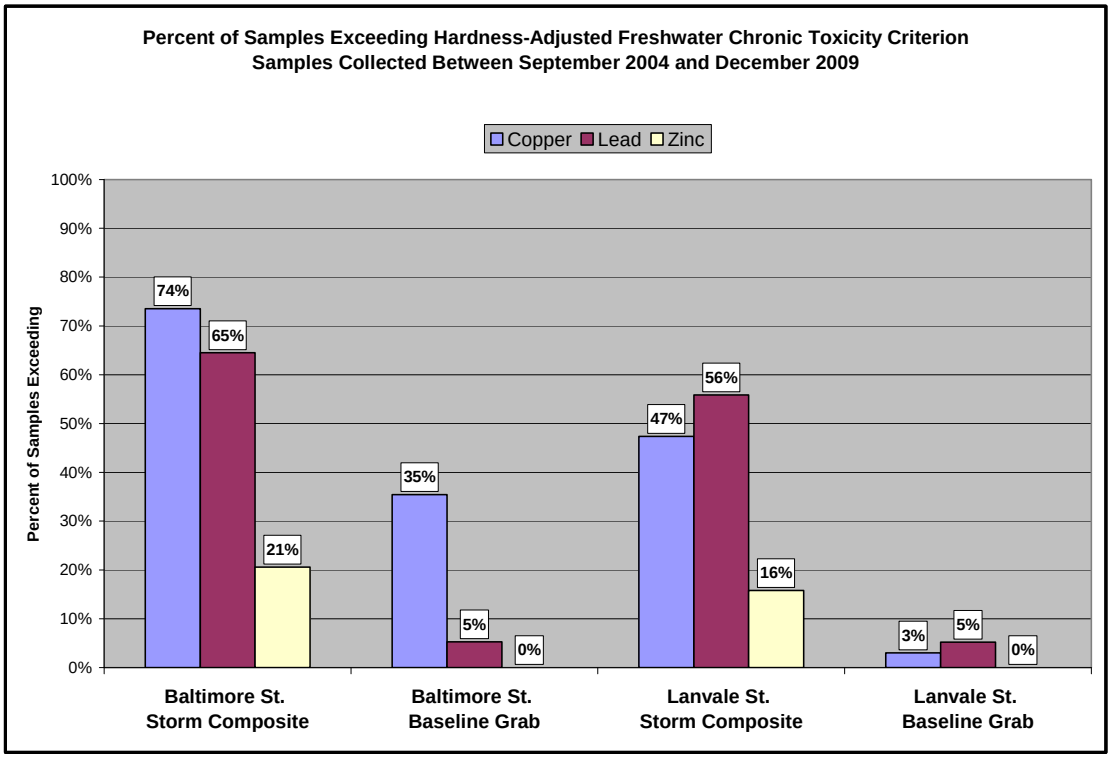
The City analyses nearly every sample from the two Watershed 263 stations for total hardness and dissolved copper, lead and zinc. An analysis was done for the sample results collected through December 2009 to find out how often the samples exceed the State's freshwater chronic criteria for these metals. Formulas for adjusting the freshwater criteria for hardness were taken from these reports prepared by MDE: Water Quality Analysis of Copper and Lead for the Jones Falls in Baltimore County and Baltimore City, Maryland and Water Quality Analysis of Zinc Contamination for the Jones Falls Baltimore City and Baltimore County, Maryland. Table F2b.2 and Figure F2b.1 present the percentage of samples that exceeded the criteria for samples from the Baltimore St. and Lanvale St. stations. It may not be appropriate to compare stormwater results to the chronic criteria- it may be more appropriate to compare them to the acute criteria. However, the City's analyst working on this did not have the formulas to make the adjustments for hardness to the acute criteria.

There is a problem of copper toxicity for the dry weather flow at Baltimore St. The stormwater composites at both the Baltimore St. and Lanvale St. stations had high percentages exceeding the criteria for each of the metals.

Table F2b.2 Percentage of Samples from Watershed 263 Monitoring for which the Copper, Lead or Zinc Concentration Exceeded the Hardness-Adjusted Freshwater Chronic Criteria (September 2004 through December 2009)

Station and Type of Sample	Percent of Copper Samples	Percent of Lead Samples	Percent of Zinc Samples
Baltimore St. Storm Composite	74%	65%	21%
Baltimore St. Baseline Grab	35%	5%	0%
Lanvale St. Storm Composite	47%	56%	16%
Lanvale St. Baseline Grab	3%	5%	0%

Figure F2b.1 Percent of Samples Exceeding the Freshwater Chronic Criteria for Copper, Lead or Zinc at Baltimore St. and Lanvale St.



E. coli MPN counts have been performed on Watershed 263 samples from the beginning of sampling in October 2004. An analysis was done comparing each count to the State's criteria for frequency of use. Table F2b.3 lists the geometric mean and percent of samples at below the critical counts for each station and sample type. Using this analysis, the dry weather flow at the Lanvale St. station is worse than at the Baltimore St. station.

Table F2b.3 E. Coli MPN Counts: Geometric Means and Comparision to State's Criteria for Frequency of Use (October 2004 through January 2010)							
Station and Type	Number of Samples	Geometric Mean (MPN/100 ml)	Percent At or Below Frequent Full Body Contact Recreation (235 MPN/100 ml)	Percent At or Below Moderately Frequent Full Body Contact Recreation (298 MPN/100 ml)	Percent At or Below Occasional Full Body Contact Recreation (410 MPN/100 ml)	Percent At or Below Infrequent Full Body Contact Recreation (576 MPN/100 ml)	Percent Above Infrequent Full Body Contact Recreation (576 MPN/100 ml)
BALTIMORE ST. Baseline Grab	128	191	54%	55%	63%	69%	31%
BALTIMORE ST. Storm Composite	32	33,603	3%	3%	3%	3%	97%
LANVALE ST. Baseline Grab	107	1,457	26%	28%	34%	39%	61%
LANVALE ST. Storm Composite	35	22,701	0%	0%	0%	0%	100%

The total phosphorus and total nitrogen (estimated by the sum of total Kjeldahl nitrogen and nitrate+nitrite nitrogen) for each Watershed 263 sample was compared to the nutrient concentration guidelines of 0.1 mg/L for total phosphorus and 3 mg/L for total nitrogen. Table F2b.4 lists the number of samples- with percentages- at or exceeding the guidelines for each station and each sample type. Both stations are regarded as being "high" for total phosphorus and total nitrogen since the percentages for dry weather samples are at or exceed the guidelines more than 25% of the time. Using this analysis, the Baltimore St. station is worse than the Lanvale St. station.

Table F2b.4 Watershed 263 Dry Weather & Storm Samples: Compare to Nutrient Concentration Guidelines (September 2004 through March 2010)						
Station and Type	Number of Total Phosphorus Samples	Number of Samples Total Phosphorus >=0.1 mg/L	Percent of Samples Total Phosphorus >=0.1 mg/L	Number of Total Nitrogen Samples	Number of Samples Total Nitrogen >=3 mg/L	Percent of Samples Total Nitrogen >=3 mg/L
Baltimore St. Baseline Grab	131	115	88%	111	82	74%
Baltimore St. Storm Composite	37	35	95%	34	23	68%
Lanvale St. Baseline Grab	110	51	46%	94	51	54%
Lanvale St. Storm Composite	42	40	95%	31	8	26%

c. **Stony Run and Powder Mill Run**

In June 2005 the City established the Linkwood stormwater monitoring station on Stony Run in the Jones Falls watershed to use for assessing restoration in Stony Run, and for the monitoring that the City is required to do for the Maryland Stormwater Design Manual. In December 2005, the City decided to use its Powder Mill SIS station located in the Gwynns Falls watershed as the control in this study. The USGS provides flow monitoring at both the Linkwood (USGS station ID 01589464) and the Powder Mill (USGS station ID 01589305) stations. In June 2009 the City established the stormwater sampling station Kennison at one of the outfalls to Powder Mill Run. The USGS does not have flow monitoring equipment at this station.

The City will have to develop a flow rating to use with the water level measuring equipment. The Kennison sampling station was established in anticipation of restoration construction planned for Powder Mill Run, which is expected to begin around July 2011. Table F2c.1 lists the number of samples, and the number of water quality analyses performed on those samples, collected for this monitoring project during 2009.

Table F2c.1 Stony Run and Powder Mill Restoration Monitoring During 2009

Station and Type	Number of Surveys or Storm Events	Number of Samples	Number of Water Quality Analyses Performed
Linkwood Baseline	12	12	131
Powder Mill Baseline	12	12	236
Linkwood Storm	4	33	144
Powder Mill Storm	6	46	230
Kennison Storm	3	28	140
Total			881

Please note that metals are not analyzed and bacteria counts are not performed on samples collected at the Linkwood sampling station. Total phosphorus, nitrate+nitrite nitrogen and total Kjeldahl nitrogen are analyzed for samples collected at the Linkwood station. Table E2.3 lists the percentage of dry weather samples from Linkwood from January 2009 through January 2010 which exceed the guideline for total phosphorus (0.1 mg/L) as 21% and for total nitrogen (3 mg/L) as 17%. Both of these percentages are in the “elevated” range. Comparing the event mean concentrations (EMCs) from storms monitored at Linkwood from June 2005 through June 2009 to these guidelines, 37 out of 38 (97%) EMCs exceeded the total phosphorus guideline and 9 out of 27 (33%) exceeded the total nitrogen guideline.

At each station discrete stormwater samples are collected by an automated sampler at timed intervals once the stream level rises above the programmed trigger level. Figures F2c.1 through F2c.14 show the concentration versus flow per watershed area for the discrete stormwater samples analyzed from Linkwood (June 2005 through June 2009) and Powder Mill (January 2006 through October 2009) for the following parameters: total phosphorus, total nitrogen (estimated as the sum of TKN and nitrate+nitrite nitrogen), TKN, nitrate+nitrite nitrogen, total suspended solids, volatile suspended solids and percent volatile suspended solids.

Using the discrete sample concentrations and the storm’s flow record, a storm event mean concentration (EMC) was calculated for each

station for each parameter for each storm. Figures F2c.15 through F2c.20 present the storm EMC for each storm for both Linkwood and Powder Mill for the following parameters: total phosphorus, total nitrogen (estimated as the sum of TKN and nitrate+nitrite nitrogen), TKN, nitrate+nitrite nitrogen, total suspended solids and volatile suspended solids.

The storm EMC and baseline results for these stations for 2009 are included in the table "Baltimore City Chemical Monitoring 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report. The results from discrete storm samples, as well as all other sample results, from these stations during 2009 can be found in the table "Baltimore City Monitoring Sample Results 2009" in that Access database.

Figure F2c.1 Linkwood Storm Samples Total Phosphorus Versus Flow

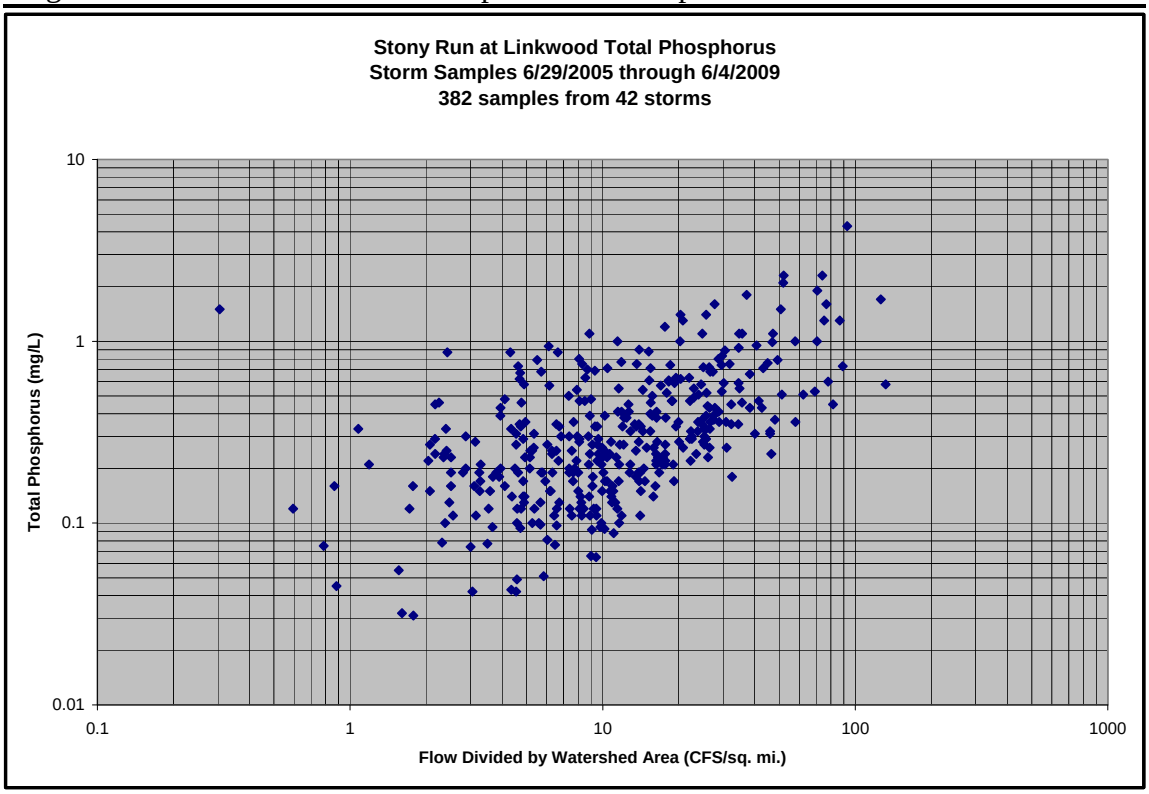


Figure F2c.2 Powder Mill Storm Samples Total Phosphorus Versus Flow

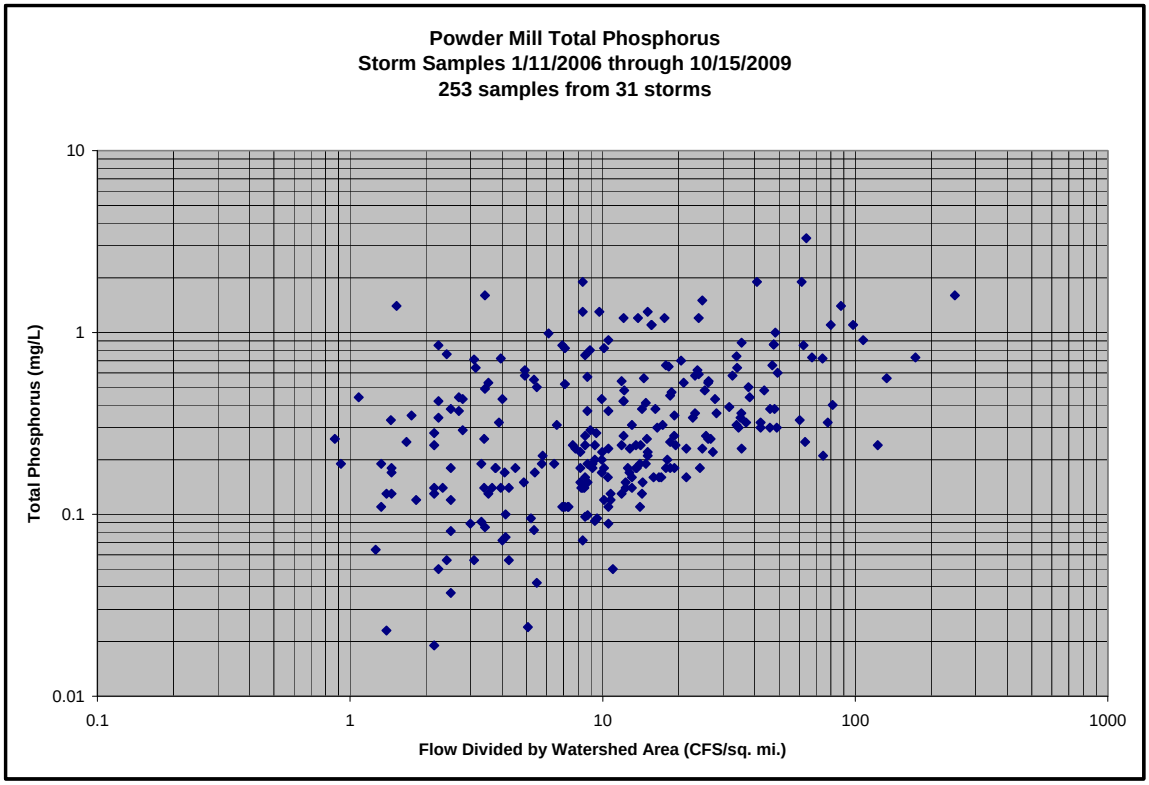


Figure F2c.3 Linkwood Storm Samples Total Nitrogen Versus Flow

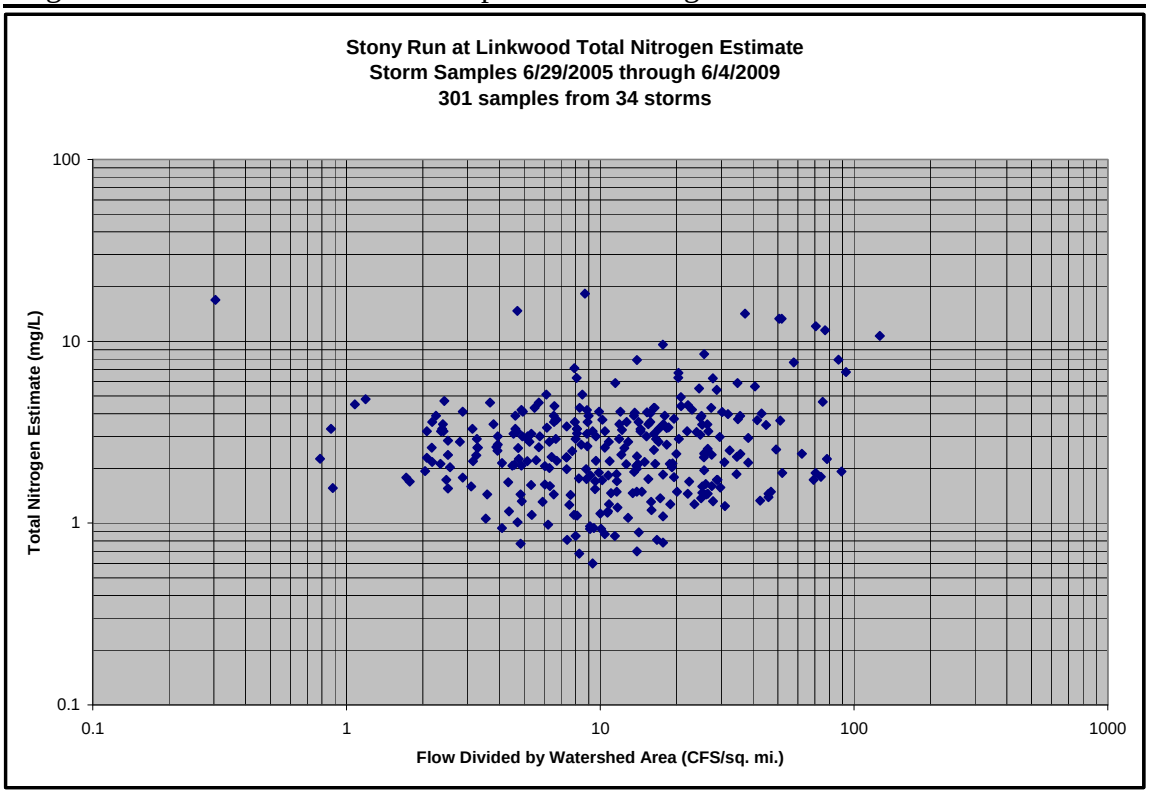


Figure F2c.4 Powder Mill Storm Samples Total Nitrogen Versus Flow

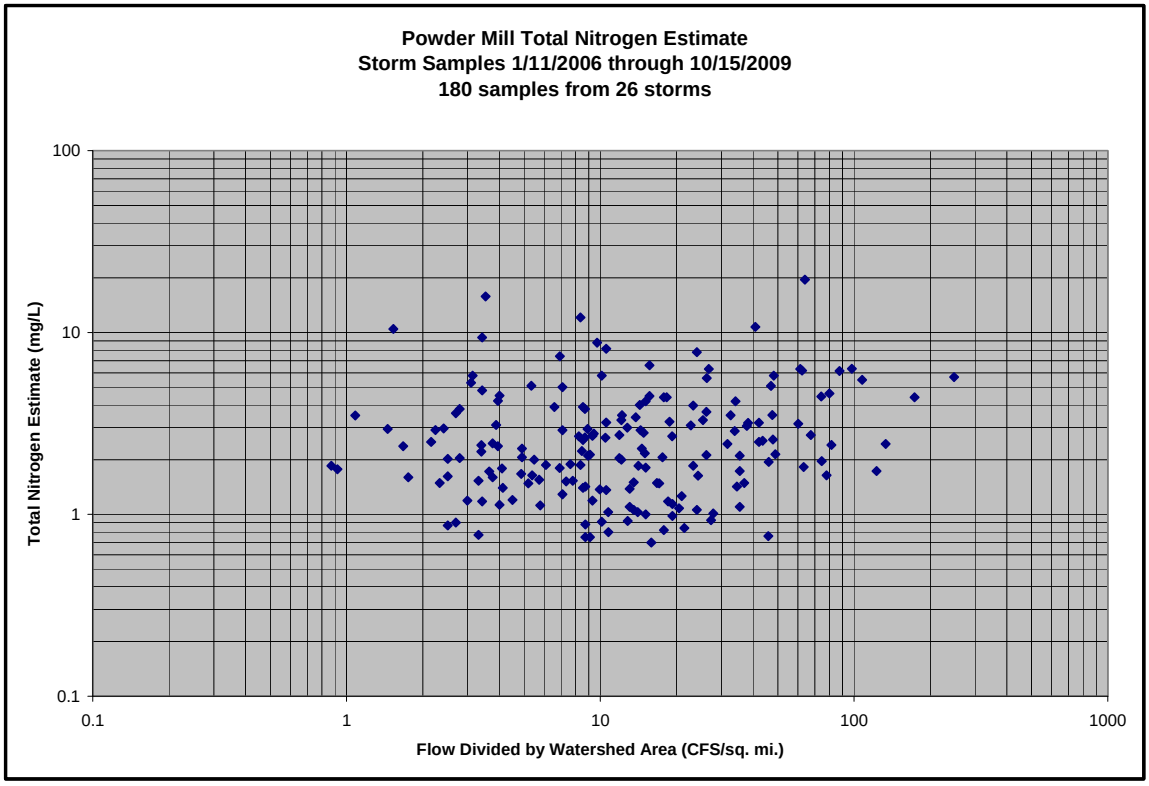


Figure F2c.5 Linkwood Storm Samples TKN Versus Flow

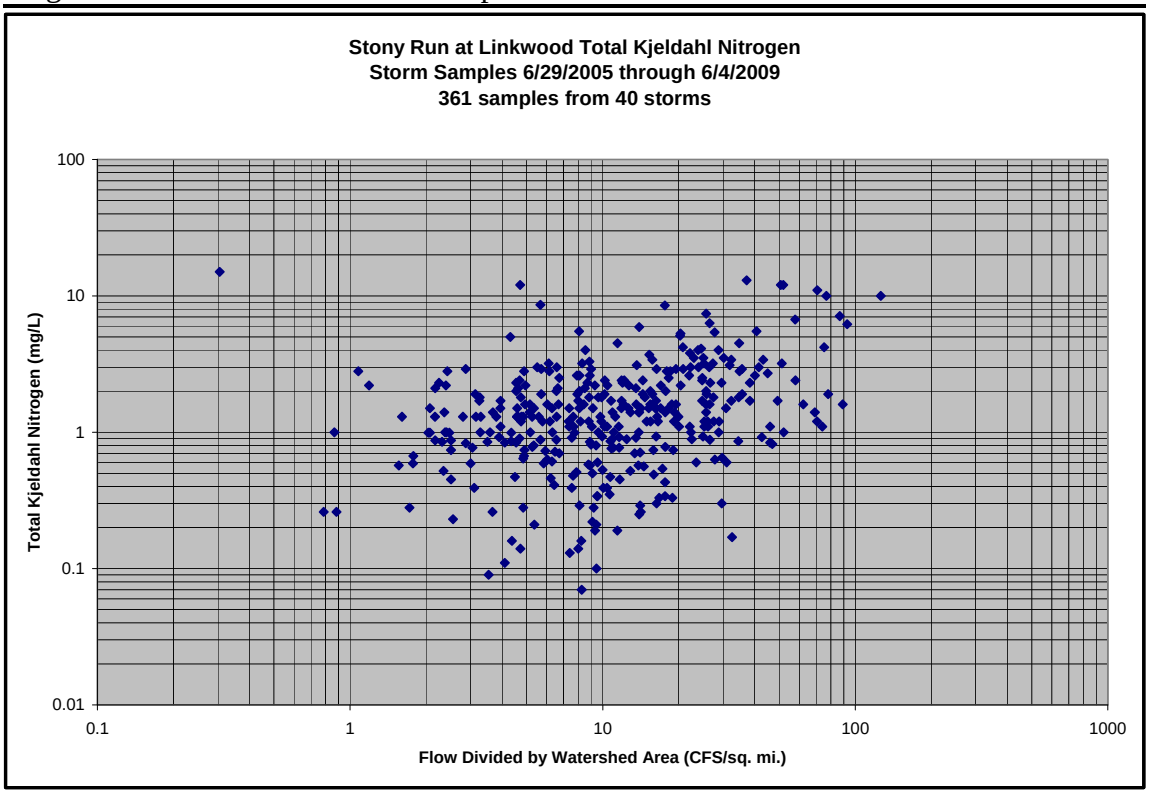


Figure F2c.6 Powder Mill Storm Samples TKN Versus Flow

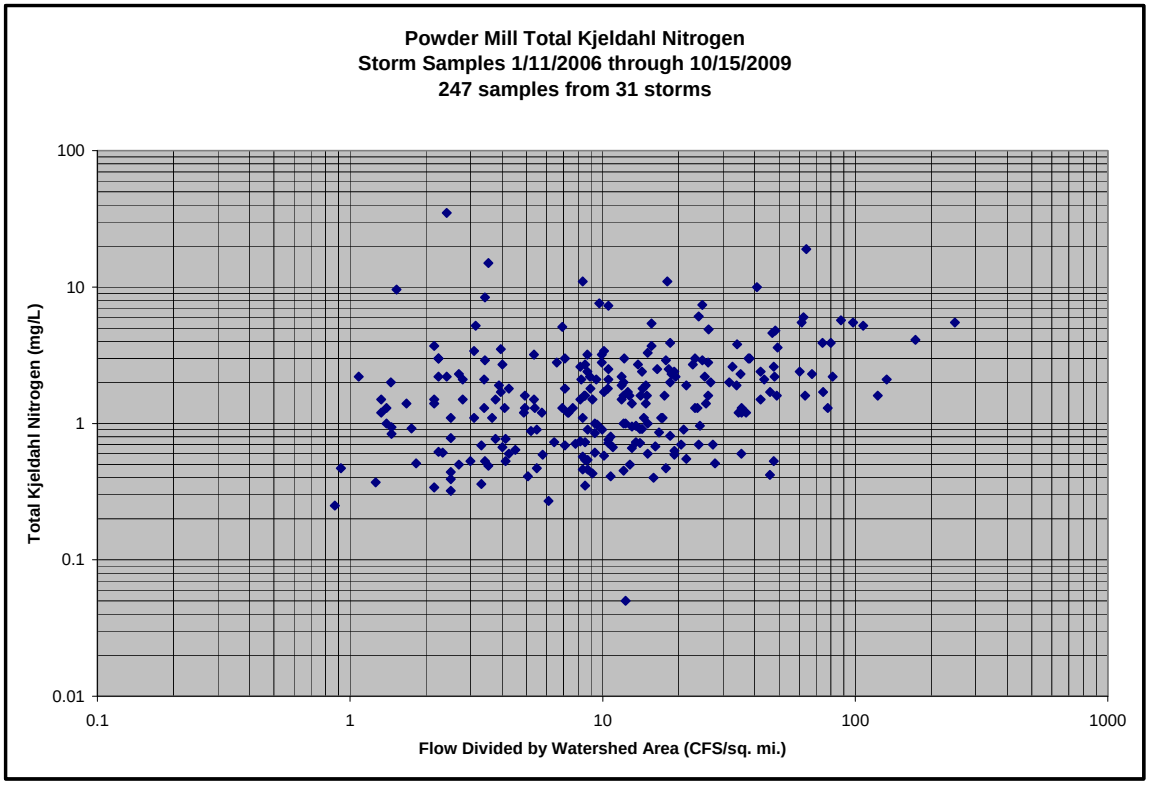


Figure F2c.7 Linkwood Storm Samples Nitrate+Nitrite Nitrogen Versus Flow

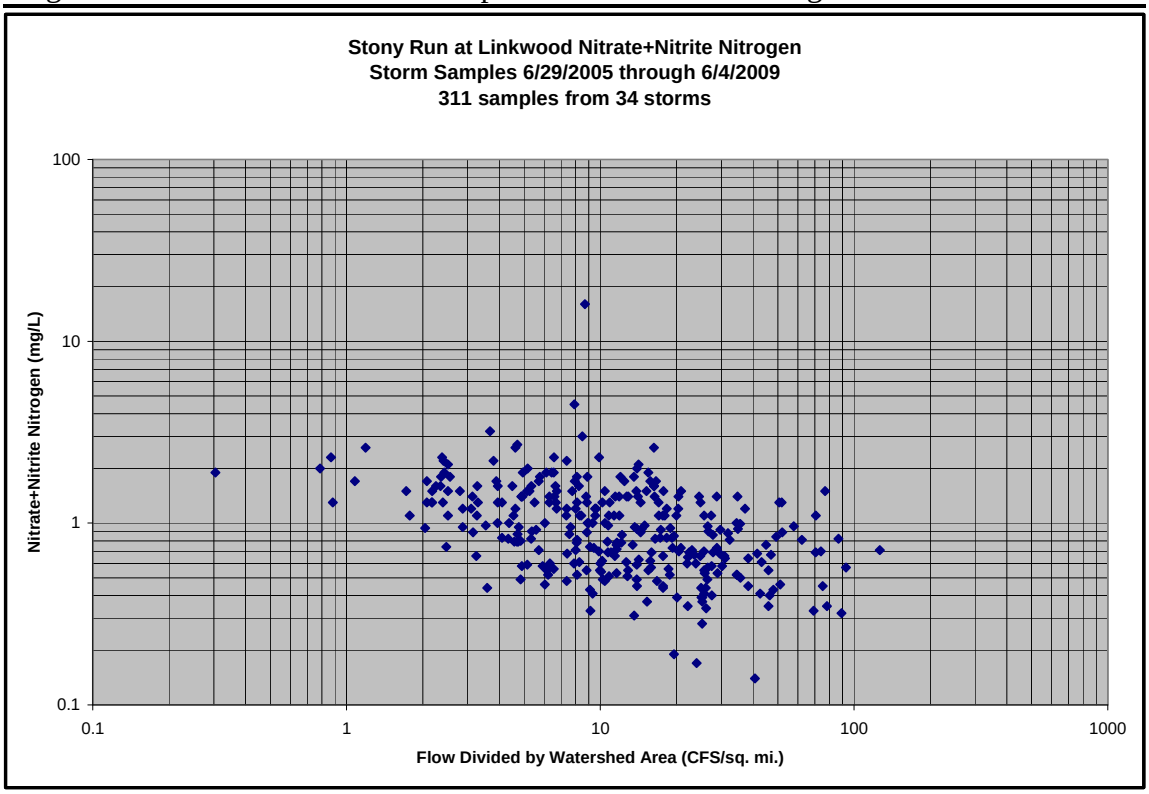


Figure F2c.8 Powder Mill Storm Samples Nitrate+Nitrite Nitrogen Versus Flow

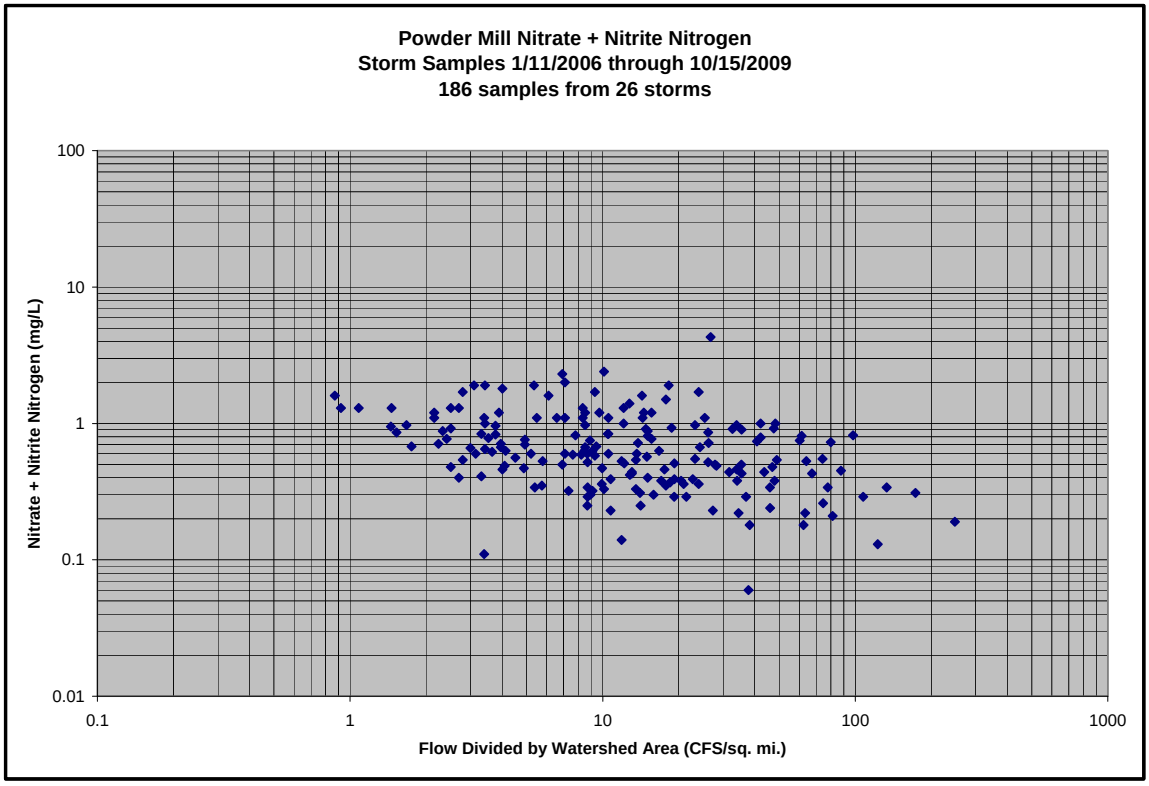


Figure F2c.9 Linkwood Storm Samples Total Suspended Solids Versus Flow

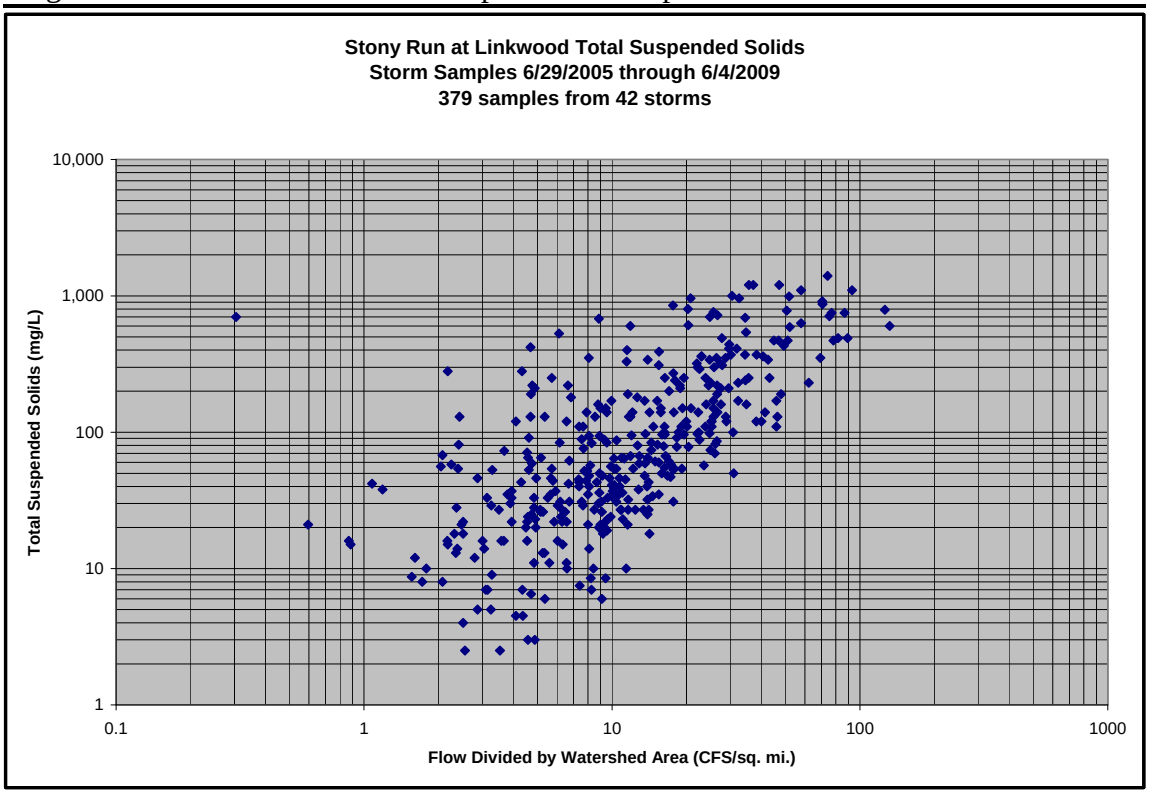


Figure F2c.10 Powder Mill Storm Samples Total Suspended Solids Versus Flow

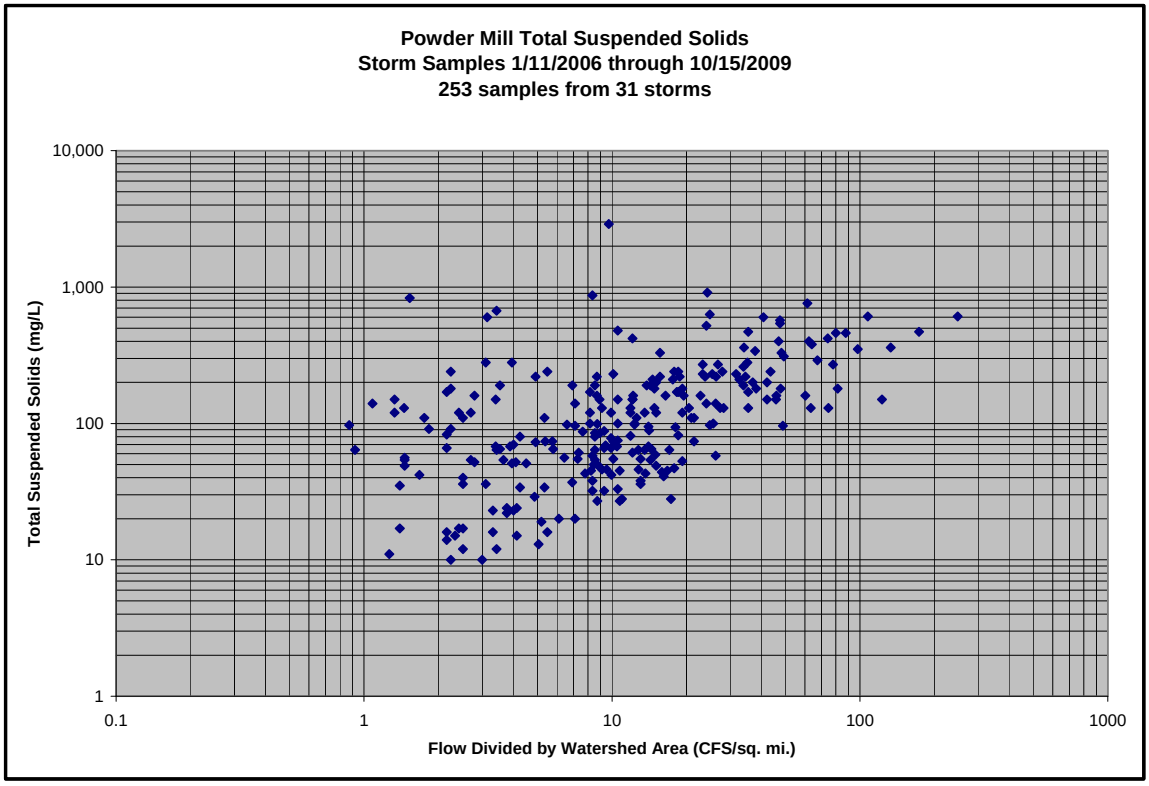


Figure F2c.11 Linkwood Storm Samples Volatile Suspended Solids Versus Flow

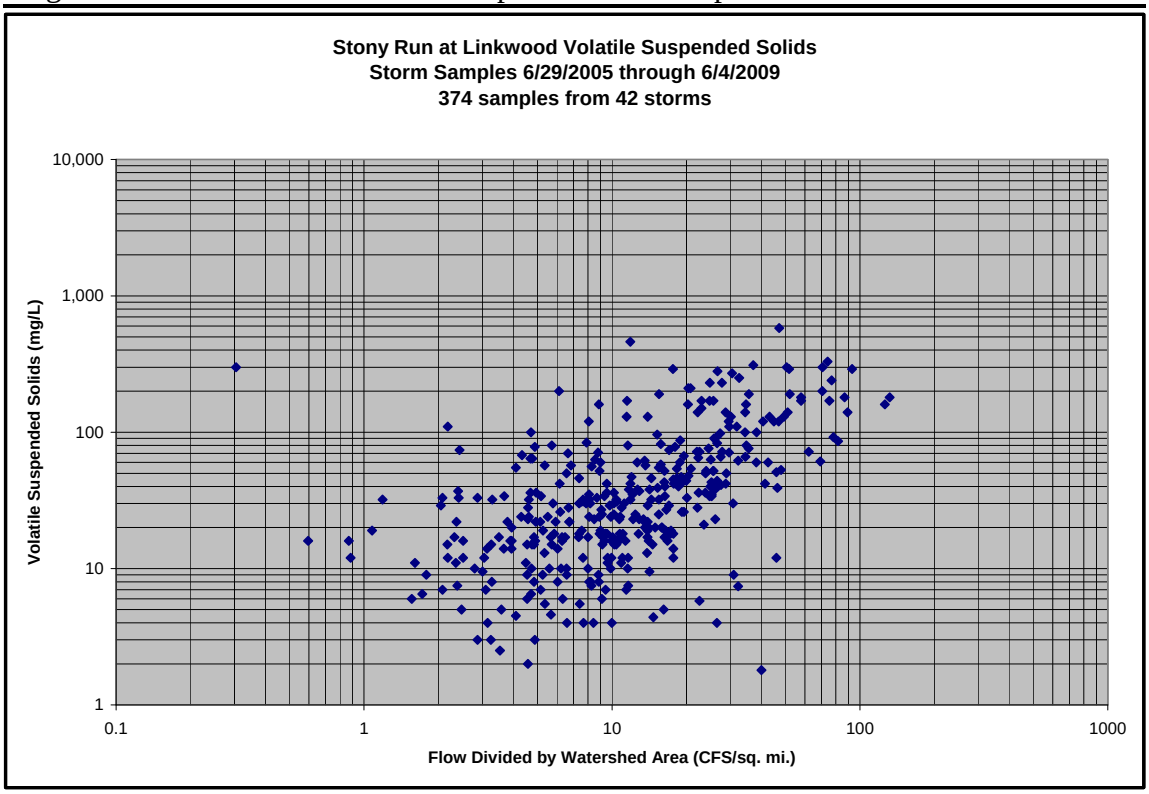


Figure F2c.12 Powder Mill Storm Samples Volatile Suspended Solids Versus Flow

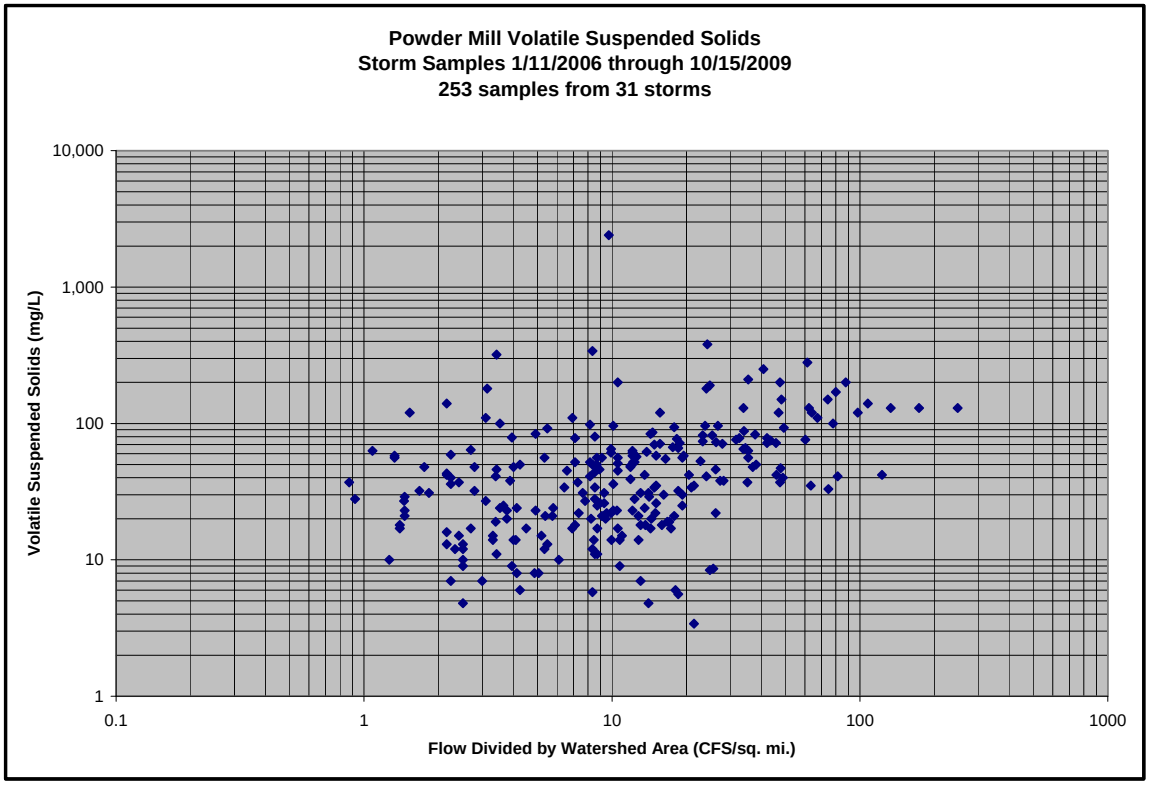


Figure F2c.13 Linkwood Storm Samples % Volatile Suspended Solids Versus Flow

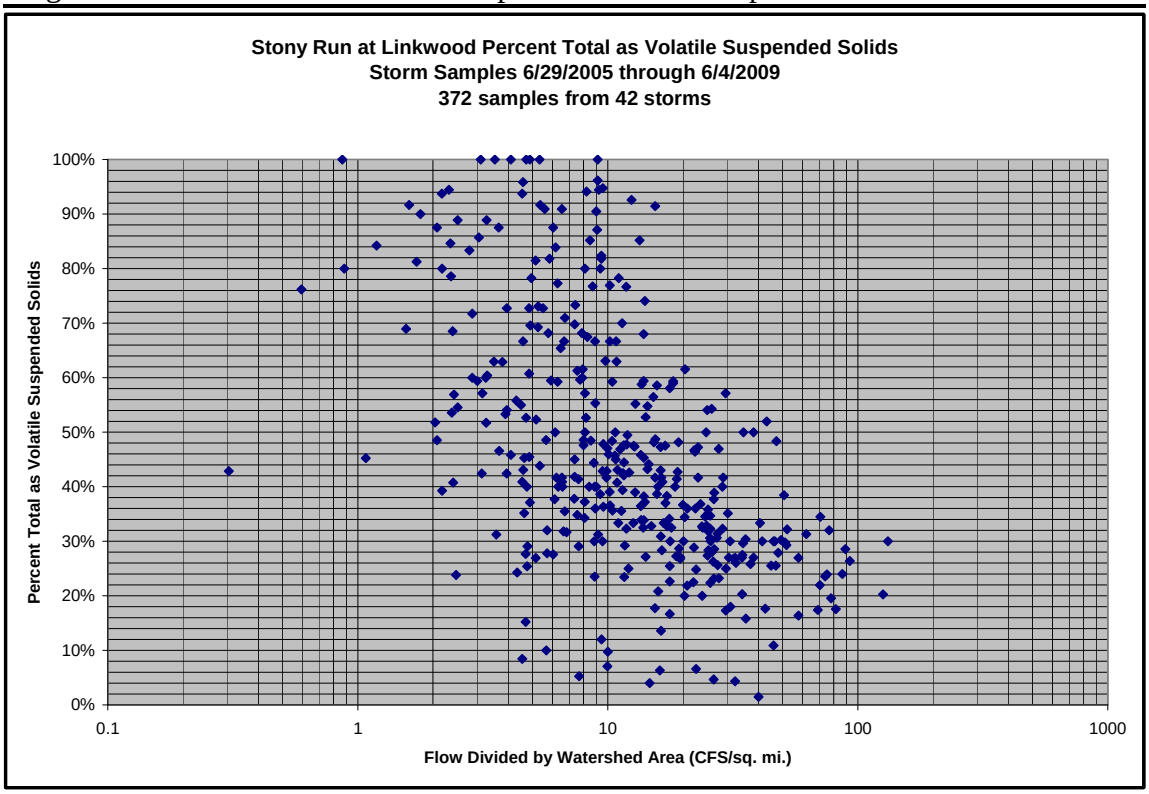


Figure F2c.14 Powder Mill Storm Samples % Volatile Suspended Solids Versus Flow

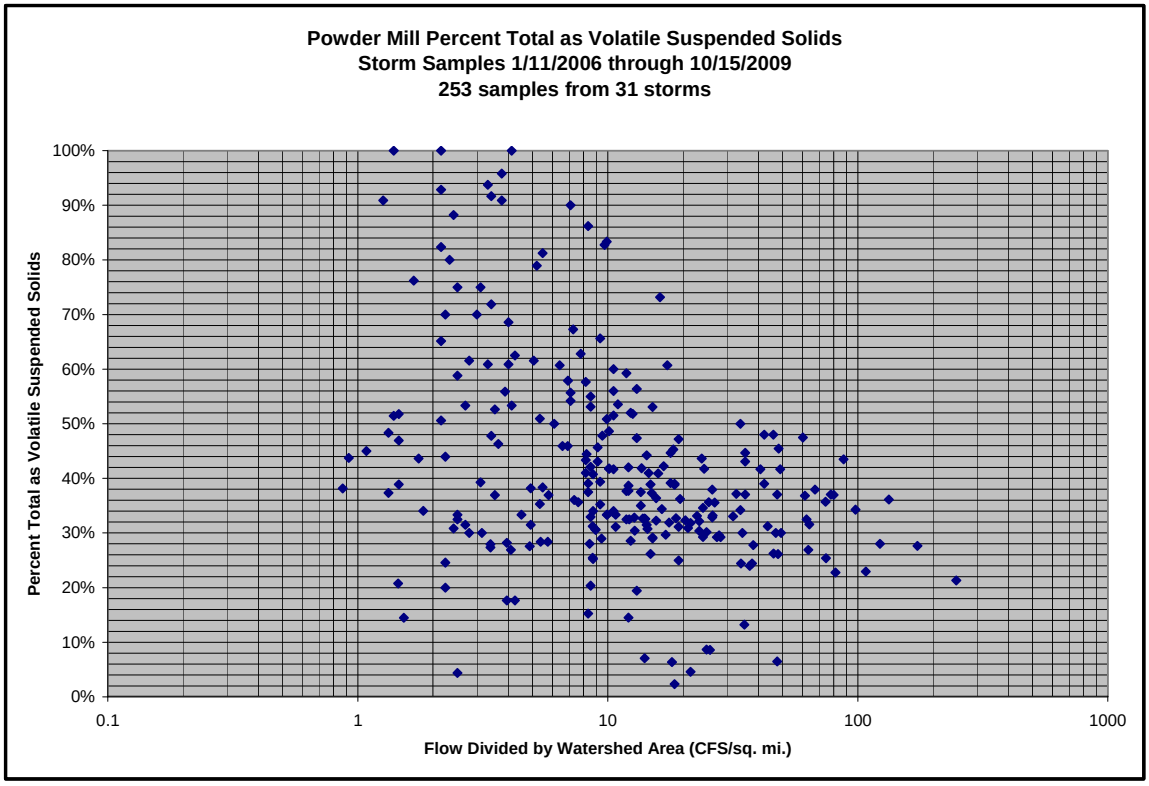


Figure F2c.15 Linkwood & Powder Mill Total Phosphorus Storm EMCs

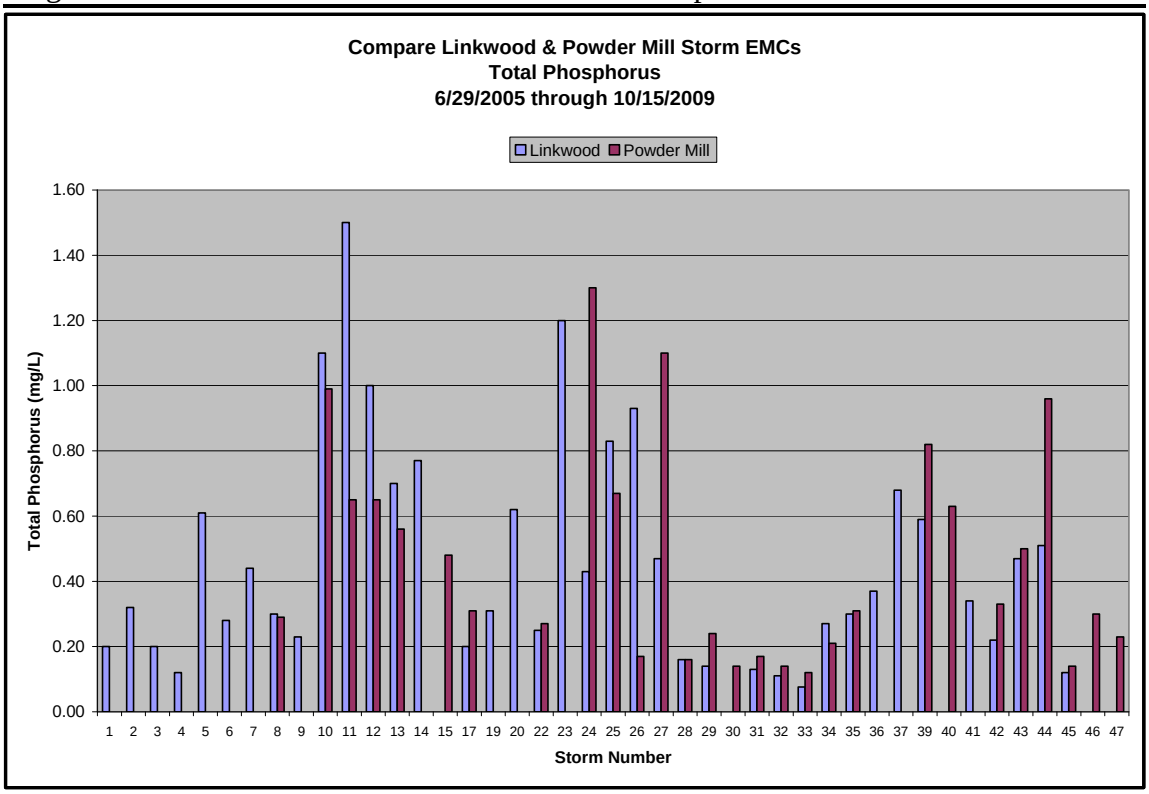


Figure F2c.16 Linkwood & Powder Mill Total Nitrogen Storm EMCs

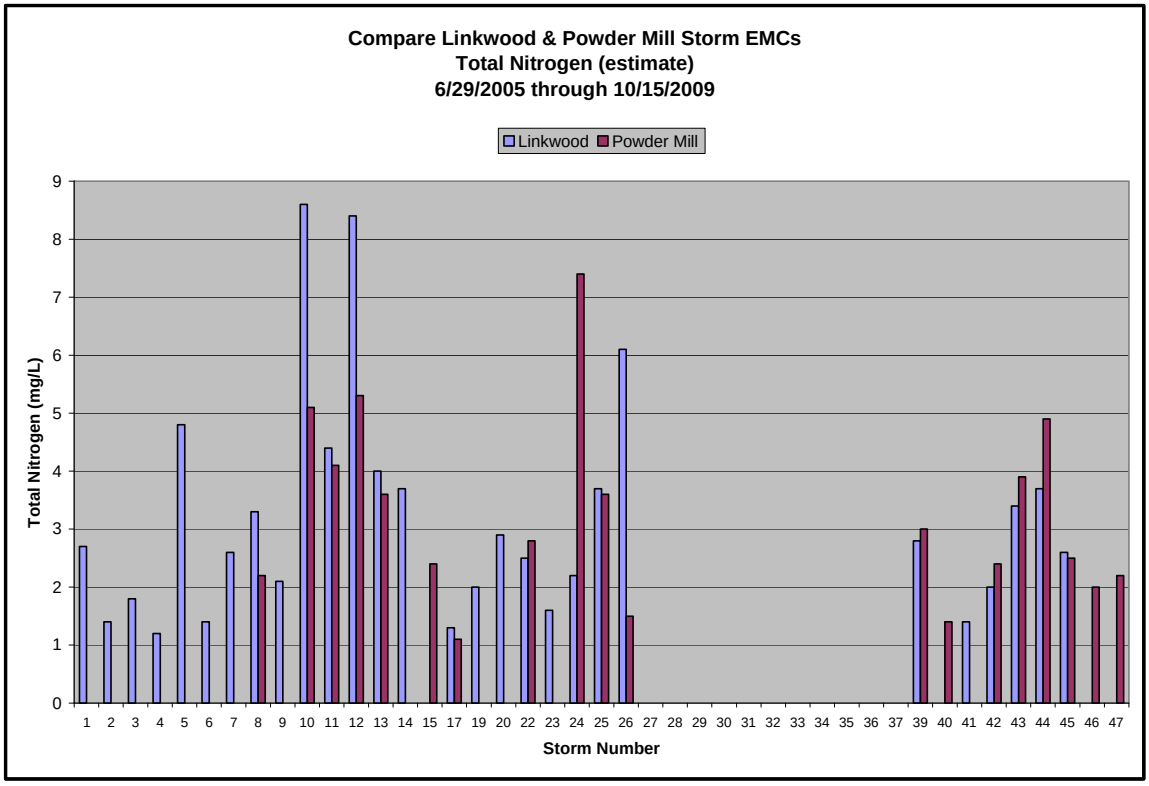


Figure F2c.17 Linkwood & Powder Mill TKN Storm EMCs

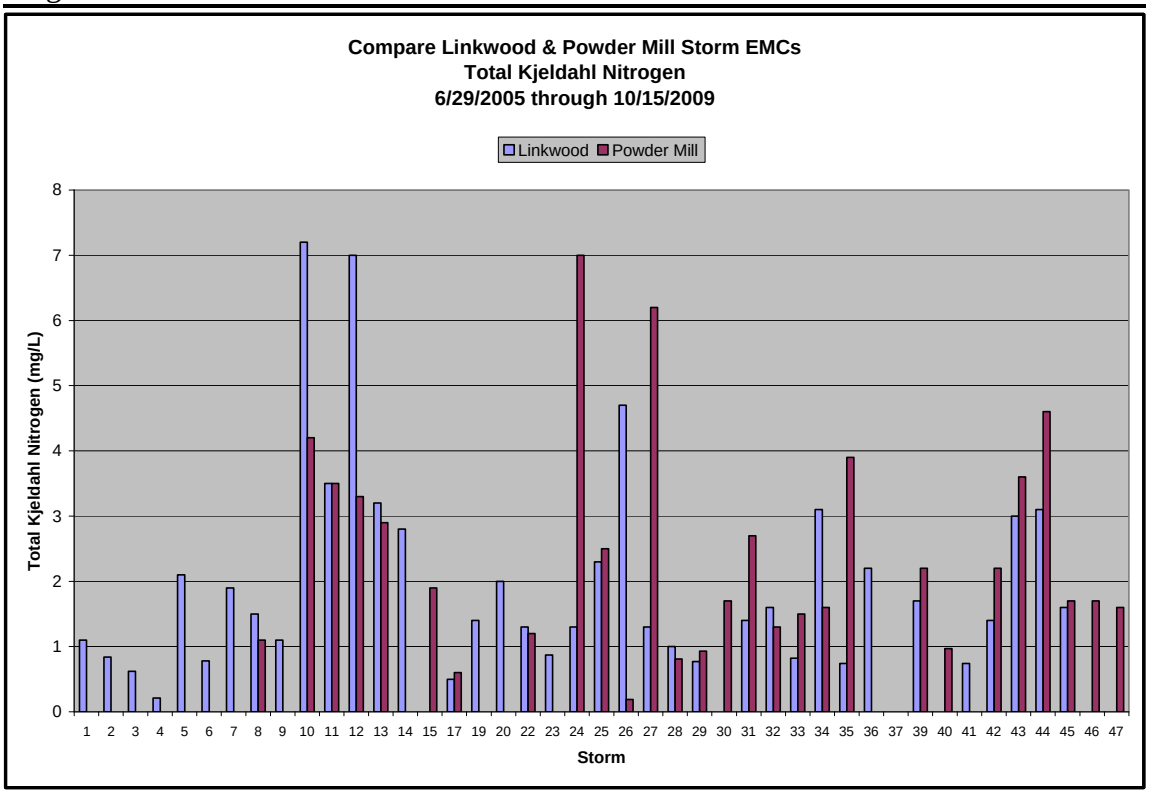


Figure F2c.18 Linkwood & Powder Mill Nitrate+Nitrite Nitrogen Storm EMCs

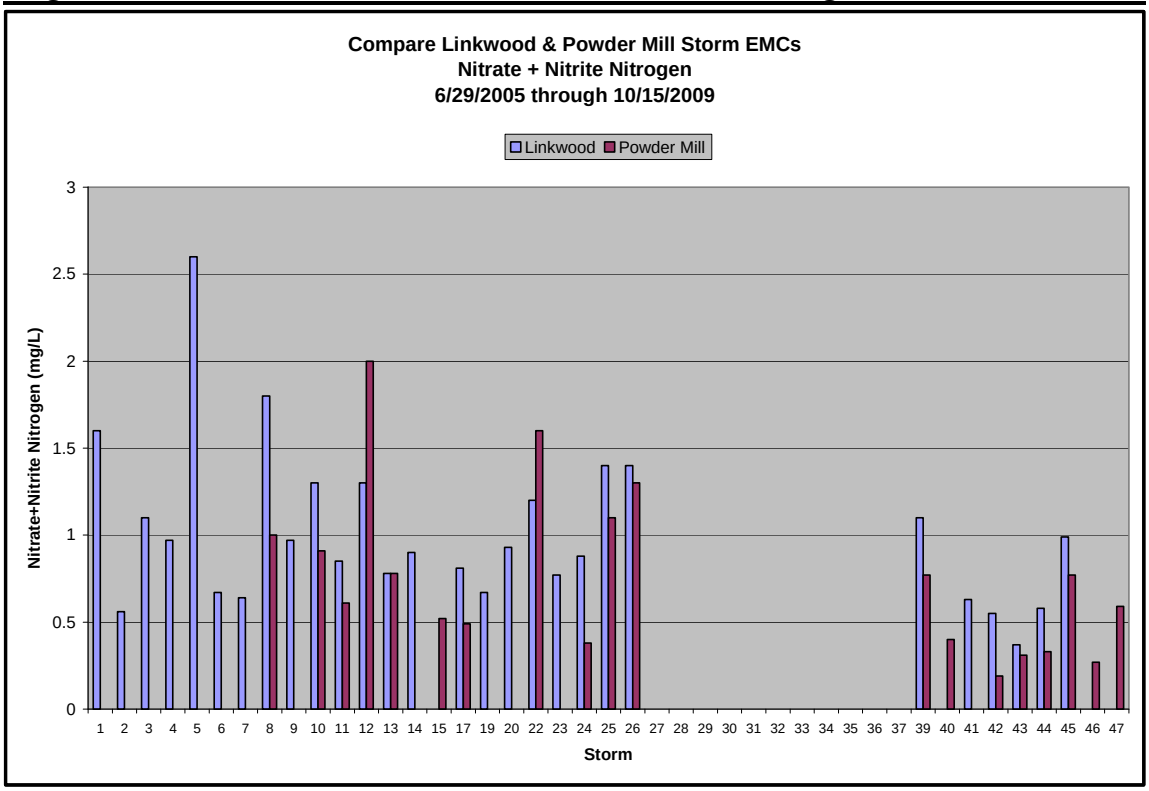


Figure F2c.19 Linkwood & Powder Mill Total Suspended Storm EMCs

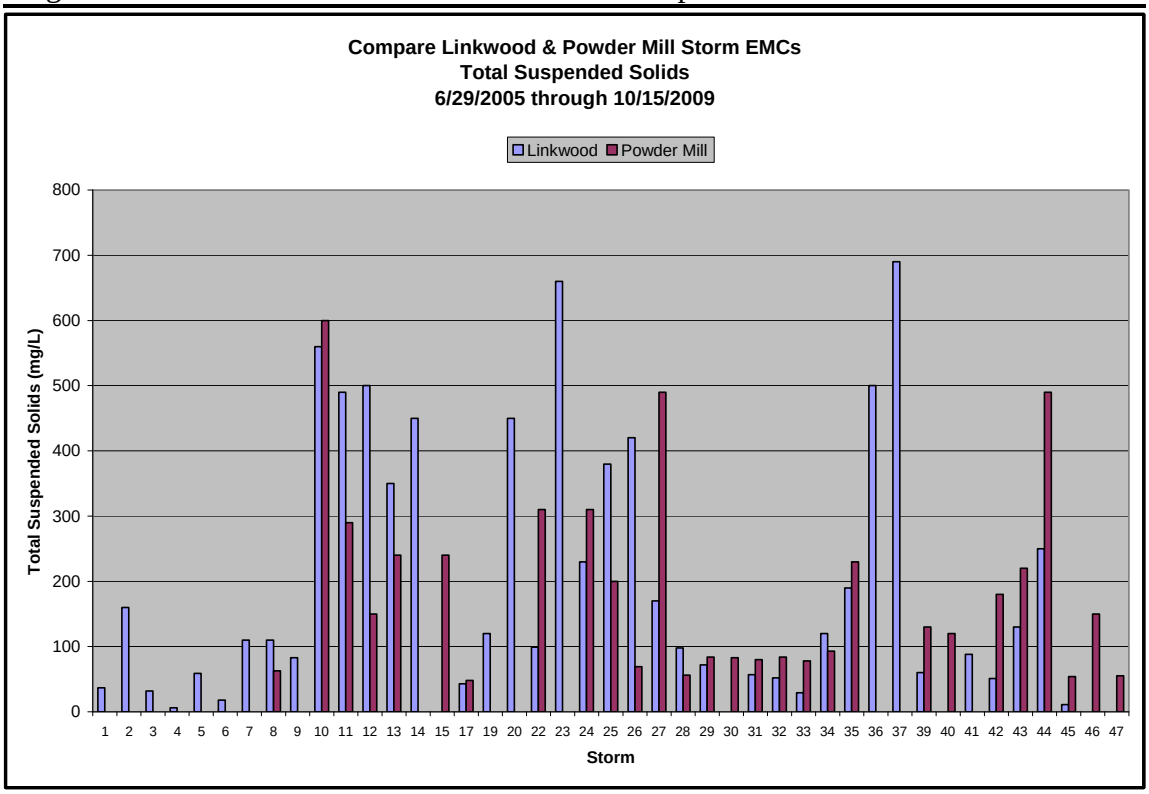
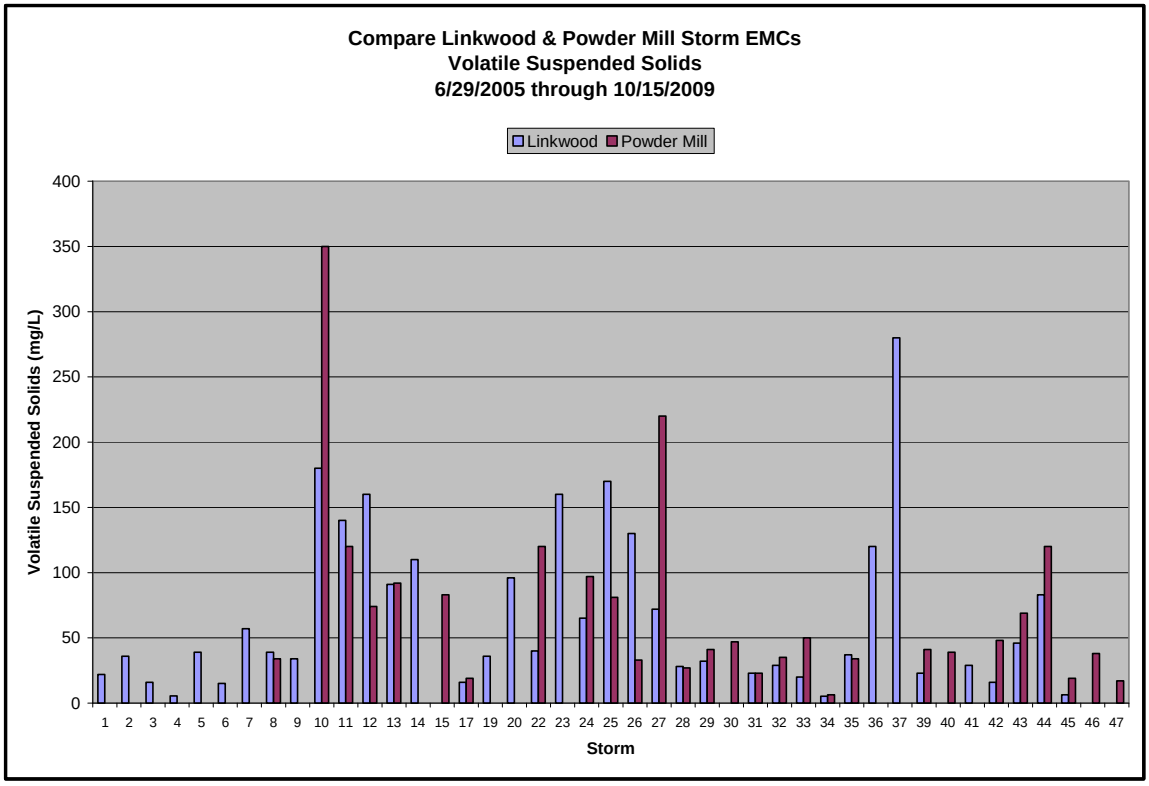


Figure F2c.20 Linkwood & Powder Mill Volatile Suspended Solids Storm EMCs



3. **Annual Reporting**

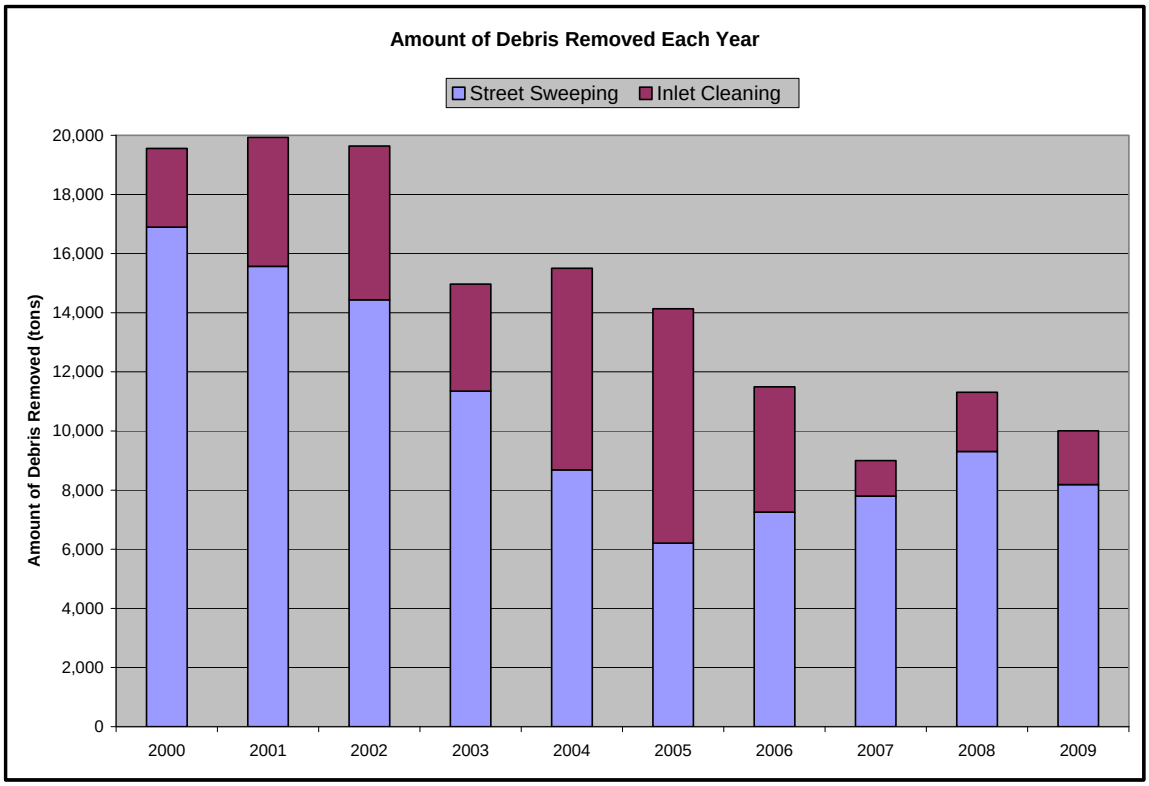
This is the last annual report under the 5-year permit that expired in January 2010. That permit required the City to restore or treat 20% of the City's impervious area, which amounts to 4,675 of a total of 23,373 acres. As a means of measuring how well the practices implemented under the permit have met the goal of treating 20% of the impervious area, the City has chosen to estimate the amount of phosphorus annually retained or removed by these practices, and compare that amount to the estimated phosphorus load that 23,373 acres of impervious area would annually generate, which is 51,650 pounds of phosphorus (assuming each acre generates an annual load of 2.21 pounds of phosphorus). Below is a discussion of how the City assigned an estimate for the amount of phosphorus annually retained or removed by each of these groups of practices: street sweeping and inlet cleaning; volume control BMPs; and stream restoration.

Street Sweeping and Inlet Cleaning:
The City will continue to multiply the tonnage of debris collected by the median concentration of phosphorus (120 ppm) in the debris collected from the Hamilton Street Sweeping Study to relate the benefit of the City's Street Sweeping and Inlet Cleaning Program to percent impervious area treated. To recap the method, the estimated amount of phosphorus removed by street sweeping and inlet cleaning is converted to an equivalent area of impervious surface treated using the assumption that the average total phosphorus loading for 1 acre of impervious area is 2.21 lbs per acre per year.

Table F3.1 and Figure F3.1 present the amount of debris removed each year by street sweeping and inlet cleaning. During 2009, there were 10,010 tons of debris removed, which equates to the equivalent of treating 1,100 acres of impervious surface, which equals 4.7% of the City's impervious surface area.

Table F3.1 Conversions of Debris Removed by Street Sweeping & Inlet Cleaning to Equivalent Treated Area for 2000 through 2009						
Year	Inlet Cleaning Debris Removed (tons)	Street Sweeping Debris Removed (tons)	Sum of Debris Removed (tons)	Estimated Amount of Total Phosphorus (tons)	Equivalent Treatment (acres of impervious surface)	Percent of City's Impervious Area
2000	2,658	16,897	19,555	2.35	2,100	9.0%
2001	4,362	15,569	19,931	2.39	2,200	9.4%
2002	5,204	14,437	19,641	2.36	2,100	9.0%
2003	3,624	11,347	14,971	1.80	1,600	6.8%
2004	6,817	8,686	15,503	1.86	1,700	7.3%
2005	7,925	6,208	14,133	1.70	1,500	6.4%
2006	4,234	7,261	11,495	1.38	1,200	5.1%
2007	1,202	7,800	9,002	1.08	1,000	4.3%
2008	2,001	9,308	11,309	1.36	1,200	5.1%
2009	1,824	8,186	10,010	1.20	1,100	4.7%

Figure F3.1 Amount of Debris Removed by Street Sweeping and Inlet Cleaning



Volume Control BMPs:

The volume-control BMPs (see Table F3.2) treat runoff from 1,679 acres, which include 831 impervious acres. The City has been using the following methodology to assign an estimated an annual phosphorus removal for the volume control BMPs:

- One acre foot of treatment volume provides the necessary water quality treatment volume of 13.3 acres of impervious area.
- The total treatment volume of the three volume control BMPs is 13.3 acre-feet. Therefore, using the State's stormwater criteria, the BMPs combined treat an equivalent impervious area of 178 acres (13.3 times 13.3).
- The Maryland Stormwater Design Manual states that BMPs of this nature remove approximately 40 percent of the total phosphorus load.
- Using the Center for Watershed Protection's short-cut method, the load reduction from this is 40 percent of 0.226*annual runoff*pollutant concentration*area (L=0.226*R*C*A). Assuming a total phosphorus EMC of 0.27mg/L (from the National Stormwater Quality Database); an annual runoff of 36.3 inches (for 100 percent impervious cover); and 40 percent efficiency, the phosphorus load reduction estimate is 158 pounds per year.

Table F3.2 Volume Control BMPs Estimated Annual Phosphorus Removal

Project	Status	Watershed Area (acres)	Impervious Area (acres)	Treatment Volume (acre-feet)	Equivalent Treatment Impervious Area (acre)	Estimated Annual Phosphorus Removal (lbs)
Brooklyn Park Stormwater BMP	Completed 2004	306	138	7.5	100	89
Gwynns Run Stormwater BMP	Completed 2003	1,373	693	5.8	77	68
Watershed 263 Six BMPs	Completed 2009	0.44	0.44	0.039	1	1
Total Completed		1,679	831	13.3	178	158

Stream Restoration:
The average phosphorus concentration of stream sediment measured in Stony Run was 0.439 lbs/ton of sediment. This estimate is in line with data collected at several streams in the Baltimore Metropolitan area and will be used as the average for City streams under restoration.

1) The average stream bank total phosphorus loading rate is therefore: 0.136 lbs per foot per year (0.31 tons of sediment per linear foot multiplied by 0.439 lbs phosphorus per ton of sediment).

Loading rates from stream bank erosion can be compared to loadings from impervious areas by computing the annual per acre loading from impervious areas using the short-cut method (developed by the Center for Watershed Protection), and the average event mean concentration from the National Stormwater Quality Database.

2) The average total phosphorus loading for 1 acre of impervious area (EMC=0.27 mg/L) is 2.21 lbs per acre per year.

3) Therefore, one acre of impervious area generates as much annual total phosphorus loading as 16.25 feet of stream.

The City will use a conservative estimate of stream restoration effectiveness of 50 percent (reduction in sediment and phosphorus load). This number compares to sediment and phosphorus load reductions for the Spring Branch Project of 83 and 43 percent respectively.

Summary of the Estimated Annual Amount of Phosphorus Retained or Removed by the City's BMPs:
Table F3.3 summarizes the estimated amount of phosphorus removed or retained by the City's BMPs that were discussed above. Since the City has 23,373 acres of impervious surface, and assuming each acre generates an annual load of 2.21 pounds of phosphorus, then the expected annual load is 51,650 pounds of phosphorus. The total estimated annual amount of phosphorus retained by the City's BMPs is 3,352 pounds. This represents 6% of the expected annual load from the City's impervious surfaces.

Table F3.3 Estimated Amount of Phosphorus Retained by BMPs

Project Name	**Type**	**Estimated Annual Amount of Phosphorus Withheld (lbs)**
School Greening Phase I	asphalt removal	15
School Greening Phase II	asphalt removal	12
School Greening Phase III	asphalt removal	10
Vacant Lot Greening Phase I	asphalt removal	1
Street Sweeping & Inlet Cleaning (2009)	cleaning practice	2,400
Brooklyn Park Stormwater BMP	volume control	89
Gwynns Run Stormwater BMP	volume control	68
Biddison Run Phase I	stream restoration	102
Upper Stony Run	stream restoration	158
Middle Stony Run	stream restoration	187
Watershed 263 Six BMPs	volume control	1
Maidens Choice Stream #1	stream restoration	184
Lower Stony Run	stream restoration	126
Total Completed		**3,352**

G. Assessment of Controls

1. Watershed Restoration Assessment

a. Chemical Monitoring

Moores Run Long-term Discharge Characterization
Table G1a.1 gives the number of sampling events, the number of samples collected, and the number of water quality analyses performed for monitoring associated with the long-term discharge characterization for the Moores Run during 2009. There were six storm events that were monitored at the Radecke Avenue station, but only three that were successfully monitored at the Hamilton Avenue station. There were twelve baseline monitoring events at these stations. The storm EMCs and baseline sampling results for Radecke Avenue and Hamilton Avenue during 2009 can be found in table "Baltimore City Chemical Monitoring 2009" in the Access database "Baltimore City NPDES Stormwater Permit Data 2009.mdb" on the CD-ROM accompanying this report. The results for all the discrete samples from all monitoring at theses two stations during 2009 can be found in table "Baltimore City Monitoring Sample Results 2009" in that Access database. A list of sampling activities for 2009 at the Hamilton Avenue can be found in Table G1a.2. A list of sampling activities for 2009 at the Radecke Avenue station can be found in Table G1a.3.

Table G1a.1 Moores Run Long-term Discharge Characterization During 2009

Station and Type	Number of Surveys or Storm Events	Number of Samples	Number of Water Quality Analyses Performed
Mary Ave. Baseline	12	12	260
Hamilton Ave. Baseline	12	12	257
Radecke Ave. Baseline	12	12	272
Hamilton Ave. Ammonia Screening	27	27	158
Radecke Ave. Ammonia Screening	26	26	153
Hamilton Storm	3	23	345
Radecke Storm	6	44	698
Total			2,143

Total Petroleum Hydrocarbons (TPH)
The City uses automated samplers to collect samples during storms at the Hamilton Avenue and Radecke Avenue monitoring stations. In

order to analyze storm samples for TPH, the samples must be collected manually, and preserved immediately. This incurs a great expense in overtime wages. The City did not have personnel manning these stations during any of the storm events monitored during 2009. Thus, no TPH analyses were run on storm samples during 2009.

Water Temperature and pH

The automated sampling equipment installed at the Hamilton Avenue station is capable of operating pH and water temperature sensors; however, the City did not collect pH or water temperature data during any of the three events successfully monitored at the Hamilton Avenue station during 2009. The equipment used at the Radecke Avenue station cannot operate pH or water temperature sensors.

Table G1a.2 Summary of Monitoring Activities During 2009 for Hamilton Avenue	
First Quarter 2009	
1/22/2009	Visited site as part of Herring Run Ammonia Screening
1/26/2009	Collected 1 grab baseline sample
2/3/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
2/12/2009	Visited site as part of Herring Run Ammonia Screening
2/19/2009	Visited site as part of Herring Run Ammonia Screening
2/23/2009	Collected 1 grab baseline sample
3/6/2009	Visited site as part of Herring Run Ammonia Screening
3/11/2009	Visited site as part of Herring Run Ammonia Screening
3/18/2009	Visited site as part of Herring Run Ammonia Screening
3/24/2009	Visited site as part of Herring Run Ammonia Screening
3/30/2009	Collected 1 grab baseline sample
Second Quarter 2009	
4/13/2009	Unsuccessful storm sampling
4/15/2009	Successful storm sampling- designated Event ID 188; submitted 8 storm samples for lab analysis; did not analyze for TPH; did not collect pH or water temperature data
4/22/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
4/27/2009	Collected 1 grab baseline sample
5/6/2009	Visited site as part of Herring Run Ammonia Screening
5/6-7/2009	Successful storm sampling- designated Event ID 189; submitted 7 storm samples for lab analysis; did not analyze for TPH; did not collect pH or water temperature data
5/13/2009	Visited site as part of Herring Run Ammonia Screening
5/18/2009	Collected 1 grab baseline sample
5/29/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
6/3/2009	Successful storm sampling- designated Event ID 190; submitted 8 storm samples for lab analysis; did not analyze for TPH; did not collect pH or water temperature data
6/11/2009	Visited site as part of Herring Run Ammonia Screening
6/16/2009	Visited site as part of Herring Run Ammonia Screening
6/22/2009	Collected 1 grab baseline sample
6/30/2009	Visited site as part of Herring Run Ammonia Screening

Table G1a.2 Summary of Monitoring Activities During 2009 for Hamilton Avenue (continued)	
Third Quarter 2009	
7/7/2009	Visited site as part of Herring Run Ammonia Screening
7/17/2009	Visited site as part of Herring Run Ammonia Screening
7/21/2009	Visited site as part of Herring Run Ammonia Screening
7/27/2009	Collected 1 grab baseline sample
7/29/2009	Unsuccessful storm sampling: automated sampler only collected one sample; sample was not submitted for analyses
8/4/2009	Visited site as part of Herring Run Ammonia Screening
8/13/2009	Visited site as part of Herring Run Ammonia Screening
8/18/2009	Visited site as part of Herring Run Ammonia Screening
8/24/2009	Collected 1 grab baseline sample
9/15/2009	Visited site as part of Herring Run Ammonia Screening
9/28/2009	Collected 1 grab baseline sample
Fourth Quarter 2009	
10/6/2009	Visited site as part of Herring Run Ammonia Screening
10/15/2009	Unsuccessful storm sampling: automated sampler did not trigger because stream level did not rise enough
10/22/2009	Visited site as part of Herring Run Ammonia Screening
10/26/2009	Collected 1 grab baseline sample
11/3/2009	Visited site as part of Herring Run Ammonia Screening
11/16/2009	Collected 1 grab baseline sample
12/1/2009	Visited site as part of Herring Run Ammonia Screening
12/10/2009	Visited site as part of Herring Run Ammonia Screening
12/14/2009	Collected 1 grab baseline sample

Table G1a.3 Summary of Monitoring Activities During 2009 for Radecke Avenue	
First Quarter 2009	
1/22/2009	Visited site as part of Herring Run Ammonia Screening
1/26/2009	Collected 1 grab baseline sample
2/3/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
2/12/2009	Visited site as part of Herring Run Ammonia Screening
2/19/2009	Visited site as part of Herring Run Ammonia Screening
2/23/2009	Collected 1 grab baseline sample
3/11/2009	Visited site as part of Herring Run Ammonia Screening
3/18/2009	Visited site as part of Herring Run Ammonia Screening
3/24/2009	Visited site as part of Herring Run Ammonia Screening
3/30/2009	Collected 1 grab baseline sample
Second Quarter 2009	
4/13-14/2009	Successful storm sampling- designated Event ID 187; submitted 7 storm samples for lab analysis; samples analyzed for sodium; did not analyze for TPH; did not collect pH or water temperature data
4/15/2009	Successful storm sampling- designated Event ID 188; submitted 8 storm samples for lab analysis; samples analyzed for sodium; did not analyze for TPH; did not collect pH or water temperature data
4/22/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
4/27/2009	Collected 1 grab baseline sample
5/6/2009	Visited site as part of Herring Run Ammonia Screening

Table G1a.3 Summary of Monitoring Activities During 2009 for Radecke Avenue (continued)	
Second Quarter 2009 (continued)	
5/6-7/2009	Successful storm sampling- designated Event ID 189; submitted 8 storm samples for lab analysis; samples analyzed for sodium; did not analyze for TPH; did not collect pH or water temperature data
5/13/2009	Visited site as part of Herring Run Ammonia Screening
5/18/2009	Collected 1 grab baseline sample
5/29/2009	Visited site as part of Herring Run Ammonia Screening; precipitation that day
6/3-4/2009	Successful storm sampling- designated Event ID 190; submitted 10 storm samples for lab analysis; samples analyzed for sodium; did not analyze for TPH; did not collect pH or water temperature data
6/11/2009	Visited site as part of Herring Run Ammonia Screening
6/16/2009	Visited site as part of Herring Run Ammonia Screening
6/22/2009	Collected 1 grab baseline sample
6/30/2009	Visited site as part of Herring Run Ammonia Screening
Third Quarter 2009	
7/7/2009	Visited site as part of Herring Run Ammonia Screening
7/17/2009	Visited site as part of Herring Run Ammonia Screening
7/21/2009	Visited site as part of Herring Run Ammonia Screening
7/27/2009	Collected 1 grab baseline sample
7/29/2009	Successful storm sampling- designated Event ID 191; submitted 6 storm samples for lab analysis; did not analyze for TPH; did not collect pH or water temperature data
8/4/2009	Visited site as part of Herring Run Ammonia Screening
8/13/2009	Visited site as part of Herring Run Ammonia Screening
8/18/2009	Visited site as part of Herring Run Ammonia Screening
8/24/2009	Collected 1 grab baseline sample
9/15/2009	Visited site as part of Herring Run Ammonia Screening
9/28/2009	Collected 1 grab baseline sample
Fourth Quarter 2009	
10/6/2009	Visited site as part of Herring Run Ammonia Screening
10/15/2009	Successful storm sampling- designated Event ID 192; submitted 5 storm samples for lab analysis; samples analyzed for sodium; EMC not computed for BOD because first sample reported as <50 mg/L (that reporting limit is too high); did not analyze for TPH; did not collect pH or water temperature data
10/22/2009	Visited site as part of Herring Run Ammonia Screening
10/26/2009	Collected 1 grab baseline sample
11/3/2009	Visited site as part of Herring Run Ammonia Screening
11/16/2009	Collected 1 grab baseline sample
12/1/2009	Visited site as part of Herring Run Ammonia Screening
12/10/2009	Visited site as part of Herring Run Ammonia Screening
12/14/2009	Collected 1 grab baseline sample

Moores Run SWMM Model Results

The City hired a consultant to estimate the pollutant loads for 2009 for the Moores Run at Radecke Avenue. The City supplied the consultant with the following data from 2009: flow data recorded by the USGS at the Radecke Avenue station, rainfall data from the City's flood warning station at Hazelwood Elementary School, the EMCs from storms monitored at the Radecke Avenue station, and results from

baseline (dry weather) samples collected at the Radecke Avenue station. A copy of the consultant's report can be found in the file "Moores Run Watershed SWMM Model 2009 Annual Report.doc" on the CD-ROM accompanying this report. Table G1a.4 and Figures G1a.1 through G1a.6 compare the SWMM load estimates for 2009 with previous SWMM estimates for 1999, and 2003 through 2008. Note that these loads are based on modeling runs calibrated with different data sets.

The 2009 loading rate for each of the six parameters increased compared to 2008. The rates of increase ranged from 25% (for lead) to 40% (for nitrogen). For each parameter, except total nitrogen, this was the second consecutive year with an increase. The 2009 loading rate for copper is the highest loading rate among the eight years that have been run through the SWMM model.

Table G1a.5 Compare the Annual Loads Computed by the Different SWMM Runs Done for the Moores Run at Radecke Avenue (in pounds/acre/year)

Parameter	**1999**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total Suspended Solids	199	219	249	434	434	217	224	283
Total Phosphorus	0.874	0.990	1.31	2.50	1.49	0.612	0.765	1.02
Total Nitrogen	5.18	6.07	9.42	5.74	8.24	4.11	3.49	4.88
Total Copper	0.0446	0.0512	0.0562	0.0556	0.0949	0.0477	0.0700	0.0953
Total Zinc	0.402	0.459	0.489	0.285	0.297	0.203	0.259	0.347
Total Lead	0.0759	0.0854	0.0956	0.0689	0.0683	0.0399	0.0449	0.0562

Figure G1a.1 Compare Annual Total Suspended Solids Loads for Moores Run

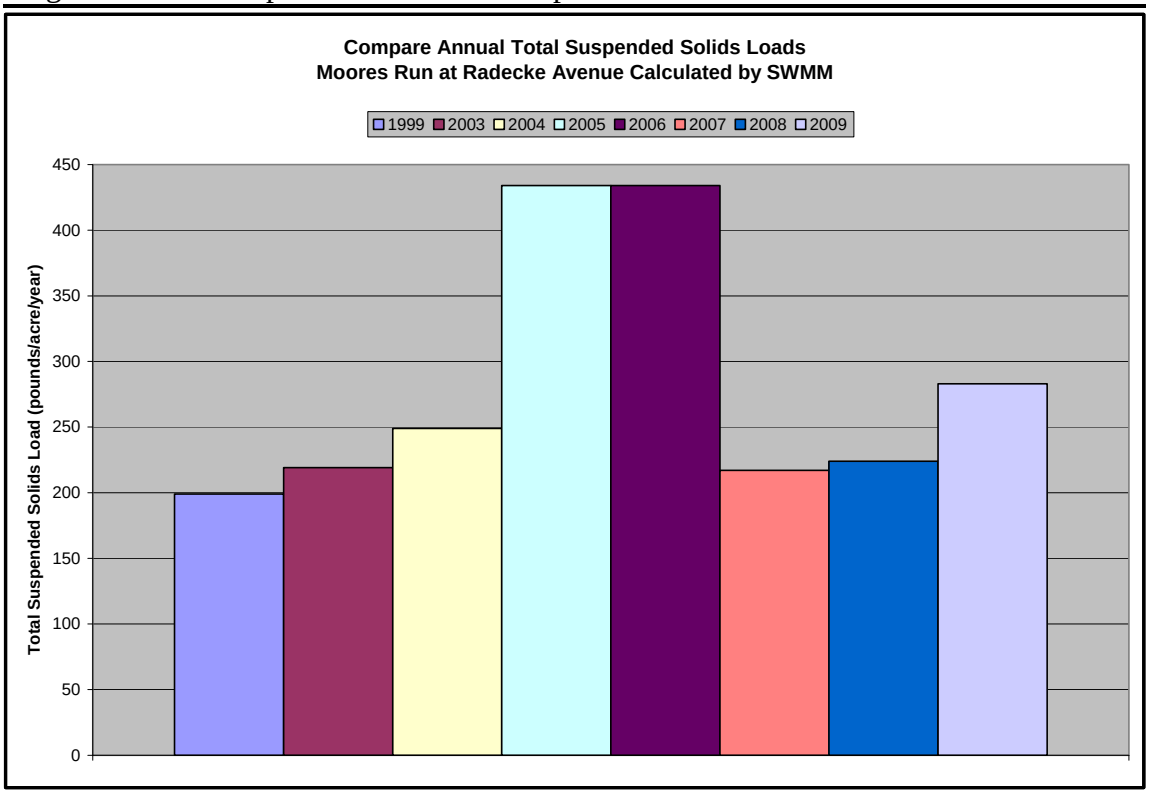


Figure G1a.2 Compare Annual Total Phosphorus Loads for Moores Run

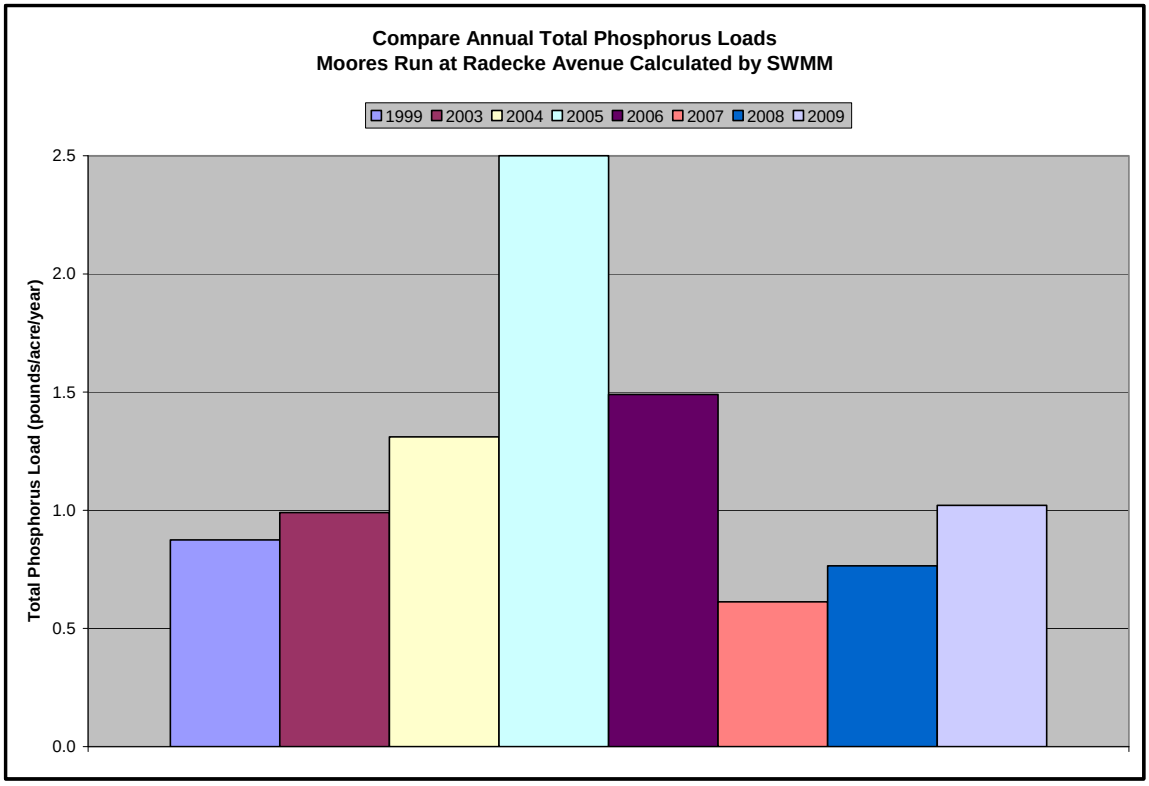


Figure G1a.3 Compare Annual Total Nitrogen Loads for Moores Run

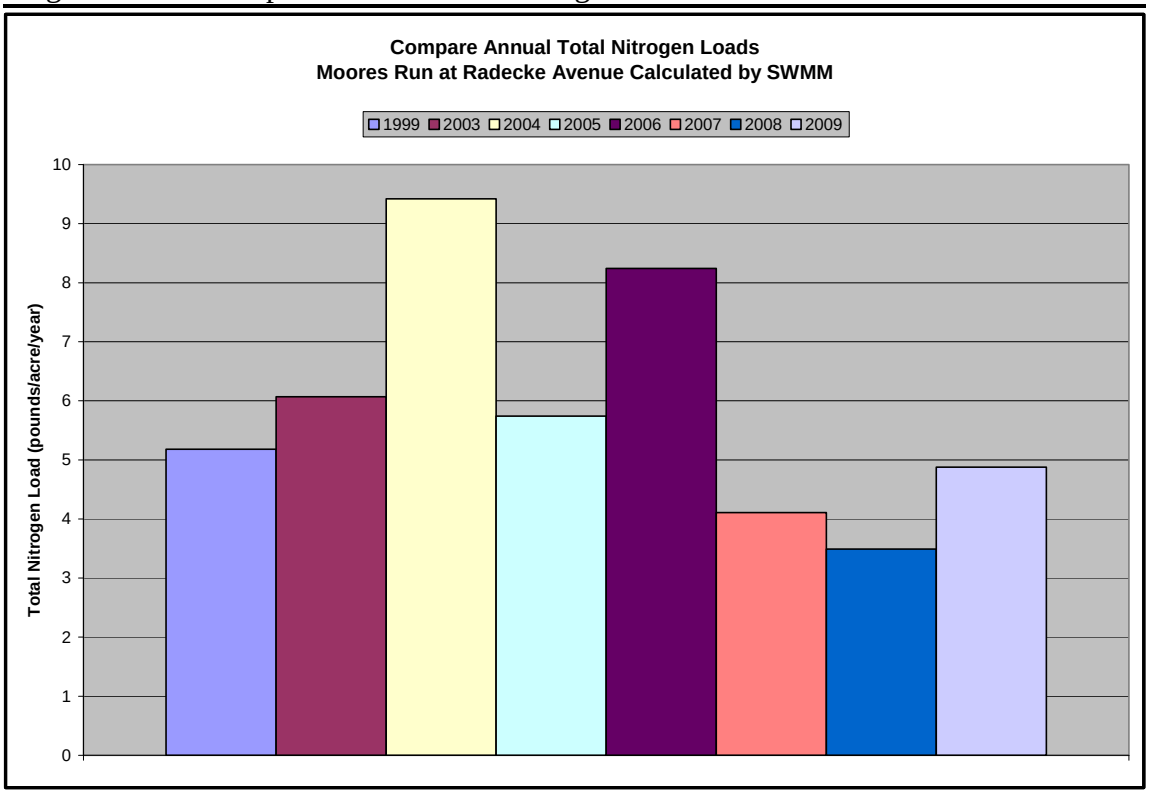


Figure G1a.4 Compare Annual Total Copper Loads for Moores Run

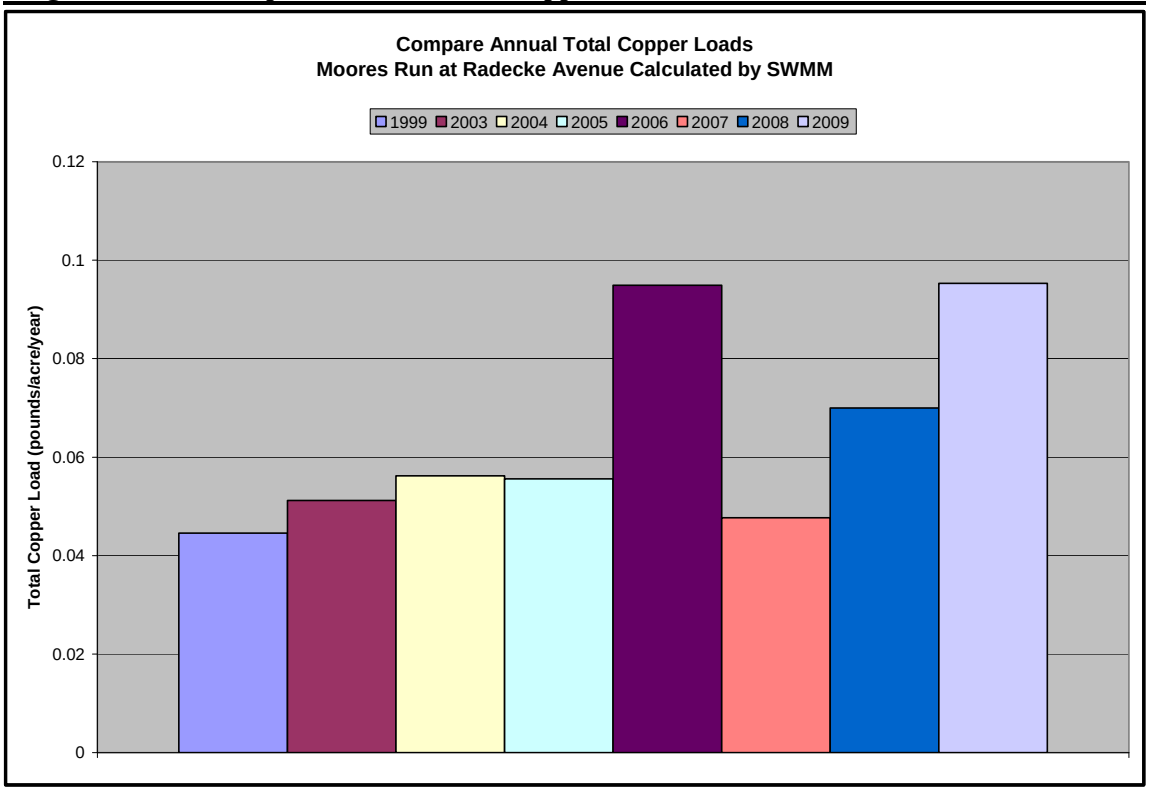


Figure G1a.5 Compare Annual Total Zinc Loads for Moores Run

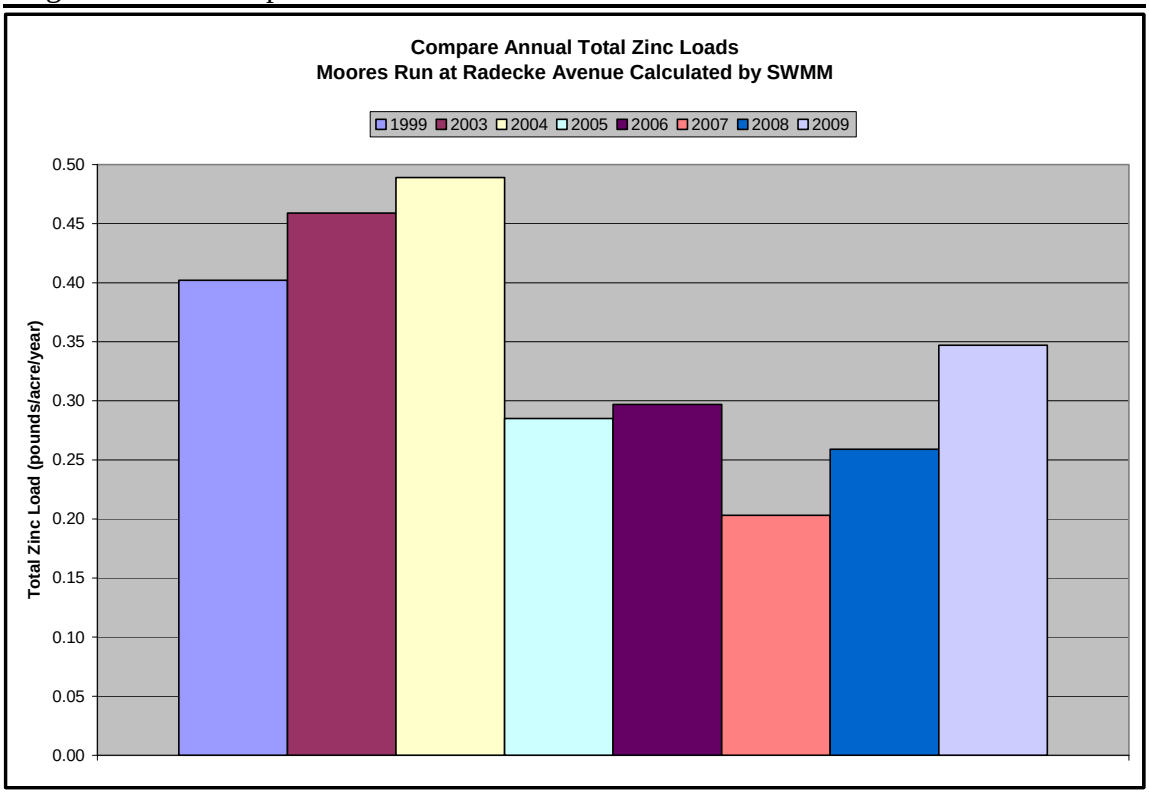
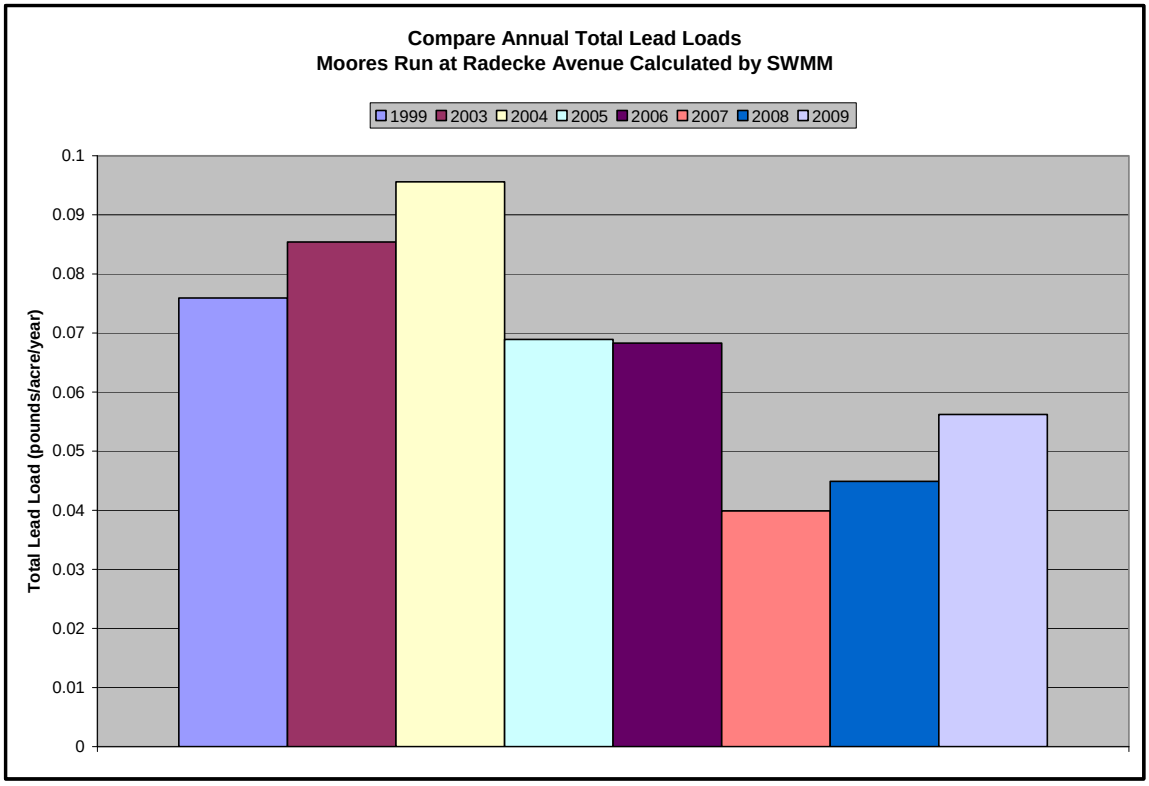


Figure G1a.6 Compare Annual Total Lead for Moores Run



Moores Run Trends Analyses

In order to look for trends over time, scatterplot graphs of the storm EMCs from monitoring at Hamilton Avenue and Radecke Avenue from May 1995 through October 2009 were made for the following parameters: total nitrogen, nitrate+nitrite nitrogen, TKN, total phosphorus, total copper, dissolved copper, total lead, dissolved lead, total zinc, dissolved zinc, fecal coliform counts, e. coli counts (begun 9/25/2008), enterococci counts (begun 9/25/2008), suspended solids, volatile suspended solids (begun 2/10/2005) and BOD. The storm EMC over time scatterplots for Hamilton Avenue and Radecke Avenue for total nitrogen, total phosphorus, total suspended solids, 5-day BOD and e. coli MPN counts can be found in Figures G1a.7 through G1a.16. Copies of the graphs of all the parameters can be found in the Excel file "Hamilton & Radecke Stm EMC Time Graphs.xls" on the CD-ROM accompanying this report. Please note that there was no storm monitoring at Hamilton Avenue from August 2004 through October 2005 while there was utilities renovation (construction) in the area- including the building of the Hamilton Avenue monitoring station.

Figure G1a.7 Hamilton Avenue Total Nitrogen Storm EMCs

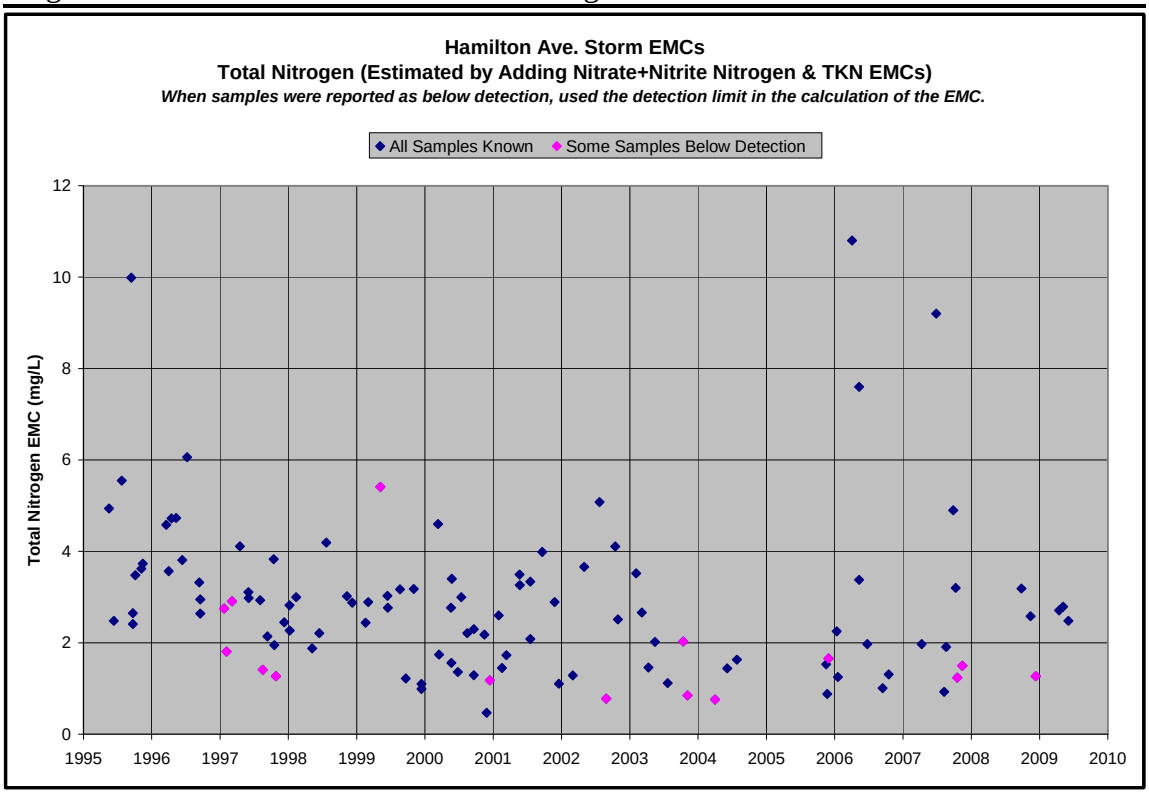


Figure G1a.8 Radecke Avenue Total Nitrogen Storm EMCs

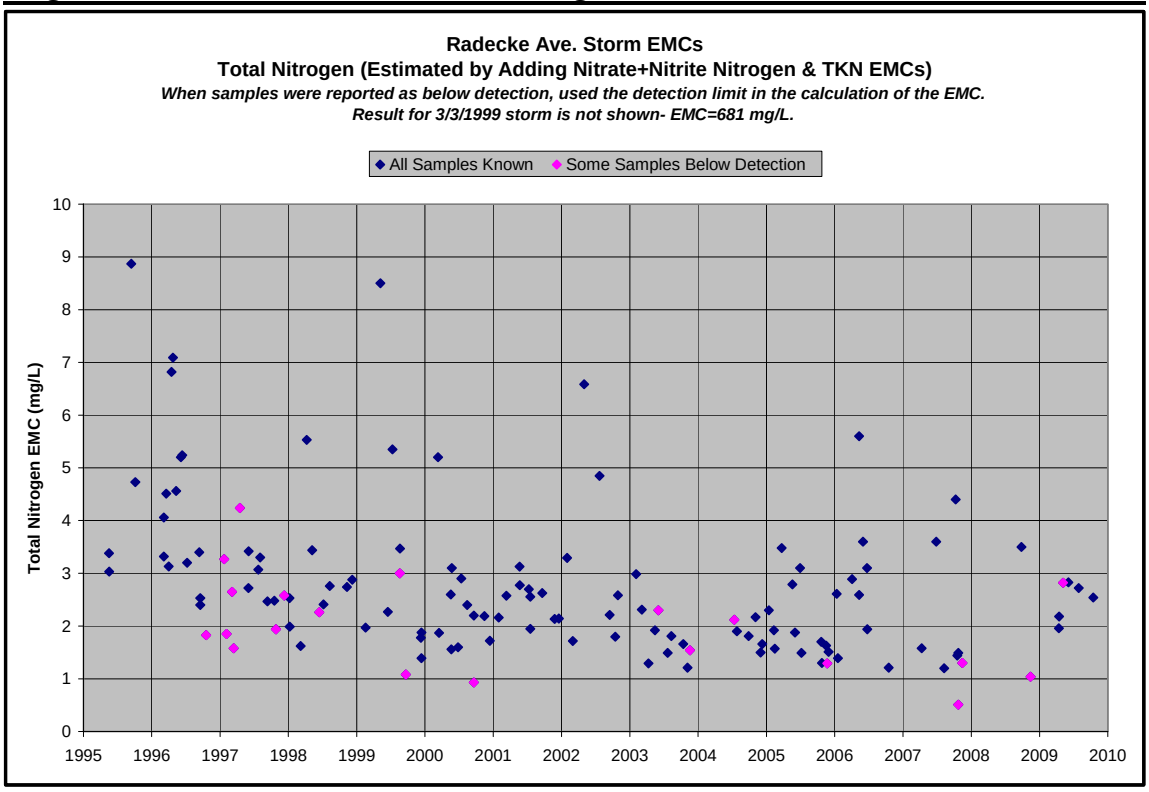


Figure G1a.9 Hamilton Avenue Total Phosphorus Storm EMCs

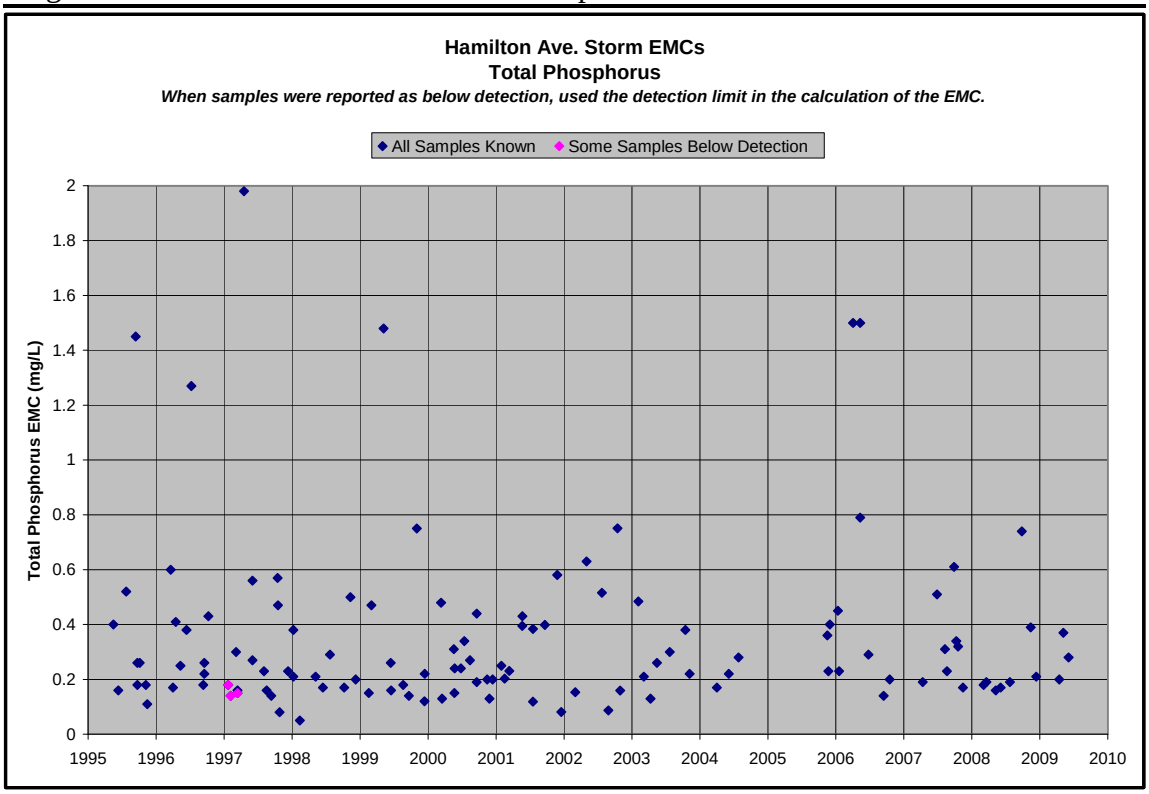


Figure G1a.10 Radecke Avenue Total Phosphorus Storm EMCs

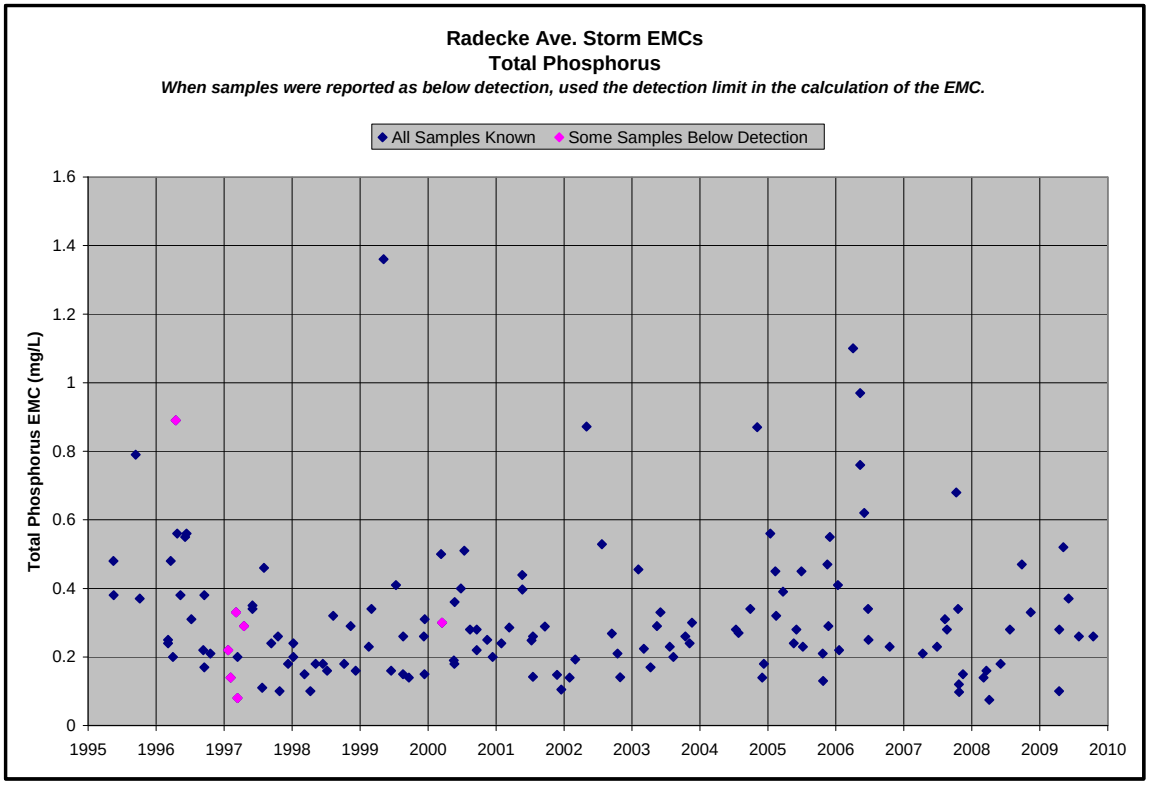


Figure G1a.11 Hamilton Avenue Suspended Solids Storm EMCs

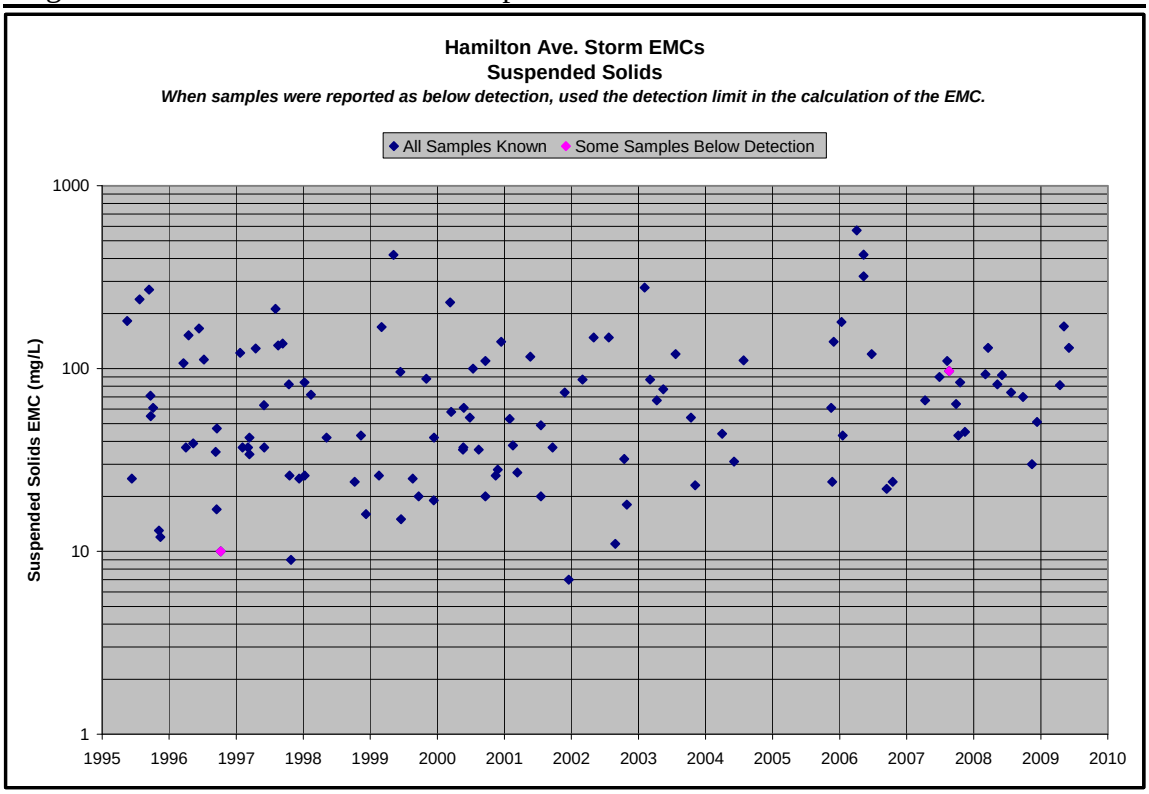


Figure G1a.12 Radecke Avenue Suspended Solids Storm EMCs

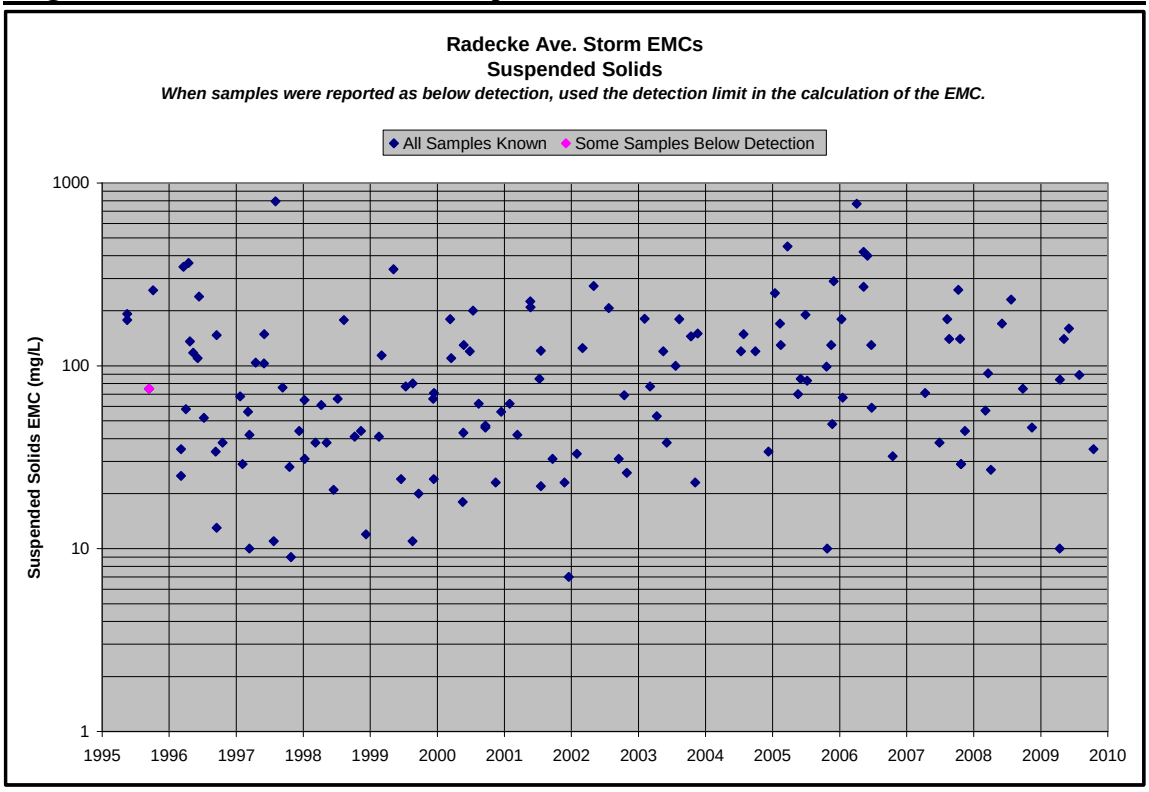


Figure G1a.13 Hamilton Avenue BOD 5-Day Storm EMCs

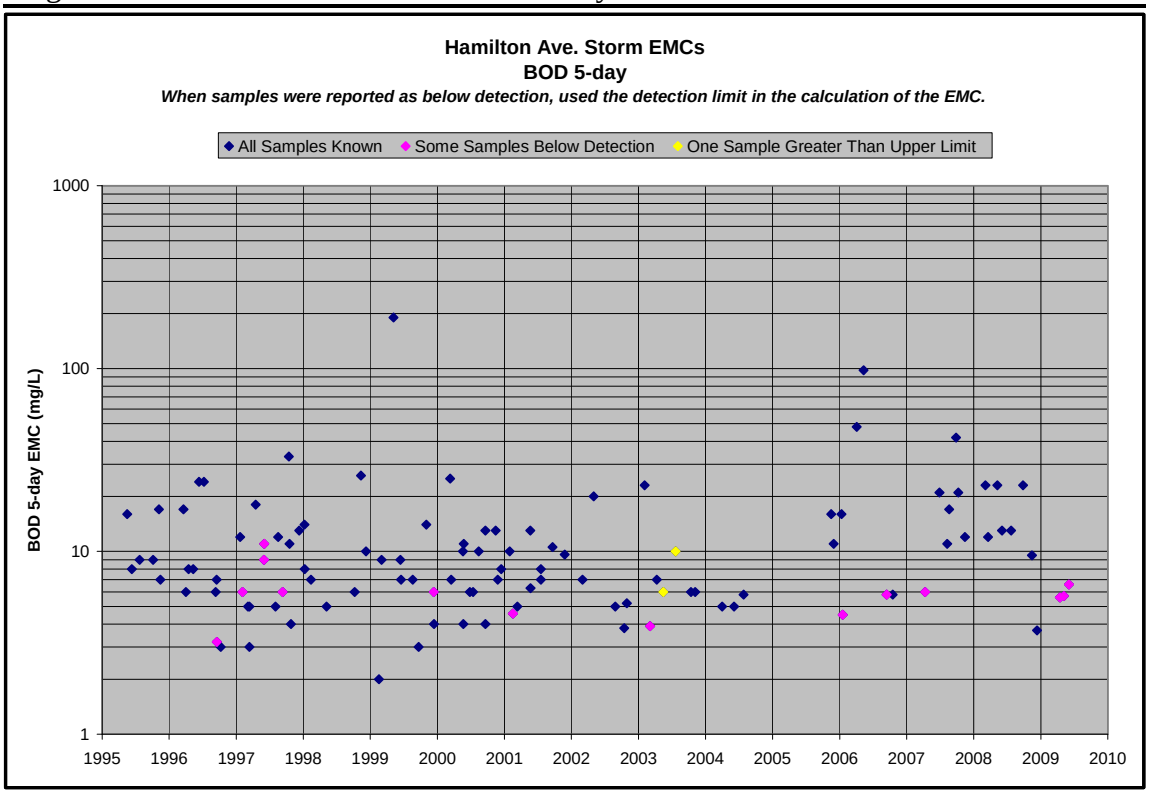


Figure G1a.14 Radecke Avenue BOD 5-Day Storm EMCs

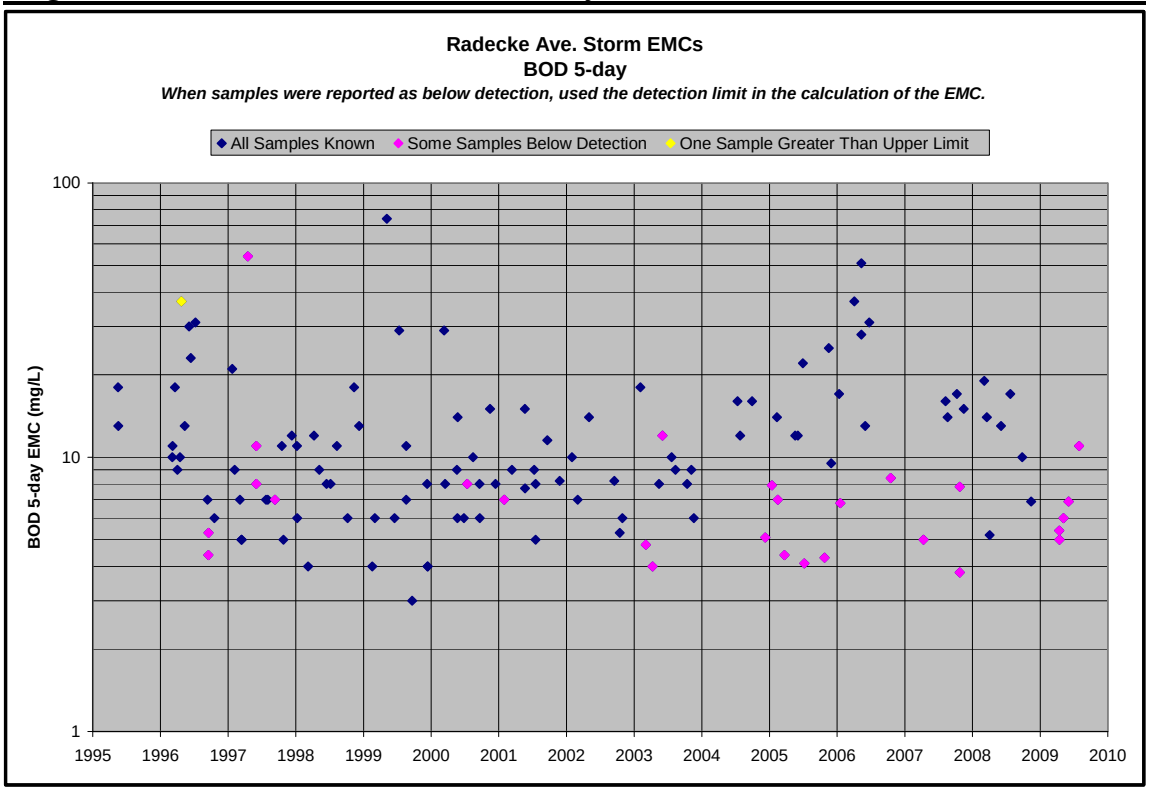


Figure G1a.15 Hamilton Avenue E. Coli MPN Count Storm EMCs

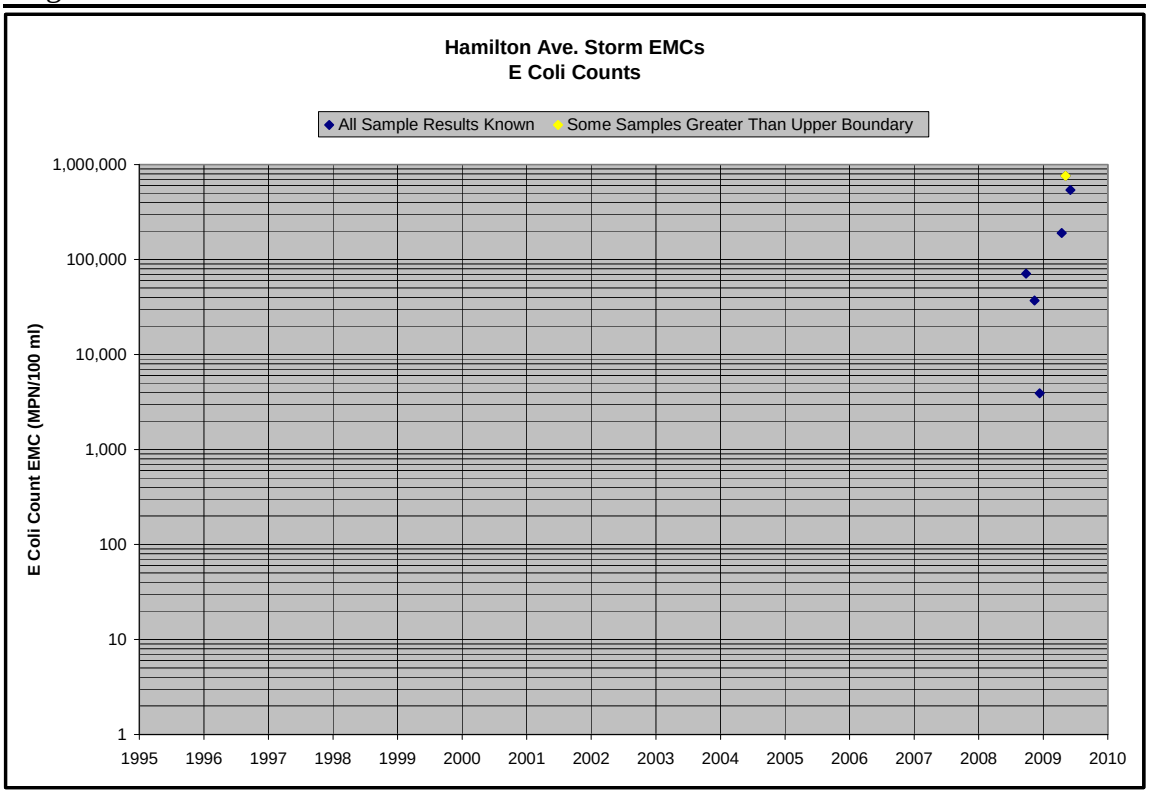
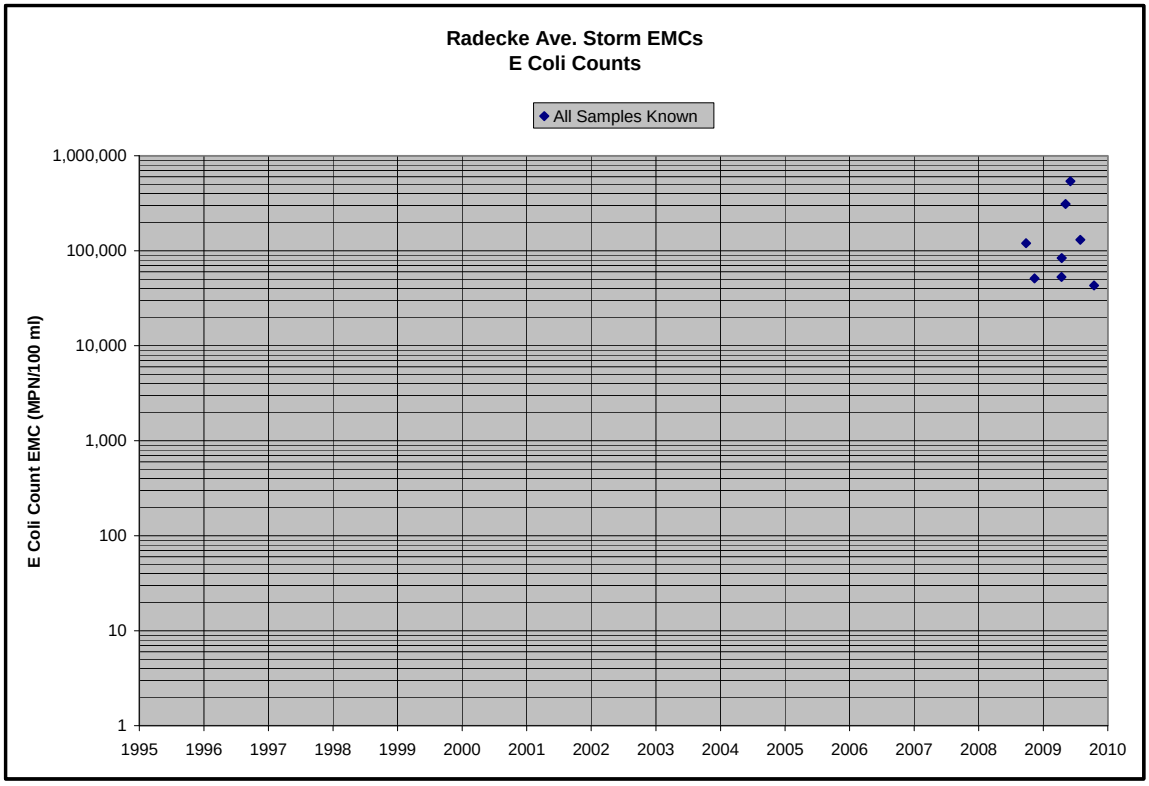


Figure G1a.16 Radecke Avenue E. Coli MPN Count Storm EMCs



In addition to Hamilton Avenue and Radecke Avenue, there are two other dry weather monitoring stations in the Moores Run. The samples at the Mary Avenue station are collected underground in the storm drain network. The flow from the Mary Avenue station, like that from the Hamilton Avenue station, contributes to the flow at Radecke Avenue. The other dry weather monitoring station is Biddle St. & 62nd St., which is well downstream of the Radecke Avenue station and near to where the Moores Run crosses the City line. Scatterplot graphs of dry weather samples collected at the monitoring stations in the Moores Run were also made. These graphs can be found in the folder "City Streams Dry Weather Time Concentration Graphs" on the CD-ROM accompanying this report.

Moores Run Metals Toxicity Analysis

Since March 2003 the City analyzed nearly every baseline sample from the four Moores Run stations for total hardness and dissolved copper, lead and zinc. About one-third of the SIS samples from the Biddle St. & 62nd St. station were also analyzed for these parameters. An analysis was done for the sample results collected through December 2009 to find out how often the samples exceed the State's freshwater chronic criteria for these metals. Formulas for adjusting the freshwater criteria for hardness were taken from these reports prepared by MDE: Water Quality Analysis of Copper and Lead for the Jones Falls in Baltimore County and Baltimore City, Maryland and Water Quality Analysis of Zinc Contamination for the Jones Falls Baltimore City and Baltimore County, Maryland. The results of this analysis are shown in Table G1a.5 and Figure G1a.17.

The Hamilton Avenue station had 1 of 69 baseline samples with a hardness level outside the range of the adjustment curves: this sample was excluded from this analysis. The Hamilton Avenue station had 1 of 68 (~1%) and the Mary Avenue station had 1 of 69 (~1%) baseline samples that exceeded the lead freshwater chronic toxicity criteria. None of the four stations had any baseline samples that exceeded the copper or zinc freshwater chronic toxicity criterion.

These hardness adjustment curves were also applied to the storm EMCs from Hamilton Avenue and Radecke Avenue. It may not be appropriate to compare stormwater results to the chronic criteria; rather, it may be more appropriate to use the acute criteria. However, the City's analyst working on this did not have the formulas to make the adjustments for hardness to the acute criteria. This analysis found that 15 of 26 (58%) of the storm EMCs for the Hamilton Avenue station and 24 of 43 (56%) of the storm EMCs for the Radecke Avenue station exceeded the copper freshwater chronic criterion; 1 of

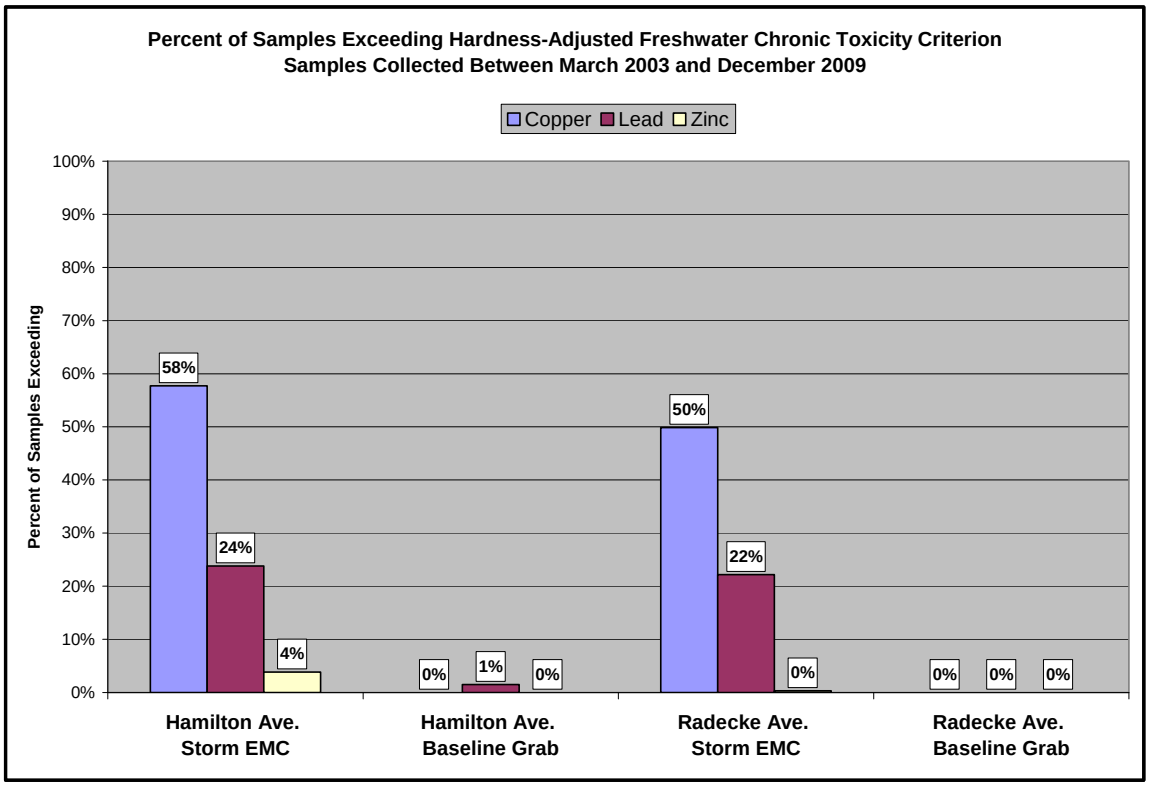
26 (4%) of the storm EMCs for the Hamilton Avenue station, but none for Radecke Avenue exceeded the zinc freshwater chronic criterion.

The lead concentrations for some discrete stormwater samples are reported by the lab as below detection. This then results in an EMC calculation that is indeterminate- the EMC is bound by a range. For some of the storm events, the hardness-adjusted chronic criterion fell within the range assigned as the lead EMC, and thus a determination could not be made for that event whether or not its lead EMC exceeded the freshwater chronic criterion. This happened for 5 storms for the Hamilton Avenue station and 13 storms for the Radecke Avenue station. For those storms for which a determination could be made, 5 of 21 (24%) of the events at the Hamilton Avenue station and 7 of 30 (23%) of the events at the Radecke Avenue exceeded the hardness-adjusted freshwater chronic criterion for lead.

Table G1a.7 Percentage of Samples from Moores Run Long-term Monitoring Stations for which the Copper, Lead or Zinc Concentration Exceeded the Hardness-Adjusted Freshwater Chronic Criteria (March 2003 through December 2009)

Station and Type of Sample	Percent of Copper Samples	Percent of Lead Samples	Percent of Zinc Samples
Hamilton Ave. Storm EMC	58%	24%	4%
Hamilton Ave. Baseline Grab	0%	1%	0%
Radecke Ave. Storm EMC	50%	22%	0%
Radecke Ave. Baseline Grab	0%	0%	0%

Figure G1a.17 Moores Run Long-Term Discharge Characterization Stations: Percent of Samples Exceeding Hardness-Adjusted Freshwater Chronic Toxicity Criterion



Moores Run E. Coli MPN Count Analysis

Table G1a.8 lists the e. coli MPN count geometric mean and percentage of sample counts which were at or below each of the State's water use contact rules for the dry weather samples collected at the Hamilton Ave. and Radecke Ave. stations between November 2008 and January 2010. These metrics point to poor water quality in terms of bacteria. The storm event mean concentration (EMC) for the e. coli MPN counts were also compared to the State water contact rules and the results are listed in Table G1a.8.

Table G1a.8 E. Coli MPN Counts: Geometric Means and Comparision to State's Criteria for Frequency of Use
(Dry Weather Samples: November 2008 through January 2010; Storm EMCs: September 2008 through October 2009)

Station	Number of Samples	Geometric Mean (MPN/100 ml)	Percent At or Below Frequent Full Body Contact Recreation (235 MPN/100 ml)	Percent At or Below Moderately Frequent Full Body Contact Recreation (298 MPN/100 ml)	Percent At or Below Occasional Full Body Contact Recreation (410 MPN/100 ml)	Percent At or Below Infrequent Full Body Contact Recreation (576 MPN/100 ml)	Percent Above Infrequent Full Body Contact Recreation (576 MPN/100 ml)
HAMILTON AVE. Dry Weather Grab	14	2,834	0%	7%	7%	7%	93%
RADECKE AVE. Dry Weather Grab	14	2,142	0%	0%	21%	21%	79%
HAMILTON AVE. Storm EMC	6	96,327	0%	0%	0%	0%	100%
RADECKE AVE. Storm EMC	8	112,411	0%	0%	0%	0%	100%

Moores Run Total Phosphorus and Total Nitrogen Analyses
Table E2.3 listed the percentage of dry weather samples at Hamilton Ave. between January 2009 and March 2010 that were at or exceeded the total phosphorus guideline of 0.1 mg/L as 15%, and that were at or exceeded the total nitrogen guideline of 3 mg/L as 15%. For both of these metrics, the Hamilton Ave. station is in the "elevated" range. The percentages for the dry weather samples from the Radecke Ave. station were 8% at or exceeding the total phosphorus guideline and 0% at or exceeding the total nitrogen guideline. For both of these metrics, the Radecke Ave. station is in the "normal" range. The storm event mean concentrations (EMCs) for events from May 1995 through October 2009 were compared to these guidelines. Hamilton Ave. station EMCs were at or exceeded the total phosphorus guideline for 118 out of 122 events (97%), and were at or exceeded the total nitrogen guideline for 41 out of 113 events (36%). Radecke Ave. station EMCs were at or exceeded the total phosphorus guideline for all of the 143 events (100%), and were at or exceeded the total nitrogen guideline for 39 out of 133 events (29%).

Moores Run Storm Sample Total and Volatile Suspended Solids Analysis
Starting with the storm on February 10, 2005, the City began analyzing the discrete storm samples collected at the Radecke Avenue and Hamilton Avenue stations for volatile suspended solids. This is being done in conjunction with the storm monitoring at the Linkwood station on Stony Run and at the stations on Powder Mill Run. In the 45 storm events monitored at the Radecke Avenue station through October 2009, 335 samples were analyzed for volatile suspended solids. In the 30 storm events monitored at the Hamilton Avenue station from November 2005 through June 2009, 211 samples were analyzed for volatile suspended solids. No storms were monitored at the Hamilton Avenue station from August 2004 through October 2005 because of infrastructure construction. Figures G1a.18 through G1a.21 present the discrete storm samples results for the Hamilton Avenue and Radecke Avenue stations coded by storm for total suspended solids versus flow per area and volatile suspended solids versus flow per area. Both stations show similar relationships with total suspended solids and volatile solids concentrations positively correlated with flow per area.

Figure G1a.22 presents a comparison of the storm EMCs for total suspended solids and volatile suspended solids from the Hamilton Avenue and Radecke Avenue stations from February 2005 through October 2009. The City successfully monitored both stations only for 25 out of 48 storms from February 2005 through October 2009. For those 25 storms when both stations were successfully sampled, the

total suspended solids EMCs and volatile suspended solids EMCs for the Hamilton Avenue and Radecke Avenue stations track well together (see Figure G1a.23).

Figure G1a.18 Hamilton Avenue Discrete Storm Samples Total Suspended Solids Versus Flow per Area Coded by Storm Nov. 2005-Jun. 2009

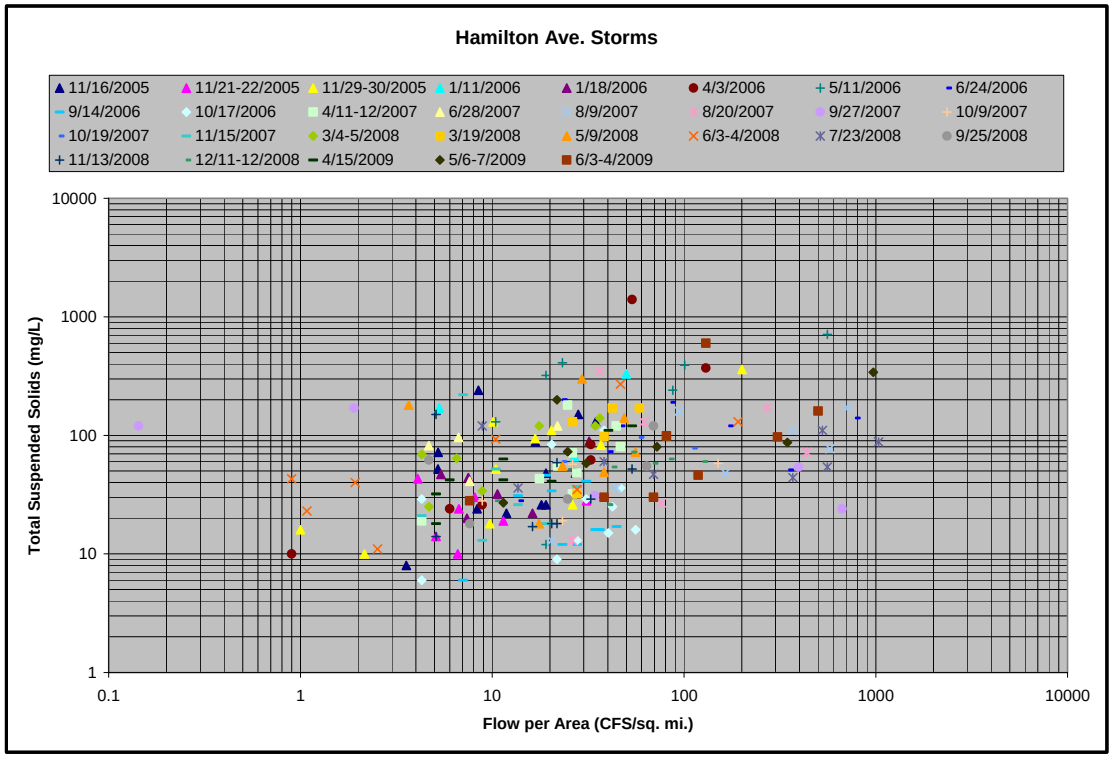


Figure G1a.19 Radecke Avenue Discrete Storm Samples Total Suspended Solids Versus Flow per Area Coded by Storm Feb. 2005-Oct. 2009

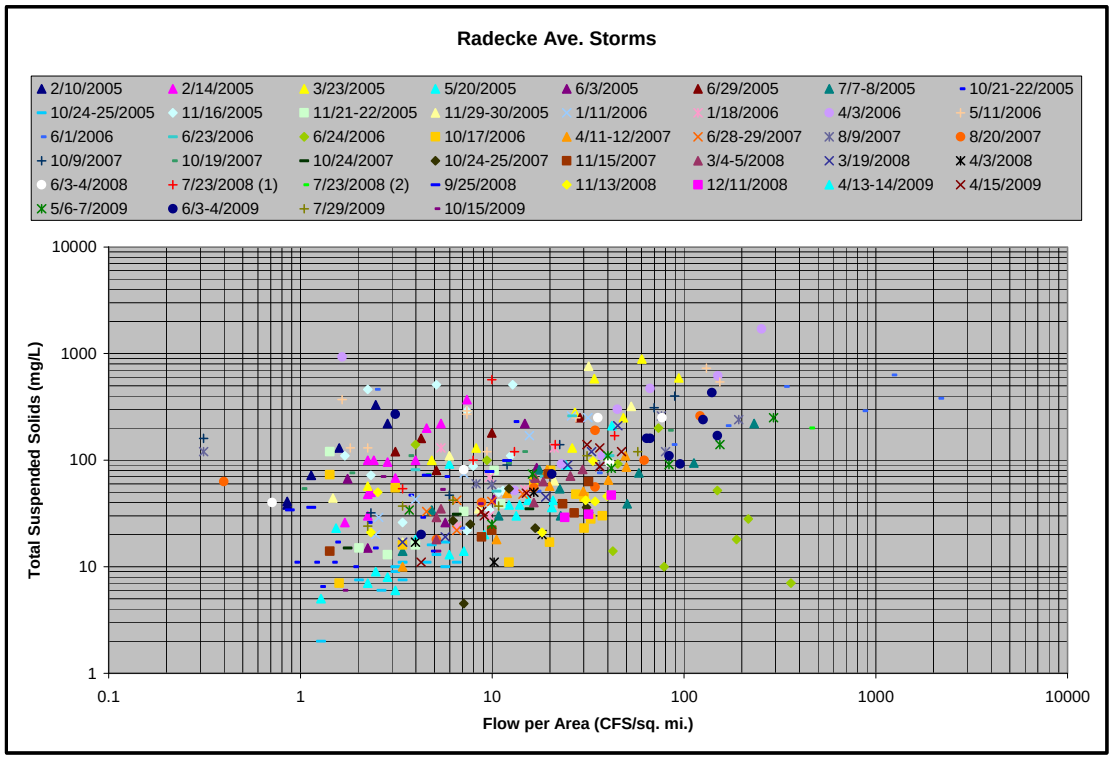


Figure G1a.20 Hamilton Ave. Discrete Storm Samples Volatile Suspended Solids Versus Flow per Area Coded by Storm Nov. 2005-Jun. 2009

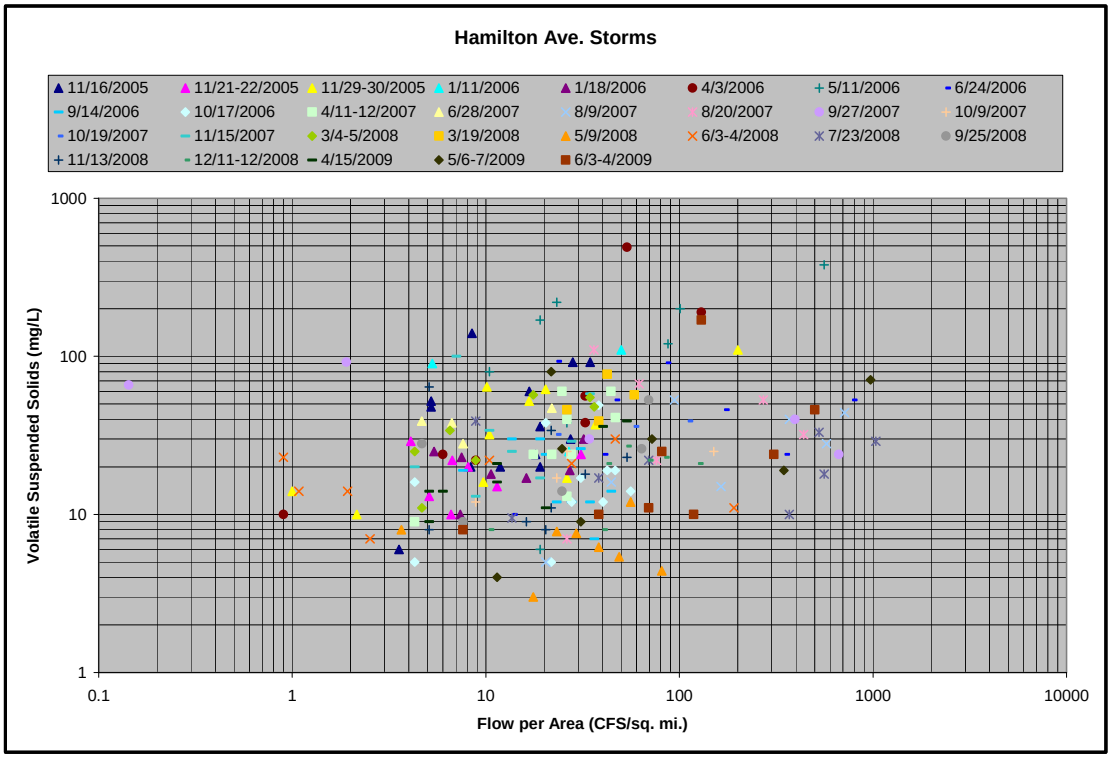


Figure G1a.21 Radecke Avenue Discrete Storm Samples Volatile Suspended Solids Versus Flow per Area Coded by Storm Feb. 2005-Oct. 2009

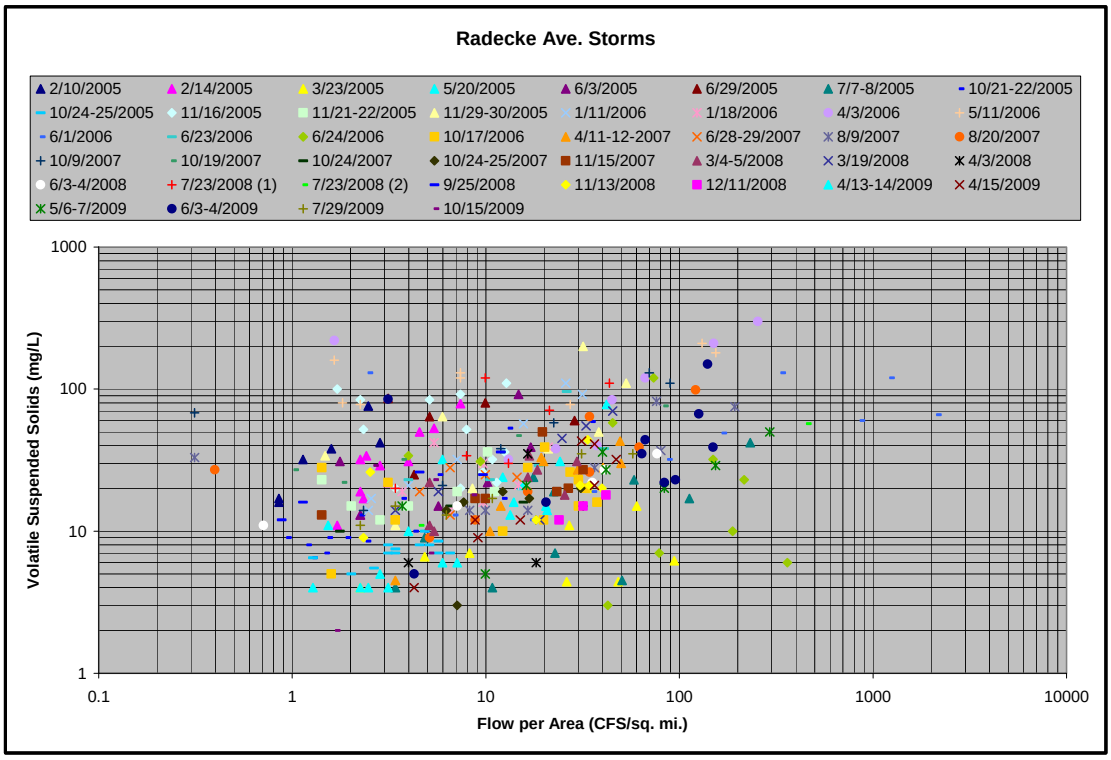


Figure G1a.22 Comparison of Storm EMCs for Total & Volatile Suspended Solids from the Hamilton Avenue & Radecke Avenue Stations

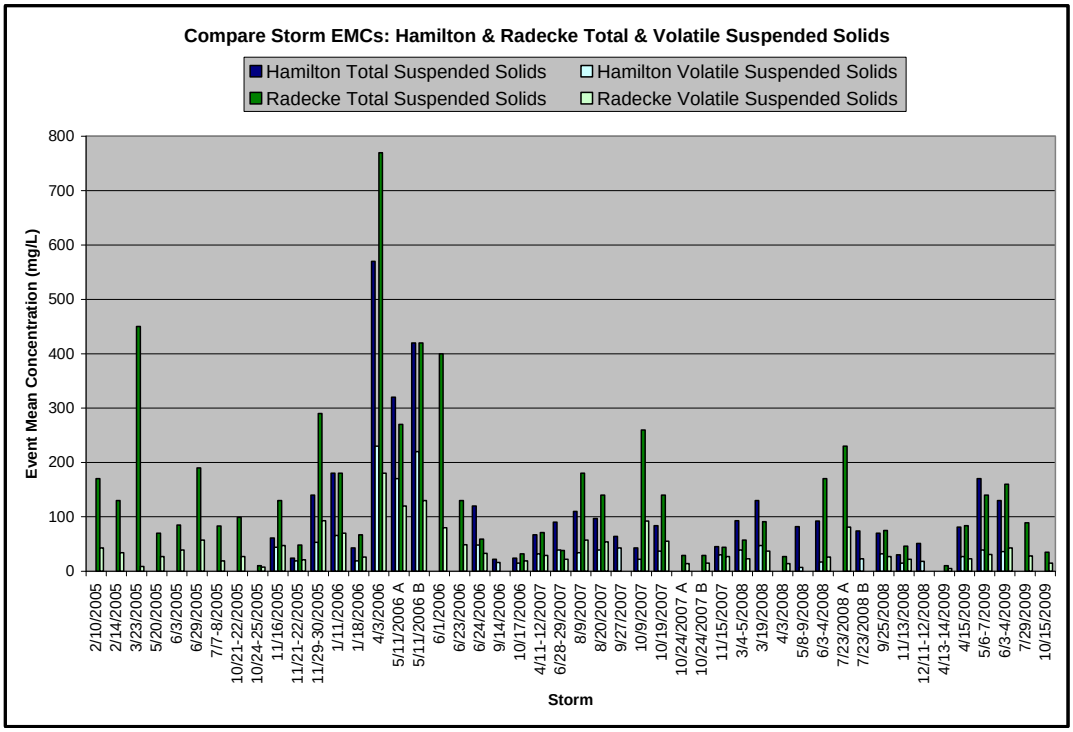
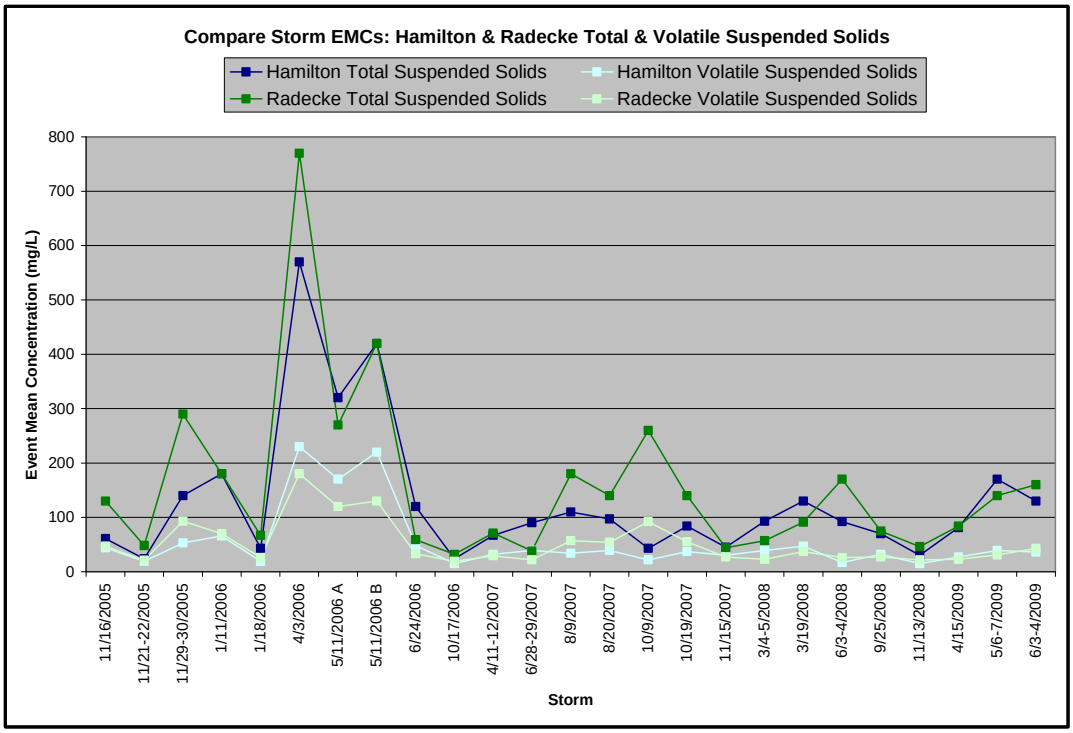


Figure G1a.23 Comparison of Storm EMCs for Total & Volatile Suspended Solids from the Hamilton Avenue & Radecke Avenue Stations When Both Stations Were Successfully Sampled



b. **Moores Run Biological Monitoring**

The City conducts biological monitoring for benthic macroinvertebrates and fish at four stations in the Moores Run: HAMT02, HAMT01, BCY119 and MR03. A record for each macroinvertebrate sample collected from these stations from 2002 through 2009 can be found in the Excel file "Macroinvertebrate Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report. The count sheets for the benthic macroinvertebrate samples collected during 2009 can be found in the Excel file "2009 Macroinvertebrate Counts Sheets for Individual Stations.xls" on the CD-ROM accompanying this report. A record for each fish sample collected from these stations from 2002 through 2009 can be found in the Excel file "Fish Sample Results 2002 through 2009.xls" on the CD-ROM accompanying this report. For more information on the City's biological monitoring efforts please see Section E3, "Watershed Assessment from Biological Monitoring".

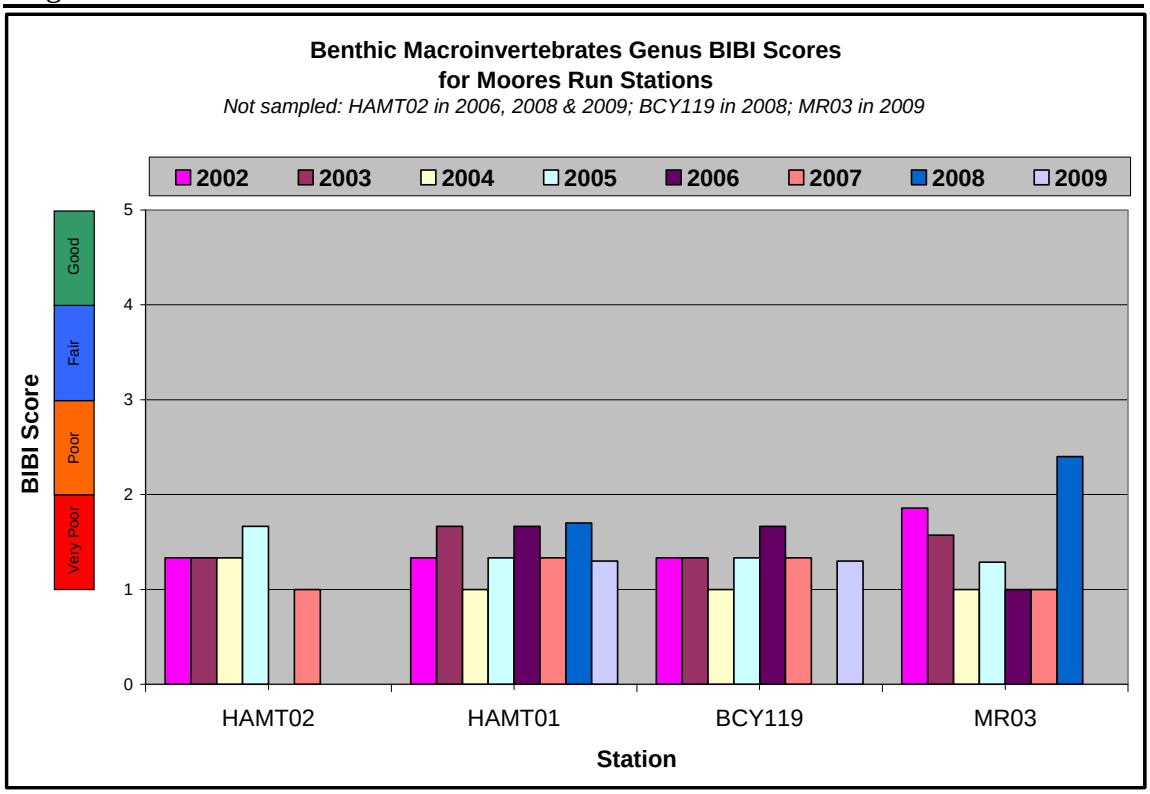
i. **Moores Run Macroinvertebrate Sampling**

Table G1bi.1 and Figure G1bi.1 present the results from benthic macroinvertebrate sampling at the four Moores Run stations for 2002 through 2009. Please note that all of these scores have been computed using the method endorsed by the MBSS in 2005. Stations HAMT02 and MR03 were not sampled for macroinvertebrates during 2009. The score for station HAMT01 slightly declined from 2008 to 2009. The score of 2.4 for MR03 in 2008 is the only sample for these stations so far that has achieved a rating as high as "poor"; all other samples have been rated as "very poor".

Table G1bi.1 Moores Run Benthic Macroinvertebrate Genus BIBI Scores 2002-2009

Station	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
HAMT02	1.3	1.3	1.3	1.7	Not Sampled	1.0	Not Sampled	Not Sampled
HAMT01	1.3	1.7	1.0	1.3	1.7	1.3	1.7	1.3
BCY119	1.3	1.3	1.0	1.3	1.7	1.3	Not Sampled	1.3
MR03	1.9	1.6	1.0	1.3	1.0	1.0	2.4	Not Sampled

Figure G1bi.1 Moores Run Benthic Macroinvertebrate BIBI Scores 2002-2009



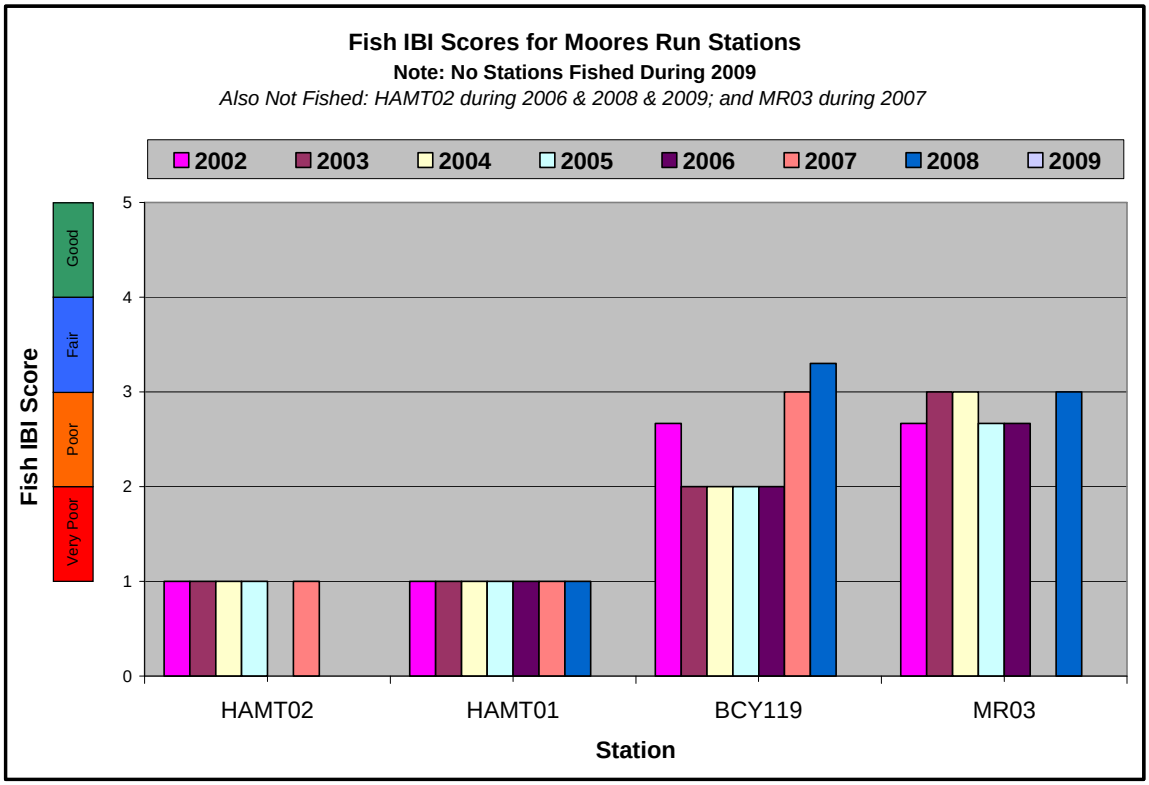
ii. Moores Run Fish Sampling

Tables G1bii.1 and Figure G1bii.1 present the results from fish sampling at the four Moores Run stations for 2002 through 2009. None of these four stations were fished during 2009. There have been no fish captured at the stations HAMT02 or HAMT01- resulting in an FIBI score of 1.0, which is the lowest score possible, for each year. The stations BCY119 and MR03 rate better on the IBI scale for supporting fish than they do for supporting benthic macroinvertebrates. Stations MR03 and BCY119 achieved their highest fish IBI scores in 2008. Both stations scored in the "fair" range.

Table G1bii.1 Moores Run Fish IBI Scores 2002-2009

Station	2002	2003	2004	2005	2006	2007	2008	2009
HAMT02	1.0	1.0	1.0	1.0	Not Sampled	1.0	Not Sampled	Not Sampled
HAMT01	1.0	1.0	1.0	1.0	1.0	1.0	1.0	Not Sampled
BCY119	2.7	2.0	2.0	2.0	2.0	3.0	3.3	Not Sampled
MR03	2.7	3.0	3.0	2.7	2.7	Not Sampled	3.0	Not Sampled

Figure G1bii.1 Moores Run Fish IBI Scores 2002-2009



c. **Physical Monitoring**

i. **Geomorphologic Stream Assessment of Moores Run**
The City did not conduct a hydrogeomorphological assessment of the Moores Run during 2009.

ii. **Stream Habitat Assessment**
The Water Quality Monitoring and Inspection Section performed a habitat assessment survey of the upper Moores Run watershed on March 24, 2010. The watershed is located in a highly residential area. The survey area covered Moores Run from the quadruple cell outfall at Hamilton Avenue to Radecke Avenue. The watershed survey also included the Moores Run tributary at Todd Avenue. This survey followed the protocols set forth in the Stream Habitat Assessment section in the Maryland Biological Stream Survey (MBSS) Sampling Manual, February 2001, which instructs surveyors to note the following parameters: instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, riffle/run quality, embeddedness, shading and trash rating. Please note that since the surveys were conducted between March and May, which is a time of the year wherein the leaves

may not have reached their full growth, the percent shading data was excluded from the tables below. Additional parameters used in this survey were channel alteration, bank vegetative protection, condition of banks and riparian vegetative zone. Each habitat parameter, except percent embeddedness, was rated with a numerical score. Each score was ranked in one of four categories. The categories from best to worst are optimal, suboptimal, marginal and poor.

Tables G1cii.1 and G1cii.2 show a comparison of the scores from the surveys done for the 2004 Annual Report (May 18, 2005), the 2005 Annual Report (May 1, 2006), the 2006 Annual Report (April 2, 2007), 2007 Annual Report (May 5, 2008), 2008 Annual Report (April 30, 2009) and this report (March 24, 2010). The following discussion compares the past two habitat assessments (April 30, 2009 and March 24, 2010). In addition, in the Excel file "Moores Run Habitat Assessments 2005 through 2010 Graphs.xls" on the CD-ROM accompanying this report, there is a bar graph for each segment for each parameter showing the scores for each year's assessment for that parameter for that segment. An example of these bar graphs is shown in Figure G1cii.1.

Instream habitat: The rating improved for Segments 1 through 3 and 6 through 8 from suboptimal to optimal. Segment 4 rating decreased from suboptimal to poor. Moores Run tributary rating increased from marginal to suboptimal. There was no change observed in Segments 5 and 11.

Epifaunal substrate: Segment 1 and the Moores Run tributary's rating improved from marginal to suboptimal. Segment 3 improved from suboptimal to optimal. A rating decrease from suboptimal to marginal was observed in Segments 4 and 10. The remaining segments had no change in rating.

Velocity/Depth diversity: Rating decreased in Segments 1, 8, and 10 from suboptimal to marginal. Segment 11 had a rating increase from poor to suboptimal. Moores Run tributary's rating went from marginal to suboptimal. The ratings for the other segments were unchanged.

Pool/glide/eddy quality: Rating for Segments 2 and 5 increased from marginal to suboptimal. Rating for Segments 8 and 10 decreased from suboptimal to marginal. The rating for the other segments and the Moores Run tributary were unchanged.

Riffle/run quality: Rating decreased from optimal to suboptimal in Segments 1 and 7. Rating increased from marginal to suboptimal in Segments 5 and 9. There was a rating decrease in Segment 10 from suboptimal to marginal. All other segments and the Moores Run tributary were unchanged.

Embeddedness: Rating decrease from optimal to suboptimal was observed in Segments 1, 7, 8, and 10. Segment 4 had a rating drop from marginal to poor. Moores Run tributary's rating increased from marginal to suboptimal. The remaining segments were unchanged.

Trash rating: The trash rating improved in Segments 5, 10, and the Moores Run tributary from marginal to suboptimal. The remainder of Moores Run remained unchanged.

Channel alteration: No change in rating in Moores Run and its tributary with the exceptions of Segment 1 and 10. The rating increased from suboptimal to optimal in Segment 1. Segment 10 had a rating decrease from optimal to suboptimal.

Bank vegetative protection: Rating decreased in Segment 5 and the Moores Run tributary from suboptimal to optimal. Segments 6, 8, and 9 had a rating increase from suboptimal to optimal. No changes to report in the other segments.

Condition of banks: There was overall improvement in condition of bank quality for both the main stem and the tributary. Segments 2 through 4 and 9 had a rating increase from suboptimal to optimal. Segment 6 went from marginal to optimal. Segment 7 increased from marginal to suboptimal. The Moores Run tributary had the most drastic change in rating: the rating increased from poor to optimal.

Riparian vegetative zone: Riparian vegetative zone quality increased in Segments 1, 2, 5, 6, and the Moores Run tributary from poor to marginal. Quality increased in Segments 8 from marginal to suboptimal. Segment 10 had a sharp decline in rating from optimal to poor. All other segments were unchanged.

Figure G1cii.1 Moores Run Habitat Assessment Scores 2005-2009 (Part I)

	Moores Run above Radecke Ave. Segments											
	1	2	3	4	5	6	7	8	9	10	11	Tributary
Parameter												
Instream Habitat												
2005	16	16	16	4	16	16	16	16	13	16	1	13
2006	15	16	15	4	15	15	15	14	13	14	1	13
2007	15	14	16	4	15	11	15	14	13	15	1	15
2008	15	15	17	4	15	11	11	15	14	14	1	12
2009	12	14	13	13	13	15	15	15	13	15	3	10
2010	16	16	18	5	12	17	16	16	13	15	1	15
Epifaunal Substrate												
2005	16	16	16	1	16	16	15	16	13	16	1	14
2006	14	15	15	4	15	15	14	14	10	14	0	14
2007	15	14	15	5	15	10	12	10	10	14	0	10
2008	14	14	17	4	14	10	8	12	11	14	0	12
2009	10	12	11	11	11	15	13	14	13	15	10	7
2010	15	14	17	8	11	12	14	11	11	10	7	15
Velocity/Depth Diversity												
2005	8	10	14	6	8	8	8	10	8	9	11	8
2006	8	10	10	6	11	8	8	11	10	10	6	8
2007	10	13	12	6	6	8	8	10	9	10	6	10
2008	8	12	15	6	11	9	9	12	8	9	6	8
2009	11	11	13	8	10	15	14	15	13	15	2	10
2010	10	15	14	8	10	11	13	8	12	10	11	15
Pool/Glide/Eddy Quality												
2005	5	7	12	13	10	8	10	15	12	3	13	1
2006	5	7	10	16	10	8	10	11	12	3	8	1
2007	5	7	11	16	11	10	9	10	11	4	10	1
2008	8	14	12	17	12	12	10	14	13	3	8	1
2009	9	10	13	12	7	9	13	12	11	11	13	5
2010	8	12	12	13	11	8	13	10	11	9	13	3
Riffle/Run Quality												
2005	11	13	11	3	12	12	13	14	10	14	2	7
2006	11	13	11	2	11	13	13	14	12	14	2	7
2007	13	15	13	2	13	13	12	14	13	15	0	8
2008	13	13	13	1	15	15	14	14	13	13	1	6
2009	18	12	15	1	6	13	16	15	8	11	1	8
2010	12	12	13	1	13	13	13	13	11	10	2	9
Embeddedness (%)												
2005	50	50	50	0	60	70	50	50	70	50	0	50
2006	50	50	50	0	60	60	60	60	60	50	0	50
2007	60	60	50	75	60	60	60	50	60	50	0	50
2008	40	50	50	0	50	60	50	50	50	50	0	50
2009	10	50	50	70	50	30	20	20	30	20	0	70
2010	40	40	40	0	40	30	30	30	40	40	0	40

Scoring Color Code		
Score	Category	Color Code
16 to 20	optimal	
11 to 15	suboptinal	
6 to 10	marginal	
1 to 5	poor	

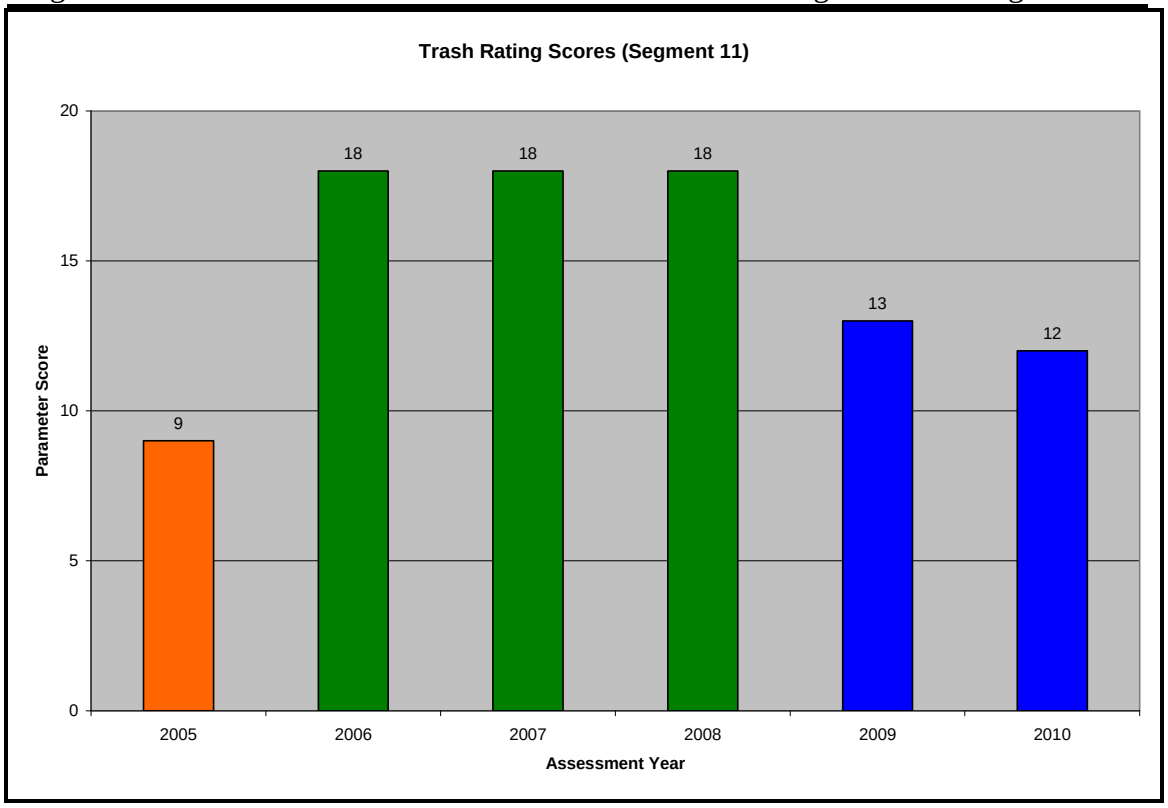
Figure G1cii.2 Moores Run Habitat Assessment Scores 2005-2009 (Part II)

	Moores Run above Radecke Ave. Segments											
	1	2	3	4	5	6	7	8	9	10	11	Tributary
Parameter												
Embeddedness												
2005	11	11	11	0	9	7	11	11	7	11	0	11
2006	12	11	11	0	9	9	10	10	10	11	0	11
2007	10	10	11	3	10	9	10	11	10	11	0	13
2008	13	13	13	0	13	8	13	13	13	13	0	12
2009	19	11	12	7	11	14	16	16	14	17	0	7
2010	14	14	14	0	14	14	13	14	13	13	0	14
Trash Rating												
2005	11	8	4	8	9	8	11	7	5	7	9	11
2006	8	11	11	10	10	11	8	12	3	9	18	11
2007	8	8	7	12	11	10	9	10	5	10	18	15
2008	8	8	3	8	6	6	5	5	3	8	18	13
2009	8	8	3	9	9	8	9	8	8	10	13	6
2010	8	8	3	8	13	8	8	10	7	11	12	13
Channel Alteration												
2005	16	16	16	16	16	16	16	16	17	17	1	13
2006	16	16	16	16	16	16	16	16	17	14	1	13
2007	16	16	16	16	16	16	16	16	16	15	1	15
2008	17	17	17	17	16	17	17	17	17	15	1	13
2009	15	16	16	17	16	16	16	16	16	17	1	12
2010	18	18	18	18	16	17	18	17	18	15	2	15
Bank Vegetative Protection												
2005	11	12	15	15	15	15	18	16	17	11	2	8
2006	11	13	16	16	14	16	16	16	17	10	2	8
2007	12	12	16	16	14	14	16	14	16	10	2	10
2008	14	14	17	15	15	16	13	12	17	10	2	8
2009	20	18	18	20	16	13	19	15	14	13	1	20
2010	18	18	17	17	14	18	16	16	18	14	2	15
Condition Of Banks												
2005	18	18	14	18	18	14	16	17	16	8	20	18
2006	18	13	14	18	18	14	16	17	15	16	20	18
2007	18	14	15	18	13	14	15	16	14	15	20	16
2008	18	17	16	16	18	14	15	16	18	16	20	18
2009	17	12	13	11	17	10	10	18	15	11	20	5
2010	18	17	16	16	15	17	14	17	18	15	20	18
Riparian Vegetative Zone												
2005	7	7	9	12	6	6	9	11	10	9	2	2
2006	7	7	10	14	6	6	8	11	10	6	2	2
2007	7	4	8	15	6	6	11	11	10	6	2	2
2008	8	9	12	15	6	6	7	15	12	7	2	2
2009	2	4	8	13	5	4	7	10	16	16	5	4
2010	10	7	10	15	10	6	8	15	16	3	2	6

Scoring Color Code

Score	Category	Color Code
16 to 20	optimal	
11 to 15	suboptinal	
6 to 10	marginal	
1 to 5	poor	

Figure G1cii.1 Moores Run Habitat Assessment: Trash Rating Scores for Segment 11



iii. Hydrologic Model

No work was done on a hydraulic assessment for Moores Run during 2009.

2. Stormwater Management Assessment

This section of the permit requires the City to evaluate the effectiveness of stream restoration as a BMP focusing on the Stony Run Projects. The City is hoping to have the U.S. Fish & Wildlife Service work on this assessment; however, no work was done during 2009. The City continues to collect biological and chemical monitoring data in Stony Run. A discussion of these results can be found in Section F2, "Restoration Monitoring".

H. Program Funding

Table H.1 presents a breakdown of the City's budget for activities related to the City's stormwater discharge permit for Fiscal Years 2005 through 2010. The City's fiscal year spans July 1st through June 30th (i.e., Fiscal Year 2010 began July 1, 2009 and will end on June 30, 2010).

Table H.1 Fiscal Analyses (Rounded to Nearest Hundreds)						
Permit Condition	**Fiscal Year 2005**	**Fiscal Year 2006**	**Fiscal Year 2007**	**Fiscal Year 2008**	**Fiscal Year 2009**	**Fiscal Year 2010**
B. Legal Authority	$0	$0	$0	$0	$0	$0
C. Source Identification						
1. GIS	$24,500	$24,700	$25,200	$26,700	$28,800	$15,200
2. Database Maintenance	$36,800	$36,200	$41,200	$41,200	$43,400	$43,400
D. Management Programs						
1. Stormwater Management	$283,100	$297,300	$329,200	$605,000	$401,300	$300,400
2. Pollution Prevention	$413,700	$406,400	$460,700	$464,600	$437,800	$436,700
3. Erosion and Sediment	$240,900	$240,900	$279,200	$493,800	$278,900	$232,000
4. Public Education	$36,700	$37,000	$41,600	$41,200	$44,100	$127,900
5. Road Maintenance						
Street Sweeping	$2,136,500	$2,297,800	$2,504,100	$2,862,200	$2,984,500	$2,984,500
Inlet Cleaning	$3,365,800	$4,350,900	$4,635,000	$4,150,300	$4,860,400	$4,660,600
E. Watershed Assessment & Planning						
1. Assessment/evaluation	$936,000	$843,600	$1,117,600	$2,319,400	$768,200	$1,171,900
2. Restoration Projects	$704,600	$6,225,300	$216,500	$222,300	$2,594,900	$3,176,600
F. Watershed Restoration						
1. 20% Restoration	$54,000	$54,700	$59,300	$910,800	$65,300	$63,700
2. Water Quality Improvement Monit.	$58,600	$66,400	$75,000	$74,300	$62,400	$58,100
G. Assessment of Controls						
1. Chemical Monitoring	$40,300	$43,500	$48,600	$45,100	$47,800	$35,000
2. Biological Monitoring	$7,900	$7,800	$9,200	$9,300	$8,800	$8,500
3. Physical Stream Assessment	$38,800	$1,900	$39,300	$2,200	$2,300	$2,300
4. Design Manual Monitoring	$0	$21,600	$0	$0	$0	$0
Sub-Total	**$8,378,200**	**$14,956,000**	**$9,881,700**	**$12,268,400**	**$12,628,900**	**$13,316,800**
General Expenses Water Quality Management Section (Cover Many Permit Conditions)	$235,600	$317,800	$299,800	$387,200	$304,200	$329,200
Grand Total	**$8,613,800**	**$15,273,800**	**$10,181,500**	**$12,655,600**	**$12,933,100**	**$13,646,000**