BALTIMORE CITY

MS4 ANNUAL REPORT

Reporting Period: July 1, 2015 to June 30, 2016

CATHERINE E. PUGH
MAYOR

BALTIMORE CITY
DPW
DEPARTMENT OF PUBLIC WORKS
RUDOLPH S. CHOW, P. E.
DIRECTOR

Table of Contents

List of Appendices (*italicized text indicates electronic files only*)

Appendix A: Organization Chart

Appendix B: Summary Table of Null Values in the MS4 Geodatabase

Appendix C: Source Information using MS4 Geodatabase (MS Access)

Appending D: Ammonia Screening and Stream Impact Sampling Results (Excel)

Appendix E: Bacteria Monitoring Histographs [Ref. MS4 Restoration and TMDL WIP, Appendix G, dated August 2015]

Appendix F*:* Habitat Monitoring

Appendix G: Moores Run, 2016 Abbreviated Geomorphic Condition and Channel Stability Resurvey by USFW (*Appendices, Adobe Acrobat*)

Appendix H: Watershed Protection and Restoration Program Annual Report Table for FY 2016 (Excel)

Appendix I: Illicit Discharge Detection and Elimination

Appendix J: Baltimore Clean Guide

Appendix K: Summary Report for Pop Up GROW Centers

Appendix L: Progress Status of Milestones

Appendix M: Progress Status of Projects, Programs, and Partnerships for 20% Restoration [Ref. MS4 Restoration and TMDL WIP, Appendix C, dated August 2015]

Appendix N: Progress of Chesapeake Bay TMDL [Ref. MS4 Restoration and TMDL WIP, Appendix D, dated August 2015]

Appendix O: Progress of Regional TMDLs for Nutrients [Ref. MS4 Restoration and TMDL WIP, Appendix E and F, dated August 2015]

1 Introduction

This report includes the progress of compliance for the period of Fiscal Year (FY) 2016, in association with Baltimore City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharge Permit (Permit Number: 11-DP-3315, MD0068292). The current permit was issued on December 27, 2013. Annual report periods follow the City's fiscal calendar: July 1 to June 30. This Annual report has been formatted to match the reporting requirements as listed in Part V of the permit.

1.1 Permit Administration

Designation of individual to act as a liaison between the City and MDE for the implementation of this permit:

Kimberly L. Grove, P.E.
Chief, Office of Compliance and Laboratories
3001 Druid Park Drive, Rm 232
Baltimore, MD 21215
410-396-0732
Kimberly.grove@baltimorecity.gov

Several organization charts (as of June 30, 2016) are provided in Appendix A of this report:

- City agency organization chart with designations of MS4 permit condition responsibilities.
- DPW organization chart.

1.2 Legal Authority

The City maintained adequate legal authority in accordance with NPDES regulations 40 CFR 122.26(d) (2) (i) during FY 2016.

2 Implementation Status

Table 2-1 is a summary of the status for implementing the components of the stormwater management program that are established as permit conditions.

Table 2-1: Summary of Implementation Status

Permit Condition	Component	Due	Status as of June 30, 2016
Part IV.C. Source Identification	GIS Data	Annual report	Baltimore City transitioned the source identification to the MS4 Geodatabase. See Table 2-2 for details.
Part IV.D.1 Stormwater Management	Identification of problems and modifications of ESD to MEP	Annual report	No problems identified during this reporting period.
	Modification to ordinances to eliminate impediments to ESD to MEP	Annual report	No modifications were initiated during this reporting period.
Part IV.D.2 Erosion and Sediment Control	Responsible personnel certification 3 / year	Annual Report	The City's program was replaced by MDE's on-line program.
	Inventory of projects > 1 acre	Initial 4/1/14 then quarterly	Included in Appendix C.
Part IV.D.3 Illicit Discharge Detection and Elimination	Alternative program for MDE submittal	12/27/14	The City is using the same alternative analysis (Ammonia Screening) as reported since 1998. Results are discussed in Section 5.3.5. Results are provided in Appendix D.
	Annual visual surveys of commercial / industrial areas	Annual	See Section 5.3.
Part IV.D.4 Trash and Litter	Inventory and evaluation all solid waste operations	12/27/14	Submitted part of *Public Outreach Strategy for trash and Litter Programs for the City of Baltimore*, submitted February 20, 2015.
	Public education and outreach strategy	12/27/14	See Section 5.5.
	Evaluation of effectiveness of education program	Annual Report	See Section 5.5.
Part IV.D.5 Property Management and Maintenance	NOIs and SWPPPs submitted for NPDES stormwater general permit coverage for industrial permits	6/30/14	NOIs and SWPPPs were submitted for the City's solid waste facilities, fleet maintenance facilities, and wastewater treatment plants.
	Alternative maintenance program	12/27/14	No alternative maintenance program is being proposed.
Part IV.D.6 Public Education	Maintain a compliance hotline for water quality complaints	Annual Report	2 new customer service requests to 3-1-1 system were added in

Permit Condition	Component	Due	Status as of June 30, 2016
			November 2014. See Sections 5.2 and 5.3.
Part IV.E.1 Watershed Assessment	Detailed watershed assessments of entire City	12/27/18	Updated assessments were initiated. Format and content, related to MEP conditions and alignment with MS4 geodatabase are scheduled for discussion with MDE in FY 2016.
Part IV.E.2 Restoration Plans	Impervious surface assessment consistent with MDE methods = baseline	12/27/14	MDE approved the baseline impervious area on July 28, 2016. See Section 6 for more details.
	Restoration of 20% of City's impervious surface area	12/27/18	
	Restoration Plan for each WLA approved by EPA prior to the effective date of the permit	12/27/14	
	Restoration Plan for of subsequent TMDL WLA	One year of approval	*Implementation Plan for the Middle Branch / Northwest Branch TMDL in Baltimore City was submitted on January 4, 2016. MDE provided comments on April 1, 2016. Comments are addressed in Section 6.6.3.*
Part IV.E.4. TMDL Compliance	Annual assessment to evaluate the effectiveness of the City's restoration plans	Annual Report	See Section 6.
Part IV.F. Assessment of Controls	Continue assessments	Annual Report	See Appendices C and F-G.
Part IV.G. Program Funding	Fiscal analysis of the capital, operation, and maintenance expenditures necessary to comply with all conditions of this permit	Annual Report	See Section 4 and Appendix H.

In Fiscal Year 2016, Baltimore City initiated the migration of the source identification data to a prescribed geodatabase, per MDE's NPDES MS4 Geodatabase Design and User's Guide, dated March 2015. A summary of the migration efforts are provided in Table 2-2. Starting in May 2015, Baltimore City participated in a work group with MDE to modify the geodatabase to address end user questions and comments. Through this process, MDE agreed to change some fields from mandatory to conditional; however, the updated database structure had not been issued at the time of this report. The geodatabase also included rules for completed records related to mandatory fields. As a short-term solution to complete the database, Baltimore City used designated values as a "null" value. These values are listed in Appendix B.

Table 2-2: Summary of MDE Geodatabase Migration

Title	Type	Status	Notes
Permit Administration			
Permit Info	AT	Complete	
Source Identification			
Outfall	F - PT	Partial	Outfall inventory in progress.
Outfall Drainage Area	F - PG	Complete	
BMP POI	F - PT	Partial	See schedule in Table 2-3.
BMP	AT	Partial	See schedule in Table 2-3.
BMP Drainage Area	F – PG	Partial	See schedule in Table 2-3.
Impervious Surface	AT	Complete	Based on WIP Progress Tables (Appendix M)
Monitoring Site	F - PT	Complete	
Monitoring Drainage Area	F	Complete	
Alt BMP Line	F - L	Partial	Leakin Park pending. Western Run included but not accounted against baseline in WIP.
Str Rest Protocols	AT	Pending	Will be included in Fy 2017
Shoreline Management Practices	AT	NA	
Alt BMP Point	F – PT	NA	Septic systems are not relevant to Baltimore City.
Alt BMP Poly	F – PG	Complete	Street sweeping shown as City. Will be further defined (min. 8-digit watershed) in FY 2017. Tree planting for FY 16 only shows trees planted up to December 2015. Will be updated in FY 2017 report
Rest BMP	F – PT	Pending	Only includes planned WIP projects and as-built projects. Redevelopment projects under construction are pending. Will be completed in FY 2017 report.
Management Programs			
Stormwater Management	AT	Complete	
BMP Inspections		Complete	
Alt BMP Line Inspections	AT	Pending	Will be included in FY 2017 Report.
Alt BMP Point Inspections	AT	NA	Septic systems are not relevant to Baltimore City.
Alt BMP Poly Inspections	AT	Pending	Will be included in FY 2017 report
Rest BMP Inspections	AT	Complete	
Erosion Sediment Control	AT	Complete	
Quarterly Grading Permits	AT	Complete	Also includes Quarter 1 of FY 2017
Quarterly Grading Permit Info	AT	Complete	Also includes Quarter 1 of FY 2017
Responsible Personnel Certification Information	AT	NA	Referred to MDE on-line training.
IDDE	AT	Complete	Based on PST investigations completed in FY 2016

Title	Type	Status	Notes
Municipal Facilities	F – PT	Complete	
Chemical Application	AT	Complete	
Restoration Plans and Total Maximum Daily Loads			
County Wide Watershed Assessments	AT	Complete	
Local Stormwater Watershed Assessments	AT	Pending	Will be included in FY 2017 report, pending method of assessing current loads
Assessment of Controls			
Chemical Monitoring	AT	Complete	
Local Concern	AT	NA	
Biological Monitoring	AT	Complete	
Program Funding	AT	Complete	
Narrative Files	AT	Complete	

Note: F – PT= Feature class with point type shape files; F – PG= Feature class with polygon type shape files; F – L: Feature class with line type shape files; AT = Associated Table

Past MS4 annual reports concentrated on reporting constructed and inspected BMPs which provided qualitative control and therefore would be counted in reference to the City's baseline impervious area or restoration goal. This methodology did not provide the full picture of all BMPs that have been installed in the City as part of private development. Given the challenges of depending on as-built plan submittals from developers, a work group of MS4 managers evaluated alternative as-built certification processes in order to accurately account for BMPs within a jurisdiction. The proposed methodology was submitted to MDE in December 2016. Pending MDE's approval of the alternative as-built certification process, Table 2-3 provides the City's schedule to complete the records for all installed BMPs within the City by the end of the permit period.

Table 2 – 3: Schedule for data input

Schedule	Description
FY 2016 Annual Report	• All BMPs with as-built plans approved as of June 30, 2016, regardless of inspection status (est. 446 facilities) • Estimate 711 of BMPs from projects approved between FY 2005 to 2015 (711). Schedule to complete alternative as-built certification and inspection is pending MDE's approval of proposed methodology.
FY 2017 Annual Report	• All BMPs with confirmed construction as of June 30, 2017, regardless of inspection status • Estimate # of BMPs from projects approved prior to FY 2005 with schedule to complete alternative as-built certification and inspection
FY 2018 Annual Report	• All BMPs with confirmed construction as of June 30, 2018, regardless of inspection status

3 Narrative Summary of Data

3.1 Stream Impact Sampling

DPW continued the Stream Impact Sampling program, which includes monthly sampling at thirty-two (32) outfall or stream locations. This sampling program was initiated in 1997; the results are available on-line at the City's Cleanwater Baltimore website[1]. The sampling program includes sampling results for nutrients, sediment, bacteria, metals and other health indicators. The results of the sampling events for this reporting period are included in Appendix D.

3.1.1 Nutrient Monitoring

A total of 364 samples were analyzed for nutrients as part of the City's SIS program. Table 3-1 shows the evaluation of historic nutrient analysis (2009 through the reporting period), 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" if the percentage was less than 11%; "elevated" if it was between 11% and 25%; and "high" if it was greater than 25%. The majority of the stations remained at the same water quality level as cumulative data since January 2009 for both nutrients. The station at Perring Parkway showed no samples above the thresholds for the nutrients in FY 2016. Conversely, the station at Linwood and Elliot showed all samples above the threshold for nitrogen in FY 2016.

Fifteen (15) of the stations showed an increase in the percentage of samples above the total phosphorus threshold, equivalent to 30% of the total samples in FY 2016. The geometric mean of those samples in FY 2016 above the threshold was on the order of 0.16 mg/L. At least half of the samples at stations at Chinquapin Run, Gwynns Falls Parkway, Central & Lancaster, and Warner & Alluvian measured total phosphorus above the threshold.

Twenty-six (26) of the stations showed no samples above the threshold for nitrogen in FY 2016. Only eleven (11) of the stations showed an increase in the percentage of samples above the total nitrogen threshold, equivalent to 17% of the total samples in FY 2016. The geometric mean of those samples in FY 2016 above the threshold was on the order of 3.9 mg/L. FY 2016 samples from stations at Chinquapin Run, Hamilton Avenue, Stony Run, Linwood & Elliot, Central & Lancaster, and Light Street showed percentages significantly higher than the preceding historic data. Multiple sanitary sewer overflows (SSOs) were reported within the City within the drainage area of each of these locations except Hamilton Avenue within FY 2016, further supporting the relationship between infrastructure and nitrogen loading.

[1] In 2017 the Clean Water Baltimore website will be integrated into DPW's new web site and the Clean Water Baltimore web site eliminated.

Table 3-1: Summary of Nutrient Analysis for SIS Program

Station	Percent of Samples Total Phosphorus >=0.1 mg/L			Percent of Samples Total Nitrogen >=3 mg/L		
	1/2009 - 6/2016	7/2015 - 6/2016	1/2009 - 6/2015	1/2009 - 6/2016	7/2015 - 6/2016	1/2009 - 6/2015
Back River Watershed Herring Run Sub-watershed						
PERRING PKWY	19%	0%	22%	3%	0%	3%
MT. PLEASANT GC	29%	20%	30%	9%	20%	8%
CHINQUAPIN RUN	22%	50%	19%	24%	75%	18%
TIFFANY RUN	14%	20%	13%	4%	0%	4%
HARFORD RD.	19%	20%	19%	5%	0%	6%
WRIGHT AVE.	26%	20%	26%	1%	0%	1%
PULASKI HWY.	14%	20%	13%	6%	0%	7%
Back River Watershed Moores Run Sub-watershed						
MARY AVE.	41%	40%	41%	16%	20%	15%
HAMILTON AVE.	35%	30%	36%	47%	90%	40%
RADECKE AVE.	24%	40%	21%	12%	10%	12%
BIDDLE ST. & 62ND ST.	36%	40%	35%	1%	0%	1%
Jones Falls Watershed						
SMITH AVE.	27%	25%	27%	4%	8%	3%
WESTERN RUN	26%	25%	26%	4%	0%	4%
STONY RUN	24%	25%	24%	28%	42%	25%
LOMBARD ST.	31%	17%	34%	7%	8%	7%
Gwynns Falls Watershed						
POWDER MILL	31%	42%	29%	12%	0%	14%
PURNELL DR.	25%	33%	24%	1%	0%	1%
DEAD RUN DNST.	32%	25%	33%	0%	0%	0%
GWYNNS FALLS PKWY.	35%	50%	33%	10%	8%	11%
GRUN HILTON ST.	37%	42%	36%	11%	0%	13%
GF HILTON ST.	30%	33%	30%	0%	0%	0%
MAIDENS CHOICE	27%	25%	27%	6%	0%	8%
GRUN CARROLL PARK	56%	33%	61%	48%	42%	49%
WASHINGTON BLVD.	27%	42%	24%	3%	8%	2%
Baltimore Harbor Watershed						
LINWOOD & ELLIOTT [1]	49%	45%	50%	84%	100%	77%
LAKEWOOD & HUDSON [1]	40%	27%	46%	74%	64%	78%
CENTRAL & LANCASTER	48%	50%	48%	16%	33%	13%
LIGHT ST.	40%	8%	45%	13%	25%	11%
WARNER & ALLUVION	49%	50%	49%	19%	8%	21%
WATERVIEW AVE.	30%	25%	31%	13%	0%	15%
JANEY RUN	33%	8%	37%	12%	0%	14%

Station	Percent of Samples Total Phosphorus >=0.1 mg/L			Percent of Samples Total Nitrogen >=3 mg/L		
	1/2009 - 6/2016	7/2015 - 6/2016	1/2009 - 6/2015	1/2009 - 6/2016	7/2015 - 6/2016	1/2009 - 6/2015
Patapsco River Watershed						
REEDBIRD AVE.	34%	9%	38%	10%	0%	11%
[1] Sampling began at LINWOOD & ELLIOTT and LAKEWOOD & HUDSON in March 2013.						
Key						
	Normal: <= 11% of Samples					
	Elevated: Between 11-25% of Samples					
	High: >25% of Samples					

3.1.2 Bacteria Monitoring

DPW measures fecal bacteria with e. coli most probable number (MPN) counts at twenty-three (23) stations. Table 3-2 lists the percentage of surface water dry weather grab samples collected from November 2008 to June 2016, with a reference to the prescribed thresholds for recreation for each freshwater sampling station. A high percentage means that the water suitable for use for recreation. At least half of the samples at stations at Mt. Pleasant Golf Course, Tiffany Run, Pulaski highway, Smith Avenue, Stony Run, and Gwynns Falls Parkway measured e.coli at or below the threshold for frequent full body contact in FY 2016. Although several SSOs were reported in the drainage area the percentage of samples above the threshold for total nitrogen increased, the bacteria levels decreased in FY 2016 at the Stony Run station. Some stations remain at a high risk for recreation. Eight (8) of the stations showed results at or below infrequent full body contact recreation for less than half of the samples obtained in FY 2016.

The geometric mean for each fiscal year for each station is shown graphically in Appendix E. Many of the stations showed an increase in bacteria levels compared to the previous year but were still below historic levels, except for Chinquapin Run, where an SSO occurred upstream of the sampling station.

Table 3-2: Summary of E. Coli Sampling for SIS Program

Station Name	At or Below Frequent Full Body Contact Recreation (235 MPN/100 ml)			At or Below Infrequent Full Body Contact Recreation (576 MPN/100 ml)		
	11/2008 - 6/2016	7/2015 - 6/2016	11/2008 - 6/2015	11/2008 - 6/2016	7/2015 - 6/2016	11/2008 - 6/2015
Back River Watershed Herring Run Sub-watershed						
PERRING PKWY	29%	40%	28%	49%	50%	49%
MT. PLEASANT GC	35%	70%	29%	46%	70%	43%
CHINQUAPIN RUN	29%	13%	30%	51%	25%	54%
TIFFANY RUN	47%	80%	42%	68%	90%	65%

Station Name	At or Below Frequent Full Body Contact Recreation (235 MPN/100 ml)			At or Below Infrequent Full Body Contact Recreation (576 MPN/100 ml)		
	11/2008 - 6/2016	7/2015 - 6/2016	11/2008 - 6/2015	11/2008 - 6/2016	7/2015 - 6/2016	11/2008 - 6/2015
HARFORD RD.	27%	40%	25%	52%	50%	52%
WRIGHT AVE.	32%	20%	33%	52%	50%	52%
PULASKI HWY.	43%	50%	42%	65%	60%	65%
Back River Watershed Moores Run Sub-watershed						
MARY AVE.	4%	20%	1%	17%	20%	16%
HAMILTON AVE.	9%	40%	4%	20%	50%	16%
RADECKE AVE.	13%	10%	13%	38%	30%	40%
BIDDLE ST. & 62ND ST	33%	20%	35%	52%	40%	54%
Jones Falls Watershed						
SMITH AVE.	76%	83%	74%	83%	83%	82%
WESTERN RUN	24%	42%	22%	58%	83%	54%
STONY RUN	55%	83%	50%	83%	100%	80%
Gwynns Falls Watershed						
POWDER MILL	20%	17%	21%	48%	58%	46%
PURNELL DR.	25%	8%	28%	56%	42%	58%
DEAD RUN DNST.	51%	46%	51%	77%	69%	78%
GWYNNS FALLS PKWY.	57%	75%	54%	73%	92%	70%
GRUN HILTON ST.	9%	17%	7%	25%	50%	20%
GF HILTON ST.	40%	42%	40%	61%	58%	62%
MAIDENS CHOICE	35%	27%	37%	61%	27%	66%
GRUN CARROLL PARK	3%	8%	1%	3%	8%	1%
WASHINGTON BLVD.	3%	8%	1%	14%	33%	10%

DPW measures fecal bacteria with enterococci most probable number (MPN) counts at nine (9) stations. Table 3-3 lists the percentage of surface water dry weather grab samples collected from November 2008 to June 2016, with a reference to the prescribed thresholds for recreation for each sampling station.

The geometric mean for each fiscal year for each station is shown graphically in Appendix E. With the exception of the Linwood & Elliot sampling station, the FY 2016 geometric mean was the lowest mean among the seven fiscal years of monitoring for all of the other enterococci sampling stations.

Some stations remain at a high risk for recreation. Two (2) of the stations showed results at or below infrequent full body contact recreation for much less than 50% of the samples obtained in FY 2016; however, those sampling locations are within the storm sewer system.

Table 3-3: Summary of Enterococci Sampling for SIS Program

Station	At or Below Frequent Full Body Contact Recreation (104 MPN/100 ml)			At or Below Infrequent Full Body Contact Recreation (500 MPN/100 ml)		
	4/2009 - 6/2016	7/2015 - 6/2016	4/2009 - 6/2015	4/2009 - 6/2016	7/2015 - 6/2016	4/2009 - 6/2015
Patapsco River Watershed						
REEDBIRD AVE.	45%	62%	42%	69%	90%	66%
Baltimore Harbor Watershed						
WATERVIEW AVE.	25%	39%	22%	61%	83%	57%
WARNER & ALLUVION	6%	0%	7%	29%	52%	24%
LIGHT ST.	42%	57%	40%	72%	96%	68%
CENTRAL & LANCASTER	8%	9%	8%	36%	52%	33%
LAKEWOOD & HUDSON [1]	12%	18%	9%	22%	36%	17%
LINWOOD & ELLIOTT [1]	1%	0%	2%	9%	5%	11%
JANEY RUN	36%	43%	35%	62%	78%	59%
Jones Falls Watershed						
LOMBARD ST.	9%	17%	7%	34%	50%	31%

[1] Sampling began at LINWOOD & ELLIOTT and LAKEWOOD & HUDSON in March 2013.

3.1.3 Biological and Habitat Monitoring

DPW collected macroinvertebrate samples in the spring of 2016; examination of the samples is not yet complete and the results will be included in the FY 2017 MS4 Annual Report. Instead, DPW will present the results for the macroinvertebrate samples collected in the spring of 2015. DPW uses a combination of fixed and random sampling. There are 8 fixed stations, two of which are associated with the long-term discharge characterization of Moore Run. The results for those two stations are discussed in Section 3.2.2. For the random sampling, one of three watersheds is completed each year. During the spring of 2015, random sampling was done in the Gwynns Falls watershed.

Table 3-4 presents the benthic index of biotic integrity (BIBI) scores for 6 fixed stations from 2002 through 2015. Four out of six stations were rated as “very poor” for their 2015 samples; station 250 on Dead Run, with a BIBI score of 2.3, and station 1235 on Biddison Run, with a BIBI score of 2.4, were rated as “poor”. Three out of six stations had a higher BIBI score in 2015 compared to 2014; two stations had a decrease; and one station was unchanged.

Table 3-4: Macroinvertebrate BIBI Scores for Fixed Stations

Station	Stream	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15
Gwynns Falls Watershed															
250	Dead Run	1.7	1.0	1.0	1.0	1.7	---	---	1.3	1.3	2.3	1.0	1.0	1.7	2.3
430	Maidens Choice Run	---	---	---	---	---	---	---	---	1.0	1.7	1.0	1.0	1.3	1.7
Jones Falls Watershed															
880	Stony Run	---	---	---	---	---	---	---	---	1.3	1.3	1.0	1.0	1.7	1.3
949	Stony Run	---	---	---	---	---	---	---	---	1.7	1.0	1.0	1.0	1.3	1.3
1053	Stony Run	1.3	1.0	1.0	1.3	---	1.0	1.0	1.3	2.3	1.7	1.0	1.0	2.0	1.3
Back River Watershed															
1235	Biddison Run	---	3.3	1.3	1.9	1.3	1.3	1.6	1.0	1.9	1.3	1.6	2.1	1.9	2.4

There were 10 random stations sampled in the Gwynns Falls watershed in 2015. There were 8 samples with BIBI scores from 1.0 through 1.7, which rated as "very poor"; one sample with a score of 2.0, which rated as "poor"; and one sample with a score of 3.0, which rated as fair. Random sampling was performed in the Gwynns Falls watershed in 2003, 2006, 2009, 2012 and 2015. Figure 3-1 graphically shows the distribution of the BIBI scores for each of those 5 years. The curve representing the distribution of the 2015 samples is better than the curve from the last set of samples in 2012; and it stands out as the best of the five years, just narrowly better than 2003 because of the one sample that scored 3.0.

The BIBI, embeddedness, epifaunal and habitat scores for all fixed station and random station samples from 2015 are listed Appendix C of this report.

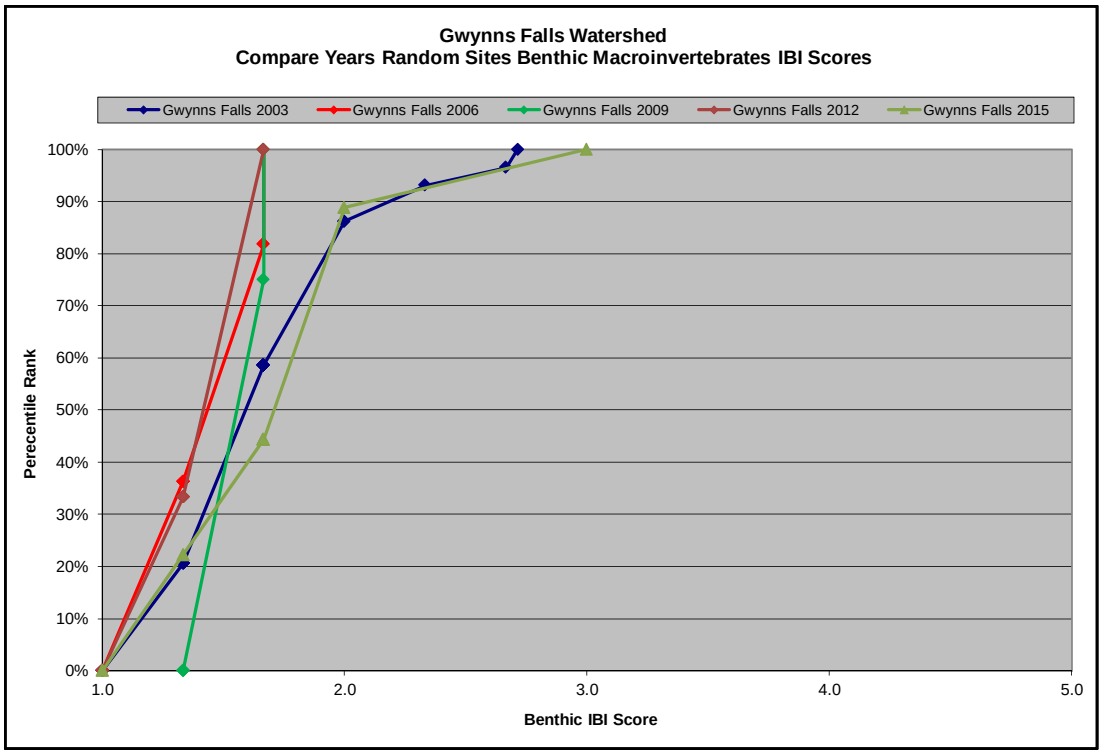


Figure 3-1: BIBI Scores for Macroinvertebrate Samples Random Sampling in the Gwynns Falls Watershed

3.2 Watershed Assessment at Moore's Run

3.2.1 Chemical Monitoring

During this reporting period, eight (8) storm events and twelve (12) base flow events were monitored at Hamilton Avenue - the outfall station associated with the long-term discharge characterization for the Moores Run. Ten (10) storm events and twelve (12) base flow events were monitored at Radecke Avenue - the in-stream station associated with the long-term discharge characterization for the Moores Run. The results of the monitoring events are provided in Appendix C. The automated sampling equipment encountered equipment problems, so storm monitoring was not performed between December 2015 and March 2016. DPW had set up the automated samplers at both stations in anticipation of storms on April 12, 2016 and June 23, 2016; however, the rainfall was insufficient to raise to trigger the automated samplers.

DPW did not analyze any of the base flow samples or storm samples for total petroleum hydrocarbons (TPH). DPW changed its protocol to have base flow and storm samples analyzed for TPH beginning with samples collected on August 23, 2016. Starting with the base flow samples collected on September 2, 2015, DPW changed its protocol and began to have base flow samples analyzed for biochemical oxygen demand (BOD). Thus, DPW did not measure the base flow samples collected on July 27 and August 24,

2015 for BOD. BOD results for the base flow samples are not included for sampling on March 22, 2016 due to laboratory error.

The base flow samples collected on January 21, 2016 were not analyzed for total suspended solids because the lab DPW uses to analyze total suspended solids could not accept samples on that date.

DPW did not measure water temperature or pH for base flow samples collected on October 27, November 24, and December 15, 2015 due to equipment problems with sensors.

DPW and USGS modified their flow monitoring contract to add a water temperature sensor and a pH sensor at the Radecke Avenue station. As of October 1, 2015, all data collected at this location by the USGS station has been published on-line. DPW used this data to compute event means for water temperature and pH for 8 out of 10 storms monitored at the Radecke Avenue station that came after the USGS sensors were installed.

DPW and USGS again modified their contract to add a water temperature sensor and a pH sensor at the Hamilton Avenue station. As of June 28, 2016, all data collected at this location by the USGS station is published on-line. The installation of these USGS sensors came after all of the storms monitored by DPW during FY 2016. Consequently, there are no water temperature or pH EMCs for the storms monitored at the Hamilton Avenue station for the FY 2016 storms.

In addition to these monitoring events, these two locations were monitored as part of the Ammonia Screening and Stream Impact Sampling program. The results of the monitoring are included in Appendices C and D of this Annual Report.

3.2.2 Biological Monitoring

DPW collects macroinvertebrate samples at two fixed locations for the long-term discharge characterization of the Moores Run. Every sample from 2002 through 2015 at both stations has been rated as “very poor”. The BIBI, embeddedness, epifaunal and habitat scores for all fixed station and random station samples from 2015 are included in Appendix C.

Table 3-5: Macroinvertebrate BIBI Scores for Fixed Stations Moores Run Watershed

Station	Stream	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10	‘11	‘12	‘13	‘14	‘15
1367	Moores Run	1.3	1.3	1.0	1.3	1.7	1.3	---	1.3	1.3	1.3	1.7	1.3	1.7	1.3
1659	Moores Run Trib.	1.3	1.7	1.0	1.3	1.7	1.3	1.7	1.3	1.7	1.7	1.0	1.3	1.3	1.0

3.2.3 Habitat Assessment

DPW performed a habitat assessment survey of the upper Moores Run watershed on June 9, 2016. The results, along with ten other assessments completed from May 18, 2005 through August 14, 2014, are included in Appendix F of this report. The following observations are based on a comparison of the 11 assessments:

- The condition of the banks from the latest assessment improved compared to the assessment done on August 14, 2014, which was the worst for any of the assessments for condition of the banks.
- Riparian vegetative zone banks from the latest assessment improved compared to the assessment done on August 14, 2014.

Approximately 1.7 miles of stream restoration is proposed for Moore's Run as part of the MS4 Restoration and TMDL WIP, as shown in Appendix M of this report.

3.2.4 Geomorphic Monitoring

The U.S. Fish and Wildlife Service (USFW) completed the physical monitoring of the Moore's Run site. The results of the monitoring are provided in Appendix G of this report.

3.2.5 Stormwater Management Assessment at Stony Run

In 2016, the City contracted USFW to evaluate five stream restoration projects completed within the City to date, including Stony Run. USFW used a stream restoration monitoring methodology to evaluate the stability and functional success of stream restoration projects in Baltimore City. The results of the evaluation will be included in the FY 2017 MS4 Annual Report.

The physical survey of the stream profile and of permanently monumented cross-sections in the Stony Run is planned to FY 2017, to complement USFW assessment.

4 Expenditures and Proposed Budget

4.1 Expenditures and Budgets Related to MS4 Permit Compliance

DPW is predominantly responsible for compliance with the City's MS4 permit. Although the efforts of other City agency services are reported in this Annual Report for permit conditions like property maintenance, inspections and enforcement, the expenditure information shown in Table 4-1 is strictly limited to DPW services. Annual expenditures and budgets for FY 2016 and 2017 are summarized in Table 4-2. This information is also included in the geodatabase in Appendix C.

The expenditures and budgets shown in Tables 4-1 and 4-2 do not include debt service payments, to avoid confusion with expenditures made using debt service mechanisms like bonds. This follows a similar format as the Financial Assurance Plan submitted to MDE on July 1, 2016. Debt service payments in FY 2016 were on the order of $3,230,424.

Table 4-1: Fiscal Analysis of FY 2016 Expenditures

Description of Total Annual Cost	FY 2016 Actual
Stormwater management	$1,021,415
Erosion and sediment	$755,060
Illicit detection/elimination (IDDE)	$1,966,165
Trash elimination	$671,317
Property management	$33,229
Inlet cleaning	$4,849,933
Street sweeping	$4,942,590
Road maintenance - other	$0
Public education	$343,635
Watershed assessment	$204,747
Watershed restoration (all projects)	$1,223,713
Chemical monitoring	$153,045
Biological monitoring	$82,017
Physical assessment	$0
Design manual monitoring	$0
TMDL assessment	$50,564
Total NPDES program	**$16,297,432**
Other activities related to stormwater*	$5,969,544
Total Stormwater	**$22,266,976**
Funded by Stormwater Utility	$13,671,713
Funded by W/WW Utility	$1,816,353
Funded by General Fund	$2,553,398
Funded by Other Sources	$4,225,512

Note: "Other activities" include the maintenance and remediation of stormwater infrastructure (collection system).

Table 4-2: NPDES Program Expenditures and Budgets

Fiscal Year	Operations	Capital	Total
FY 2016 (Expenditure)	$15,056,107	$1,241,325	$16,297,432
FY 2017 (Budget)	$18,350,622	$22,735,291	$41,085,913
Total	$33,406,729	$23,976,616	$57,383,345

4.2 Stormwater Fee and Stormwater Utility

The Stormwater Utility is an enterprise fund, established in 2013, to protect the use of revenue received from the stormwater restoration fee and other miscellaneous. The predominant source of revenue for the stormwater utility is the stormwater restoration fee. Other sources of revenue are as follows:

- Plans review fees for stormwater management and erosion and sediment control
- Penalty fines for stormwater management and erosion and sediment control
- Fees in lieu of on-site stormwater management (quantitative and qualitative control)

The stormwater restoration fee was established in the City Code in June 2013; the first bills were issued in September 2013. The fee structure and rate was established to remain constant for four years (FY 2014 through 2017). The required reporting, as prescribed by MDE, is included in Appendix H of this report. Note that the stormwater fee expenditure for capital projects includes the payment of debt service mechanisms.

4.2.1 Grants Received by DPW

In FY 2015, the City received $58,110 from the Chesapeake Bay Trust (CBT) Watershed Assistance Grant Program to develop design standards for the installation ESD practices specific to the City. The design standards will allow common, repetitive practices to be designed and reviewed more quickly, reducing the costs for non-profits, businesses, and public agencies while also ensuring design quality. This effort will be completed by the end of 2016.

4.2.2 Grant Support by DPW

Stormwater utility funds were used to provide direct funding for the following activities in FY16:

- **Chesapeake Bay Trust (CBT) Outreach and Restoration Grant Program**: Following the Growing Green Design Competition, the City decided that financial support would provide greatest benefit in CBT's Outreach and Restoration Grant Program. In FY16 DPW $100,000 from the City's Stormwater Utility Fund to leverage $147,188 from CBT. The following projects were funded:
  - **St. John Lutheran Church, $52,933:** taking a comprehensive approach to its rainwater management at its church, playground, and parking facilities.
  - **Second Chance, Inc., $75,000:** The Gateway Greening Project is intended to control the flow and treat the water quality of stormwater from the parking lot.

  - **Fusion Partnerships, $25,000:** The project will install a stormwater bioretention garden at the South Baltimore Charter School in southwest Baltimore.
  - **Ridge to Reefs, $49,933:** This project will create a social marketing campaign to encourage proper disposal of household waste to reduce sanitary sewer overflows caused by improper disposal of materials into the sanitary system.
  - **Mount Royal Community Development Corporation, $24,726:** The TreeVision program trains residents to plant, maintain, and care for trees.
  - **Department of Recreation and Parks, $19,596:** The "Discover Gwynns Falls!" project will connect Baltimore City residents to the Gwynns Falls Park through a variety of programs and volunteer projects, highlighting the importance of natural areas in a fun recreational park.

- **Blue Alley Monitoring**: In January 2016, DPW awarded $7,895 to Blue Water Baltimore (BWB) to monitor stormwater runoff from two alleyways and two bump-out retrofits that were installed as part of the "Blue Alleys" project in the neighborhoods of Butchers Hill and Patterson Park. The monitoring will evaluate the stormwater treatment potential of these practices.

In addition to the direct funding listed above, the City provided grant preparation assistance and letters of support to other City agencies, non-profits and academic institutions in grant applications that improve water quality in Baltimore City. DPW's support included staff participation in project meetings, providing GIS data, assisting in project review, and helping the various groups access both information and city agencies. In FY16, DPW provided letters of support to fourteen (14) City agencies, non-profits organizations and universities for grant proposals. The following grant proposals were successful in receiving a total of $1,086,000 from Federal, State, and local foundations:

- TreeBaltimore ($500,000) for planting 800 trees and tree pits in the South Baltimore Gateway neighborhoods (target areas identified in the MS4 Restoration WIP).
- Blue Water Baltimore ($500,000) for community planning to engage 5 communities in identifying stormwater projects on public and private property (target areas identified in the MS4 Restoration WIP). DPW is participating and providing technical assistance.
- Trash Free Maryland ($30,000) for outreach and education to reduce trash pollution (supports the City's Trash TMDL).
- Pigtown Main Street ($56,000) to prepare designs for stormwater bumpouts along Washington Boulevard (target area identified in the MS4 Restoration WIP).

4.3 Capital Projects – Expenditures and Financing

The capital improvements for the stormwater management include projects specifically listed in the Appendix M of this report, plus the capital projects to remediate or replace stormwater infrastructure.

These projects are funded by a combination of the stormwater utility, county transportation bonds, general obligation bonds, and grant funding. The capital costs listed in Appendix H include both the expenditure for contracted services, capitalization of in-house efforts, and the payment of debt service for capital contracted expenditures from previous years. In FY 2012 and 2014, the City was approved for a total of $30.4 million in County Transportation Bonds and $4.1 million in GO Bonds. Approximately $15.6 million of that debt service amount will be used to finance projects specifically listed in the MS4 Restoration WIP. The stormwater utility is responsible for paying the principle, interest, and administrative costs related to these bonds.

The stormwater fee was established at a constant rate ($15/ERU) for the first four years of implementation (FY 2014 through FY 2017). This would allow a surplus of revenue to be accumulated to enable the City to sell revenue bonds in FY 2018, when a significant increase in capital costs is anticipated. This financing schedule aligns with the construction schedule for most of the projects listed in MS4 Restoration WIP.

The City has been approved for approximately $583,000 in the State Revolving Loan Fund (SRLF) for FY 2017 for the Chinquapin Run stream restoration projects and the Masonville Cove ESD Projects, which were listed in the MS4 Restoration WIP. For FY 2018, MDE has listed $20.7 million in the Intended Use Plan for the SRLF for Baltimore City. This debt service funding was shown in the Financial Assurance Plan submitted by the City in July 2016.

5 Enforcement Actions, Inspections and Public Education

5.1 Stormwater Management Program

Programmatic and implementation information for the period of this Annual Report (July 1, 2014 to June 30, 2015) is as follows:

- Number of Concept Plans received: 158
- Number of Site Development Plans received: 143
- Number of Final Plans received: 141
- Number of Redevelopment projects received: 78
- Numbers of Stormwater exemptions issued: 142

DPW received and approved as-built drawings for 24 stormwater management BMPs between July 1, 2015 and June 30, 2016. The required data for these BMPs are in Appendix C of this report. A summary of waivers and variances for this time period is provided in Table 5-1.

Table 5-1: Summary of waivers and variances

Description	**Requested**	**Granted**
Quantitative Control Waiver	6	5
Qualitative Control Waiver	53	52
Redevelopment Waiver	51	48
Phased Development Waiver	0	0
Administrative Waiver	0	0
Variance	2	1
Total	**111**	**109**

No changes to the City's ordinance or code related to the stormwater management program (Article 7, Division II) were pursued during this time.

During this reporting period, 161 inspections of ESD treatment practices and structural stormwater management facilities were conducted as part of preventive maintenance inspections. Of those inspections, 141 sites with approved as-built plans and 20 without certified approved as-built plans were inspected. A total of 15 sites required one or more follow-up inspections; one violation notice was issued, resulting in a fine of $100. Of the facilities inspected, 6 of the inspections resulting in identifying a facility that was removed. The removed facilities were installed prior to 2000, and were not reported in the BPM inspection tables, because mandatory fields require us to provide information that cannot be reported.

In reviewing the records for the projects approved form 2005 to 2015, there were approximates 711 new facilities approved; however construction status is pending verification. As discussed in Section 2 of this report, all facilities constructed after 2005 will be reported in the FY2017 Annual Report, regardless of the inspection status.

5.2 Erosion and Sediment Control

The City added a new customer service request for erosion and sediment control in 2014. Complaints are reported via phone, internet or mobile phone application and tracked through the 3-1-1 system. During FY 16, a total of 194 service requests were received.

During this reporting period, 1,824 inspections were conducted for compliance with approved erosion and sediment control plans. A total of 10 violation notices were issued by the City, resulting in a sum of $28,000 received as penalty fines and 4 stop work orders. The summary information regarding earth disturbances exceeding one acre are included in Appendix C of this report.

No changes to the City's ordinance or code related to the erosion and sediment control program (Article 7, Division III) were pursued during this time.

5.3 Illicit Discharge Detection and Elimination (IDDE)

5.3.1 Routine Field Screening Locations

DPW conducts an MDE-approved alternative to IDDE: ammonia screening (AS) and stream impact sampling (SIS) to initiate pollution source tracking (PST) investigations. The geographic distribution of AS and SIS sampling locations are shown in Figure 5-1, with geo-reference data provided in Appendix C. The monitoring results from the surveys for the AS and SIS programs for FY 2016 are included in Appendix D of this report. These monitoring results, plus historic data, are also available on-line at the Cleanwater Baltimore website[2].

5.3.1.1 EPA MS4 Inspection

On August 26, 2015 a compliance team from the U.S. Environmental Protection Agency inspected the City of Baltimore's MS4 program. The purpose of the inspection was to assess the City's compliance with the requirements of the NPDES MS4 permit, the implementation status of the current MS4 program and to follow-up on the status of EPA's 2009 inspection. EPA provided the City with an inspection report in January 2016 that included specific Permit requirements and their associated observations made during the inspection.

[2] In 2017 the Clean Water Baltimore website will be integrated into DPW's new web site and the Clean Water Baltimore web site eliminated.

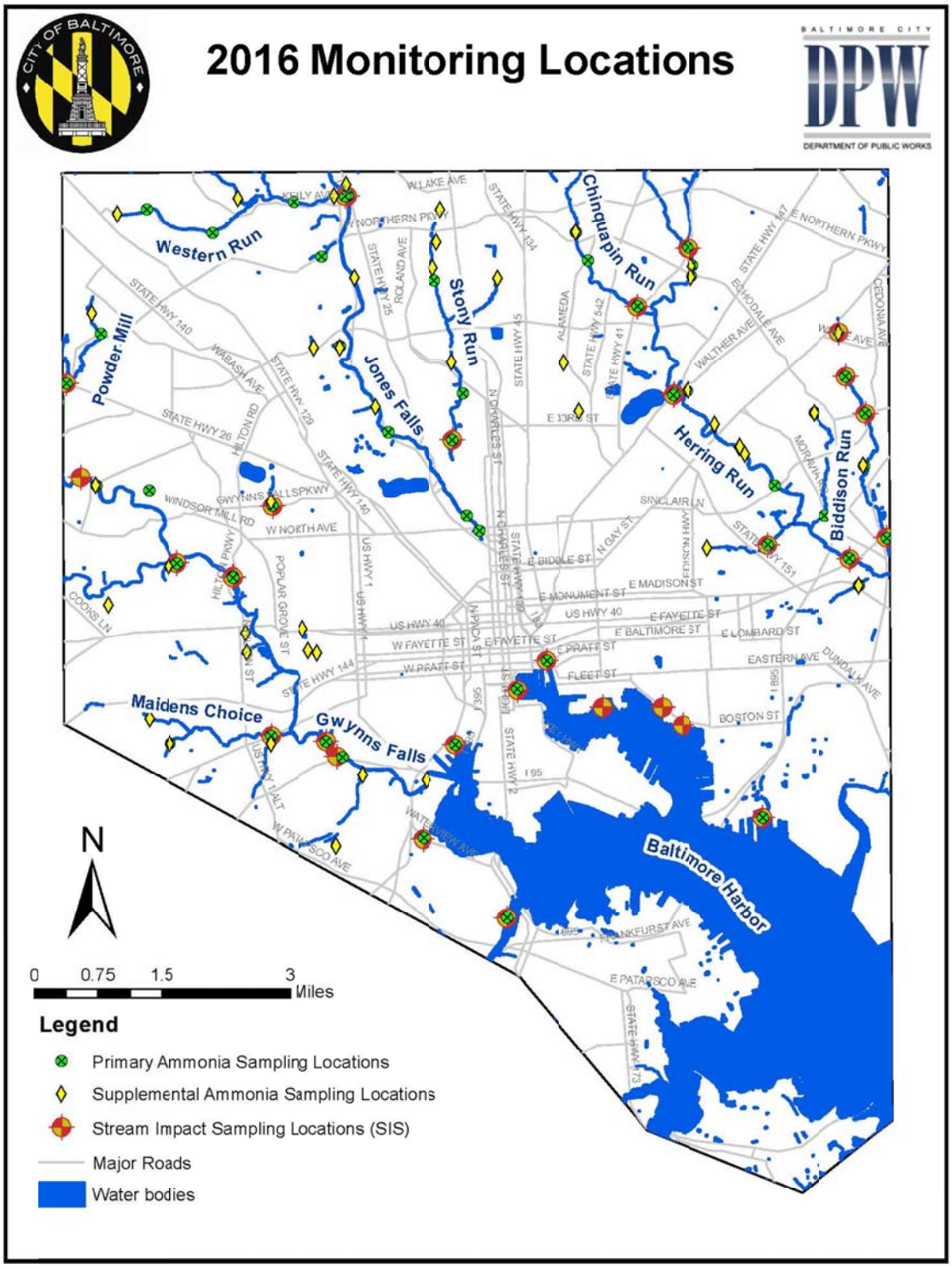


Figure 5-1: Sampling Locations for the Ammonia Screening (AS) and Stream Impact Sampling (SIS)

5.3.2 Supplemental Field Screening

5.3.2.1 East Harbor Storm Drain Ammonia Survey

In the summer of 2015, after the completion of the South Harbor Storm Drain Ammonia Survey in FY 2015, DPW continued with a supplemental field survey of outfalls along the East Baltimore Harbor. The purpose of the survey was to conduct water quality sampling on smaller storm drain systems that were not part of the routine field screening programs. Sampling locations were not limited to outfalls, since many of the outfalls were inaccessible (private property) or were submerged by tidal waters. A total of 29 stormwater assets were sampled during the survey:

- One outfall;
- 27 manholes; and
- One storm drain channel.

Sampling was performed during low tide and dry weather (no rain event within 48 hours). The water samples were analyzed for ammonia-nitrogen. In areas where iron accumulation was observed within the pipe system, or air conditioning condensation was suspected, a sample was analyzed for enterococcus as a secondary water quality parameter for sewage. Twenty-five (25) of the assets in the survey had flow, and a sample was collected for ammonia-nitrogen analysis. Eleven (11) of the samples yielded an ammonia-nitrogen measurement above 0.3 mg /L. Only three (3) were determined to be related to sewage based on enterococcus analysis; and, therefore, warranted the initiation of a pollution source tracking (PST) Investigation. The results of the PST investigations are as follows:

- Two (2) direct connections from private properties were identified and abated prior to July 1, 2016.
- One (1) direct connection from private property was identified and remains in negotiation with property management toward a solution for abatement.

In addition to ammonia nitrogen measurements, area reconnaissance and the physical state of base flow (odor, color) resulted in the initiation of other PST investigations that found two (2) potable water main breaks. The survey continued beyond July 1, 2016, and the remaining outfalls along the Harbor are planned to be sampled by the end of FY 2017.

5.3.2.2 Ridge to Reefs Illicit Discharge Project

In September of 2015, the City issued a letter of support for Ridge to Reefs for a Chesapeake Bay Trust Watershed Assistance Grant to provide funding for tracking and eliminating illicit discharges in the Jones Falls and Lower Patapsco watersheds. Ridge to Reefs was awarded the grant and a kick off meeting with staff from DPW and Ridge to Reefs was held in April 2016 to discuss the proposed illicit discharge screening and the support the City would be providing.

5.3.3 3-1-1 Customer Service Request for Polluted Water

Complaints are reported via phone, internet or mobile phone application and tracked through the 3-1-1 system. Complaints that are designated with the type “WW Waterway Pollution Investigation” are initially assigned to the Water Quality Monitoring and Inspections Section of OCAL. During FY 2016, a

total of 177 service requests were received. Thirty-seven (37) resulted in a pollution source tracking investigation. Six (6) of these investigations led to the discovery of an illicit discharge that was removed: four (4) dry weather sanitary sewer overflows (SSO) from the public system; and two (2) private sanitary sewer improper connections to the storm drain system. These six illicit discharges are included among those further discussed in Section 5.3.4.

5.3.4 Pollution Source Tracking (PST)

DPW initiates PST investigations based on the results of field screening, 3-1-1 customer service requests or requests from other programs (such as Blue Water Baltimore, MDE or EPA).

During FY 2016, a total of 250 PST investigations were conducted: 205 PST investigations were initiated during FY 2016; and another 45 PSTs, which were initiated prior to FY 2016, were continued. While conducting these 250 PSTs, DPW staff stopped at 1,641 locations in the open channel and storm drain system to make water quality chemical analyses, make observations, drop dye, etc. As a result of the PST investigations, the following one hundred three (103) illicit discharges were identified and abated, with further details provided in Appendix I:

- Seventy (70) dry weather sanitary sewer overflows (SSOs) from the public sewer; 10 of these were designated as sanitary discharge of unknown origin (SDUOs) at some point during their investigations;
- Twenty-three (23) sewage inputs from private properties to the storm drain system;
- Nine (9) drinking water transmission losses; and
- One (1) other type of illicit discharge: residential washing machine wastewater that had been connected to the resident's sump pump and discharged down the alley; resident was made to connect this flow to his sanitary sewer connection.

Additionally, twenty-four (24) illicit discharge sources were located and await further repairs:

- Three (3) sanitary sewage inputs that were designated as SDUOs at some point during their investigations;
- Three (3) SSOs;
- Seventeen (17) drinking water transmission losses; and
- One (1) polluted water discharge from a fruit juice business.

There are twelve (12) on-going investigations for which a pollution source has not yet been identified:

- Two (2) SDUOs;
- An additional seven (7) discharges that suggest that the source is coming from the sanitary sewer network; and
- Two (2) with high chlorine levels suggesting the source is from drinking water transmission losses.

5.3.5 FOG Program

In November 2013, DPW initiated an inspection program to reduce fats, oils and grease (FOG) within the sanitary sewer system. The Program has a two-pronged approach that manages FOG from both the private and public sides of the property line by:

- Requiring all food services establishments (FSE) that have the potential to discharge FOG-laden wastewater to have an adequate grease control device (GCD), and
- Reducing build-up of fats, oils and grease in the sewer lines using a commercial grade degreaser.

FOG education efforts are focused on both residents and owners of FSEs. Flyers were included with water bills. Outreach at festivals and community meetings included distribution of education materials. All education materials are available on the Cleanwater Baltimore website[3] .

The Pollution Control Section within DPW performs the inspections and educates FSEs about FOG best management practices. There were 3,623 inspections of FSEs during FY 2016: this is an increase of 8% compared to the 3,356 inspections during FY 2015. During FY 2016, 1,597 FSEs (44%) were found not to be in compliance. There were 2,049 notices of violation (NOV) issued to the 1,597 FSEs were found not to be in compliance. Two (2) establishments were fined for a total of $1,000. A breakdown by type of NOV is included in Appendix I of this Annual Report.

In the Annual Report for FY 2015, the City reported that there were 144 Baltimore City Public Schools that needed to install GCDs. These schools are relying on getting State funding to add GCDs as they undergo major renovations. The State Board of Public Works approved funding for 32 out of the 144 schools which need GCDs in early September 2016. This work will be done during FY 2017. The approval for renovations (which includes installation of GCDs) for the remaining 112 schools is pending.

5.3.6 Exterior Lead Paint Removal Waste Control Program

This program is administered by the Pollution Control Section within DPW. During FY 2016, there were 376 permitted sites. Inspectors made 315 site visits and issued 42 stop work notices requiring corrective action. There were no documented illegal discharges to the storm drain system.

5.3.7 NPDES Industrial Discharge Permits

The City has fourteen (14) municipal facilities covered under the NPDES Industrial Discharge Permit, as listed in Table 5-2. During FY 2015, NOIs for these facilities and updated stormwater pollution prevention plans (SWPPPs) were submitted to MDE. Permit conditions related to staff training and routine inspections are managed by the responsible agency. DPW implemented an internal environmental compliance audit program in FY 2016, which consisted of site walkthrough inspections and SWPPP audits. During FY 2016, a total of four (4) internal audits were conducted. In addition to the internal environmental compliance audit program, a geodatabase was created to monitor each facility's last quarterly inspection and SWPPP trainings.

[3] In 2017 the Clean Water Baltimore website will be integrated into DPW's new web site and the Clean Water Baltimore website eliminated.

Table 5-2 – Summary of NPDES Permitted Municipal Facilities

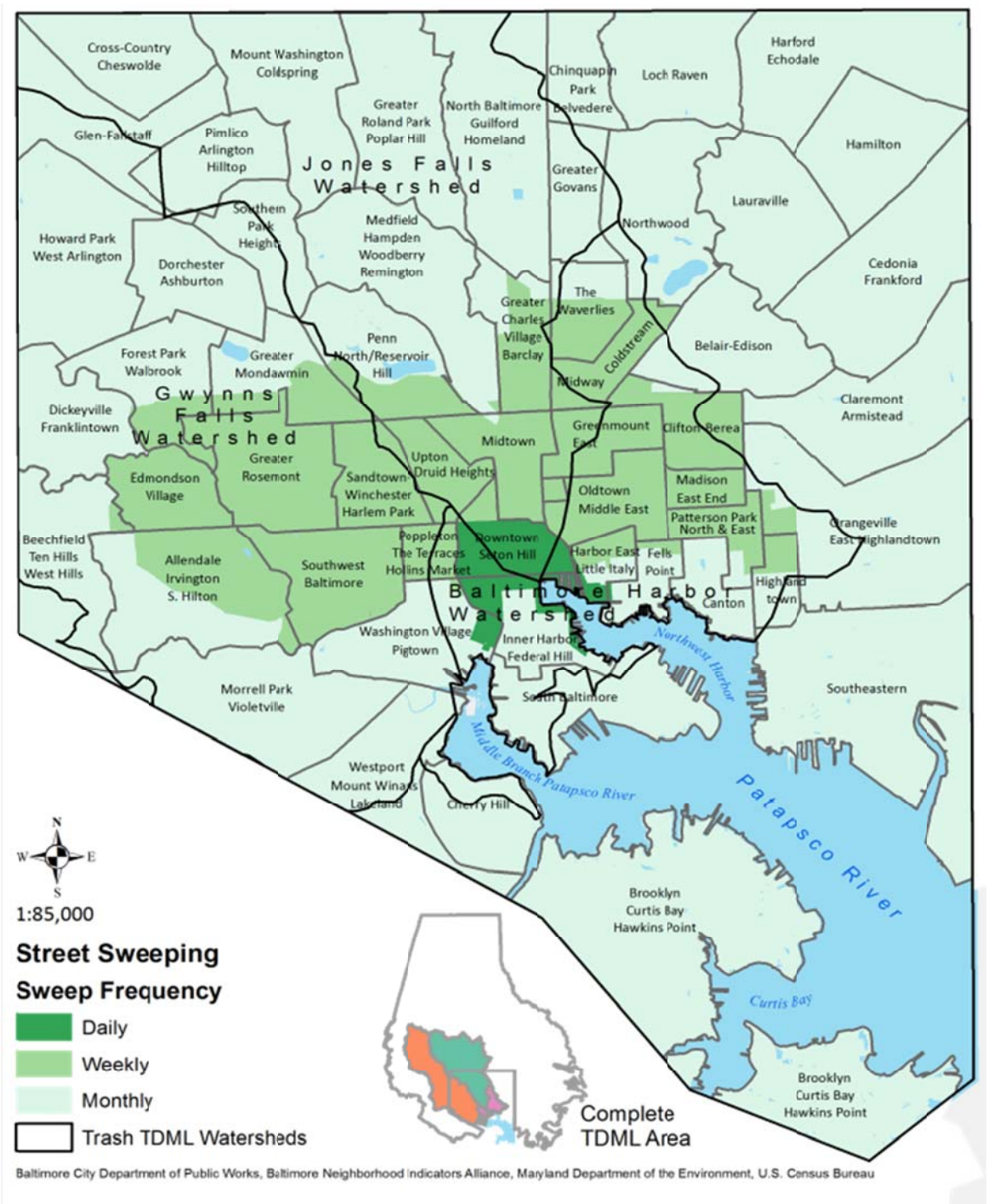
Facility Name	Agency	Address	State	SIC Description
Reedbird Landfill	DPW	701 Reedbird Ave	12SW0252	Sector L.3 – Landfills and Land Application Sites
Bowley's Lane Sanitation Yard	DPW	6101 Bowleys Lane	12SW0254	Sector L – Landfills and Land Application Sites
Quarantine Road Municipal Landfill	DPW	6100 Quarantine Rd	12SW0257	Sector L – Landfills and Land Application Sites
Northwest Transfer Station	DPW	5030 Reisterstown Road	12SW1307	Sector L – Landfills and Land Application Sites
Quarantine Road Landfill	DPW	5701 Quarantine Rd	12NE0684	Sector L – Landfills and Land Application Sites
Northeastern Substation	DGS	4325 York Rd	12SW0702	Sector P – Land Transportation and Warehousing
Western Substation	DGS	239 N Calverton Rd	12SW0703	Sector P – Land Transportation and Warehousing
Middletown Fueling Station	DGS	410 Front St	12SW0704	Sector P – Land Transportation and Warehousing
Northwestern Substation	DGS	4410 Lewin Ave	12SW0705	Sector P – Land Transportation and Warehousing
Fallsway Substation	DGS	201 Fallsway	12SW0707	Sector P – Land Transportation and Warehousing
Mechanic Shop	DGS	6400 Pulaski Hwy	12SW0708	Sector P – Land Transportation and Warehousing
Central Garage	DGS	3800 E Biddle St	12SW2123	Sector P – Land Transportation and Warehousing
Patapsco WWTP	DPW	3501 Asiatic Ave	12SW0629	Sector T – Treatment Works
Back River WWTP	DPW	8201 Eastern Avenue	12SW0630	Sector T – Treatment Works

5.4 Property Management and Maintenance

5.4.1 Street Sweeping and Trash Reduction

In FY 2016, the mechanical street sweepers operated by DPW- Bureau of Solid Waste removed 12,143 tons of debris while sweeping 111,435 miles of street surface. This is an increase in both tonnage and mileage, despite a significant decrease in operation in the month of January 2016 due to a major snow storm. Street sweeping frequency is shown in Figure 5-2. The efficiency of the street sweeping operations, specifically in the expanded areas, is still hindered by the coordination of parked vehicles.

The City launched a city-wide Municipal Trash Can program, with nearly 171,000 cans distributed to households beginning in March 2016 and ending in July 2016. The purpose of the program was to provide an incentive to residents to improve water management and prevent litter. A description of the education and outreach are discussed in Section 5.5.6 of this report.


Cross-Country
Cheswolde
Mount Washington
Coldspring
Harford
Echodale
Chinquapin
Park
Belvedere
Loch Raven
Greater
Roland Park
Poplar Hill
North Baltimore
Guilford
Homeland
Glen-Falstaff
Pimlico
Arlington
Hilltop
Jones Falls
Watershed
Greater
Govans
Hamilton
Lauraville
Southern
Park
Heights
Medfield
Hampden
Woodberry
Remington
Northwood
Howard Park
West Arlington
Dorchester
Ashburton
Cedonia
Frankford
The
Waverlies
Greater
Charles
Village
Barclay
Coldstream
Penn
North/Reservoir
Hill
Belair-Edison
Forest Park
Walbrook
Greater
Mondawmin
Midway
Gwynns
Falls
Watershed
Claremont
Armistead
Dickeyville
Franklintown
Greenmount
East
Clifton-Berea
Midtown
Upton
Druid Heights
Greater
Rosemont
Edmondson
Village
Sandtown
Winchester
Harlem Park
Oldtown
Middle East
Madison
East End
Patterson Park
North & East
Orangeville
East Highlandtown
Beechfield
Ten Hills
West Hills
Allendale
Irvington
S. Hilton
Southwest
Baltimore
Poppleton
The Terraces
Hollins Market
Downtown
Seton Hill
Harbor East
Little Italy
Fells
Point
Baltimore Harbor
Watershed
Canton
Highland
town
Washington Village
Pigtown
Inner Harbor
Federal Hill
Northwest Harbor
Morrell Park
Violetville
South Baltimore
Southeastern
Middle Branch Patapsco River
Westport
Mount Winans
Lakeland
Cherry Hill
Patapsco River
Brooklyn
Curtis Bay
Hawkins Point
Curtis Bay
Brooklyn
Curtis Bay
Hawkins Point
N
W
E
S
1:85,000
Street Sweeping
Sweep Frequency
Daily
Weekly
Monthly
Trash TDML Watersheds
Complete
TDML Area
Baltimore City Department of Public Works, Baltimore Neighborhood Indicators Alliance, Maryland Department of the Environment, U.S. Census Bureau

5.4.2 Inlet Cleaning

In May 2016, DPW completed the installation of screens and inserts for 414 inlets which would improve the efficiency of inlet cleaning and street sweeping by preventing trash and debris from entering the storm pipe system. Modified inlets will be installed in five neighborhoods: McElderry Park, Oliver, Baltimore-Linwood, Franklin Square, and Carrollton Ridge. The neighborhoods were selected based on the 3-1-1 service requests for choked inlets and dirty streets. The modifications are only being made to a portion of the 1,092 inlets located within the selected neighborhoods, based on inlet type and the proximity to routine street cleaning routes.

Routine preventive inlet cleaning began for all inlets in these five (5) neighborhoods. The initial operations used contracted services to allow time DPW to gauge the work effort (crew size and efficiencies) to create positions and procure equipment. The first work order was completed in July 2016. The results of this effort will be included in the Annual Report for FY 2017.

5.4.3 Integrated Pest Management

During FY 2016, the Department of Transportation (DOT) applied 35 gallons of Lesco Prosecutor Pro herbicide, which contained 105 pounds of glyphosate acid. This is a decrease of 15 gallons (45 pounds of glyphosate acid) compared to the amount applied during FY 2015. During FY 2016, DOT did not apply any Brushmaster herbicide, compared to the 30 gallons of Brushmaster herbicide that DOT applied during FY 2015.

During FY 2016, the Department of Recreation and Parks (BCRP) applied approximately 108 gallons of concentrated glyphosate (Round Up equivalent), which contained 324 pounds of glyphosate acid. This is an increase of 48 gallons (144 pounds of glyphosate acid) compared to the amount applied during FY 2015. BCRP has six (6) Public Agency Applicators who are certified by MDA (3 in Horticulture and 3 in Parks). All have attended MDA approved trainings to maintain their certifications. All registered (not certified) applicators are re-registered annually with MDA as per the State process.

Between the two departments, there were 429 pounds of glyphosate acid applied during FY 2016 compared to 330 pounds applied during FY 2015.

5.4.4 Deicing Materials

DOT applied 20,994 tons of sodium chloride during FY 2016. In FY 2016, there were 5 storm events, which totaled 35 inches of snow; with 30 of those inches coming from one event. In addition to the snow events, there were 2 other days when predicted icy road conditions required the application of road salt for the purpose public safety.

5.5 Public Education and Outreach

5.5.1 Education and Outreach Activities

A summary of outreach events is provided in Table 5-3:

Table 5-3: Summary of Outreach Activities for FY 2016

Description	Details
Public Presentations on the MS4 WIP and Stormwater Fee Credit Program (encouraging the public to install stormwater practices)	• MS4 presentation to the Community Development Network of MD (9/19/14) • Presentation on stormwater fee credits at 4th Council District community meeting (10/23/14) • Interfaith Partners for the Chesapeake (4/26/15) • Baltimore Colleges and Universities for a Sustainable Environment (6/16/15) • South Baltimore Business Alliance (6/24/15)
School presentations providing information on trash reduction, recycling, rats, and storm drains, related to the health of the harbor	• 51 Presentations • 23 Schools • 2,012 Students • Post-presentation testing
Community events where DPW provided educational materials on environmental topics	• Big Truck Day - May 21, 2016 • Mayors Spring and Fall Cleanups – Oct. 24, 2015 & April 23,2016 • African American Heritage Festival – June 20 - 21, 2015 • Mayors Cabinet in the Community (various times throughout the year) • Mayors Public Safety Meetings (various times throughout the year) • Artscape – July 17 – 19, 2015 • Montebello Centennial – Sept 19, 2015 • Book Festival – September 25 – 27, 2015 • Various community meetings (various times throughout the year)
Incentives related to trash reduction	• Announcement of Clean Corps program to involve neighbors in organized, ongoing efforts to keep their communities clean – Mayor's Fall Cleanup, 10/2015 • Release of Baltimore City Clean Guide, a one-stop resource for citizens to help them get help with common trash and blight problems – Mayor's Spring Cleanup, 4/2016 • Oyster shell recycling becomes available to

Description	Details
	the general public at Sisson Street Yard in May 2016. By the end of the summer season we collected almost 500 pounds of shells, enough to provide homes for 35,000 oyster spat. • Christmas tree mulching (Saturdays in January) • Household Hazardous Waste collections (First Friday/Saturdays; July-October 2015, April-June 2016) • Discount Recycle Bin sales/Free Paper Shredding (April, June 2016) • Recycle Bin Sale (Big Truck Day, May 2016) • Continued to provide disposal service for the Water Wheel, a public-private project at the Jones Falls outfall to the Inner Harbor.

Baltimore's stormwater restoration fee has a credit program which includes a fee reduction for participation in registered stormwater participation events. These include community clean-ups, stream and harbor clean-ups, tree plantings, and installation of community BMPs. Outreach efforts and information promoting these types of trash reduction efforts and BMP installations have included posting on the Clean Water Baltimore web site and DPW's Facebook page, providing flyers at DPW attended events, reminders sent to City Council members for distribution, and at community and partner meetings attended by DPW liaisons. The results of the registered stormwater participation events, as reported to DPW, are as follows[4]:

- 114 stormwater participation events completed
- 2,977 volunteers participated
- 43.5tons of trash collected
- 641 trees planted[5]

DPW's Communications Office also highlights the work of stormwater participation events through social media (Facebook and Twitter.)

In FY16 DPW gave a workshop to Friends of Parks groups organized by the Department of Recreation and Parks (BCRP), and worked with the agency to register and report its monthly trail clean-up days. DPW also provided outreach materials for stormwater participation credits to participants in the Mayor's Fall 2015 and Spring 2016 Clean-ups.

[4] When compared with FY15 totals, although there were 10 fewer events registered in FY16 the volunteers / event and lbs. of trash collected was higher, after factoring in Project Clean Stream.
[5] Trees are reported as afforestation.

5.5.2 Growing Green Design Competition

In 2015 the "Baltimore City Growing Green Design Competition: Vacant Lots Transformed[6]" awarded funding to six projects for the design and implementation of innovative concepts for retrofitting vacant lots, creating community spaces, and reducing and treating stormwater. The competition was an opportunity to pilot the Green Pattern Book and test community-based stormwater management projects. The following projects were completed in FY16[7]:

1. Lots of Art: The Hollins Roundhouse Association repurposed two vacant corner lots into a green space that is used for passive recreation and a public arts space.

2. Riggs Avenue Community Space: The project by the Chesapeake Bay Foundation removed approximately 8,000 square feet of asphalt, replacing it with native plantings and gardens.

3. Gateway Garden: A project by Civic Works, the community green space includes a rain garden, native plantings, and public art.

4. Flower Factory at Broadway East: This project by Real Food Farm integrates stormwater management with a new brand of urban agriculture - cut flower production.

5. Peace Park: Druid Heights Community Development Corporation redeveloped two adjacent lots into a community gathering space that incorporates rain gardens and permeable paving.

DPW worked with the competition winners to approve all stormwater management plans, maintenance agreements, and permits. This was done to ensure that the projects would receive the necessary oversight to make sure that they can count toward the MS4 restoration goal; it is estimated that 0.37 acres of impervious surface will be treated with these projects.

5.5.3 Stormwater Advisory Committee

In November of 2014, DPW created the Stormwater Advisory Committee (SWAC). The purpose of SWAC is to advise the Department on stormwater projects, programs, and issues, and to help educate stakeholder groups on related matters. The SWAC is made up of volunteer members representing a diversity of sectors, including environmental non-profits, businesses and industries, anchor institutions and citizens. DPW and other City agencies serve as ex-officio members to support the committee. SWAC members were[8]:

1. Jennifer Aiosa, Friends of Patterson Park / Blue Water Baltimore
2. Kimberly Brandt, 1000 Friends of Maryland
3. Ellis Brown, Morgan State University
4. Bif Browning, Southwest Partnership
5. Debbie Cameron, Baltimore Tree Trust

[6] The Growing Green Competition was launched as part of the Mayor's Growing Green Initiative. The competition was a partnership between DPW, the Department of Planning, and the U.S. Environmental Protection Agency.
[7] Dayspring Green Parking Lot is on hold due to property acquisition.
[8] Members listed in italics left the committee during FY16.

6. Terry Cummings, Chesapeake Bay Foundation [Chair]
7. Brian Hammock, CSX / South Baltimore Business Alliance
8. Matthew Kimball, Building Owners and Managers Association of Baltimore
9. Ashley Pennington, Johns Hopkins University Office of Sustainability
10. Anthony Pressley, Druid Heights CDC
11. Alan Pressman, BGE
12. Ann V. Robinson, Mt. Winans Community Association
13. *Daryl Sabourin, ASR Inc., Domino Sugar / Baltimore Port Alliance [Vice-Chair]*
14. Noah Smock, Baltimore Community ToolBank
15. Bonnie Sorak, Interfaith Partners for the Chesapeake

SWAC meets on a quarterly basis; meetings during FY16 were: August 3, 2015; November 2, 2015; February 1, 2016, and May 3, 2016. Advisory Committee meetings are open to the public and are advertised in advance. Meeting dates, minutes of past meetings, and other information regarding the Stormwater Advisory Committee can be found at www.cleanwaterbaltimore.org.

During FY16 DPW updated the SWAC members on the City's MS4 Permit and its Financial Assurance Plan, and the Trash TMDL Implementation Plan, which SWAC reviewed and provided comments. SWAC sub-committees provided input on the following:

- Policy: The sub-committee provided recommendations regarding stormwater fee credits and the NPDES Industrial Permit as well as reviewed and made recommendations for updating the stormwater fee credit regulations.

- Outreach & Communications: The sub-committee provided recommendations on developing a stormwater communications plan.

5.5.4 Baltimore City Water Industry Career Mentoring Program

In January 2015, DPW and the Mayor's Office of Employment Development, together with the Chesapeake Water Environment Association (CWEA), launched the Baltimore City Water Industry Career Mentoring Program. The program had two goals: (1) educating local young adults about the water industry and its career opportunities; and (2) developing a pipeline of future workers with the right skills to fill entry-level positions in the field. The mentoring program targeted City residents between the ages of 18 and 24 who had their high school diploma or GED, but were unemployed or underemployed, and not engaged in post-secondary education or job training. DPW continued this effort for a second year. Eleven of the program participants were hired by DPW with one other hired by a private employer.

5.5.5 GROW Center

Baltimore City generates a great deal of waste from trees and limbs that have been cut and removed from our parks and streets, as well as waste from demolished houses and renovated roadways. This waste will only increase with the Mayor's plan to demolish 4,000 vacant houses over the next ten years. Currently, this material is either stored at Camp Smallwood (tree debris) or taken to landfills (building debris). As a means for repurposing this waste for greening and stormwater management projects, the

City is exploring the creation of "GROW Centers". GROW stands for Green Resources and Outreach for Watersheds, and will be a place that links existing community greening networks to a much needed source of free/low cost materials and technical expertise for stormwater management installation and vacant lot revitalization. The GROW Centers would provide the following services:

- Materials for purchase. Mulch, bricks, crushed concrete, wood products, salvaged building materials and other quality-controlled materials that would be free and/or available for purchase by city residents and non-profits to use in micro-practice installation such as rain gardens, community gardens, and permeable paths and walkways. Trees, plants and quality-controlled materials like bio-soils will also be available in manageable volumes.

- Education and training. Experts will provide advice and guidance on green infrastructure projects, including hands-on training sessions, workshops, and educational classes on design, the proper use of the materials, securing funds and resources, and maintenance.

To test this concept, the Baltimore Office of Sustainability, in partnership with the Department of Public Works and numerous community partners, hosted a pilot Neighborhood Grow Center at the Baltimore Community ToolBank in April 2016 (see Appendix K). The goal of the GROW Center was to create a 'greening resource hub' where city residents could acquire the skills, knowledge, and materials to take on greening and stormwater projects, while also strengthening community networks of greeners across the city. The programs took place every weekend in April, and attracted over 200 visitors from 61 city neighborhoods. The GROW Center hosted three plant giveaways, two networking events, and 20 workshops, which drew 140 participants combined.

5.5.6 Healthy Harbor Dashboard

In September 2015, the Waterfront Partnership hired the Baltimore Neighborhood Indicators Alliance (BNIA) to help develop a Healthy Harbor Dashboard to track, map and report on progress to improve water quality in the City's waterways. DPW was a partner along with other area environmental NGOs. The dashboard tracks 8 (eight) issue areas:

1. Acres Treated by green Infrastructure BMPs
2. Number of trees planted
3. Pipe maintenance
4. Number of Consent Decree projects
5. Dry weather overflows
6. Litter and debris collected (street sweeping, water wheel, harbor skimmers and community clean-ups)
7. Number of volunteers in restoration activities
8. Social media engagement

5.5.7 Effectiveness of Education Program for Trash and Litter

Public education and outreach is an essential strategy to achieve the long-term, sustained prevention of trash entering our streams and waterways. Whereas DPW is the responsible party for implementing and

providing solid waste services, public education and outreach requires partnerships to be effective. Partnerships involve voluntarily actions and/or cooperation by State, federal, private, non-profits, and community groups and residents, and can be both structural and non-structural practices.

5.5.7.1 Municipal Can Program

As described in Section 5.4.1, the City expanded the Municipal Trash Can program city-wide, beginning in March 2016. Leading up to the expanded program and during the distribution period, DPW provided extensive education and outreach to help residents understand the program, how to properly manage their waste, and the benefits of the cans for reducing litter and rats. Outreach consisted of mailers, flyers (in English and Spanish), community meetings, social media and press coverage, and an FAQ section on the DPW website.

5.5.7.2 Baltimore City Clean Guide

In April 2016, the Baltimore City Clean Guide was released. The guide was an effort to consolidate into one document all information on proper trash disposal, rat prevention, recycling, reporting trash and dumping to 311 and street sweeping. The guide is available on DPW's website, at DPW event tables and distributed to all Baltimore Clean Corps Captains. A copy of the document is provided in Appendix J of this report. The city-wide guide is based on the Patterson Park Neighborhood Clean Guide, which was developed by the neighborhood association with Chesapeake Bay Trust and foundation funding.

5.5.7.3 Clean Corps Baltimore

Clean Corps Baltimore launched in October 2015 in conjunction with Mayor's Fall Cleanup. Clean Corps is a peer-to-peer network of city neighborhoods, working in partnership with the City and nonprofits to reduce trash and litter in their communities. Clean Corp works by neighbors talking to neighbors to distribute information and resources to others who are committed to having clean streets and alleys. Clean Corps members are trained and provided with the tools and knowledge necessary to educate their neighbors; and engage them in community cleanups, art projects, and advocacy.

Clean Corps is staffed and funded as a public-private partnership between DPW, the Office of Sustainability, the Environmental Control Board, Baltimore Green Works, and the Waterfront Partnership.

The goal of the program is to train Clean Corps captains in 20 target neighborhoods; to date 14 neighborhoods have been trained. These are:

- Baltimore Highland
- Belair-Edison
- Carrollton Ridge
- Coldstream-Homestead -Montebello
- Curtis Bay
- Druid Heights
- Greater Mondawmin
- Hampden
- McElderry Park
- Oliver
- Patterson Park,
- Pigtown,
- Sandtown Winchester
- Waverly

Residents from 15 communities outside the targeted neighborhoods have also attended Clean Corps captain training. These communities include: Brooklyn, CARE, Berea, Butcher Hill, Violetville, Walbrook, Roland Park, Overlea, Lauraville, Howard Park, Easterwood, Jonestown, Ednor Gardens, Greenmount West, Darley Park.

Trainings includes an overview of the program, proper use of 311 (including downloading the app), how to organize a cleanup, a review of the key agencies and the services provided, a review of key nonprofits and how they can assist, and suggestions as to how to talk to neighbor about trash issues. As part of the trainings, Clean Corps Captains are provided with gloves, trash grabber, name badge and lanyard, Clean Corps safety vest, trash bags, pledges, yard and window signs, magnets, t-shirts, heavy cardboard street sweeping signs, and the Baltimore City Clean Guide.

Since its launch, Clean Corps has held 27 workshops, trained 189 Clean Corps Captains, held 34 community clean-ups, and painted 14 stormwater alley murals and 25 storm drains.

5.5.7.4 Anti-Litter Campaign

It is recognized that a marketing and advertising campaign will need to be developed to complement and support Clean Corps and the Municipal Can program. Public education needs to be more than simply raising awareness; it needs to change behaviors. In FY16, two efforts were initiated to develop an anti-litter campaign.

As part of DPW's Strategic Plan, several Goal Teams were created to develop tactics for improving fiscal responsibility, infrastructural renewal, human capital, and the environment. One of the tactics was "Create an anti-littering campaign". The Tactic Team, made up of DPW staff from across the agency, researched the topic, met with experts from within and outside of DPW, and reviewed campaigns from elsewhere. The Team submitted a Mayor's Enhancement Grant to fund the creation of an anti-litter communications plan; the proposal was initially awarded but later withdrawn due to budget cuts.

DPW also worked with federal, state, and local NGOs to secure funding to complete social marketing focus groups to better understand littering and trash behaviors. Focus groups were held in Spring 2016 with participants from 5 neighborhoods: Waverly, Mondawmin, McElderry Park, Oliver and the Port. Results of the study will be included in the FY 2017 report.

5.5.7.5 Mayor's Fall and Spring Clean-ups / Community Pitch-ins

The Mayor's Spring and Fall Clean-ups are opportunities for residents to organize community clean-ups and beautification projects. The purpose of the clean-ups is to collect litter and trash. DPW provides bags to residents, coordinates dumpsters, and picks up the trash from each location. In FY16:

- 652 communities participated (historic high)
- 12,752 residents volunteered (historic high)
- 234.8 tons of trash was collected

DPW also coordinates the Community Pitch-in program, which provides up to 4 dumpsters/year to community groups. In FY16, 687 requests were made for dumpsters. These events focus on larger debris collection, like old furniture and other material that is likely to be dumped.

6 Water Quality Improvements

6.1 MS4 Restoration and TMDL Watershed Implementation Plan (WIP)

The City submitted its WIP to MDE on December 22, 2014. The public comment period associated with the WIP ended on January 30, 3015, due to a request to extend the public comment period in consideration of the holiday season. The City received over 200 comments during the public comment period; the comments and the City's response were summarized in a Comment Response Document.

Comments were received from MDE on March 23, 2015. A revised calculation of the baseline impervious area, with supporting GIS files and responses to the specific MDE comments, was submitted to MDE on June 30, 2015. MDE approved the baseline impervious area and 20% restoration goal of 4,291 acres on July 28, 2015. The WIP was revised based on public and MDE comments. Both the revised WIP and Comment Response Document were submitted to MDE on August 24, 2015 and posted on the Cleanwater Baltimore website. The proposed restoration plans cited in Section 6 of this Annual Report refer to the revised WIP and MDE approved baseline impervious area.

6.2 Milestone Schedule

The WIP included programmatic and project milestones as part of an accountability framework for restoring the Chesapeake Bay. The proposed milestone schedule and status as of June 30, 2015, related to the Chesapeake Bay TMDL, are included in Appendix L. All programmatic milestones were completed as scheduled. For the project milestones, the contract advertisement occurred in August 2016.

6.3 Implementation of Projects, Programs, and Partnerships

6.3.1 Project Implementation and Tracking

The progress status of the projects listed in the WIP is provided in Appendix M of this Annual Report, specifically Table M-1. The original plan scope, cost and schedule are shown in addition to the current projections. Specific locations will be shown in the FY 2017 report. Sixty-three (63) projects were in the design phase during Fiscal Year 2016; three (3) of the projects were advertised for construction in August 2016. The current projections are based on the progress of the design at the time of this report. Each of the current proposed projects is included in the restoration BMPs tables of the georeference database in Appendix C. Several of the ESD projects include multiple locations; at this point in the design, a single centroid point is being used for the geographic location of the project. Two projects were added as a result of the final design of the Lower Lower Stony Run Restoration project. Chinquapin Run stream restoration was significantly increased to coincide with a sanitary repair project; advertisement was delayed based on access issues.

Thirteen (13) projects were removed from the list based on the feasibility of the project. Three greening projects were removed due to conflicts with INSPIRE school renovations. The pond retrofit project at North Point Road was removed since the pond was found to be located on a contaminated site; land disturbance needed to be minimized at this location. Some of the projects were removed due to access issues with private property owners.

MDE has noted that the City has used conservative nutrient reduction efficiencies for the projects and has suggested using a higher efficiency similar to Stormwater to the MEP, as listed in the MAST program. However, the City will continue to use an efficiency assigned to "Micro-bioretention (C/ D soils)" as listed in the supporting documents for the on-line Maryland Assessment Scenario Tool (MAST).

6.3.2 Program Implementation and Tracking

The progress status of the programs listed in the WIP is provided in Appendix M of this Annual Report, specifically Table M-2. Street sweeping operations continued to increase in FY 2016. The effectiveness was due to changes in vehicle maintenance. The increase in mileage was more significant than the increase in tonnage, possibly indicating the effect of the municipal trash can program and corresponding outreach and education. The majority of the street sweeping operations occur more frequently than bi-weekly, as shown in Figure 5-3. Current program implementation and corresponding georeference database records are reported as City-wide. The City plans to better define this operation based on frequency and geographic distribution of the operation (weight and tonnage by watershed) in the FY 2017 report.

In the past, inlet cleaning was reported based on complaint response, not necessarily meeting the criteria of quarterly cleaning. In May 2016, the City initiated a routine inspection and pro-active cleaning program for the 5 neighborhoods where inlet modifications were installed. In June, the City also initiated pro-active cleaning of inlets along interstate highway I-83 and I-295. The results of this inlet cleaning program will be included in the FY 2017 report.

Although the City's IDDE program identified and abated many illicit discharges, only the disconnections of illicit connections are listed in Table M-1. These connections were confirmed as existing prior to 2010. The equivalent impervious area restoration was calculated using the same calculation for septic system connections to a WWTP, as listed in the "Accounting for Stormwater Wasteload Allocations and Impervious Area Treated" guidance document by MDE, dated August 2014. The City plans to work with MDE to revise this credit for direct sanitary discharges to the storm system since this type of discharge would have a higher, direct pollutant loading than a septic system discharging through groundwater migration. The nutrient reductions for IDDE are based on the "Recommendations of the Expert Panel to Define Removal Rates for the Elimination for Discovered Nutrient Discharges from Grey Infrastructure", dated November 10, 2014. The calculations are included in Appendix I of this report.

6.3.3 Partnership Implementation and Tracking

The progress status of the partnerships listed in the WIP is provided in Appendix M of this Annual Report, specifically Table M-3. The migration of the georeference database was the main focus of FY 2016 efforts; all BMPs with approved as-built documentation, implemented to meet development requirements, were simply listed in the Table under development, using conservative pollutant removal efficiencies for pond and bioretention retrofits. Some of these projects also included the projects implemented by volunteer efforts. In the FY 2017 report, these projects will be better defined by type and geography. The City expects that the equivalent impervious area restoration and the pollutant removal efficiencies will increase.

6.4 Impervious Area Restoration

The progress status of implementation of proposed projects, programs, and partnerships of the WIP is provided in Appendix M. Since the projects are still in the design phase, the majority of the impervious area restoration is provided by programs, specifically street sweeping. Although the proposed projects were reduced based on feasibility, about 837 acres of impervious restoration projects are already in design or completed by the end of FY 2016. Based on the tables listed in the Appendix M, the current impervious acre restoration achieved within this permit period is 3,624 acres. This is equivalent to 84% of the current permit goal. The City is still on track for meeting the impervious area restoration goals by the end of the permit period.

6.5 Bay TMDL Compliance

The current status of implementation of proposed projects, programs, and partnerships were input into the Maryland Assessment Scenario Tool (MAST) to evaluate compliance with the Bay TMDL. The output from this model included in Appendix N. An estimation of the pollutant removals using MDE's Guidance Document is also provided in Appendix N. IDDE practices were not available in the current MAST.

6.6 Regional TMDL Compliance

6.6.1 Nutrients and Sediment

An estimation of the nutrient and sediment removals, based on the current implementation status, using MDE's Guidance Document is provided in Appendix O. Currently, records for street sweeping and inlet cleaning are not geographically referenced so the estimated reduction per watershed (regional TMDL comparison) is not accurate. This accuracy will be improved pending modifications of the data collection for these two programs. As street sweeping and inlet cleaning are continuous activities, the removal estimates for these activities will be shown as a historic trend to account for any impacts due education, outreach, or enforcement.

IDDE efforts for sanitary direct connections were incorporated into the estimation for nutrient and sediment removal. In the WIP, the City proposed a re-evaluation of the baseline load allocations for sediment based on a feasibility analysis. Coordination with MDE's Science Services Administration was initiated in FY 2016 and will continue in FY 2017.

6.6.2 Bacteria

The results of the City's routine stream sampling program of e.coli at monitoring stations in non-tidal waters are shown in Appendix D for the Jones Falls, Back River, and Gwynns Falls watersheds. There are no stream sampling stations in the Lower North Branch Patapsco watershed. A comparison of the historic monitoring results with the prescribed thresholds for frequent and infrequent full body contact recreation is provided in Section 3.1 of this Annual Report.

The City is under a consent decree in Civil Action No. JFM-02-1524 for unpermitted discharges from the wastewater collection system. A modification to the consent decree was lodged on June 1, 2016 in the United States District Court for the District of Maryland by the U.S. Department of Justice, the U.S.

Environmental Protection Agency, and the Maryland Department of the Environment. At the time of this report, the 60-day public comment period has been completed; but no further modifications have been issued. The final implementation schedule for the local bacteria TMDLs is pending the final determination of this consent decree, specifically the implementation schedule of Phase I and Phase II projects.

The City has continued to make significant capital investments in rehabilitating the sanitary sewer system. This capital investment, in combination with IDDE operations listed in Section 5.3 and public education efforts, prevent bacteria loadings. Further information on these efforts is provided in quarterly Consent Decree reports, posted on the City's website.

The City contracted the University of Baltimore and the University of Maryland Baltimore County to perform microbial source tracking. The program will start in January 2017 and progress for at least six months. A progress report will be included in the FY 2017 Annual report; the final results will be included in the FY 2018 report.

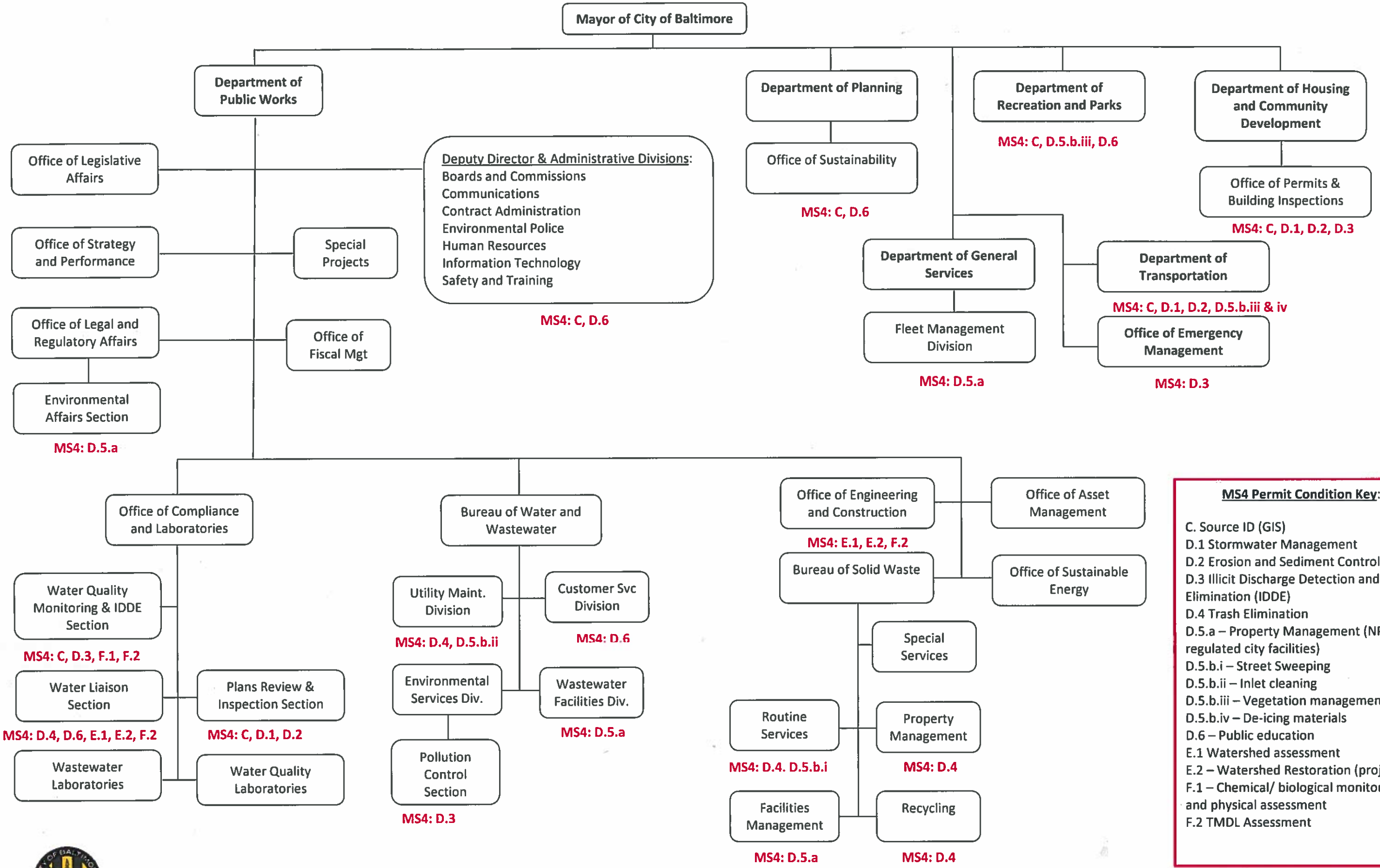
6.6.3 Trash

On January 5, 2015, EPA approved the report entitled "*Total Maximum Daily Loads (TMDL) of Trash and Debris for the Middle Branch and Northwest Branch Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment, Baltimore City and County, Maryland*". In compliance with the MS4 permit, the City developed the "Baltimore City Trash TMDL Implementation Plan", submitted to MDE on January 4, 2016, to present strategies to meet the TMDL waste load allocations. Progress on the milestone schedule for the trash TMDL is included in Appendix L of this report.

6.6.4 PCB

The MS4 WIP included a vague schedule for implementation to address PCB waste load allocations. The City has initiated discussions with MDE- Science Services to better define the allocations and methodologies for progress assessments. These discussions are planned as part of a larger MS4 managers work group in 2017. A more refined implementation schedule will be submitted as part of the FY 2017 Annual Report, pending the results of this work group.

Appendix A: Organization Chart



MS4 Permit Condition Key:

C. Source ID (GIS)
D.1 Stormwater Management
D.2 Erosion and Sediment Control
D.3 Illicit Discharge Detection and Elimination (IDDE)
D.4 Trash Elimination
D.5.a – Property Management (NPDES regulated city facilities)
D.5.b.i – Street Sweeping
D.5.b.ii – Inlet cleaning
D.5.b.iii – Vegetation management
D.5.b.iv – De-icing materials
D.6 – Public education
E.1 Watershed assessment
E.2 – Watershed Restoration (projects)
F.1 – Chemical/ biological monitoring and physical assessment
F.2 TMDL Assessment

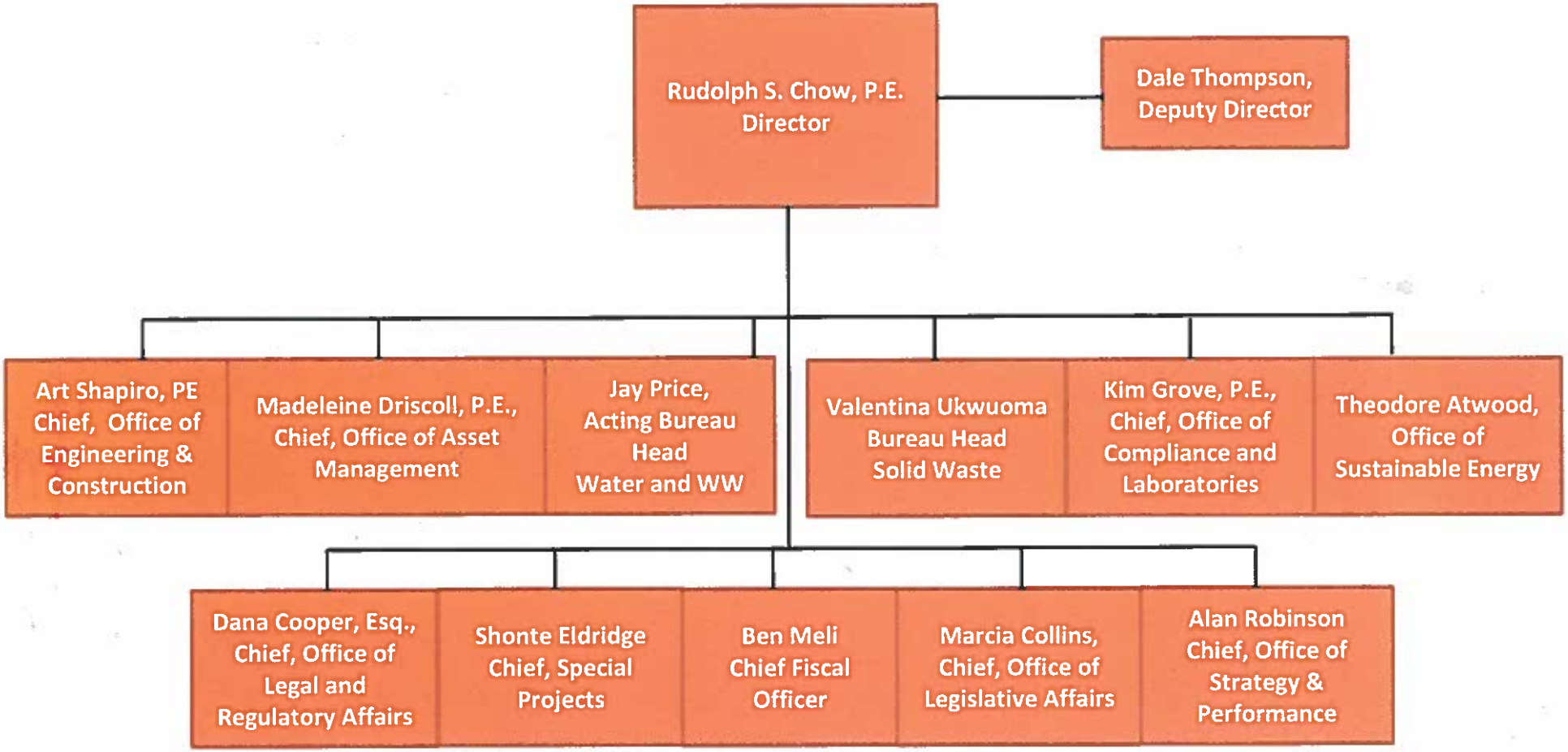
STEPHANIE RAWLINGS-BLAKE
MAYOR

City of Baltimore Organization Chart in Reference to MS4 Permit Conditions as of June 30, 2016

STEPHANIE RAWLINGS-BLAKE
MAYOR

Department of Public Works Organization Chart*

BALTIMORE CITY DPW
DEPARTMENT OF PUBLIC WORKS
RUDOLPH S. CHOW, P. E.
DIRECTOR



*Note: Reflects organization structure as of June 30, 2016.

Appendix B: Summary Table of Null Values in the MS4 Geodatabase

Summary of Null Values Used on MDE Geodatabase

Table	Field	Value	Comments	Schema
Biological Monitoring	EVENT_TIME	12:00	Not recorded in field report.	
	FIBI	-999	FIBI is not done; it is not required for this permit.	X
	EMBEDDEDNESS	-999	Not recorded in field report.	
Chemical Monitoring	WATER_TEMP	-999	Not recorded in field report.	
	pH	-999	Not recorded in field report.	
	BOD_dt	-999	Not recorded in field report.	
	BOD_EMC0	-999	Not recorded in field report.	
	BOD_EMC_dt	-999	Not recorded in field report.	
	TSS_dt	-999	Not recorded in field report.	
	TSS_EMC0	-999	Not recorded in field report.	
	TSS_EMC_dt	-999	Not recorded in field report.	
	TPH_dt	-999	TPH is not done	
	TPH_EMC0	-999	TPH is not done	
	TPH_EMC_dt	-999	TPH is not done	
BMPPOI	IMP_ACRES	-999	Data not shown on as-built plans	
	APPR_DATE	1/1/1900	Data not shown on as-built plans	
	BUILT_DATE	1/1/1900	Data not shown on as-built plans	X
RestBMP	IMP_ACRES	-999	For projects not constructed	
	BUILT_DATE	1/1/1900	For projects not constructed	
	PE_ADR	-999	For projects not constructed	
	PROJECTED_IMPL_YR	9999	For projects not constructed	
	IMPL_COST	-999	Missing data or data was not recorded	
BMP	BMP_DRAIN_AREA	-999	Data not shown on as-built plans	
	BUILT_DATE	1/1/1900	Data not shown on as-built plans	
AltBMPPoly	IMPL_COST	-999	Missing data or data was not recorded	
AltBMPLine	MAX_DUR_CREDIT	-999	Will be provided in FY 2017	
Outfall	DIM_OUTFALL	-999	Missing data	
	HT_OUTFALL	-999	Missing data	
	WT_OUTFALL	-999	Missing data	
BMP_Inspections	REINSP_DATE	1/1/1900	For facilities which have been removed	X
IDDE	LAST_RAIN	1/1/1900	Data was not recorded at sampling time	
	SCREEN_TIME	1200	Data was not recorded at sampling time	
	WATER_TEMP	-999	Data was not recorded at sampling time	
	AIR_TEMP	-999	Data was not recorded at sampling time	
	ALGAEGROW	N	Data was not recorded at sampling time	
	ODOR	SE	Data was not recorded at sampling time	
	DEPOSITS	N	Data was not recorded at sampling time	
	VEG_COND	N	Data was not recorded at sampling time	
	STRUCT_COND	N	Data was not recorded at sampling time	
	EROSION	N	Data was not recorded at sampling time	
NarrativeFile	MDE_STATION_ID	-999	Document is not associated with a monitoring site.	X

Note: Schema indicates MDE plans to change the field to optional in next generation of database.

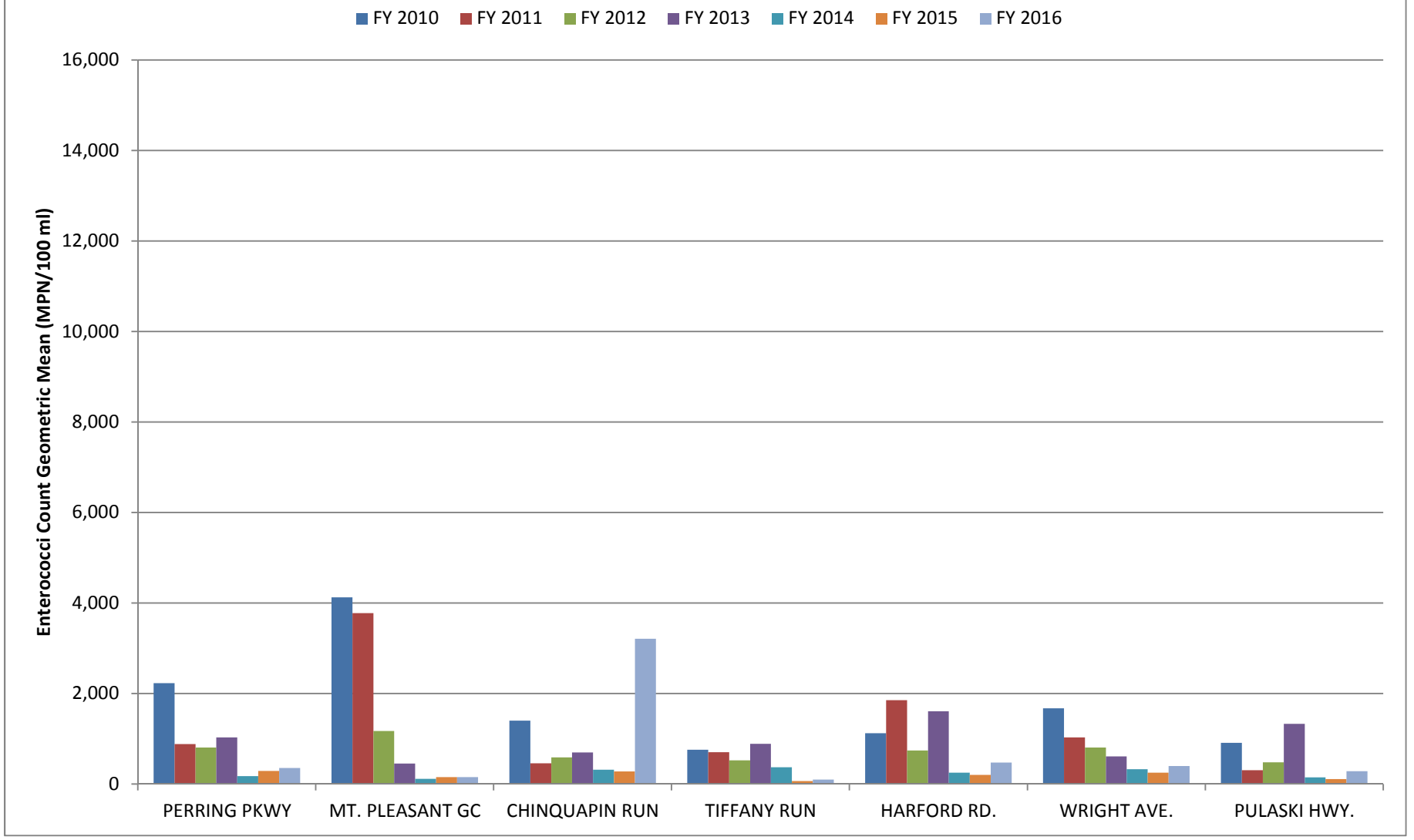
Appendix C: Source Information using MS4 Geodatabase (*electronic files only*)

Appending D: Ammonia Screening and Stream Impact Sampling Results (*electronic files only*)

Appendix E: Bacteria Monitoring Histographs

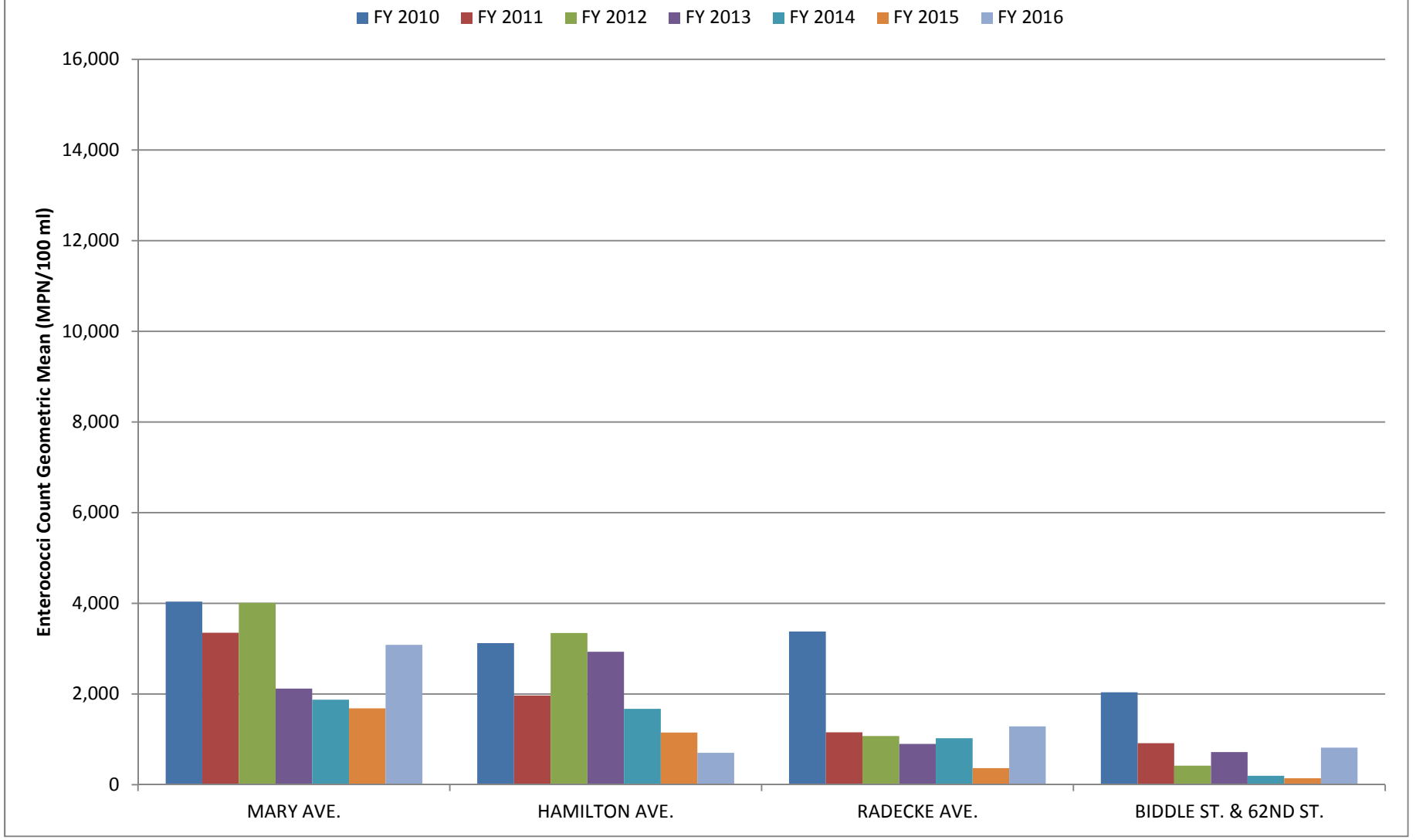
Herring Run SIS Dry Weather E. Coli MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 126 MPN/100 ml for freshwaters.



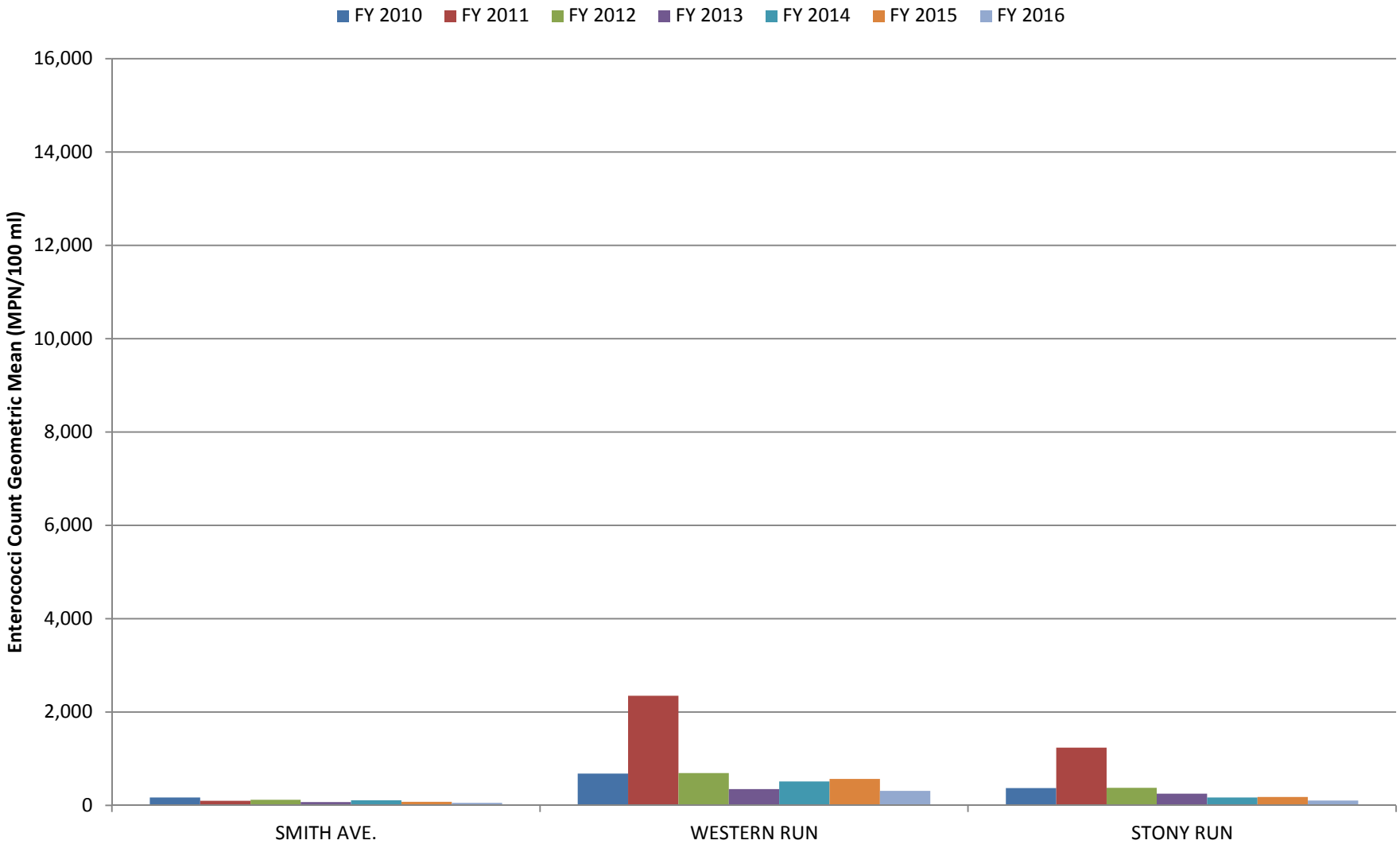
Moores Run SIS Dry Weather E. Coli MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 126 MPN/100 ml for freshwaters.



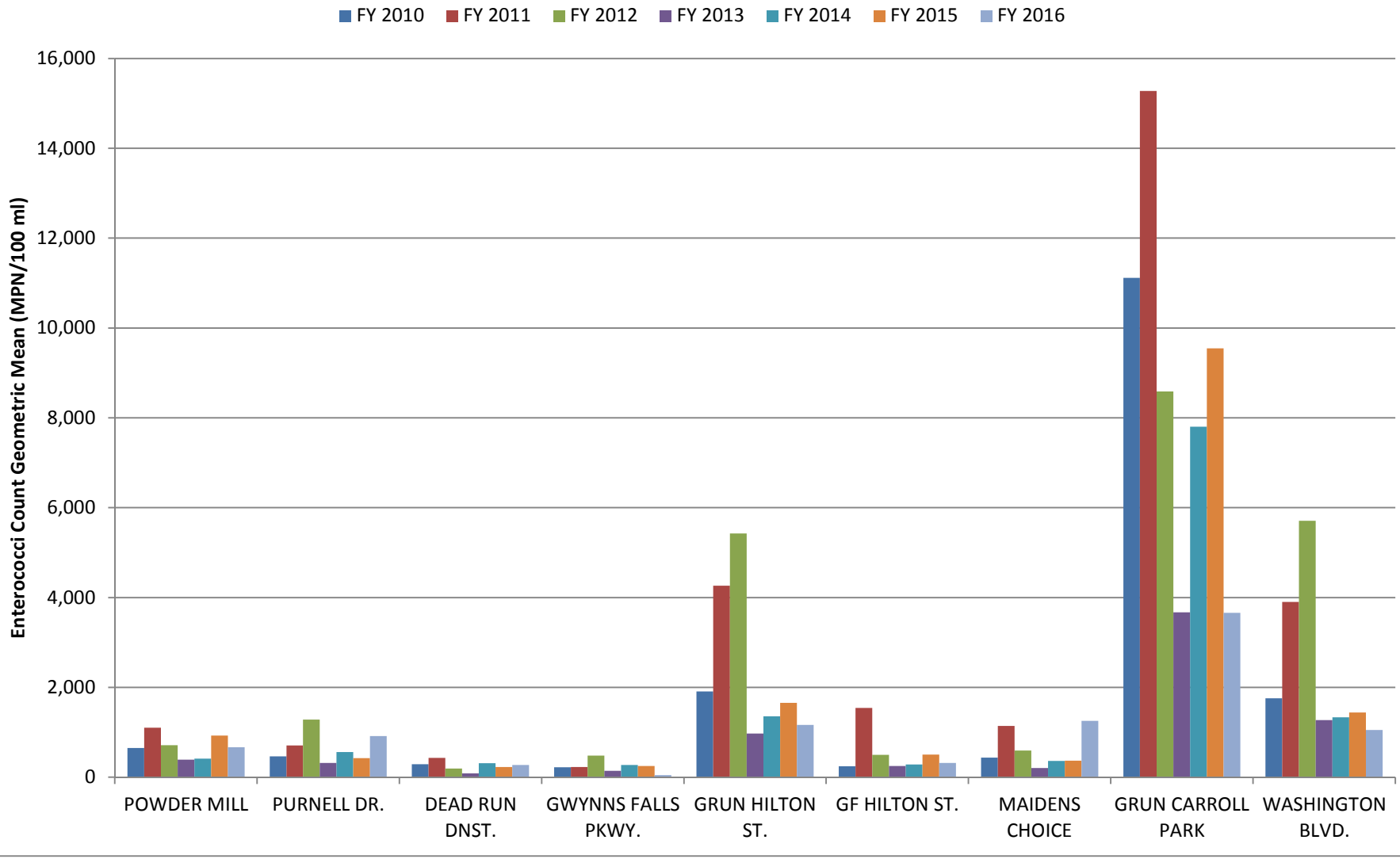
Jones Falls SIS Dry Weather E. Coli MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 126 MPN/100 ml for freshwaters.



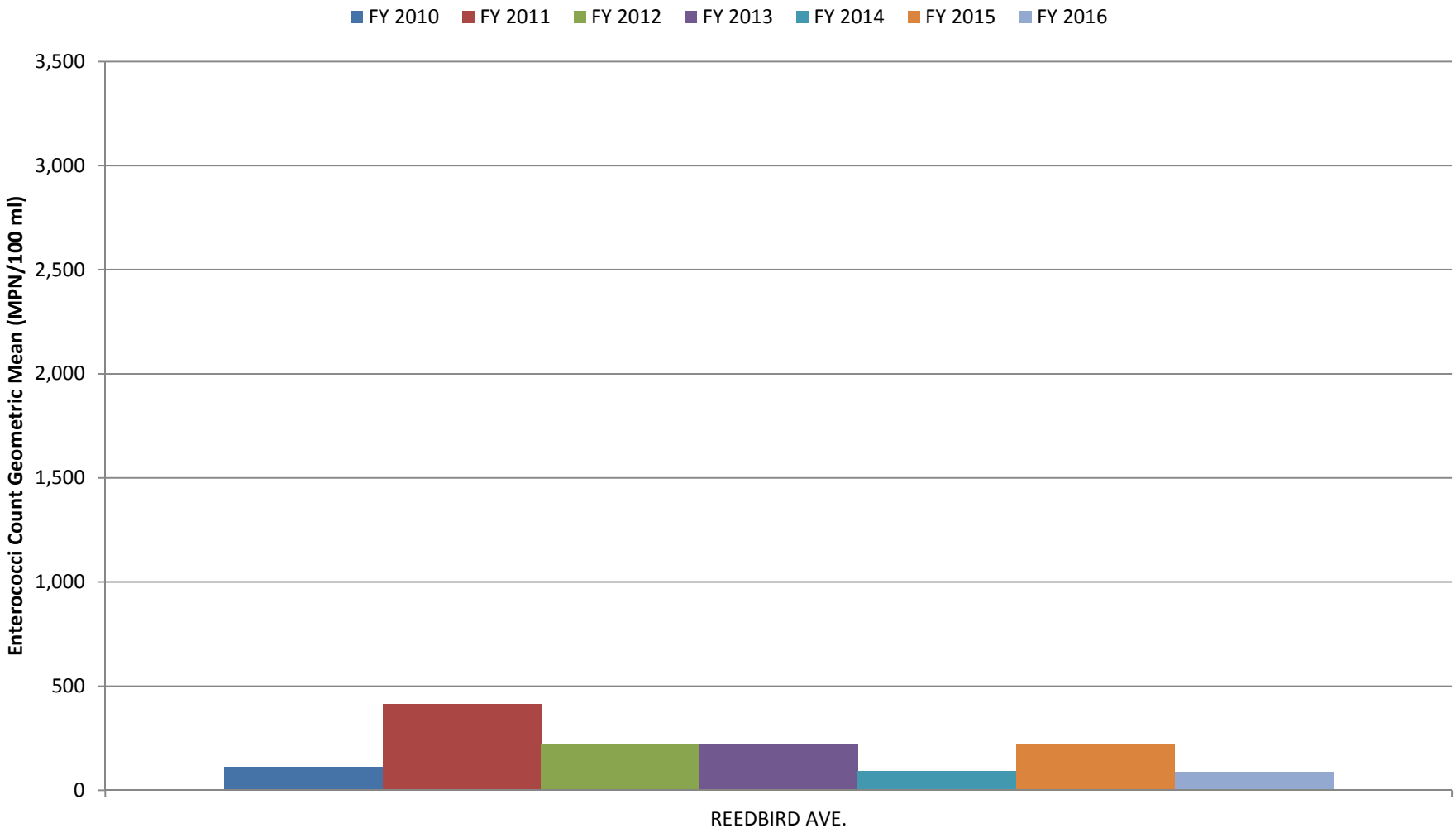
Gwynns Falls SIS Dry Weather E. Coli MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 126 MPN/100 ml for freshwaters.



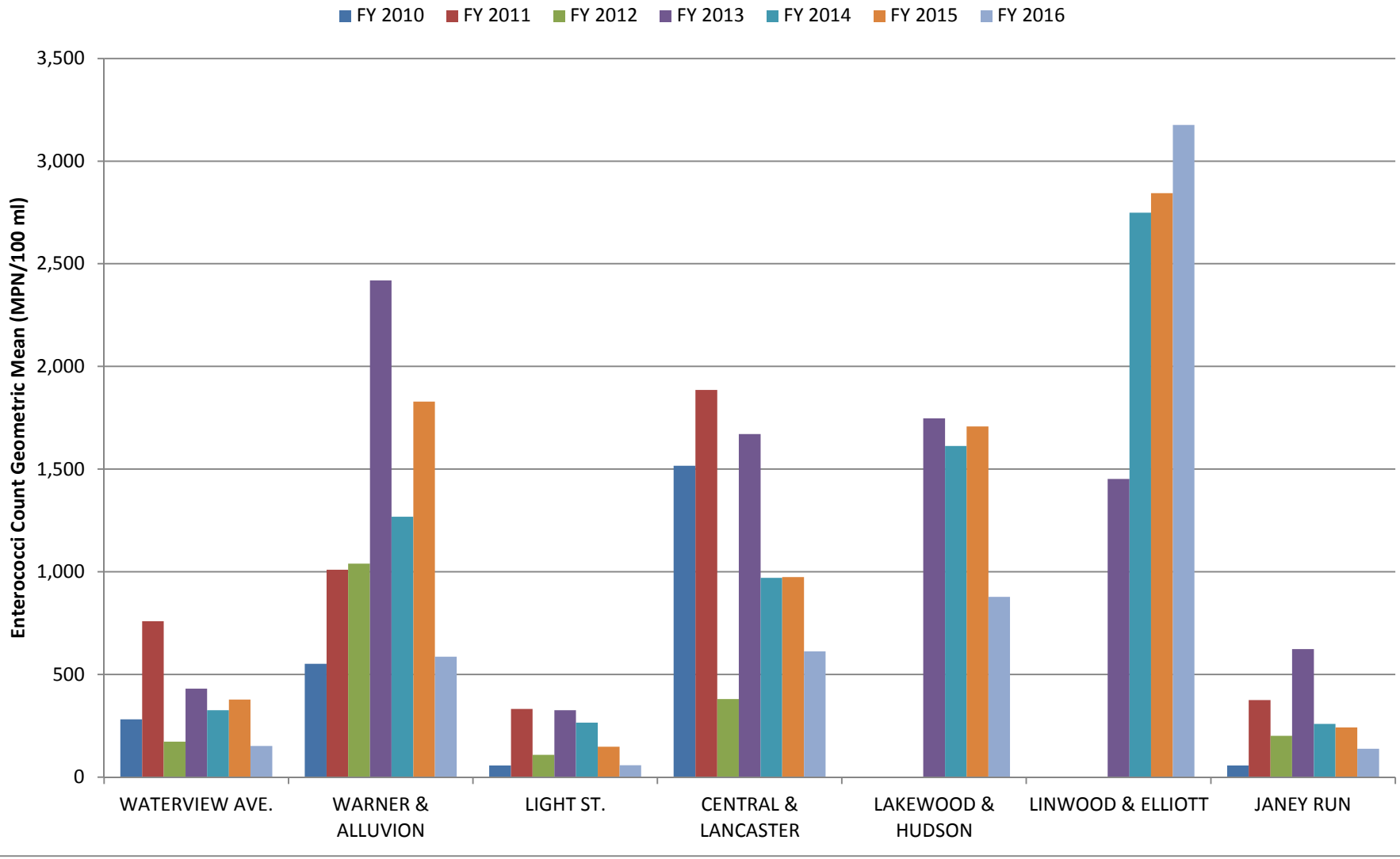
Patapsco River SIS Dry Weather Enterococci MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 35 MPN/100 ml for marine waters.



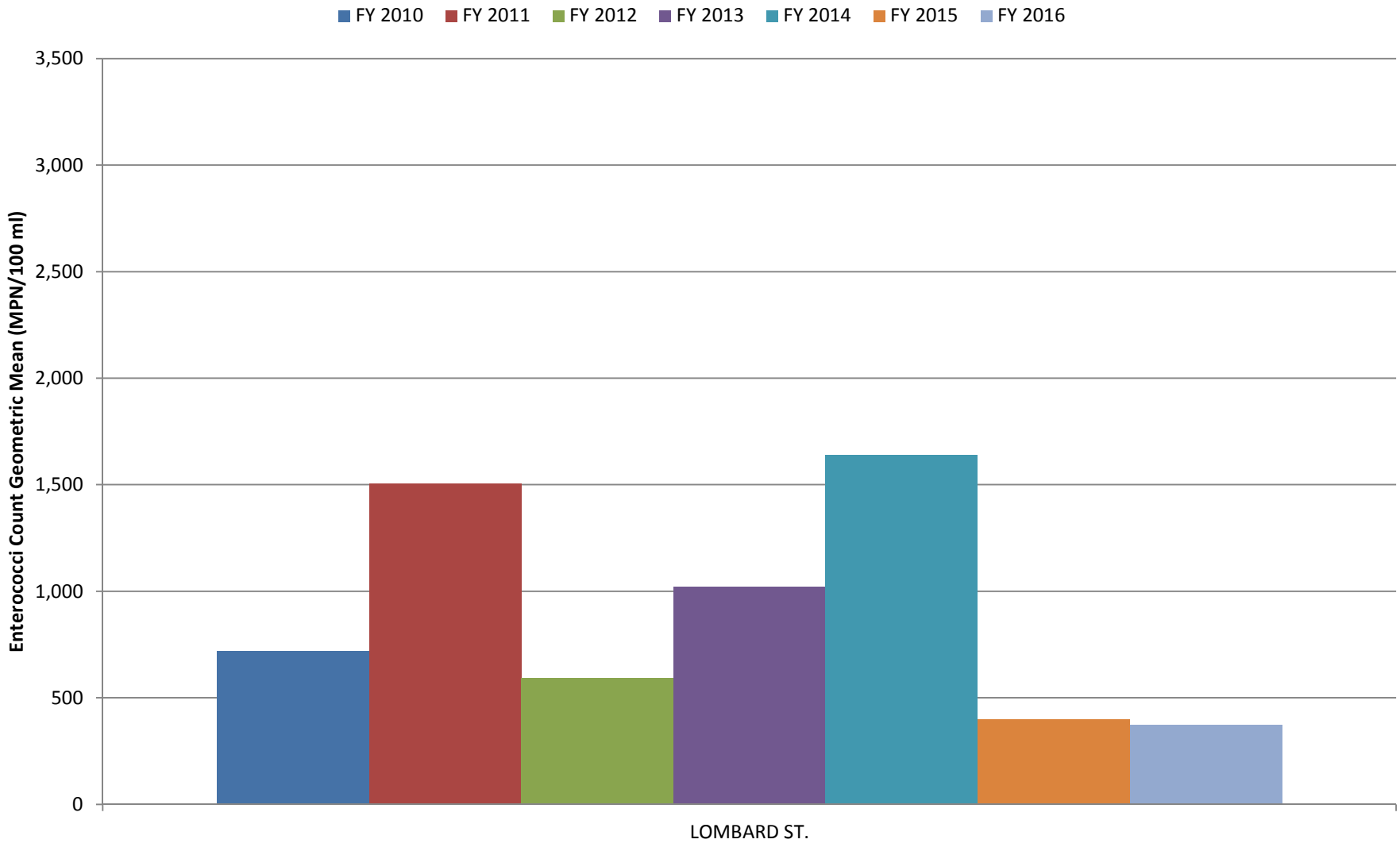
Harbor SIS Dry Weather Enterococci MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 35 MPN/100 ml for marine waters.



Jones Falls SIS Dry Weather Enterococci MPN Count Geometric Means by Fiscal Year

Please note: from COMAR 26.08.02.03-3 the criteria is that the Steady State Geometric Mean Indicator Density be less than or equal to 35 MPN/100 ml for marine waters.



Appendix F: Habitat Monitoring

	Moores Run above Radecke Ave. Segments											
	1	2	3	4	5	6	7	8	9	10	11	Tributary
Parameter												
Instream Habitat												
2005-05-18	16	16	16	4	16	16	16	16	13	16	1	13
2006-05-01	15	16	15	4	15	15	15	14	13	14	1	13
2007-04-02	15	14	16	4	15	11	15	14	13	15	1	15
2008-05-05	15	15	17	4	15	11	11	15	14	14	1	12
2009-04-30	12	14	13	13	13	15	15	15	13	15	3	10
2010-03-24	16	16	18	5	12	17	16	16	13	15	1	15
2011-03-03	17	18	18	6	17	14	14	16	15	15	1	14
2012-06-28	18	16	18	5	15	11	11	10	10	15	2	13
2013-09-03	13	17	16	15	14	14	14	17	14	16	2	12
2014-08-21	15	15	14	12	8	8	15	16	8	13	5	13
2016-06-09	16	17	17	8	17	7	15	16	14	15	1	10
Epifaunal Substrate												
2005-05-18	16	16	16	1	16	16	15	16	13	16	1	14
2006-05-01	14	15	15	4	15	15	14	14	10	14	0	14
2007-04-02	15	14	15	5	15	10	12	10	10	14	0	10
2008-05-05	14	14	17	4	14	10	8	12	11	14	0	12
2009-04-30	10	12	11	11	11	15	13	14	13	15	10	7
2010-03-24	15	14	17	8	11	12	14	11	11	10	7	15
2011-03-03	16	17	17	8	16	14	13	9	12	10	6	13
2012-06-28	12	15	15	8	14	10	14	9	9	10	6	13
2013-09-03	13	16	16	6	10	11	14	15	9	10	8	11
2014-08-21	14	16	13	13	8	8	16	14	8	15	6	13
2016-06-09	15	15	17	10	15	6	8	10	11	10	8	11
Velocity/Depth Diversity												
2005-05-18	8	10	14	6	8	8	8	10	8	9	11	8
2006-05-01	8	10	10	6	11	8	8	11	10	10	6	8
2007-04-02	10	13	12	6	6	8	8	10	9	10	6	10
2008-05-05	8	12	15	6	11	9	9	12	8	9	6	8
2009-04-30	11	11	13	8	10	15	14	15	13	15	2	10
2010-03-24	10	15	14	8	10	11	13	8	12	10	11	15
2011-03-03	10	10	10	11	10	10	14	15	15	10	12	10
2012-06-28	7	14	10	6	10	8	8	13	9	10	1	11
2013-09-03	7	14	10	6	12	8	11	14	7	10	12	10
2014-08-21	8	12	9	12	8	10	10	9	7	10	11	12
2016-06-09	8	14	14	9	16	10	10	15	12	13	11	9
Pool/Glide/Eddy Quality												
2005-05-18	5	7	12	13	10	8	10	15	12	3	13	1
2006-05-01	5	7	10	16	10	8	10	11	12	3	8	1
2007-04-02	5	7	11	16	11	10	9	10	11	4	10	1
2008-05-05	8	14	12	17	12	12	10	14	13	3	8	1
2009-04-30	9	10	13	12	7	9	13	12	11	11	13	5
2010-03-24	8	12	12	13	11	8	13	10	11	9	13	3
2011-03-03	14	14	13	17	14	13	14	15	15	13	15	3
2012-06-28	8	16	6	15	8	7	8	13	10	11	8	11
2013-09-03	8	10	8	14	11	9	14	13	9	9	14	4
2014-08-21	8	13	7	14	7	8	10	9	8	9	13	11
2016-06-09	8	14	16	13	12	8	8	11	12	12	11	7
Riffle/Run Quality												
2005-05-18	11	13	11	3	12	12	13	14	10	14	2	7
2006-05-01	11	13	11	2	11	13	13	14	12	14	2	7
2007-04-02	13	15	13	2	13	13	12	14	13	15	0	8
2008-05-05	13	13	13	1	15	15	14	14	13	13	1	6
2009-04-30	18	12	15	1	6	13	16	15	8	11	1	8

Parameter	Moores Run above Radecke Ave. Segments											
	1	2	3	4	5	6	7	8	9	10	11	Tributary
2010-03-24	12	12	13	1	13	13	13	13	11	10	2	9
2011-03-03	15	17	18	14	17	13	15	15	15	15	1	11
2012-06-28	10	14	15	0	15	10	11	12	10	12	0	7
2013-09-03	6	9	10	0	6	8	10	13	6	12	1	6
2014-08-21	6	14	10	8	8	11	12	9	9	12	0	7
2016-06-09	11	14	14	2	13	8	10	11	8	12	1	6
Embeddedness (%)												
2005-05-18	50	50	50	0	60	70	50	50	70	50	0	50
2006-05-01	50	50	50	0	60	60	60	60	60	50	0	50
2007-04-02	60	60	50	75	60	60	60	50	60	50	0	50
2008-05-05	40	50	50	0	50	60	50	50	50	50	0	50
2009-04-30	10	50	50	70	50	30	20	20	30	20	0	70
2010-03-24	40	40	40	0	40	30	30	30	40	40	0	40
2011-03-03	50	50	50	50	50	60	50	50	50	50	0	50
2012-06-28	30	30	30	0	50	50	30	50	50	20	0	30
2013-09-03	50	50	50	40	50	60	50	50	50	50	0	60
2014-08-21	50	40	50	50	60	50	40	50	50	50	50	50
2016-06-09	50	50	50	50	30	75	50	50	50	50	0	50
Embeddedness												
2005-05-18	11	11	11	0	9	7	11	11	7	11	0	11
2006-05-01	12	11	11	0	9	9	10	10	10	11	0	11
2007-04-02	10	10	11	3	10	9	10	11	10	11	0	13
2008-05-05	13	13	13	0	13	8	13	13	13	13	0	12
2009-04-30	19	11	12	7	11	14	16	16	14	17	0	7
2010-03-24	14	14	14	0	14	14	13	14	13	13	0	14
2011-03-03	14	14	14	14	14	9	14	14	14	14	0	14
2012-06-28	14	14	14	0	11	10	14	10	10	17	0	14
2013-09-03	11	11	11	13	11	9	11	11	11	11	0	13
2014-08-21	11	12	11	11	8	11	12	11	11	11	11	11
2016-06-09	11	11	11	11	13	6	11	11	11	11	0	11
Trash Rating												
2005-05-18	11	8	4	8	9	8	11	7	5	7	9	11
2006-05-01	8	11	11	10	10	11	8	12	3	9	18	11
2007-04-02	8	8	7	12	11	10	9	10	5	10	18	15
2008-05-05	8	8	3	8	6	6	5	5	3	8	18	13
2009-04-30	8	8	3	9	9	8	9	8	8	10	13	6
2010-03-24	8	8	3	8	13	8	8	10	7	11	12	13
2011-03-03	6	6	8	6	13	9	10	6	7	12	18	8
2012-06-28	8	6	7	3	13	13	10	13	12	11	16	14
2013-09-03	6	7	10	13	13	14	10	7	6	12	18	7
2014-08-21	10	6	10	15	13	8	10	10	10	12	18	6
2016-06-09	14	8	3	16	11	10	8	8	6	9	15	7
Channel Alteration												
2005-05-18	16	16	16	16	16	16	16	16	17	17	1	13
2006-05-01	16	16	16	16	16	16	16	16	17	14	1	13
2007-04-02	16	16	16	16	16	16	16	16	16	15	1	15
2008-05-05	17	17	17	17	16	17	17	17	17	15	1	13
2009-04-30	15	16	16	17	16	16	16	16	16	17	1	12
2010-03-24	18	18	18	18	16	17	18	17	18	15	2	15
2011-03-03	17	17	17	17	16	17	17	17	17	15	1	15
2012-06-28	18	18	18	15	15	16	17	18	18	18	1	14
2013-09-03	18	18	18	16	17	18	18	18	18	18	1	14
2014-08-21	18	18	17	17	16	18	18	17	18	18	1	18
2016-06-09	17	17	17	16	17	17	17	16	16	16	2	15

	Moores Run above Radecke Ave. Segments											
	1	2	3	4	5	6	7	8	9	10	11	Tributary
Parameter												
Bank Vegetative Protection												
2005-05-18	11	12	15	15	15	15	18	16	17	11	2	8
2006-05-01	11	13	16	16	14	16	16	16	17	10	2	8
2007-04-02	12	12	16	16	14	14	16	14	16	10	2	10
2008-05-05	14	14	17	15	15	16	13	12	17	10	2	8
2009-04-30	20	18	18	20	16	13	19	15	14	13	1	20
2010-03-24	18	18	17	17	14	18	16	16	18	14	2	15
2011-03-03	17	16	15	17	14	13	15	16	16	13	2	16
2012-06-28	17	16	14	14	17	17	16	16	17	13	2	17
2013-09-03	15	17	17	10	15	18	14	15	16	12	2	16
2014-08-21	18	17	12	13	15	15	12	10	10	11	2	6
2016-06-09	18	17	13	16	16	17	14	12	16	10	2	18
Condition Of Banks												
2005-05-18	18	18	14	18	18	14	16	17	16	8	20	18
2006-05-01	18	13	14	18	18	14	16	17	15	16	20	18
2007-04-02	18	14	15	18	13	14	15	16	14	15	20	16
2008-05-05	18	17	16	16	18	14	15	16	18	16	20	18
2009-04-30	17	12	13	11	17	10	10	18	15	11	20	5
2010-03-24	18	17	16	16	15	17	14	17	18	15	20	18
2011-03-03	18	16	15	16	16	14	15	16	16	16	20	14
2012-06-28	16	17	15	17	18	15	14	16	16	18	20	18
2013-09-03	18	18	17	14	16	14	14	17	16	18	20	16
2014-08-21	14	8	10	9	10	8	10	9	9	12	20	15
2016-06-09	18	16	13	14	17	15	13	15	15	17	18	16
Riparian Vegetative Zone												
2005-05-18	7	7	9	12	6	6	9	11	10	9	2	2
2006-05-01	7	7	10	14	6	6	8	11	10	6	2	2
2007-04-02	7	4	8	15	6	6	11	11	10	6	2	2
2008-05-05	8	9	12	15	6	6	7	15	12	7	2	2
2009-04-30	2	4	8	13	5	4	7	10	16	16	5	4
2010-03-24	10	7	10	15	10	6	8	15	16	3	2	6
2011-03-03	4	8	8	12	8	4	9	10	7	4	2	7
2012-06-28	14	14	8	17	10	12	14	18	19	11	2	4
2013-09-03	6	6	11	14	10	5	6	10	16	9	4	3
2014-08-21	4	6	14	9	14	7	9	18	16	11	1	5
2016-06-09	10	11	16	18	14	18	15	18	18	17	4	6

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

Appendix G: Moores Run, 2016 Abbreviated Geomorphic Condition and Channel Stability Resurvey by USFW

- *Main Report*
- *Appendices A to E (electronic files only)*

Draft-MOORES RUN, BALTIMORE CITY, MARYLAND 2015 ABBREVIATED GEOMORPHIC CONDITION AND CHANNEL STABILITY RESURVEY

By: Sandra L. Davis and Mark A. Secrist

Habitat Restoration Division
Stream Habitat Assessment and Restoration
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office

CBFO-S16-04

Prepared in cooperation with:

City of Baltimore, Department of Public Works, Bureau of Water and Wastewater

Annapolis, MD
December 2016

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

The City of Baltimore (City) and the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office (Service) entered into a cooperative agreement (Agreement 51410-1902-5119) to facilitate stream and riparian habitat assessment and restoration projects within the City. The survey of Moores Run, which is part of a stream monitoring network under the City's National Pollutant Discharge Elimination System (NPDES) permit, is included under this agreement.

The Service conducted an initial geomorphic condition and channel stability field survey for Moores Run in October 2003. Under that project scope of work, the Service conducted a limited data analysis, including a comparison of existing City data sets with the data gathered by the Service, a bank erosion prediction, and Rosgen Level III stream stability and sediment supply analysis. In 2005, 2007, 2008, 2009, 2010, 2012, 2013 and 2015 the Service completed abbreviated geomorphic surveys to assess stream stability conditions and evaluate changes in stream stability (Eng *et al*, 2006; Davis and Starr, 2008; Eng *et al*, 2009; Davis and Starr, 2010; Davis and Starr, 2012; Davis and Starr, 2013).

In 2015, the Service completed another abbreviated geomorphic survey to assess the current stream stability conditions, as well as to validate stability predictions made in the 2013 resurvey. The stream stability analysis for previous surveys followed the methodology provided in the Rosgen (2001b) *A Stream Channel Stability Assessment Methodology*. However, in 2008, Wildland Hydrology, Inc. revised the stability analysis methodology (Rosgen 2008). The Service analyzed the 2008 through 2015 stream data using the revised stability analysis. The Service did not reanalyze the stream data from the previous surveys. In certain situations, the Service was not able to compare the analysis results because of the change in the stability analysis method. However, when possible the Service compared current analysis results with results from previous surveys.

This report contains a summary of the field data collected by the Service, the comparison between 2003, 2005, 2007, 2008, 2009, 2010, 2012, 2013 and 2015 data, as well as an interpretation of the 2015 data and revised Rosgen Level III stream stability and sediment supply analysis.

II. MOORES RUN EXISTING CONDITIONS

The Moores Run assessment area starts at the quadruple-cell box culvert located near the intersection of Hamilton Avenue and Evanshire Avenue, and ends approximately 520 feet downstream of the Radecke Road crossing in Baltimore City, Maryland (Figure 1).

A. Moores Run 2015 Reach Delineation

In 2003, the Service divided Moores Run into nine stream reaches based on geomorphic characteristics and stability conditions. Since the stream type and stability conditions of the reaches have not significantly changed, the Service used the same nine originally identified reaches from the previous surveys (Table 1).

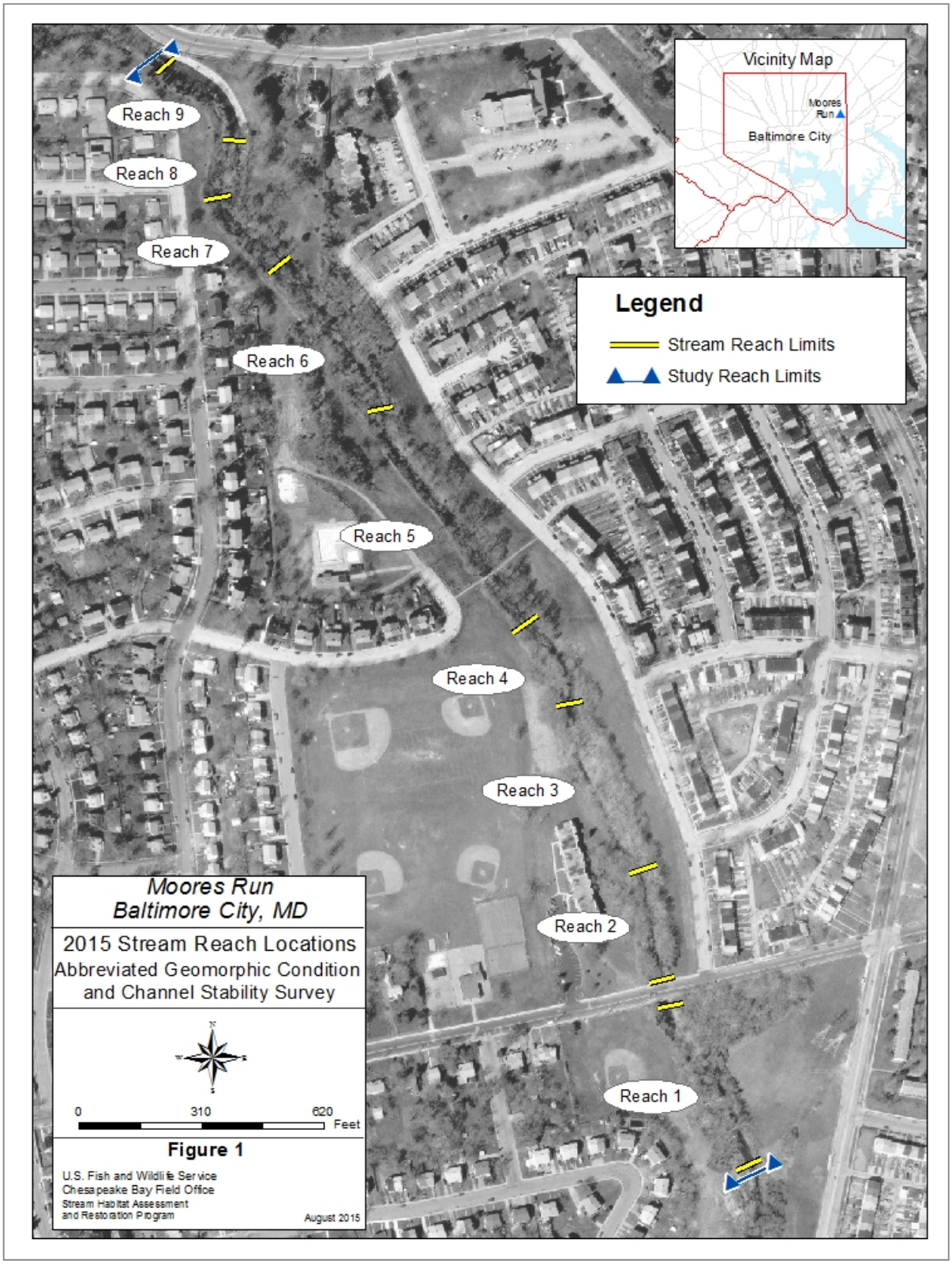

Vicinity Map
Moores Run
Baltimore City
Legend
Stream Reach Limits
Study Reach Limits
Reach 9
Reach 8
Reach 7
Reach 6
Reach 5
Reach 4
Reach 3
Reach 2
Reach 1
Moores Run
Baltimore City, MD
2015 Stream Reach Locations
Abbreviated Geomorphic Condition
and Channel Stability Survey
0
310
620
Feet
Figure 1
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
Stream Habitat Assessment
and Restoration Program
August 2015

Table 1. Reach Number and Length			
Reach Number	**Reach Length (ft)**	**Reach Number**	**Reach Length (ft)**
01	520	06	489
02	255	07	134
03	448	08	169
04	317	09	354
05	672	**Total**	**3,358**

B. Rosgen Stream Types

Similar to previous surveys, in 2015 the Service was able to classify 80 percent of Moores Run. There were no stream type changes from 2013 to 2015. In 2015, there were five Rosgen Level I stream types in Moores Run (*i.e., B, Bc, C, D and F).* The F stream type represents 44 percent, the C stream type represents 19 percent, the D stream type represents 23 percent, the B stream type represents 5 percent and the B_c stream type represents 9 percent of the classified stream reaches (Table 2). Reach 04 and 09 are transitional reaches, consisting predominately of pools, which the Service did not classify. Because Moores Run was straightened, only one value for sinuosity was calculated for the entire assessment area.

Table 2. Rosgen Stream Type Classification

Reach	Classification Cross Section	Stream Type	Entrenchment Ratio	Width/ Depth Ratio	Sinuosity	Reach Slope (ft/ft)	Substrate
01	Service XS G	C	2.96	19.32	1.07	0.0051	Gravel with Bedrock
02	Baltimore XS 32	Bc	3.07	18.20		0.0097	Cobble with Boulder
03	Service XS A	D	4.87	19.33		0.014	Cobble
04	N/A	Transitional Reach – Not Classified				0.0010	Gravel/Cobble with Bedrock
05	Service XS C	F	Not Resurveyed in 2015			0.013	Cobble with Boulder
06	N/A	F	Not Resurveyed in 2015			0.013	Cobble with Bedrock
07	N/A	B	Not Resurveyed in 2015			0.043	Cobble with Boulder
08	N/A	D	Not Resurveyed in 2015 Similar to Reach 03			0.025	Cobble with Boulders & Bedrock
09	N/A	Transitional Reach – Not Classified				0.0071	Gravel/Sand

Reach 01, the farthest downstream reach, is a Rosgen C stream type that is slightly entrenched with a moderate width/depth ratio, shallow slope, and a gravel substrate with bedrock grade control. Reach 02 is a Rosgen Bc stream type with a moderately steep slope and a cobble/boulder substrate.

Reach 03 and 08 are Rosgen D (i.e., braided) stream types, which are slightly entrenched with moderate width/depth ratios. Reach 03 has a moderately steep slope and cobble substrate and reach 08 has a highly steep slope and a cobble substrate with bedrock control.
Reaches 04 and 09 are transitional reaches consisting predominately of pools. Reach 04 has a gravel/cobble substrate with bedrock. Reach 09 has a predominately sand and gravel substrate. The classification cross section for reach 03 is now a pool. To continue to classify that section in the future the Service recommends installing a new cross section in a riffle for that reach.

Reaches 05 and 06 are Rosgen F stream types, which are highly entrenched with moderate width/depth ratios, moderately steep slopes, and a cobble/boulder substrate. Reach 06 has bedrock control. Reach 07 is a Rosgen B stream type that is moderately entrenched with a moderate width/depth ratio, highly steep slope, and a cobble/boulder substrate.

III. SERVICE FIELD DATA COMPARISON SUMMARY

In 2015, the Service collected the following geomorphic and channel stability field data to assess the current stream stability, sediment supply, bank stability, and to estimate erosion quantities for Moores Run:

- Cross Section Survey
- Longitudinal Profile Survey
- Reach Average - Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBS) Assessment
- Bank Profiles
- Cross Section – BEHI and NBS Assessment
- Pfankuch Channel Stability Assessment

The Moores Run field protocol document provides descriptions of survey tasks (Eng *et al,* 2004*).* The Service used the revised stability analysis methodology for the 2015 stream data (Rosgen 2008). When appropriate, the Service compared current analysis results with results from previous surveys. The 2015 field data and comparison plots are located in the appendices.

A. Stream Stability and Sediment Supply Assessment

The Service conducted a Rosgen Level III stream stability and sediment supply assessment (Rosgen 2008). This assessment provides predictions of lateral stability, vertical (aggradation) stability, vertical (degradation) stability, channel enlargement potential, Pfankuch channel stability, and sediment supply for Moores Run.

The Service was unable to conduct all of the Level III assessment procedures. The Service did not collect bar samples because of the large substrate (*i.e*., boulder and large cobble substrate) and sand substrate and consequently, did not assess critical dimensionless shear stress and critical shear stress. Lastly, due to the lack of sediment yield curves, the Service did not model sediment capacity. Additionally, the Service did not conduct a Rosgen Level III assessment for Reach 04 and 09 because they are both transitional reaches.

Despite the absence of these criteria, the Service had sufficient data to support the overall predicted stability ratings. In cases where individual stability criteria values were not available and their absence affected the overall stability rating, the Service reviewed the collective individual criteria ratings and selected an overall predicted lateral and vertical stability rating and enlargement potential rating for the existing conditions. A summary of the 2015 Rosgen Level III assessment data is in Appendix E.

The Service further documented stream stability in Moores Run by conducting monumented cross section and longitudinal profile resurveys. The overlays associated with the resurveys allow the Service to observe trends in the Moores Run vertical and lateral stability over time, as well as to validate predictions made in previous years. Lateral stability potentials were validated using cross section and bank profile overlays; vertical stability potentials were validated using both longitudinal profile overlay and cross section overlays.

1. Lateral Stability

Lateral stability of Moores Run was determined by conducting the Rosgen Level III lateral stability potential assessment. The criteria for the revised lateral stability analysis did not change from the previous method, so the Service can continue to make comparisons with the previous results. The assessment predicts lateral stability potentials by evaluating width/depth state (study/reference) ratios, depositional patterns, meander patterns, dominant BEHI and NBS, and confinement. The Service used the cross section and bank profile resurveys to validate the lateral stability potential.

a. Lateral Stability Potential Results

In 2015, the lateral stability assessment ratings resulted in three ratings: stable, moderately unstable, and unstable (Table 3). The stable rating represents 52 percent, the moderately unstable rating represents 20 percent, and the unstable rating represents 28 percent of the assessment area. There were no changes in the lateral stability ratings between 2013 and 2015.

Table 3. Lateral Stability Potential Comparison

Study Reach	Survey Year								
	2003	2005	2007	2008*	2009*	2010*	2012*	2013*	2015*
01	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable
02	Stable	Stable	Moderately Unstable	Stable	Stable	Stable	Stable	Stable	Stable
03 (Left Channel)	Stable	Stable	Stable	Stable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable
03 (Right Channel)	Unstable	Unstable	Unstable	Unstable	Stable	Stable	Stable	Unstable	Unstable
04	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
05	Stable	Stable	Moderately Unstable	Moderately Unstable	Unstable	Unstable	Moderately Unstable	Stable	Stable
06	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable
07	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
08 (Left Channel)	Stable	Stable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable
08 (Right Channel)	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable
09	Highly Unstable	On-going bank stabilization project	On-going bank stabilization project	Stable	Stable	Stable	Stable	Stable	Stable

(*) Used the revised Wildland Hydrology, Inc. (Rosgen 2008) river stability assessment procedures

b. Cross Section Comparison

In order to reassess channel stability conditions and to validate erosion rates the Service resurveyed seven out of the eight cross sections selected in 2005 (Figure 2). Due to a large fallen tree and debris jam, the Service was unable to collect the riffle cross section data for reach 05 cross section C. The cross section monuments were damaged; therefore, removal of the fallen tree still would have rendered the cross section unsuitable for stability condition validation and comparison with previous years. In addition, there were no other suitable classification riffles present in reach 5. Despite the absence of riffle cross section criteria for reach 5, the Service had sufficient data to support the overall predicted stability ratings. In cases where the absence of riffle cross section information affected the stability ratings, the Service reviewed the collective individual criteria ratings and selected an overall predicted lateral and vertical stability rating and enlargement potential rating for the existing conditions. In addition, a run cross section (cross section 18) was surveyed in reach 05. Where appropriate, the Service was able to use information from that overlay to validate stability predictions.


Legend
Moores Run Resurveyed Cross Sections
Study Reach Limits
Baltimore XS 14
Baltimore XS 18
USFWS XS C
USFWS XS B
USFWS XS A
Baltimore XS 28
Baltimore XS 32
USFWS XS G
Moores Run
Baltimore City, MD
2015 Cross Section Locations
Abbreviated Geomorphic Condition
and Channel Stability Survey
0
350
700
Feet
Figure 2
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
Stream Habitat Assessment
and Restoration Program
July 2015

The cross sections selected represent the range of stability conditions present in Moores Run (Eng *et al*. 2007). The Service did not survey the remaining cross sections established in 2003 by the City of Baltimore and the Service because they represent duplicate bank erosion conditions, less dominant bank erosion conditions, or low erosion potentials. All cross section and bank profile plots, field data, and photographs are in Appendix A.

To document lateral channel adjustments the Service overlaid 2003, 2005, 2007, 2008, 2009, 2010, 2012, 2013 and 2015 cross section and bank profile plots. The changes in channel characteristics for the resurveyed cross sections are summarized in Table 4. The channel characteristics for 2015 were compared with 2013 to determine the degree of change. A summary table with changes in channel characteristics for all years is located in Appendix A.

A comparison of the 2013 and 2015 cross-section data showed changes in bankfull width ranged from a decrease of 2.91 feet to an increase of 1.10 feet. The bankfull area changes ranged from a decrease of 8.42 square feet to an increase of 23.16 square feet. The comparison found width/depth ratios ranged from a decrease of 4.31 to an increase of 2.05.

A comparison of the 2015 and 2003 cross-section data showed only slight changes in the cross-section parameters, with the exception of bankfull area and width/depth ratios (Table 5). Significant changes in bankfull area ranged from an increase of 55.85 to 8.94 square feet. The width/depth ratio changes ranged from a decrease of 1.04 to 12.08.

c. Data Analysis

There were no changes in the lateral stability predictions for Moores Run between 2013 and 2015. For the most part the cross section overlay data for Reaches 01 through 06 further validated the lateral stability predictions. Both cross section data and lateral stability assessments show that the majority of Moores Run is laterally stable. The reaches predicted to be laterally unstable are reaches 01 and 03. The prediction for reach 01 is validated by changes shown in the 2013 and 2015 cross section overlay comparison (Table 4). Reach 01 is trending towards an increased width/depth ratio. As the width/depth ratio in a stream increases, the sediment capacity and competency decreases, causing excess deposition. The additional deposition then redirects stream flow towards the banks, causing increased bank erosion, scour, and subsequently increased lateral instability.

The Service found one potential discrepancy in the lateral stability predictions from 2013. Reach 03, due to a very high bank erosion index, is predicted to be laterally unstable. However, trends in the cross section overlays do not show the stream widening in that reach. Instead, Reach 03 is currently downcutting. It is likely that Reach 03 is in an early successional stage. It is common for stream types to first downcut, and then widen in stream succession scenarios (Rosgen, 2008). It is possible Reach 03 is in the beginning stages of a trend toward instability. Therefore, although validation is currently showing little lateral change, the current BEHI/NBS indexes and stream successional state indicate that the reach is likely trending towards instability in the future. More discussion regarding reach 03 can be found in the vertical stability sections of this report.

Table 4. Monumented Cross Section Data Comparison

Cross Section			Year		
			2013	2015	
Reach	Name	Parameter	Data	Data	Change
01	Service XS G	Width (ft)	45.63	47.13	1.50
		Mean Depth (ft)	2.51	2.33	-0.18
		Area (ft^2)	114.38	110.04	-4.34
		Maximum Depth (ft)	3.88	4.10	0.22
		Wetted Perimeter (ft)	47.63	51.20	3.57
		Hydraulic Radius (ft)	2.40	2.15	-0.25
		Width/Depth Ratio	18.18	20.23	2.05
02	Baltimore XS 32	Width (ft)	45.53	45.90	0.37
		Mean Depth (ft)	2.56	2.46	-0.10
		Area (ft^2)	116.61	112.84	-3.77
		Maximum Depth (ft)	4.24	4.19	-0.05
		Wetted Perimeter (ft)	47.64	47.59	-0.05
		Hydraulic Radius (ft)	2.45	2.37	-0.08
		Width/Depth Ratio	17.79	18.66	0.87
03	Baltimore XS 28	Width (ft)	56.20	56.50	0.30
		Mean Depth (ft)	2.06	2.46	0.40
		Area (ft^2)	115.82	138.98	23.16
		Maximum Depth (ft)	4.60	5.04	0.44
		Wetted Perimeter (ft)	64.25	72.18	7.93
		Hydraulic Radius (ft)	1.80	1.93	0.13
		Width/Depth Ratio	27.28	22.97	-4.31
	Service XS A	Width (ft)	45.00	42.09	-2.91
		Mean Depth (ft)	4.19	4.65	0.46
		Area (ft^2)	146.03	160.10	14.07
		Maximum Depth (ft)	5.93	6.90	0.97
		Wetted Perimeter (ft)	50.47	48.46	-2.01
		Hydraulic Radius (ft)	4.18	3.30	-0.88
		Width/Depth Ratio	10.74	9.05	-1.69
04	Service XS B	Width (ft)	60.91	60.68	-0.23
		Mean Depth (ft)	4.00	3.88	-0.12
		Area (ft^2)	243.80	235.38	-8.42
		Maximum Depth (ft)	6.71	6.70	-0.01
		Wetted Perimeter (ft)	67.29	67.99	0.70
		Hydraulic Radius (ft)	3.62	3.46	-0.16
		Width/Depth Ratio	15.23	15.64	0.41
05	Baltimore XS 18	Width (ft)	41.57	41.64	0.07
		Mean Depth (ft)	3.05	3.04	-0.01
		Area (ft^2)	126.96	126.54	-0.42
		Maximum Depth (ft)	4.09	3.93	-0.16
		Wetted Perimeter (ft)	45.62	45.19	-0.43
		Hydraulic Radius (ft)	2.78	2.8	0.02
		Width/Depth Ratio	13.63	13.70	0.07
	Service XS C	Width (ft)	49.89	Not surveyed in 2015	
		Mean Depth (ft)	2.12		
		Area (ft^2)	105.92		
		Maximum Depth (ft)	3.05		
		Wetted Perimeter (ft)	51.22		
		Hydraulic Radius (ft)	2.07		
		Width/Depth Ratio	23.53		
06	Baltimore XS 14	Width (ft)	46.09	45.93	-0.16
		Mean Depth (ft)	3.08	3.18	0.10
		Area (ft^2)	141.92	146.25	4.33
		Maximum Depth (ft)	5.20	5.68	0.48
		Wetted Perimeter (ft)	52.83	51.94	-0.89
		Hydraulic Radius (ft)	2.68	2.82	0.14
		Width/Depth Ratio	14.96	14.44	-0.52

Table 5. Monumented Cross Section 2003 and 2015 Data Comparison

Cross Section			Survey Year		
			2003	2015	
Reach	Name	Parameter		Data	Change
01	Service XS G	Width (ft)	46.50	47.13	0.63
		Mean Depth (ft)	2.17	2.33	0.16
		Area (ft^2)	101.10	110.04	8.94
		Maximum Depth (ft)	4.48	4.10	-0.38
		Wetted Perimeter (ft)	51.72	51.20	-0.52
		Hydraulic Radius (ft)	1.95	2.15	0.20
		Width/Depth Ratio	21.43	20.23	-1.20
02	Baltimore XS 32	Width (ft)	45.10	45.90	0.80
		Mean Depth (ft)	2.29	2.46	0.17
		Area (ft^2)	103.48	112.84	9.36
		Maximum Depth (ft)	3.87	4.19	0.32
		Wetted Perimeter (ft)	46.37	47.59	1.22
		Hydraulic Radius (ft)	2.23	2.37	0.14
		Width/Depth Ratio	19.69	18.66	-1.04
03	Baltimore XS 28	Width (ft)	54.10	56.50	2.40
		Mean Depth (ft)	1.87	2.46	0.59
		Area (ft^2)	101.14	138.98	37.84
		Maximum Depth (ft)	4.10	5.04	0.94
		Wetted Perimeter (ft)	61.70	72.18	10.48
		Hydraulic Radius (ft)	1.64	1.93	0.29
		Width/Depth Ratio	28.93	22.97	-5.96
	Service XS A	Width (ft)	44.00	42.09	-10.41
		Mean Depth (ft)	2.28	4.65	2.37
		Area (ft^2)	100.23	160.10	55.85
		Maximum Depth (ft)	3.81	6.90	3.09
		Wetted Perimeter (ft)	50.08	48.46	-10.30
		Hydraulic Radius (ft)	2.00	3.30	1.92
		Width/Depth Ratio	19.30	9.05	-12.08
04	Service XS B	Width (ft)	60.20	60.68	0.48
		Mean Depth (ft)	3.50	3.88	0.38
		Area (ft^2)	210.98	235.38	24.40
		Maximum Depth (ft)	6.24	6.70	0.46
		Wetted Perimeter (ft)	65.34	67.99	2.65
		Hydraulic Radius (ft)	3.23	3.46	0.23
		Width/Depth Ratio	17.20	15.64	-1.56
05	Baltimore XS 18	Width (ft)	41.62	41.64	0.02
		Mean Depth (ft)	2.73	3.04	0.31
		Area (ft^2)	113.64	126.54	12.90
		Maximum Depth (ft)	5.09	3.93	-1.16
		Wetted Perimeter (ft)	49.94	45.19	-4.75
		Hydraulic Radius (ft)	2.28	2.8	0.52
		Width/Depth Ratio	15.25	13.70	-1.55
	Service XS C	Width (ft)	50.00	Not surveyed in 2015	
		Mean Depth (ft)	2.17		
		Area (ft^2)	108.35		
		Maximum Depth (ft)	3.11		
		Wetted Perimeter (ft)	51.81		
		Hydraulic Radius (ft)	2.09		
		Width/Depth Ratio	23.04		
06	Baltimore XS 14	Width (ft)	44.12	45.93	1.81
		Mean Depth (ft)	2.84	3.18	0.34
		Area (ft^2)	125.09	146.25	21.16
		Maximum Depth (ft)	5.13	5.68	0.55
		Wetted Perimeter (ft)	53.21	51.94	-1.27
		Hydraulic Radius (ft)	2.35	2.82	0.47
		Width/Depth Ratio	15.54	14.44	-1.09

2. Vertical Stability

The revised stream stability analysis has two vertical stability evaluations that assess the aggradation and degradation potentials of the channel separately (Rosgen 2008). The previous vertical stability analysis had only one vertical stability evaluation to determine whether the stream was aggrading, degrading, or stable (Rosgen 2001b). The Service analyzed the 2008, 2009, 2010, 2012, 2013 and 2015 stream data using the revised stability analysis. However, the Service did not reanalyze the stream data from surveys prior to 2009. The Service used longitudinal profile and cross section plots to validate the vertical stability potentials.

a. Vertical (Aggradation) Stability Results

The revised stability analysis has added a new vertical stability evaluation that assesses the aggradation potential, using the following parameters: sediment competence, sediment capacity, width/depth state (study/reference) ratios, stream succession state, depositional patterns, and debris/blockages.

For 2015, the vertical (aggradation) stability assessment for Moores Run resulted in one rating category: no deposition (Table 6). There were no changes in the vertical (aggradation) stability ratings in Moores Run between 2013 and 2015.

For Reach 04, 05, 06, 07 and 09, the Service was unable to conduct a vertical (aggradation) stability analysis to the same level as the other reaches, because a riffle cross section was not surveyed in these reaches in 2015. The predictions for these reaches were determined through analysis of depositional patterns, debris blockages, and the longitudinal profile and cross section overlays.

b. Vertical (Degradation) Stability Results

The revised stability analysis used the following parameters to evaluate the degradation potential of the stream: sediment competence, sediment capacity, width/depth state (study/reference) ratios, degree of incision, stream type stage, depositional patterns, meander pattern, entrenchment, and confinement. Although the revised vertical (degradation) stability analysis had similar assessment parameters to the previous analysis, the rating values and categories have changed. Thus, a direct comparison with surveys prior to 2008 is not appropriate.

For 2015, the vertical (degradation) stability assessment for Moores Run resulted in two rating categories: not incised and slightly incised (Table 6). The not incised rating represents 57 percent, and the slightly incised rating represents 43 percent of the assessment area. There were no changes in the vertical (degredation) stability assessment from 2013 to 2015.

For Reach 04, 05, 06, 07 and 09, the Service was unable to conduct a vertical (degredation) stability analysis to the same level as the other reaches, because a riffle cross section was not surveyed in these reaches. The predictions for these reaches were determined through analysis of depositional patterns, debris blockages, and the longitudinal profile and cross section overlays.

Table 6. Vertical Stability Potential Comparison

Study Reach	Survey Year													
	2003	2005	2007	2008*		2009*		2010*		2012*		2013*		2015*	
				Aggradation	Degradation	Aggradation	Degradation	Aggradation	Degradation	Aggradation	Degradation	Aggradation	Degradation	Aggradation	Degradation
01	Stable	Stable	Stable	Moderate Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised
02	Stable	Stable	Stable	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised
03 (Left Channel)	Aggrading	Aggrading	Aggrading	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Slightly Incised	No Deposition	Not Incised	No Deposition	Not Incised
03 (Right Channel)	Degrading	Degrading	Degrading	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised
04	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised
05	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised	No Deposition	Not Incised	No Deposition	Slightly Incised	No Deposition	Slightly Incised
06	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Slightly Incised	No Deposition	Not Incised	No Deposition	Not Incised
07	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised
08 (Left Channel)	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised
08 (Right Channel)	Stable	Stable	Stable	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised
09	Stable	On-going bank stabilization project	On-going bank stabilization project	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised	No Deposition	Not Incised

(*) Used the revised Wildland Hydrology, Inc. (Rosgen 2008) river stability assessment procedures

c. Longitudinal Profile Comparison

The Service surveyed 3,413 feet of stream for the 2015 longitudinal profile (Appendix B). A comparison of the 2013 and 2015 longitudinal profiles showed an adequate alignment of facet features to allow for an accurate evaluation of bed elevation change. This evaluation showed an overall change in bed elevation of 49 percent, with 26 percent of the bed decreasing in elevation and 23 percent of the bed increasing in elevation (Table 7). Elevation decreases ranged from 0.10 to 2.0 feet and elevation increases ranged from 0.10 to 1.0 feet. Reaches 01, 02, 03, 06, and 07 had the highest percentage of change, ranging from 60 to 75 percent.

Table 7. 2015 Moores Run Bed Elevation Changes

Reach	Reach Length (ft)	Elevation Decrease (Degradation)			Percent	Elevation Increase (Aggradation)			Percent
		Length (ft)	Depth (ft)			Length (ft)	Depth (ft)		
			Min.	Max.			Min.	Max.	
01	520	154	0.10	0.78	30	172	0.10	0.84	33
02	255	10	0.10	0.50	4	160	0.10	0.75	71
03	448	150	0.10	1.5	33	120	0.10	0.50	27
04	317	90	0.10	1.5	28	60	0.10	1.0	19
05	672	100	0.10	0.50	15	40	0.10	1.0	6
06	489	160	0.10	2.0	33	110	0.10	1.0	22
07	134	70	0.10	0.3	52	30	0.10	0.20	22
08	169	60	0.10	0.80	36	20	0.10	0.5	12
09	354	70	0.10	1.0	20	60	0.10	0.4	17
Total	**3,358**	**864**	**0.10**	**2.0**	**26**	**772**	**0.00**	**1.0**	**23**

c. Data Analysis

To validate the 2013 overall vertical stability ratings, the Service compared the vertical stability ratings to the changes shown in the 2013 and 2015 longitudinal profile overlay. There was no evidence of a base level change for any of the reaches, and any elevation changes were similar to those observed in previous years. In general, the bed elevation changes were associated primarily with localized scour and deposition. In addition, some of the bed elevation changes are likely due to natural variability in large-sized bed material (i.e., boulders), as found in Reach 02, 07, and 08.

The Service found that stability ratings accurately predicted the vertical stability for all the reaches, since the longitudinal profile indicates that the general trend is towards degredation.

The Service observed a potential discrepancy with the 2013 vertical (degradation) rating for Reach 06. The Service classified this reach as an F stream type; however, the vertical (degradation) rating indicates that this reach is “not incised”. Although this result initially appears contradictory, the cross section survey shows that the active channel bench is developing into a bankfull bench. The Service observed this bankfull bench development throughout Reach 06. The vertical (degradation) evaluation reflects a stability trend towards a more stable stream condition: an F stream type evolving towards a Bc stream type.

The bankfull widths of this reach will eventually narrow as the active channel bench develops into a bankfull bench. As the stream narrows, the stream will become less entrenched and reflect a stability trend towards a more stable stream condition. These facts help to explain how Reach 06 has a "not incised" vertical (degradation) rating, while being a F stream type.

In addition, Reach 03 currently has a vertical (degradation) rating of "not incised." Although this is currently accurate, analysis of the overlay of Reach 03 cross section A (Table 4 and Appendix A) indicates that the bed is in the process of degrading at that location. Without intervention, the Service expects the degradation trend to continue, eventually causing instability throughout the entire reach, and a shift in the vertical (degradation) rating for reach 03. The Service recommends further monitoring of Reach 03, particularly cross section A.

Another area of potential future instability is Reach 05, particularly in the area of former cross section 18. Although the reach currently has vertical aggradation and degradation prediction ratings of "no deposition" and "slightly incised," respectively, if the debris jam remains, it is likely to further affect the velocity vectors in the reach, causing both scour and deposition in the bed.

3. Enlargement Potential

The Service analyzed the 2015 stream data using the revised enlargement potential analysis. The revised analysis uses the following parameters to evaluate the enlargement potential of the stream: successional stage shift, lateral stability, and vertical aggradation and degradation stability (Rosgen 2008).

a. Enlargement Potential Results

For 2015, the enlargement potential for Moores Run resulted in two rating categories: slight increase and moderate increase (Table 8). The slight increase rating represents 87 percent, and the moderate increase rating represents 13 percent of the assessment area. There were no changes in enlargement potential ratings between 2013 and 2015.

b. Data Analysis

To validate the 2013 enlargement potential ratings, the Service compared the enlargement potential ratings to changes in the 2013 and 2015 cross section overlays. The changes in the cross section overlays validate the 2003 predictions when observing the overall cross section area trends from 2003 to 2015.

Table 8. Enlargement Potential Comparison

Study Reach	Survey Year								
	2003	2005	2007	2008*	2009*	2010*	2012*	2013*	2015*
01	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase
02	Stable	Stable	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
03 (Left Channel)	Stable	Stable	Stable	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
03 (Right Channel)	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
04	Stable	Stable	Stable	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
05	Slight Increase	Slight Increase	Moderate Increase	Slight Increase	Slight Increase	Moderate Increase	Moderate Increase	Moderate Increase	Moderate Increase
06	Moderate Increase	Moderate Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
07	Stable	Stable	Stable	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
08 (Left Channel)	Stable	Stable	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
08 (Right Channel)	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase
09	Extensive	On-going bank stabilization project	On-going bank stabilization project	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase	Slight Increase

(*) Used the revised Wildland Hydrology, Inc. (Rosgen 2008) river stability assessment procedures

4. Pfankuch Channel Stability Assessment

The Pfankuch Channel Stability (Pfankuch) assessment provides an overall channel stability rating by evaluating such parameters as: mass wasting, vegetative banks, debris jams, channel capacity, cutting, deposition, consolidation of particles, and aquatic vegetation (Pfankuch 1975).

a. Pfankuch Channel Stability Results

For 2015, the Moores Run Pfankuch stability assessment of the nine reaches resulted in three rating categories: stable, moderately unstable, and unstable (Table 9). The stable rating represents 17 percent, the moderately unstable rating represents 31 percent, and the unstable rating represents 52 percent of the assessment area. There were no changes in the Pfankuch ratings between 2013 and 2015. The Pfankuch data are located in Appendix E.

b. Data Analysis

The Pfankuch ratings are representative of the evaluated conditions found in each reach.

Table 9. Pfankuch Channel Stability Comparison

Study Reach	Survey Year								
	2003	2005	2007	2008	2009	2010	2012	2013	2015
01	Stable	Stable	Stable	Stable	Stable	Stable	Moderately Unstable	Moderately Unstable	Moderately Unstable
02	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
03	Moderately Unstable	Stable	Stable	Stable	Stable	Moderately Unstable	Unstable	Unstable	Unstable
04	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
05	Stable	Stable	Stable	Stable	Stable	Stable	Unstable	Unstable	Unstable
06	Stable	Stable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Unstable	Unstable	Unstable
07	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Unstable	Unstable	Unstable
08	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable	Moderately Unstable
09	Moderately Unstable	On-going bank stabilization project	On-going bank stabilization project	Stable	Stable	Stable	Moderately Unstable	Moderately Unstable	Moderately Unstable

5. Sediment Supply

The revised sediment supply assessment used in 2013 was performed in 2015. The revised sediment supply assessment predicts sediment supply based on the results of the following criteria: lateral stability, vertical aggradation and degradation stability, channel enlargement potential, and Pfankuch channel stability rating (Rosgen 2008). Each criteria are given a numeric value and the individual values are added together to get a total score for the reach. A higher score indicates a larger potential for sediment contribution from the study reach.

a. Sediment Supply Results

For 2015, the sediment supply assessment for Moores Run resulted in three rating categories: very high, high, and moderate (Table 10). The very high rating represents 20 percent, the

moderate rating represents 33 percent, and the high rating represents 47 percent of the assessment area.

Table 10. Sediment Supply Potential Comparison

Study Reach	Survey Year								
	2003	2005	2007	2008*	2009*	2010*	2012*	2013*	2015*
01	Moderate	Moderate	Moderate	High	High	High	High	High	High
02	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
03 (Left Channel)	Moderate	Moderate	Moderate	Low	Low	Low	High	High	High
03 (Right Channel)	High	High	High	Moderate	Moderate	High	High	High	High
04	Low	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
05	Low	Low	Moderate	Moderate	Moderate	Moderate	Very High	Very High	Very High
06	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	High	High
07	Low	Low	Low	Moderate	Moderate	Moderate	High	High	High
08 (Left Channel)	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
08 (Right Channel)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
09	High	On-going bank stabilization project	On-going bank stabilization project	Low	Low	Low	Moderate	Moderate	Moderate

(*) Used the revised Wildland Hydrology, Inc. (Rosgen 2008) river stability assessment procedures

b. Data Analysis

To validate the 2013 the sediment supply predictions, the Service compared the sediment supply ratings to changes in the 2013 and 2015 longitudinal profile and cross section overlays. For Reach 07, 08 and 09, the Service was only able to validate the predictions using the longitudinal profile, because no cross sections were resurveyed for these reaches in 2015.

While the prediction of potential sediment supply is based on several criteria, the Service used cross section and longitudinal data to validate the predications. Often, it is difficult to validate the predications by only comparing the current data with the previous year. However, when reviewing the trend of changes, the channel changes shown in the longitudinal profile and cross section concur with and validate the potential sediment supply predictions.

B. Bank Stability

The Service evaluated bank stability using the Bank Erosion Hazard Index (BEHI) and channel erosional forces using the near bank shear stress (NBS) for all stream banks prone to erosion within the study area. The Service also evaluated BEHI and NBS conditions at individual cross sections in order to validate bank erosion predictions made in 2013. Reach BEHI data, photographs, and maps are located in Appendix C and cross section BEHIs and cross section bank profile data are provided in Appendix A.

1. Reach BEHI and NBS

The reach BEHI and NBS ratings are used in the Rosgen Level III stability assessment, and to estimate sediment quantities from streambank erosion.

a. Reach BEHI and NBS Results

For the 2015 survey, the Service assessed 4,355 feet of stream bank of the total 6,716 feet of bank. The Service only assessed banks prone to erosion; thus aggrading banks and stabilized banks were not included in the assessment. A summary of the 2013 and 2015 reach BEHI and NBS ratings are provided in Table 11. A complete summary of 2003 through 2015 reach BEHI and NBS ratings, as well as a geomorphic map with detailed 2015 BEHI bank locations are located in Appendix C.

The Service identified nine BEHI/NBS conditions, ranging from low/low to very high/very high. Of the banks prone to erosion, the dominate BEHI/NBS condition is high/low. The high/low combination makes up 22 percent of the banks prone to erosion in Moores Run. The moderate/moderate rating represents 17 percent of the banks, the low/low rating represents 14 percent, the high/high rating represents 13 percent, very high/very high represents 10 percent, the moderate/low rating represents 7 percent, and the low/moderate rating represents 5 percent. The remaining banks prone to erosion are rated high/moderate or very high/moderate. These bank conditions represent 6 percent of the banks, respectively.

b. Data Analysis

The Service compared the changes between the 2013 and 2015 BEHI and NBS ratings, and found that 15 conditions changed in the 2015 survey. Due to changes in bank conditions, not all of the banks identified in 2013 were assessed in 2015. There was one bank prone to erosion added in 2015.

Closer evaluations of the changes indicate that in general, Moores Run is becoming more stable. In the majority of changes between 2013 and 2015, the BEHI rating change indicated less potential for erosion. Overall the changes are minor, with one BEHI or NBS category difference between years, and Moores Run is maintaining the same stability as in 2013.One exception is Bank 23b in Reach 06. This bank changed from a moderate/high BEHI/NBS rating to a very high/moderate rating.

Table 11. 2013 and 2015 Study Reach BEHI and NBS Comparison.

Reach		2013			2015		
		BEHI	Near Bank Stress Rating	Length of Bank (ft)	BEHI	Near Bank Stress Rating	Length of Bank (ft)
1	Bank 1	High	Low	120	High	Low	125
	Bank 3	High	High	74	High	High	50
	Bank 4	Very High	Very High	254	Very High	Very High	225
2	Bank 5	Low	Low	260	Low	Low	250
3	Bank 7	High	Moderate	140	Moderate	Low	180
	Bank 8	Moderate	Moderate	88	Moderate	Moderate	85
	Bank 9	Very High	Very High	195	Very High	Very High	200
	Bank 10	Low	Low	113	Low	Low	125
4	Bank 10	Low	Low	329	Low	Low	250
	Bank 12	High	Low	140	High	Moderate	160
	Bank 13a	Moderate	Low	142	High	Low	175
	Bank 14	Not surveyed in 2013			High	Moderate	60
	Bank 13b	Moderate	Low	113	Not surveyed in 2015		
5	Bank 14	High	Low	75	High	Moderate	60
	Bank 15	Moderate	Low	213	High	Low	350
	Bank 17	High	High	113	Moderate	Low	113
	Bank 19	High	Low	75	High	Low	75
6	Bank 18	High	Low	350	High	Low	225
	Bank 19/19a	High	Low	234	High	High	345
	Bank 19c	High	Moderate	76	Not surveyed in 2015		
	Bank 21	High	Low	129	Moderate	Moderate	125
	Bank 22	High	High	70	High	High	175
	Bank 23a	Very High	Moderate	162	Very High	Moderate	175
	Bank 23b	Moderate	High	75	Very High	Moderate	75
	Bank 23c	Very High	Moderate	70	Moderate	Moderate	225
	Bank 23d	High	Moderate	250	Not surveyed in 2015		
	Bank 24	High	Moderate	202	Low	Moderate	202
7	Bank 23c	Moderate	High	75	Moderate	Moderate	125
	Bank 25	Moderate	Moderate	200	Moderate	Moderate	200

2. Representative Cross Section BEHI, NBS, and Bank Profiles

Cross section BEHI, NBS, and bank profiles are used to validate bank erosion rates. The Service evaluated BEHI and NBS conditions at monumented cross sections, and repeated surveys at these cross sections will show lateral adjustments from which the Service can calculate actual bank erosion rates for the BEHI and NBS combinations.

The Service reassessed BEHI and NBS conditions at seven monumented cross sections to validate the erosion rates and sediment contributions for these BEHI and NBS combinations. Two of the eight cross sections assessed had changes in BEHI and NBS conditions (Table 12).

As reflected in the bank erosion predictions, overall there was not much change in the monumented cross section BEHI and NBS. The most significant change is in Reach 03. The BEHI for cross section 28 in Reach 03 changed from low to moderate in 2015. The most likely cause is that Reach 03 is continuing to adjust after the loss of a significant debris jam that was present in 2009. The removal of the debris jam has changed the flow dynamics and pattern, causing more stress on right bank of Reach 03.

Table 12. Selected Cross Section BEHI and NBS Comparison

Reach	Cross Section	Bank	2013		2015	
			BEHI	NBS	BEHI	NBS
01	USFWS G	Right	Very High	Moderate	Very High	Moderate
02	Balt. 32	Left	Low	Moderate	Low	Moderate
03	Balt. 28	Right	Low	High	Moderate	High
	USFWS A	Right	Moderate	Low	Moderate	Low
04	USFWS B	Left	Very High	Moderate	Very High	Moderate
05	Balt. 18	Right	High	Low	Moderate	Low
	USFWS C	Right	High	Low	N/A	N/A
06	Balt. 14	Left	High	Moderate	High	Moderate

C. Bank Erosion Estimates

For the 2015 geomorphic condition and channel stability survey, the Service used reach BEHI and NBS ratings, bank dimensions, and a bank erodibility curve to predict reach average erosion quantities and rates for the study reaches. Because Maryland does not have bank erodibility curves, the Service used a draft bank erodibility curve developed by the Service for Washington, D.C. The Service selected this curve because it represents watershed and stream conditions at Moores Run.

a. Bank Erosion Results

In 2015, the Service reassessed the reach BEHI and NBS ratings and bank dimensions for each bank prone to erosion. The Service applied these ratings and dimensions to the draft bank erodibility curve to predict reach average erosion quantities and rates for the study reaches (Table 13).

The Service predicts that the banks will contribute a total of 920 tons of sediment in 2015, with individual study reaches ranging from 1 tons/year to 432 tons/year. Study reach erosion rates ranged from 0.0044 tons/year/feet to 0.88 tons/year/feet.

Table 13. Bank Erosion Prediction Comparison

Reach	Survey Year																	
	2003		2005		2007		2008		2009		2010		2012		2013		2015	
	Total (tons/ year)	Rate (tons/ year/ feet)	Total (tons/ year)	Rate (tons year/ feet)	Total (tons/ year)	Rate (tons/ year /feet)	Total (tons/ year)	Rate (tons/ year/ feet)	Total (tons/ year)	Rate (tons/ year /feet)	Total (tons/ Year)	Rate (tons/ year /feet)	Total (tons/ Year)	Rate (tons/ year /feet)	Total (tons/ Year)	Rate (tons/ year /feet)	Total (tons/ Year)	Rate (tons/ year /feet)
01	411	0.96	319	0.74	349	0.81	353	0.82	254	0.59	213	0.50	230.4	0.54	230.4	0.54	201.02	0.47
02	20	0.10	20	0.10	14	0.05	15	0.06	3	0.01	2	0.01	1.17	0.004	1.17	0.004	1.13	0.004
03	47	0.11	51	0.12	29	0.07	24	0.05	30	0.07	42	0.09	93.76	0.21	98.42	0.22	80.92	0.18
04	35	0.08	26	0.08	35	0.11	27	0.09	23	0.07	21	0.07	14.73	0.05	24.57	0.08	76.18	0.24
05	143	0.19	162	0.24	127	0.19	139	0.21	168	0.25	165	0.25	231.19	0.34	115.73	0.17	51.19	0.08
06	149	0.31	117	0.24	143	0.29	105	0.21	106	0.22	106	0.22	375.23	0.77	342.49	0.7	432.61	0.88
07	30	0.22	30	0.22	50	0.37	35	0.26	50	0.37	31	0.23	447.3	3.34	65.53	0.49	77.1	0.58
08	7	0.04	7	0.04	2	0.01	0.5	0.003	1	0.006	1	0.006	Boulder stabilized banks		Boulder stabilized banks		Boulder stabilized banks	
09	269	0.76	Active stabilization project		Active stabilization project		Concrete banks		Concrete banks		Concrete banks		Concrete banks		Concrete banks		Concrete banks	
Total	**1,111**		**732**		**749**		**698**		**634**		**582**		**1394**		**878**		**920**	

b. Bank Erosion Discussion

The Service compared the changes between the 2013 and 2015 bank erosion quantities, and found a predicted increase of 42 tons of sediment per year. Reasons for the difference between the 2013 and 2015 erosion quantities include changes in BEHI ratings and NBS.

IV. CONCLUSIONS

Although the 2015 abbreviated survey indicates that Moores Run is continuing to adjust, these adjustments are minor and localized. Reaches 02, 04, 05, 06, 07, 08 and 09 (approximately 71 percent of the study area) are generally stable. The stability trend of these reaches should remain stable if there are no significant changes in watershed land use or flow regime.

Reach 01 (approximately 13 percent of the study area) continues to have instability problems and will continue to adjust until reaching equilibrium. It is trending towards an increased width/depth ratio. As the width/depth ratio in a stream increases, the sediment capacity and competency decreases, causing excess deposition. This additional deposition then redirects stream flow towards the banks, causing increased bank erosion, scour, and subsequently increased lateral instability.

Although Reach 03 currently shows only localized adjustment in 2015, this reach should be carefully monitored. It is currently downcutting and is likely to be transitioning from a D stream type to a C stream type, and thereafter towards further lateral and vertical instability. In stream succession scenarios, it is common for C stream types to first downcut, and then widen (Rosgen, 2008). It is possible Reach 03 is in the beginning stages of a trend toward further instability. The most likely cause is that Reach 03 is continuing to adjust after the loss of a significant debris jam that was present in 2009. The removal of the debris jam has changed to flow pattern and dynamics and caused more stress on right bank of Reach 03, particularly around the location of cross section A.

In addition, the Service recommends additional monitoring in Reach 04, near BEHI bank 12. The bank profile data show that in that area the left bank is eroding, with approximately one foot of erosion between 2013 and 2015 (Appendix A). The bank is located directly downstream of a large 5’ x 8’ culvert. Flow from the culvert, when converging with Moores Run, is likely creating a back eddy that is eroding the left bank. The Service predicts that Moores Run will continue to adjust until it reaches a stable state, and that no significant problems will occur.

Another area of potential future instability is Reach 05, particularly in the area of former cross section 18. Although the reach currently has vertical aggradation and degradation predictions of “no deposition” and “slightly incised,” respectively, if the debris jam remains, it is likely to further affect the velocity vectors in the reach, causing both scour and deposition in the bed. The resulting lateral and vertical instability could also affect both

downstream and upstream reaches. Removal of the debris jam and monitoring is recommended.

The stream stabilization project in Reach 09 was completed in 2008. As part of this stabilization project, additional concrete banks were constructed in Reach 08 and 09; an existing culvert was replaced with a larger 36-inch culvert in Reach 08; and an additional culvert and 48-inch culvert were installed in Reach 09. The Service is concerned that the additional stormwater runoff from the replaced and new culverts may degrade the stream channel. Since the completion of the improvements in 2008, the Service has not observed any significant changes to stream stability that can be attributed to these infrastructure improvements. This area has the potential to cause instability problems in the future if not monitored. The Service also recommends continued monitoring of Moores Run to document any changes that may occur because of the additional stormwater flow. In addition, the Service recommends resurveying all of the Moores Run 2015 representative cross sections in order to validate bank erosion predictions.

LITERATURE CITED

1. Davis, S.L., and R.R. Starr. 2008. Moores Run, Baltimore City, Maryland 2007 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-SO8-02.

2. Davis, S.L., and R.R. Starr, 2010. Moores Run, Baltimore City, Maryland 2010 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-S10-02.

3. Davis, S.L., and R.R.Starr. 2012. Moores Run, Baltimore City, Maryland 2012 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-S12-03.

4. Davis, S.L., and R.R.Starr. 2013. Moores Run, Baltimore City, Maryland 2013 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-S13-01.

5. Eng, C.K., McCandless, T.L., and R.R. Starr. 2004. Moores Run, Baltimore City, Maryland Data Collection and Assessment Protocols for a Geomorphic Condition and Channel Stability Survey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-S04-03.

6. Eng, C.K., Davis, S.L., and R.R. Starr. 2006. Moores Run, Baltimore City, Maryland 2005 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-SO6-02.

7. Eng, C.K., Starr, R.R., and S.L. Davis. 2009. Moores Run, Baltimore City, Maryland 2008 Abbreviated Geomorphic Condition and Channel Stability Resurvey. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-SO9-04.

8. Pfankuch, D.J. 1975. Stream Reach Inventory and Channel Stability Evaluation. U.S. Forest Service, Missoula, MT.

9. Rosgen, D.R. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

10. ---. 2001a. A Practical Method of Computing Streambank Erosion Rates. *Procedings of the Seventh Federal Interagency Sedimentation Conference*, Vol. 2, pp II – 9 – 15, March 25 – 29, 2001, Reno, NV.

11. ---. 2001b. A Stream Channel Stability Assessment Methodology. *Procedings of the Seventh Federal Interagency Sedimentation Conference*, Vol. 2, pp II – 9 – 15, March 18 – 26, 2001, Reno, NV

12. ---. 2008. River Stability Field Guide. Wildland Hydrology. Fort Collins, CO.

Appendix H: Watershed Protection and Restoration Program Annual Report Table for FY 2016
(electronic files only)

Appendix I: Illicit Discharge Detection and Elimination

- *IDDE Summary Database (electronic file only)*
- Table I-1: Summary of PST Investigations: SDUOs
- Table I-2: Summary of PST Investigations: SSOs
- Table I-3: Summary of PST Investigations: drinking water transmission losses
- Table I-4: Summary of PST Investigations: other illicit discharges
- Table I-5: Summary of FOG Notices of Violations

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
SDUO-Private							
420	JHU-Croft Hall, RM 163 Restroom	Johns Hopkins University's campus; Croft Hall RM 163 Restroom (Institute of Nano-BioTechnology)	Jones Falls	Retests of repairs at Art Musuem confirmed that sewage still entering the storm drain system now from the main channel and not the pipe that was capped. The new problem appears to be somewhere at JHU. On 4/27/16, CCTV detected an illict discharge from an approximately 10" pipe drop connection. Dye testing of Croft Hall restrooms and labs sinks revealed that a single restroom for the Institute of Nano-BioTechnology lab (RM 163) was connected to the storm drain. Repairs made by JHU staff on 5/9/16. Ammonia and bacteria were low during the 5/12/16 first follow up.	OCAL	9/18/2007	Resolved
453	131 N. Clinton (Formerly 3302 Esther 24 Inch Drain)	3302 Esther Place 24 inch lateral drain from north at the bottom of the storm drain.	Harbor	Illicit connection at 131 N. Clinton St. and referred it to HCD. 9/1/16 Dye tests of bathroom fixtures, were negative in the storm drain, but present in the sanitary.	OCAL	9/18/2009	Resolved
512	Cross Country & Key	Storm drain manhole at Cross Country Blvd. & Key Ave.	Jones Falls	As of October 2015 the problem is still active, most recent suspect is lateral from 5924 Cross Country Blvd. 11/12/15 plumber repaired section of crushed house connection which was not letting any water through. Several samples since the plumbing repair have shown a reduction of ammonia within the storm drain.	CWP	5/27/2010	Resolved
744	McMechen & Mason	McMechen St & Mason St.	Jones Falls	A 6" pipe on the leftside of storm drain appears to have interrmittent sanitary discharge. It appears be an illicit house(s) connection somewhere within the 1500 block of Bolton St. DPW found an illicit house connection in the 1600 block of Bolton St.	OCAL	9/26/2012	Resolved
761	Fait & Grundy	Storm drain manhole on the northwest corner of Fait Ave. & Grundy St.	Harbor	New MH construction has been requested in storm drain on Grundy for CCTV access (3/2016). On 4/21/16 10" drain found in the Foster-Fleet Alley connected to the storm drain mainline on Grundy. Dye test of 3926 Foster on 4/27/16 confirmed that it is connected to the 10" drain leading to Grundy St. This is a source leading to the Fait & Grundy SDUO. 3926 Foster was removed from the 10" drain on 7/1/16. On 8/12/16 the storm drain on Grundy St was flushed extensively from 718 Grundy to Fait St. Followup on 9/21 found manhole and pipe are completely dry.	OCAL	11/30/2012	Resolved
765	315 S. Haven & 401 S. Haven St.	Storm that runs between the two buildings at 315 S. Haven St. & 401 S. Haven St.	Harbor	Discovered two direct illicit sanitary discharges one at 315 S. Haven St. and the other at 401 S. Haven St.	OCAL	12/5/2012	Resolved
853	Perkins Homes 251-269 Dallas Ct. Building	Perkins Homes 251-269 Dallas Ct. Building	Harbor	Green dye deployed in the bathroom at 251 Dallas Ct. appeared percolating through a small hole at the first joint in the storm drain manhole at 263 Dallas Ct. The leak has been narrowed to below the building's recently added exterior cleanout. 11/9/15 , work completed.	OCAL	5/22/2013	Resolved
966	2100 Block of Hamilton Ave.(BWB Outfall HER-107)	2100 Block of Hamilton Ave next to 5501 Pioneer Dr	Back River	BWB reported high ammonia (4.08mg/L) at outfall at Hamilton & Pioneer. DPW found suspected sewage in storm drain between two maholes on 2100 Blk of Hamilton. Two houses were directly connected and CIPP was installed in sanitary pipe. First followup had low ammonia and second followup storm was dry. Problem Abated.	BWB	6/16/2014	Resolved
1083	A.J. Michaels	AJ Michaels Heating, Cooling, & Plumbing building. (Storage Area & Center Office Bathrooms)	Back River	Confirmed using dye, two of the three bathrooms at A.J. Michaels are directly connected to the storm drain system. The center office bathroom and the storage area bathroom are tied into the storm drain system. The right (north) office bathroom is connected properly to the sanitary system.	OCAL	1/22/2015	Resolved

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2063	3731 Greenmount Ave Illicit Connection	Cleanout located in front of 3731 Greenmount Ave	Jones Falls	Located a pipe that had grey scum and toilet related material. Dye test at cleanout pipe located at 3731 Greenmount Ave showed up instantly. The pipe is entering the storm drain line approx 6 (one and a half segments downstream from where the inlet line for the alley enters. Follow up to rerouting of house connection on March 16, 2016, confirmed that the illicit connection has been removed and the house connection is properly connected to the sanitary system.	OCAL	7/8/2015	Resolved
2070	4500 Block of Bonner Rd	Area between 4501 Fairview Rd and 4500 blk of Bonner Rd	Gwynns Falls	High ammonia (1.02mg/L) reported during survey on 7/13. CCTV by plumber in storm inlet behing building shows flow. On 9/8 Roto-Rooter iperformed CCTV and repairing sections of pipe on top of hill. There was a blockage 65 ft from cleanout behind 4401 Fairview. Residents complained of slow sewer pipe. Wet spot on hill discovered by property owners engineer. Tested and it is sewage. Followup on 9/14 shows discharge in inlet is still active and roto-rooter still working on sanitary line. Evidence of 3 pits east of storm drain line where repairs were done. 9/22 repair work complete by roto-rooter. They found a pipe running down the hill that was filled with and hold sewage due to several breaks and blockage in the sewer pipe. Sewage flow no longer existing in the inlet pipe.	OCAL	7/14/2015	Resolved
2073	3710 Fairhaven	Sump/rain leader drain at the curb of 3710 Fairhaven Rd. 21226	Patapsco	Dye test at 3710 Fairhaven Ave. sink, investigation uncovered a possible illicit connection from property. Outfall ID: D49C2_035ES. Dye test on 7/29/15 showed dye entering sump basin through drainage tiles after deployed in sink. Owner had problem fixed.	Citizen	7/14/2015	Resolved
2078	3804 Juniper Rd House Connection		Jones Falls	At 3804 Juniper Rd there is a 4" in pipe entering the storm drain on the left-hand side looking up stream. The pipe is located 20' up from the inlet in front of the house. Direct connection assumed since intact human waste found below the pipe. Dye test showed up in less than a minute at 4" pipe located in the storm drain. On 10/15 plumber excavated and connected house to sanitary and downspouts to storm. On 10/18 followup dye testing shows abatement.	OCAL	7/16/2015	Resolved
2085	4520 Wakefield Rd Illicit Connection	4520 Wakefield Rd	Gwynns Falls	Found while following up on investigation (4506 Wakefield Rd). Visual evidence in the storm drain below a lateral pipe. The pipe is entering the right side of storm drain 31 feet above the manhole at 4520 Wakefield Rd. Deployed dye inside residence's kitchen sink. Dye instantly appeared in storm drain confirming illicit sanitary connection to storm drain. Repairs made by plumber whom reconnected the lateral to the correct wastewater line. Problem abated 10/21/2015.	OCAL	7/28/2015	Resolved
2106	2201 Rogene Drive above lower cleanout	In woods 25 feet up from the first white cleanout	Jones Falls	Responding to a consumer complaint about sewage smell in area. Found sewage discharging from hole in ground. Referred the property maintenance for repair. They said they replaced the sewer line 5-10 years ago. Followup on 11/4/15 found new problem below the lowest cleanout was active. The work above this spot was completed.	Cityworks	8/18/2015	Resolved

Table I-1: Summary of PST Investogations: SDUOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2156	707 S President St (Spinnaker Bay) Illicit Connection	707 S President St. Mezzanine level women's restroom	Harbor	High ammonia (>3.45) found on 11/05/15 during east harbor storm drain survey initiated investigation. Originally found a partially blocked sanitary segment and had it cleaned. Problem still active. Found sewage entering from a 12' uncharted storm drain entering inlet in front of 707 S President St.(Spinnaker Bay). It was suspected that a single or a few restrooms are connected to the building's roof drainage system. On 12/4/15 we found that the women's restroom in the Mezzanine level has a direct connection to a roof drainage pipe. On 1/06/16 plumbing contractors relocated a 3" sanitary pipe from women's restroom to the correct 6" trunk line. We followed up on 1/06/16 and dye was no longer present in storm drain when deployed in women's restroom. There was still wetness in the storm drain with elevated ammonia ammonia, however, a bacteria sample was taken and the result was <4 MPN. Problem abated.	OCAL	11/5/2015	Resolved
2157	2101 Rogene Drive below lower cleanout	In the wood near Bonnieview Rd and Western Run Dr.	Jones Falls	Followup on 11/4/15 Private SSO at Rogene. We found new problem active intermittent problem below the lowest cleanout. Sewage not reaching the stream.	OCAL	11/4/2015	Resolved
2158	114 E. Lexington St. (The Lenore Apartments) Illicit Connection	Southeast corner of basement of 114 E. Lexington St.	Harbor	High ammonia (0.91mg/L) reported during East Harbor Storm Drain Survey on 11/05/15. Found sewage infiltrating storm drain through an inlet connection on west side of intersection. Mulitple investigations followed. On 5/19/16 confirmed that the sanitary connection to the storm drain was removed and redirected to the correct sanitary line within the building by private property owner.	OCAL	11/5/2015	Resolved
2164	3018 Pinewood Ave Illicit Connection		Back River	Residential house connection tied to storm sewer. No house connection exists in the sanitary for the residence. The house owner complained to the city about her system backing up during large rain events. Transmittal was sent to contractor for a new lateral install. Completed on 2/22/16.	Citizen	11/23/2015	Resolved
2170	3501 St Paul St (The Marylander Apartments) Illicit Connection	Lower level parking garage of the Marylander Apartments	Jones Falls	High ammonia (1.85mg/L) reported during Jones Falls survey on 12/7. Investigation led to a 12" pipe discharging sewage directly into the storm drain within the 3400 block of N. Calvert St. The pipe was found to be a roof top drainage line from the Marylander apartments and there was a cross connection with the building's sanitary line in the lower level parking garage. Due to this connection, waste water can divert into the storm drainage line if the sanitary line becomes obstructed, blocked or overwhelmed, therefore, causing sewage to discharge into the municipal storm drain system leading to the JF 11.5 outfall. Building maintenance personal were cooperative to our investigation and plan to resolve the problem ASAP. Maintenance personal hired a plumber and had the sanitary line within the building relieved of all blockage on 12/11/15. On 12/17/15 the connection from the storm drain was disconnected.	OCAL	12/7/2015	Resolved
2235	Friends School Pre-Kindergarten Building Illicit Connection	5009 Blythewood Rd	Jones Falls	Water flowing from a 6 inch VC pipe on the left 68 ft up from the manhole. Feces and TP on the bottom of storm pipe. On 4/20/16 dye was deployed in two bathrooms and a utility sink. It was present immediately in the storm drain. Private property owner CCTV'd their line and connected the building line to another sewer line on the premises and filled the old connection with 4 feet of concrete. Followup found no flow from pipe in storm pipe.	OCAL	4/18/2016	Resolved

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2263	2400 Fairmount Ave		Harbor	Citiworks complaint claims sewage is getting discharged into alley from residence. The resident had a sewer pipe leak getting into the sump basin. This was repaired 2 years ago. Investigation found very high ammonia in the sump basin. Resident said they periodically dump bleach and water on the pit to flush it out. Dye test of kitchen sink found dye entering sump basin within 1 minute.Private property owner completed repairs on 6/23/16. Follow up on 6/24/16 after plumbing repairs found the problem to be abated.	Cityworks	5/30/2016	Resolved
2272	1501 Edison Highway Car Wash		Back River	Pipe in the inlet is discharging sewage. Whole rags and feces are present. Dye test of propertyfound car wash side is connected to inlet. They indicated they would contact a plumber to resolve issue.	OCAL	6/14/2016	Resolved
ound a subsurface SSO							
504	Chilham and Cross Country	In woods west of the house at 2210 Chilham Rd.	Jones Falls	Small uncharted outfall in woods with high ammonia. Dye deployed in sanitary was present at outfall. Cracks in the sanitary pipe found. Section of pipe appears to have had work done between road and outfall.	CWP	5/26/2010	Resolved
633	Mannasota & Parkside	Outfall underneath the Mannasota Ave. & Parkside Dr. bridge	Back River	Ammonia high during follow up to Mannasota & Nicholas SDUO. High ammonia not associated with Mannasota & Nicholas SDUO. Sewage leaking into storm but cannot dye test sanitary because in has a very large volume. This was supposed to be lined but contractor lined the wrong segment of line. It is unclear when lining of this segment will be performed. Around 6/29/16 contractors lined the sanitary main on Mannasota between Shamrock and Parkside. As of 9/21 the ammonia results were low and there is no scum on the wall. 9/22 bacteria results conclude abatement.	OCAL	8/9/2011	Resolved
799	Pulaski & Dean East Branch Bulkhead Droplets	South East corner of Pulaski Hwy and Dean St.	Harbor	High ammonia discharging as droplets from bulkhead above East Branch. Found during pipe walk on 03/21/13. Dye test revealed sanitary leak. Problem abated (08/25/15).	OCAL	1/11/2013	Resolved
869	Fagley and Fleet	Within the 600 block of Fagley St.	Harbor	Sewage flowing through storm drain. No access points to this line above 600 Fagley or to the sanitary. CCTV inspection of storm drain on 4/6/16 found that it is different from the charted pipe on file. Additionally, the pipe either changes direction, is badly offset, or becomes an unknown structure at 211' upstream of Fleet & Fagley and the camera could not continue. On 4/29/16 a dye test was performed at 3208 Foster Ave and it appears that the house connection is made to the old T.C. drain possibly leading to storm drain on Fagley instead of the correct sanitary main. On 5/4/16 633 Eaton found connected to the old T.C. Drain, however the old T.C. drain has an uncharted connection to the active sanitary mainline in the Foster alley just west of Fagley. On 5/13/16 found that a segment of the old T.C. Drain in the Fait Ave Alley was connected to the storm drain leading to Fagley & Fleet. It is evident that some homes are still connected to it. On 5/25/16 confirmed that house connections to the T.C. drain exist along the 3700 & 3800 (even) blocks of Fait Ave alley. One was confirmed with dye test and many of the others have evidence of sewage. Investigation and repairs continuing.	OCAL	9/16/2013	On-going
959	Charles & Lanvale (6 Inch Pipe)	SW Corner of N Charles St & W Lanvale St	Jones Falls	Sewage entering storm drain system from a 6" pipe on south wall of manhole. 2/10/16 Planned pipe bursting postponed due to gas leak work is on hold until BGE has repair complete. Point repair made during week of 5/9/16 but did not resolve the SDUO. Still active on 5/12/16. Sanitary mainline has been referred for CIPP	OCAL	6/6/2014	Resolved

Table I-1: Summary of PST Investogations: SDUOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
1005	3429 Ash St	Clipper Mill Rd. & Ash St. between manhole D23YY_028MH and D23YY-027MH	Jones Falls	Sewage entering storm drain Section of pipe at Clipper Mill Ave and Ash St i. Dye test on 8/14 and 5/15 confirmed leaking sanitary sewer. CIPP installed on sanitary line along Ash St. Sewage discharge in storm drain slowed but was still present. Dye testing on 10/15 of 3729 Ash St confirms house connection is leaking. 17 ft of house connection pipe was replaced (not the connection tho the manin) 11/16/15 followup shows manhole at Clipper Mill and Ash is dry. 5 ft down from the manhole at 3429 Ash the is a crack on the right side that is still leak sewage. Also the brick work in the vault is wet. The pipe below vault turns dry.	BWB	8/12/2014	Resolved
1092	Loyola Northway (2600 Block)	2600 Block of Loyola Northway.	Jones Falls	Flushed dye through the cleanout at 2620 Loyola Northway, with water hose. Dye can be seen entering the storm drain in front of 2620 Loyola Northway. House is vacant, suspect additional problems exist, with other house connections within the 2600 block of Loyola Northway. On 3/22/16 water with dye was forced through clean outs at 2600 and 2606 Loyola Northway. Both tests had presence of dye appearing in multiple storm drain joint segments	OCAL	2/10/2015	Referred, not resolved
1093	2500 Block W. Coldspring Ln.	2500 Block of W Coldspring Lane, between Pall Mall Rd and Fenney Ave.	Jones Falls	Sewage is escaping the system on W. Coldspring Ln, between Pall Mall and Fenney Ave and appears in the storm drain system at a 15" collapsed storm drain inlet pipe at 2426 W. Coldspring. Also the storm drain mainflow is escaping the system and reappear. 2/18/2016 Water main leak stopped and dye is still appearing in the storm. CCTV inspection on 4/8/16 found a broken sanitary pipe segment 212' downstream from manhole 13II1017MH (W. Coldspring & Finney). 4/21/16 point repair was made done on the sanitary. 4/22/16 positive follow up dye tests confirmed that there are multiple problems on this sanitary system, that were not eliminated with the point repair. Follow up dye test on 6/30/16 after sanitary main lining (2518 & 2508 Coldspring) was absent from the storm drain when deployed at Coldspring & Finney and at Coldspring & Pall Mall.	OCAL	2/10/2015	Resolved
2062	N Calvert St & Homewood Terrace SSO 3850	In the center of the road at N Calvert St & Homewood Terrace	Jones Falls	At N Calvert St & Homewood Terr, sewage is leaving a section of sanitary pipe and entering the storm drain via an 10" pipe. Since pathway is unkownn, designated as SDUO. CCTV later showed deficiency in sanitary, identfiying as SSO. Sanitary line replaced by pipe bursting method.	OCAL	7/1/2015	Resolved
2080	Behind 3119 N. Calvert St. Drip in Inlet SSO 3871	in back alley inlet grate allows access to main flow	Jones Falls	Small drip entering Manhole/Inlet on SE corner. Dye test on 7/21. Adjacent Sanitary Manhole was flushed on 7/22 which decreased after debris removed. After dye testing confirm pipe S35WW_011G1 is leaking as well as pipe which leads to 3117 N Calvert garage. Added dye to upper sanitary manhole pressure truck added water. Dye became present in inlet and vertical pipe in ceiling. Cctv showing disjoint 8' from lower sanitary manhole. UMD going to repair. Sanitary line leading to garage at 3117 will be videoed on 7/31. Also walked up line and found an additional. Repairs done on 8/18 of main and lateral leading to verizon building confirmed with dye sso is still active. Repair work complete by RE Harrington on 8/27. Dye test on 9/1 confirmed abatement.	OCAL	7/20/2015	Resolved

Table I-1: Summary of PST Investogations: SDUOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2189	Dale Rd & 2311 Cross Country Blvd SSO# 4125, 4224		Jones Falls	Sewage leaking into inlet pipe at a rate of 2 GPM from manhole. There are two 1/2 inch visible joints in the channel at the manhole that are leaking (see Photo). Both pipe segments above the sanitary manhole at Dale and Cross Country have CIPP Lining. Found during routine site visit.This was an SDUO until 1/20/16 which then became an SSO. DPW made repairs on 1/21/16. Followup on 3/17/16 found manhole joints are still actively leaking= identified as new SSO. Post-repair dye testing on 4/13/16 found that the lateral that enters the main at the manhole is leaking. This line was abandoned and plugged about 6-12 inches inside. 4/20/16 UMD plugged the stub and established the bench. 4/25/2016 Dye testing completed and no dye in storm. Problem abated.	OCAL	1/7/2016	Resolved
2191	5801 Greenspring Rd SSO# 4126		Jones Falls	Found during routine site visit at outfall located at Dale Rd and Cross Country. Problem found at Dale and Cross Country (See Dale Rd & Cross Country). Ammonia is elevated above the known problem at Dale Rd. Manhole and top 3 feet of pipe are leaking sewage into the inlet pipe that travels below sanitary. This was an SDUO until 1/20/16 which then became an SSO. DPW mades repairs on 1/21/16. Followup on 2/22/16 found water seeping from first joint in inlet pipe, ammonia was >3.0. Followup on 3/17/16 found repaired section of pipe is good. But found leaking asset is the left channel of the sanitary manhole. Started new investigation. This problem started again and a contractor repaired 19 ft of pipe on 5/16/16.	OCAL	1/7/2016	Resolved

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
Subsurface SSOs							
924	3509 Northern Pkwy	3509 Northern Pkwy. in median, between 3509 Northern Pkwy and Public Safety Training Center	Jones Falls	Investigation was initiated due to high ammonia (1.77 mg/l) recorded at the Merville site during survey. The problem was tracked to a choked sanitary, located in the median. The sewage from the choked sanitary was found percolating in the SD at Clover Rd. Followup on 3/17/16 found ammonia to be low in storm and now sewage leaking into storm.	OCAL	3/18/2014	Resolved
1068	500 Poplar Grove St Rear SSO ID 3445	Alley behind 500 Poplar Grove St	Gwynns Falls	Sewage entering adjacent storm. UM repaired of small section. Still active on followup dye test 5/12/15. Section of pipe was relined. Followed up dye testing on 9/16 shows no dye in storm drain. Still getting high ammonia at mulberry & Poplar Grove. OCAL conclude SSO has been abated. Starting new investigation into high ammonia and bacteria.	OCAL	12/17/2014	Resolved
2064	4000 Edmondson Ave SSO 3826	4000 Edmondson Ave	Gwynns Falls	Sewage is entering manhole at 4000 Edmondson Ave. Flowing into manhole from lateral leading from inlet.	City	7/8/2015	Resolved
2065	3803 Juniper Rd SSO 3827	In the front yard to the left of 3803 Juniper Rd	Jones Falls	High ammonia value 1.37 ppm was received by UM at JF 11.5 during JF survey. Tracked to a choked sanitary at 3803 Juniper Rd, discharging approx 50 GPM into the storm drain system. Repair was done at 3802 Juniper to remove a blockage 5' down from manhole which was a concrete piece. Follow up visit showed there is a catch at the beginning of pipe which catches rags. Removed a large bag with a long pole that was partially blocking the pipe after repair was complete.	OCAL	7/7/2015	Resolved
2068	5313 Elsrode	On the street at 5313 Elsrode Avenue	Back River	Sanitary manhole holding water/choked.	OCAL	7/9/2015	Resolved
2071	4506 Wakefield Rd	4506 Wakefield Rd	Gwynns Falls	High ammonia (1.02mg/L) reported during survey on 7/13. Investigation found partially choked sanitary line at 4506 Wakefield. Also, initiated 4500 blk Bonner Rd PST.	OCAL	7/14/2015	Resolved
2075	5313 Morello	5313 Morello Rd	Back River	Discovered problem while following up on the 5313 Elsrode Rd (mainline choke). The sanitary at Elsrode Rd was partially choked, so the lower sanitary manholes were checked and found mainline choke at 5313 Morello Rd.	OCAL	7/15/2015	Resolved
2077	3803 Juniper Rd SSO 3825	3802 Juniper Rd front yard	Jones Falls	Found high ammonia (2.37 ppm) at 28th St & Howard St. Went to a choked sanitary manhole and overflow the week before and it was choked again 3803 Juniper Rd. DPW repaired a section of pipe the was blocked by a piece of concrete 5 ft downstream from S37EE1009MH at 3802 Juniper Rd.	OCAL	7/16/2015	Resolved
2079	4506 Wakefield Rd. 071615	4506 Wakefield Rd	Gwynns Falls	High ammonia continues at 4410 Wakefield and is tracked to 4506 Wakefield Rd where there is a partially choked sanitary line. CCTv showed the line was full of grease. Additional cleaning on 7/23 but a sink hole opened up while UMD which jetting line. Dyed main and never saw in storm drain but still have high ammonia. Found direct house connection at 4520 Wakefield. Don't believe this is the sole source to high ammonia. CCTV with lateral launch camera performed by contractor. Video shows multiple residential house connections that are crushed. The storm on top of the house connections are leaking into them. New investigation started on 9/23/2016. Problem resolved.	OCAL	7/16/2015	Resolved
2096	305 Cable St. SSO# 3883	305 Cable St.	Jones Falls	Leaking sewer clean out. He explained sewer work was done on resident side but it is still leaking from cleanout which is right at the sidewalk.	City	8/10/2015	Resolved

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2099	N. Charles and Lanvale 081115 SSO #3886	Southwest corner of Charles & Lanvale	Jones Falls	Sanitary sewer overflow structure found connecting the sanitary and storm drains. Main line choke causing active overflow.	City	8/7/2015	Resolved
2102	4611 Wilmslow Rd SSO 3892	Wilmslow Rd and Cable St	Jones Falls	Flushed dye and hydrant water into cleanout of 4611 Wilmslow Rd. Dye appeared in both sanitary and storm outfall at end of Cable St. Flow also increased in outfall and can hear water entering pipe. Flushed dye and hydrant water into 305 cable St cleanout for 2 hours. Dye eventually showed at outfall 4 days later. OCAL's CCTV performed on 8/17 shows disjoint at 39 feet from 305 Cable St cleanout and 58 ft from clean out. Unable to push camera past 100 ft from cleanout due to blockage. Two repairs done by DPW at the 4611 lateral connection and below the connection, but did not address problem. Contractor built a new manhole 9/1 and repaired the disjoints at 39 and 59 feet. . We also flushed dye through cleanout again at 4611 on which confirms SSO is still active. 10/14/15 discovered manhole on top of hill which is the one associated with the storm drain. It has a pipe on the south side which is 16 inches deep and has sewage flowing in from the ceiling. 10/15 used camera to look inside 12" vc storm pipe and a large cavity exists and the sanitary is exposed showing a dripping joint. This joint was found in the sanitary pipe in cctv and dye tested. The other manhole on hill was found to be an abandoned vault. 10/22 CIPP installed in entire sanitary segment along Cable St.	OCAL	8/12/2015	Resolved
2107	4104 Fairview Ave SSO 3898	Opposite side of street next to fence	Gwynns Falls	Choked sanitary entering adjacent storm drain. Sewage discharging into storm from a 8 inch clay pipe on left looking down from storm manhole at 4104 Fairview. Choked sanitary was relieved stopping sewage discharge into storm	OCAL	8/19/2015	Resolved
2111	500 N. Edgewood St SSO 3902	On the northwest corner of the N. Edgewood St & W. Franklin St next to 500 N. Edgewood St.	Gwynns Falls	Observed an SSO at N. Edgewood St. & W. Franklin St the sewage line is flowing east on W. Franklin St and it is entering into the storm drain heading south on N. Edgewood St. The problem had sewage entering the storm drain in 2 spots. The 2 spots were both single storm drain inlet pipes entering the storm drain line and the sewage was entering at the pipe joint only one segment (3 feet) up the pipe on both sides and through some cracks also in that first pipe segment. It was confirmed with dye tests. Pipe bursting work completed on 9/10. Dye testing done on 9/11 and 9/14 confirm SSO has been abated in this section of pipe.	OCAL	8/13/2015	Resolved
2126	Springhouse Path Sewage Leak (5113 Falls Rd SSO 3939)	Springhouse Path at Falls Rd	Jones Falls	Sewage leaking into inlet pipe from sanitary the runs up Springhouse Path. Discovered while walking up storm drain main following up on the Cross Keys Above Spring House investigation, which was discovered during ammonia screening survey. Flow in the inlet pipe estimated at 0.25 GPM. Post repair work visit on 9/22 the flow increased from .25 GPM to .75 GPM. Post repair work visit on 9/25 flow decrease to 0.125 GPM. Further dye testing on 9/29 reconfirms that both sanitary pipes and manhole along Falls Rd are not leaking, and the pipe on Springhouse Path is the pipe leaking. 11/16/15 followup visit found flow increased to 0. 237 GPM (flow measured with cup). Dye present from deploy above lower joint. 11/17/15 flow decreased dye testing results show leak in the manhole. Manhole was rehabilitated and problem was abated on 12/16/15 and inlet pipe is dry.	OCAL	9/15/2015	Resolved

Table I-2: Summary of PST Investogations: SSOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2136	1333 N Milton (SSO#3944)	1333 N Milton Ave (southeast corner of N Milton Ave and E Hoffman St)	Harbor	High ammonia (0.52 mg/l) was recorded during ammonia survey at the Lakewood & Hudson site on 9/17. Tracked problem to a choked sanitary at 1333 N Milton Ave. Flow was restored to sanitary line and overflow stopped on 9/18.	OCAL	9/17/2015	Resolved
2137	Central & Fleet 091715	Northwest corner of Central Ave & Fleet St	Harbor	High ammonia (0.78 mg/l) recorded during ammonia survey. Tracked problem to choked sanitary at Central Ave & Fleet St. Sanitary was choked for several blocks.	OCAL	9/17/2015	Resolved
2138	2401 Crest Rd SSO# 3945	2401 Crest Rd	Jones Falls	Manhole choked and holding. Coming out outfall at Cross Country and Dale Rd.	OCAL	9/17/2015	Resolved
2155	5009 Blythewood Rd SSO 4024	5009 Blythewood Rd	Jones Falls	High ammonia value (0.86 mg/l) during SR survey on 11/4 started investigation. Original team noted construction sediment as source of problem. Another team investigated and found a choked sanitary line is causing an overflow underground into the storm drain and entering Stony Run through the Lawndale double cell outfall.	OCAL	11/4/2015	Resolved
2186	1239 Glenwood Ave	Manhole is located in the front yard of 1239 Glenwood Ave.	Back River	High ammonia recorded during watershed survey. Problem tracked to a choked sanitary at 1239 Glenwood Ave.	OCAL	1/5/2016	Resolved
2199	1239 Glenwood Ave SSO# 4128	1239 Glenwood Ave	Back River	Choke sanitary causing sewage to leak into storm drain inlet pipe at Glenwood Ave and Northwood Drive. M. Curbeam (UMD) said he will have the line CCTV on 1/22/16. followup found new sso.	OCAL	1/21/2016	Resolved
2222	5009 Blythewood Rd SSO# 4221	5009 Blythewood Rd	Jones Falls	Sanitary holding and discharging into storm drain.	OCAL	3/15/2016	Resolved
2226	5801 Greenspring Rd SSO# 4225	5801 Greenspring Rd	Jones Falls	Followup visit on 3/17 for SSO # find joints in the right channel of sanitary manhole leaking into the storm drain inlet pipe. On 5/5/16 contractor finished rehabbing manhole. Followup visit finds outgoing pipe is leaking again. On 5/16/16 contractor installs 19 ft of new outgoing pipe. Followup dye testing show sewage is still leaking in the storm from the manhole. Hole found in the invert section of manhole probably from bypass.Contractor repaired hole on 6/10/16. Followup on 6/16 found small amount of disharge from seam in inlet pipe. CIPP lining completed in the in flowing pipe. Follow up dye test on 6/30/16 was absent in storm drain inlet connection after one hour. Manhole believed to still be leaking. A precast MH was installed on 10/18/18. Followup on 11/14/16 inlet pipe is dry. Problem abated.	OCAL	3/17/2016	Resolved
2234	5009 Blythewood Rd SSO# 4287	5009 Blythewood Rd	Jones Falls	Choke causing overflow into adjacent storm drain. Followup visit on 4/19/16 SSO still active. Dye test confirms line is leaking into storm. Blockage about 6inches up the line from the manhole on Lawndale. UMD went down from Blythewood but only able to get 160 ft to the next manhole. 4/20/16 used pole-cam to see hard blockage at the manhole on Lawndale. Contractor removed blockage and replace section of pipe. SSO abated.	OCAL	4/18/2016	Resolved
2238	4104 Fairview Ave SSO# 4303	Across the street from 4104 Fairview Ave.	Gwynns Falls	Choke at manhole. Heavy sewage discharging into storm drain from an adjacent choked sanitary pipe. Chokes at the top of the pipe. There is a 4 inch protrusion of CIPP liner that catches rags and debris.	OCAL	4/25/2016	Resolved

Table I-2: Summary of PST Investogations: SSOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2251	2951 Rosalind Ave SSO# 4320	2951 Rosalind Ave	Jones Falls	Choke and break in sewer line with no lower manhole. Can see water entering storm and sanitary pipe. Went up 360 with pressure and 340 down. Camera went down 170 in sanitary where it went under water and camera proceeded 20 more feet. Camera went up to the missing manhole but could not proceed due to brick just below manhole, pipe fractured. Camera went down 140 in storm where it start to go underwater. UMD unburied manhole which was 8 ft underground and relieved choke. As they relieved the pipe debris was falling from the collapse. OAM has scheduled a contractor to repair the collapsed pipe. Followup dye test and ammonia shows problem is abated. Do not close investigation until final work is complete. Once water main was repaired a followup (9/2016) ammonia test found low result. CCTV performed of storm found no inputs.	OCAL	5/9/2016	Resolved
2255	2912 Woodland Ave SSO# 4332	2912 Woodland	Jones Falls	House lateral leaking between cleanout and main leaking into storm. CCTV shows some offset joint. CIPP of lateral.	OCAL	5/10/2016	Resolved
2267	2905 Christopher Ave SSO# 4361 & 4365	2905 Christopher Ave	Back River	Choke causing overflow into storm at 5 gpm. The discharge into the storm was stopped. Collapsed Pipe located at the corner of Christopher Ave and Old Harford Rd. Followup on 6/13 found discharge into storm increased to 5 gpm. Can seen sewage entering storm manhole on sidewalk at the connection from the manhole to the outgoing pipe. Suspect the school lateral may have a hole	OCAL	6/9/2016	Referred / not resolved
Surface SSOs							
994	Gwynns Falls Conservation Trail @ 2520 Talbot	500' north of Windsor Mill Rd along GF Conservation Trail behind 2520 Talbot St.	Gwynns Falls	There is a small pool of sewage in an eroded section of the trail. An old sanitary line is collapsed below the trail. Possible connection to home a 2520 Talbot needs to be determined. Follow up on 4/1/16 confirmed that no evidence of sewage has been leaking from old pipe. Repairs to trail have remained intact	Citizen	7/30/2014	Resolved
2067	Hilton Parkway & Edmondson Ave SSO 3829	North side of Edmondson bridge on west side of stream	Gwynns Falls	Overflowing sanitary manhole at a rate of 50 GPM.	City	7/9/2015	Resolved
2072	4506 Wakefield Rd House Connection SSO# 3841	Street in front of 4506 Wakefield Rd	Gwynns Falls	High ammonia continues at 4410 Wakefield after sanitary mainline choke at 4506 Wakefield was relieved. Tracked to sewage percolating from the street at 4506 Wakefield were house connection is damaged or choked.	OCAL	7/15/2015	Resolved
2074	6465 Frankford Ave Rear SSO# 3843	In the rear of 6464 Frankford Ave there is a sanitary manhole 15' off of the west corner of fence along Biddison Run	Back River	Overflowing sanitary manhole found while doing the HR survey. The right channel of the culvert has very grey water and had a very strong sewage odor.	OCAL	7/15/2015	Resolved
2092	5609 Liberty Heights Ave SSO 3877	Sanitary manhole is located 50 ft in woods from alley behind 5609 Liberty Heights Ave.	Gwynns Falls	Found surcharging sanitary while on road leading to Powder Mill SIS site and USGS station.	OCAL	8/3/2015	Resolved
2093	Hilton Parkway & Edmondson Ave SSO 3878	North side of Edmondson bridge between Hilton and Gywnns Falls stream	Gwynns Falls	Surcharging sanitary manhole on north side of bridge at Edmondson, between Hilton Pkwy and Gwynns Falls stream	OCAL	8/3/2015	Resolved
2095	4210 N. Charles St. 8" Sanitary Drip SSO# 3865	Rear property of 4210 N Charles St	Jones Falls	A small drip was noticed at one of the joints in the newly replaced section. Multiple repairs between 8/24 and 8/31. Abated	City	8/4/2015	Resolved
2104	4616 Newgate Ave SS 3896	Corner of Newgate and Newkirk 2 ft left of the fire hydrant.	Patapsco	Sewage peculating from ground. Dye test of building showed no dye. The building sewer line exits building 8 ft left of front door. Visible in basement. Sewage is suspected to be leaking from pressurized sewer line. There was evidence of a previous repair that failed where two different size pipe come together. There is a small pumping station which pumps waste from ship at the pier	OCAL	8/17/2015	Resolved

Table I-2: Summary of PST Investogations: SSOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2123	1704 W Rogers Ave SSO#3903 (Cityworks #206958)	Parking lot of Mt Washington Pediatric Hospital	Jones Falls	This sanitary manhole is routinely emptied because the downstream pipe is collapsed. A remodel to the sanitary line to pump the flow to Rogers Ave is in progress.	Cityworks	8/19/2015	Resolved
2134	Hilton Parkway & Edmondson Ave SSO 3941	Hilton Parkway & Edmondson Ave	Gwynns Falls	Discharging sanitary manhole on north side of bridge. Found will doing a drive by followup.	OCAL	9/16/2015	Resolved
2147	Lazear Rd Sanitary Stack SSO# 3979	Park at Woodington Rd and Lindley Rd	Gwynns Falls	Line choked and discharging from base of stack next to storm water outfall.	OCAL	10/5/2015	Resolved
2148	4550 N Charles SSO 3986	Sanitary line crossing stream, located 150 feet west of house at 4550 N Charles St.	Jones Falls	Citizen reported polluted water coming from pipe into a stream in the rear of 4550 N Charles St. The investigation found a leaking sanitary line, that crosses a Stony Run tributary. The leak is located at the right bank (looking upstream) of the sanitary pipe, approximately 0.1- 0.25 GPM. Repair by UMD on 10/17. Followed up on 10/19 shows SSO is abated.	Cityworks	10/8/2015	Resolved
2152	Lazear SSO 4003	Wooded area about 375 feet west of N. Woodington Rd & Lindley Rd., near sanitary manhole S03CC_004MH	Gwynns Falls	OCAL performed dye test on 10/22 to confirm abatement.	OAM	10/20/2015	Resolved
2163	Chinquapin Run SSO (5100 Perring Parkway SSO# 4036)	Just downstream of the Morgan State footbridge over the stream.	Back River	SSO at sanitary stack exceeding 10K Gallons. Discharging at a rate >100 GPM. Found during Herring Run survey. 11/19/15 still active and bypass pumping being setup. Repair done	OCAL	11/19/2015	Resolved
2171	2911 Waterview Ave SSO# 4077	2911 Waterview Ave	Patapsco	Sewage was discharging from small hose on Bypass pump for (SSO# 4074) and flowing into the storm drain inlet. Discovered during SSO 10K sampling at Waterview Ave. outfall.	OCAL	12/16/2015	Resolved
2172	2900 Waterview Ave SSO# 4074	2900 Waterview Ave	Patapsco	Contractor damaged the pressure main from the pump station. This was a 10K gallon sampling event. UMD routed the leaking hose to the sanitary manhole.	Citizen	12/14/2015	Resolved
2178	Lazear Rd SSO 4091	Lazear Rd	Gwynns Falls	Sewage is leaking from 6" pipe below the the 8" pipe on the left bank. Found during routine site visit. Dye added to manhole and it discharged from the 6" pipe. DPW plugged the 6" to stop the SSO. The sewage is now leaving the from the right bank where the pipes protrude from the concrete. Dye was added to the manhole and it discharged from the 6" and concrete below the 8' but above the 6". Contractor to seal the overflow stub a 12/30 NM visited site to find SSO has stopper. The pvc and clay pipes at both ends re-established. 1/5/16 - Contractor on scene bricking up overflow pipe. 6 inch pipe was packed with concrete and section in stream was removed.	OCAL	12/28/2015	Resolved
2179	Lazear Rd (1201 Woodington Rd) SSO# 4098	Lazear Rd (1201 Woodington Rd)	Gwynns Falls	In an effort to stop the SSO the previous day UMD plugged the 6" line and sewage leaked from a different location.	City	12/30/2015	Resolved
2180	Leon Day Park @ Ellicott Driveway (SSO# 4099)	Gwynns Falls trail between Leon Day Park and Ellicott Driveway, just east of the railroad bridge.	Gwynns Falls	Complaint received from Parks and People about a possible sewer overflow. Investigation found evidence of overflow along with a broken collar and manhole cover removed from stack. DPW replaced the cover and fix the collar with a locking cover. Also cleaned the overflow debris.	Parks and People Foundation	12/30/2015	Resolved
2184	1901 Eagle Dr SSO# 4107	1901 Eagle Dr	Gwynns Falls	SSO on a uncharted sanitary sewer behind Outward Bound building. This also occurred about 3 years ago. 1/6/16 followup found choke was relieved and root balls were removed. NM found SSO occurring down stream of this location	Cityworks	1/4/2016	Resolved

Table I-2: Summary of PST Investogations: SSOs

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS
2188	1901 Eagle Dr SSO 4110	Access to this site is easiest by parking on Frankilntown Rd at the bridge over Dead Run then follow the small stream up.	Gwynns Falls	Found while following up on SSO from previous day. Found a seep coming from the ground with a discharge of about 10 - 20 GPM. Deployed dye in Manhole 1 and it was present at seep within 15 minutes. 1/7/16 DPW dug pit to collect sewage and is channeled into pipe. 1/11/16, contractor repaired collapsed pipe	OCAL	1/6/2016	Resolved
2198	3100 Block of Artaban Rd SSO#4123	Coldesac area of 3100 Block of Artaban Rd within Artaban Townhouse community	Gwynns Falls	High ammonia (1.85ppm) reported during survey on 1/15. Investigation on 1/20/16 tracked ammonia to overflow in town home community. Waste water was overflowing from a house clean out due to choke in mainline.	OCAL	1/15/2016	Resolved
2206	4600 Parkton St SSO#4143	Behind 4600 Parkton St and Beechfield Elementary along Maidens Choice	Gwynns Falls	Evidence of overflow observed while sampling Beechfield Elementary ammonia screening site. Grey debris and toilet paper around sanitary stacks. Manhole rim and covers were also dislodged. DPW cleaned debris and readjusted manhole rim and cover	OCAL	2/4/2016	Resolved
2208	2760 Wilkens Ave SSO# 4158	Sanitary manhole along the CSX railroad tracks next to 2760 Wilkens Ave.	Gwynns Falls	Observed the overflowing sanitary manhole and CSX explained that it was observed while they were cleaning up the area (location is a notorious illegal dumping area). Using heavy equipment, CSX was attempting to clean the area regrade the trench along the railroad	Other	2/12/2016	Resolved
2217	4210 N. Charles St SSO# 4198	below storm water outfall	Jones Falls	Evidence of sewer overflow in pool. There is a 1- inch gap where PVC pipe meets the VC pipe allowing stream water to flow into sanitary pipe. Dye deployed in sanitary absent in stream. Contractor repaired pipe and encased pipe in concrete	OCAL	3/3/2016	Resolved
2228	5001 Pulaski Hwy Rear of Potts & Callahan SSO# 4232	behind rubble piles along oil line in rear of Potts & Callahan property	Back River	SSOs reported as occuring during rain events. A retaining pond is scheduled for construction in the area affected by the overflow. DPW found evidence of a significant overflow from a sanitary manhole. The manhole is in the woods and maintenance vehicles can not access it. DPW reattached and sealed the frame. Routine monitoring continued.	Citizen	3/24/2016	Resolved
2236	5512 Boxhill Ln SSO# 4293	Rear of 5512 Boxhill Ln at Stony Run	Jones Falls	BWB reported high ammonia (9.68mg/L) during an outfall screening event. DPW found that the house connection from 5512 Boxhill Ln was broken. The segment of pipe that crosses the stream was missing causing waste water to flow directly into the Stony Run. This is the second time that this sewer lateral has been damaged (1st occurred in 2007).DPW repaired pipe crossing the stream	Blue Water Baltimore	4/19/2016	Resolved
2237	6830 Everall Ave SSO# 4304	6830 Everall Ave	Back River	Surcharging sanitary manhole flowing into stream and culvert. High ammonia at Mary Ave SIS site.	OCAL	4/26/2016	Resolved
2239	1900 Eagle Dr Residential Connection	Building next to the new Outward Bound Building	Gwynns Falls	House connection was overflowing into the yard making the grass very tall and ground saturated. Clean out overflowed as well. DPW cleared the line.	Cityworks	4/18/2016	Resolved
2266	Hollander Ridge-East Boundary Ave 060316	In a fenced off area at the beginning of 2100 Block of East Boundary Ave. (Rosedale area)	Back River	High ammonia value (1.09mg/L) during ammonia screening on 6/02/16 led to an overflowing sanitary manhole beyond a dead end on East Boundary Ave.	OCAL	6/2/2016	Resolved

Table I-3: Summary of PST Investogations: Drinking water transmission losses

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS	DISCHARGE CLASSIFICATION
908	Wilkens @ Hurley Water Main Break	Hillside about 100 feet east of Hurley Ave. at Wilkens Ave.	Gwynns Falls	Potable water seeping from hillside, around 2.0 GPM.	OCAL	12/19/2013	Resolved	Potable Water
1041	West Garrison Ave & Greenspring Ave Water Leak	Problem is located at intersection of W. Garrison Ave & Greenspring Ave.	Jones Falls	Water is entering the line at a joint. It's 12 feet downstream from storm drain manhole D15QQ1040MH. There is a water valve cover on the surface that is very close to where the potable water is entering the line. Flow is 40 GPM. Followup on 3/17/16 found problem still active. UMD fixed problem.	OCAL	10/30/2014	Resolved	Potable Water
2011	23rd & Huntingdon Water Main Leak	W. 23rd St & Huntingdon Ave.	Jones Falls	Smell strong chlorine from a 24" drain at 23rd St, while conducting lateral sampling of JF11.5. Appeared to be a water main leak to locate, at the intersection of W. 23rd St & Huntingdon Ave. Approximate flow to be 25-30 GPM. Leak was located by detection crew and repaired on 8/15/16.	OCAL	5/13/2015	Resolved	Potable Water
2034	Braddish @ 2606 Lafayette Water Main Leak	Braddish Ave on east side of 2606 Lafayette Ave.	Gwynns Falls	Water main leak found while investigating another PST. Water is leaking into storm drain through two inlets and a manhole.	OCAL	5/29/2015	Resolved	Potable Water
2145	35th St. & Tivoly Ave Water Main	35th St. & Tivoly Ave	Back River	Potable water found entering storm drain through cracks in the manhole wall as well as entering from north branch inlet connection. Located Leak and Referred to construction on 10/15/15.	OCAL	9/29/2015	Resolved	Potable Water
2173	Lothian & Woodbourne (Southwest Corner)	Lothian Rd & Woodbourne Ave. (Southwest Corner)	Back River	Noticed Chinquapin Run stream was flowing very turbid during Ammonia Survey. The problem was tracked to water main break at Lothian Rd. & Woodborne Ave.	OCAL	12/9/2015	Resolved	Potable Water
2201	Ann & Fleet Water Leak	Manhole on southwest corner of Ann St & Fleet St	Harbor	Clear water entering storm drain manhole through cracks and mortar joints was observed while sampling manhole for East Harbor Storm Drain Ammonia Survey. There is a nearby water leak on the northeast corner of Ann & Fleet that was reported to 311. Followup on 2/19/16, leak is still active and now believed to be separate from leak at 533 Ann. Leak to locate w/o created. Follow up on 5/26/16, problem has been repaired.	OCAL	1/15/2016	Resolved	Potable Water
2227	5800 Greenspring Ave Water Leak	5800 Greenspring Ave	Jones Falls	Water entering storm pipe. There was leak repaired in February that was at the surface.	OCAL	3/17/2016	Resolved	Potable Water
2258	2951 Rosalind Ave Water Leak	2951 Rosalind Ave	Jones Falls	Upon UMD performing cctv of the sanitary and storm pipe, water was spraying in at multiple locations. Water main repaired.	OCAL	5/9/2016	Resolved	Potable Water

Table I-4: Summary of PST Investogations: Other Illicit Discharges

PST ID	PST NAME	LOCATION DESCRIPTION	WATERSHED	PST COMMENTS	COMPLAINT SOURCE	INVESTIGATION INITIATED	PST STATUS	DISCHARGE CLASSIFICATION
1023	1002 Iris Ave	Alley at 1002 Iris Ave	Back River	Citizen complaint to U.S. EPA of resident washing machine is discharging directly into alley. Residence appears to have added a clothes washer to an enlclosed back porch and it is suspected that they plumbed the discharge line into sump discharge pipe. Laundry wash water was redirected to wastewater connection. Problem abated.	Citizen	10/2/2014	Resolved	Other

Table I-5: Summary of FOG Notices of Violations

Action	Violation Type	Total
No GCD	Unauthorized discharge.	137
No GCD 2nd notice	Unauthorized discharge.	112
No GCD 3rd notice	Unauthorized discharge.	26
Failed 25% Rule	Unauthorized discharge.	400
Failed 25% Rule 2nd Notice	Unauthorized discharge.	90
Failed 25% Rule 3nd Notice	Unauthorized discharge.	41
Plumbing Code	Plumbing Code	318
No Maintenance Log	Inadequate / no maintenance log	617
No Maintenance Log 2nd Notice	Inadequate / no maintenance log	133
No Maintenance Log 3rd Notice	Inadequate / no maintenance log	4
Refused Admittance	Refused admittance	130
Inaccessible GCD	Inaccessible GCD	40
Inadequate Maintenance of GCD, overflow, waste/recycle grease area	Inadequate maintenance of waste / recycle grease area	5
Rescind NOV		-4
	Total violations:	2,049
	Number of inspections:	3,623

NOTES

FSEs may receive multiple NOVs for one inspection.

Baltimore City Public Schools are replacing or adding grease control devices (GCDs) during major renovations at 32/144 schools in FY17. State Board of Public Works approved funding for the GCDs in early September 2016. Balance of schools renovations pending.

Appendix J: Baltimore Clean Guide

Appendix K: Summary Report for Pop Up GROW Centers

Appendix L: Progress Status of Milestones

- Table L-1: MS4 and TMDL WIP Milestones [Ref. MS4 Restoration and TMDL WIP, part 5, dated August 2015]
- Table L-2: Trash TMDL Implementation Milestones [Ref. Implementation Plan for the Middle Branch/Northwest Branch Trash TMDL in Baltimore, Part 7.1, dated January 2016]

Table L-1: Progress Status of MS4 and TMDL WIP Milestones for FY 2016

Program Milestones	Status
Complete street tree survey, in coordination with the US Forest Service.	Initiated but not complete. BCRP is responsible entity.
Engage local universities for internships, research, and stewardship regarding water quality improvement.	Initiation complete. This will be an on-going process.
Complete Casino Area Master Plan (Middle Branch) for use of funds from the Baltimore Casino.	Complete. Dept. of Planning is responsible entity
Develop MOU with NPDES Phase II MS4 (state) and NPDES Industrial Permit (state and local) regarding potential off-site mitigation within Baltimore City, focusing on BMP accounting, maintenance, and data sharing.	No requests for mitigation by industrial permit holders in FY 2016. MDE did not issue tentative determination for Phase II MS4 permit until December 2016.
Update SWM and ESC Guidelines per state regulation and local policies to facilitate SWM and ESC Guidelines available on website.	In progress. Website changes are set for March 2017, converging with consolidation of Cleanwater Baltimore website to City DPW website.
Initiate and provide training courses for developers, NGOs, and community leaders regarding the SWM/ESC plans review process.	Initiated in summer of 2015. Additional courses scheduled in FY 2017 and will continue as a regular training course. Planned additions / webinars for website by summer 2017.
Modify review process to facilitate restoration practices, including alternative plan review structure and technical certification requirements.	Review process established within the confines of current City Code. Alternative certification process became part of a MS4 Manager work group. Draft recommendations sent to MDE in December 2016.
Create integrated tracking database for SWM/ESC plans review and inspections, including GIS elements, standard reports, paperless field report / input, and work order assignments	In progress with migration of new MDE Geodatabase. Hardware for paperless field reporting completed in FY 2016. Full migration of software scheduled for FY 2017.
Approve the City's revised zoning code with updates to the SWM requirements.	Transform Baltimore – adopted by Mayor and City Council in December 2016, anticipated to go into effect June 2017. This update to the zoning code was last done in the mid-1970s.

Program Milestones	Status
Develop standardized designs and supporting calculations for ESD practices.	In progress with support from grant funding. 60% details were completed in FY 2016. Final details and calculations to be submitted to MDE and issued to the public for use in FY 2017.
Complete feasibility studies for private participation incentive programs, such the Adopt the-Green program and STORM Centers (*now called GROW Centers*).	Delayed due to funding BUT initial GROW centers started as pop-up in Spring 2016. See Appendix K.
Complete feasibility study for the use of recycled materials in BMP construction as a sustainable alternative to material disposal.	Postponed to FY 2017. Will be a part of the GROW Center feasibility study.
Develop Stormwater BMP maintenance plan for city-owned facilities, including staffing, budget, and funding.	In progress. Maintenance plan has been developed for DPW/ MS4 projects; a larger plan is being evaluated for all City-owned facilities.
Increase staff by 6 FTE by hiring or contracting for utility maintenance	Completed as part of contracted services for inlet cleaning.
Create a "one-stop shop" for resources and information on reducing stormwater pollutants	In progress for publication similar to Clean City Guide (see Appendix J), in addition to modification to DPW website, scheduled for Spring 2017. Anticipated completion in FY 2017.
Develop and implement 3 training workshops for community stormwater BMP maintenance.	1 workshop completed at BDC. Other 2 scheduled for FY 2017.
Begin working with 10 neighborhoods on stormwater planning	Complete.
Create a consistent set of informational sheets, messages, and signage for reducing stormwater pollutants.	In progress as part of consolidation / modification of DPW website, scheduled for Spring 2017.
Project Milestones (construction initiated)	
0.85 miles of stream restoration.	Construction advertisement in August 2016.
2.4 acres restored using ESD Practices.	Construction advertisement in August 2016.

Table L-2: Progress Status of Trash WIP Milestones for FY 2016

Milestones	Status
Continue the following programs (FY 2016): • City-wide Mechanical Street Sweeping • Styrofoam Collection • DPW Digital / Social Media • DPW School Presentations • DPW Events / Community Presentations • Stormwater participation event clean-ups / Canoe 'n Scoops • FLASH Cam program • Storm Drain Art	Complete.
Launch Clean Corps (FY 2016)	Complete. See Section 5.5.7.3 of FY 2016 MS4 Annual Report for more details.
Install Phase 1 of modified inlets / Begin proactive inlet cleaning (FY 2016)	Complete. See Section 5.4.2 of FY 2016 MS4 Annual Report for more details.
Implement Municipal Can Program (FY 2016 to 2017)	Initiated in FY 2016. See Section 5.4.1 and 5.5.7.1 of FY 2016 MS4 Annual Report for more details.
Develop anti-littering marketing campaign (FY 2016 to 2017)	Initiated in FY 2016. See Section 5.5.7.4 of FY 2016 MS4 Annual Report for more details.
Work with Baltimore County to develop monitoring program (FY 2016 to 2017)	Initiated in FY 2016.
Explore ways to expand / enhance Canoe 'n Scoop and other harbor clean-ups (FY 2016 to 2017)	Initiated in FY 2016.
Prepare feasibility studies for in-line / end-of-pipe debris collectors based on project selection criteria (FY 2016 to 2017)	Initiated in FY 2016.

Appendix M: Progress Status of Projects, Programs, and Partnerships for 20% Restoration

- Table M-1: Progress Status of Projects
- Table M-2: Progress Status of Programs
- Table M-3: Progress Status of Partnerships

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
Structural / Traditional BMPs													
S01	SW Pond Retrofit	Gwynns Falls	Gwynns Run, Carrolton Park	38	25	132	17	15,525	$505,000	2016	2018		
				38	25	132	17	15,525	$505,000	2017	2018	Pending	
S02	SW Pond Retrofit	Gwynns Falls	Seton Business Park Park	62	41	214	27	25,169	$795,000	2016	2018		
				62	41	214	27	25,169	$795,000	2017	2018	Pending	
S03	Pond Retrofit and New Pond	Back River	North Point Road @ Kane and Quad	92	60	317	40	37,260	$3,290,000	2015	2016		Ex. Pond on RCRA site. Retrofit is not practicable.
												Removed	
S04	Wetland / Pond	Back River	Perring Parkway at Cloville (HR-R28B)	23	15	63	13	8,484	$344,000	2016	2018		
				46	30	127	26	17,197	$2,687,000	2017	2018	Pending	
S05	Wetland / Pond	Back River	Herring Run Park below Shannon at Lyndale (HR-R15C)	31	20	84	17	11,465	$550,000	2016	2018		
				31	20	84	17	11,465	$1,956,950	2016	2018	Under Design	
S06	Wetland	Back River	Herring Run Park below Shannon at Kavon Ave (HR-R39)	31	20	84	17	11,465	$550,000	2016	2018		
												Removed	
S07	Wetland	Back River	Herring Run Park below Parkside at Sinclair (HR-R15A)	100	65	275	56	37,260	$1,600,000	2016	2018		
												Removed	
S08	Wetland	Back River	Chinquapin Run Park between Belvedere and Alameda (CH-R6A)	69	45	190	39	25,795	$1,840,000	2016	2018		Project was removed since A05 changed, also based on feasibility.
												Removed	
S09	Bioretention Area	Baltimore Harbor	Faring Baybrook Park Rec Center (MC-18a)	5	3	17	3	1,702	$160,000	2016	2018		
				5	3	17	3	1,702	$523,300	2016	2018	Under Design	
S10	Bioretention Area	Gwynns Falls	Park Hts Virginia + Homer	3	2	11	2	1,135	$60,000	2016	2018		
				3	2	11	2	1,135	$196,250	2016	2018	Under Design	
S11	Shallow extended detention wetland	Jones Falls	West Coldspring and Brand Ave (LJ-R9)	14	9	46	8	4,624	$212,000	2016	2018		
				14	9	46	8	4,624	$693,400	2016	2018	Under Design	
S12	Shallow wetland	Jones Falls	Woodheights and La Plata (LJ-R38)	6	4	21	3	2,102	$96,000	2016	2018		
				6	4	21	3	2,102	$314,000	2016	2018	Under Design	
S13	Shallow wetland	Jones Falls	Lower Lower Stony Run	0	0	0	0	0	$0	2016	2018		Part of Project A02. Total costs shown in A02.
			1	31	20	107	17	10,614	$0	2016	2018	Under Design	
			Subtotal Structural / Traditional (WIP):	**475**	**309**	**1,455**	**243**	**181,986**	**$10,002,000**				
			Subtotal Structural / Traditional (Current):	**237**	**154**	**760**	**121**	**89,533**	**$7,670,900**				

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
ESD Practices													
E01	Micro-bioretention	Baltimore Harbor	Cloverleaf - northwest of I-895 and Frankfurst Ave (MC-30)	0.5	0.4	2.1	0.34	217	$50,000	2016	2019		
				0.5	0.4	2.1	0.34	217	$239,930	2016	2018	Under Design	
E02	Micro-bioretention	Baltimore Harbor	Bush St. Curb bump-out	0.3	0.2	1.2	0.20	127	$80,000	2011	2016		Construction advertised Aug. 2016.
				0.3	0.2	1.2	0.20	127	$102,900	2011	2017	Under Design	
E03	Micro-bioretention	Baltimore Harbor	Lafayette inner block retrofit.	0.9	0.7	4.0	0.64	411	$240,000	2011	2016		Construction advertised Aug. 2016.
				0.9	0.7	4.0	0.64	411	$308,900	2011	2017	Under Design	
E14	Micro-bioretention	Baltimore Harbor	Bay Brook MS (MC-18b)	0.3	0.3	1.5	0.2	157	$54,000	2015	2016		
				0.3	0.3	1.5	0.2	157	$138,748	2016	2018	Under Design	
E15	Micro-bioretention	Baltimore Harbor	Bay Brook MS (MC-18c)	0.2	0.2	1.1	0.2	115	$46,800	2015	2016		
				0.2	0.2	1.1	0.2	115	$120,248	2016	2018	Under Design	
E16	Micro-bioretention	Baltimore Harbor	Bay Brook MS - parking lot (MC-18d)	0.2	0.2	1.1	0.2	115	$34,800	2015	2016		
				0.2	0.2	1.1	0.2	115	$89,915	2016	2018	Under Design	
E18	Micro-bioretention	Baltimore Harbor	Brooklyn / Curtis Bay	1.1	0.9	5.0	0.8	513	$19,800	2015	2016		
				1.1	0.9	5.0	0.8	513	$508,743	2016	2018	Under Design	
E19	Micro-bioretention	Baltimore Harbor	Patterson Park (HA-R5A)	0.3	0.2	1.4	0.2	139	$40,000	2016	2018		
				0.3	0.2	1.4	0.2	139	$40,000	2016	2018	Under Design	
E20	Micro-bioretention	Baltimore Harbor	Ellwood Park (HA-R8)	0.2	0.1	0.7	0.1	72	$21,000	2016	2018		
				0.2	0.1	0.7	0.1	72	$21,000	2016	2018	Under Design	
E21	Micro-bioretention	Baltimore Harbor	Patterson Park Adjunct (HA-R6)	0.8	0.6	3.6	0.6	362	$105,000	2016	2018		
				0.8	0.6	3.6	0.6	362	$105,000	2016	2018	Under Design	
E22	Micro-bioretention	Baltimore Harbor	Patterson Park / Highlandtown / Baltimore Highlands	5.1	4.1	24.1	3.79	2,446	$710,000	2016	2018		
				5.1	4.1	24.1	3.79	2,446	$710,000	2016	2018	Under Design	
E23	Micro-bioretention	Back River	Frankford / Greater Lauraville / Belair-Edison / Cedonia	4.6	3.6	21.6	3.40	2,198	$671,000	2016	2018		
				4.6	3.6	21.6	3.40	2,198	$671,000	2016	2018	Under Design	
E24	Micro-bioretention	Back River	Erdman Avenue	1.4	1.2	6.8	1.07	694	$128,000	2016	2018		
				1.4	1.2	6.8	1.07	694	$128,000	2016	2018	Under Design	
E25	Micro-bioretention	Back River	Belair Road	0.3	0.2	1.2	0.20	127	$77,000	2016	2018		
				0.3	0.2	1.2	0.20	127	$77,000	2016	2018	Under Design	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
E26	Micro-bioretention	Jones Falls	Hampden / Remington / Wyman Park	6.3	5.0	29.7	4.67	3,020	$850,000	2016	2018		
				6.3	5.0	29.7	4.67	3,020	$850,000	2016	2018	Under Design	
E27	Micro-bioretention	Gwynns Falls	Howard Park / Grove Park / West Arlington / Fairmount	3.1	2.5	14.9	2.34	1,510	$420,000	2016	2018		
				3.1	2.5	14.9	2.34	1,510	$420,000	2016	2018	Under Design	
E28	Micro-bioretention	Gwynns Falls	Hunting Ridge / Rognel Hts / Edmondson Village / Edgewood	3.1	2.5	14.9	2.34	1,510	$420,000	2016	2018		
				3.1	2.5	14.9	2.34	1,510	$420,000	2016	2018	Under Design	
E29	Micro-bioretention	Baltimore Harbor	Sharp-Leadenhall / Federal Hill / Otterbein / S. Baltimore	1.6	1.3	7.4	1.17	755	$215,000	2016	2018		
				1.6	1.3	7.4	1.17	755	$280,000	2016	2018	Under Design	
E30	Micro-bioretention	L. N. Branch Patapsco	Cherry Hill	3.1	2.5	14.9	2.34	1,510	$500,000	2016	2018		
				3.1	2.5	14.9	2.34	1,510	$660,000	2015	2018	Under Design	
E31	Micro-bioretention	Baltimore Harbor	Lakeland / Mt. Winans / Westport	1.6	1.3	7.4	1.17	755	$420,000	2016	2018		
				1.6	1.3	7.4	1.17	755	$420,000	2016	2018	Under Design	
E32	Micro-bioretention	Baltimore Harbor	McElderry Park / CARE / Milton-Montford / Patterson Place	3.1	2.5	14.9	2.34	1,510	$438,000	2016	2018		
				3.1	2.5	14.9	2.34	1,510	$520,000	2016	2018	Under Design	
E33	Micro-bioretention	Gwynns Falls	Greater Mondawmin / Walbrook / Rosemont / NW Community Action /	3.1	2.5	14.9	2.34	1,510	$438,000	2016	2018		
				3.1	2.5	14.9	2.34	1,510	$438,000	2016	2018	Under Design	
E34	Micro-bioretention	Jones Falls	Mt. Washington / Glen / Cheswolde / Cross Country	6.3	5.0	29.7	4.67	3,020	$1,350,000	2016	2018		
				6.3	5.0	29.7	4.67	3,020	$950,000	2016	2018	Under Design	
E35	Micro-bioretention	Back River	Cameron Village / Chinquapin Park (upstream to Chinquapin Run)	5.0	4.0	23.8	3.74	2,416	$680,000	2017	2019		
				5.0	4.0	23.8	3.74	2,416	$680,000	2016	2018	Under Design	
E36	Micro-bioretention	Back River	De Wees Park	1.3	1.0	5.9	0.93	604	$180,000	2017	2019		
				1.3	1.0	5.9	0.93	604	$180,000	2016	2018	Under Design	
E37	Micro-bioretention	Back River	Orchard Ridge / Armistead Gardens / Orangeville	6.3	5.0	29.7	4.67	3,020	$630,000	2017	2019		
				6.3	5.0	29.7	4.67	3,020	$920,300	2016	2018	Under Design	
E38	Micro-bioretention	Jones Falls	Central Park Heights / Towanda Grantley / Lucille Park	3.1	4.0	14.9	2.34	1,510	$513,000	2017	2019		
				3.1	4.0	14.9	2.34	1,510	$513,000	2016	2018	Under Design	
E39	Micro-bioretention	Gwynns Falls	MorrellPark / Wilhelm Park / Gwynns Falls / Carroll-South Hilton	3.1	6.0	14.9	2.34	1,510	$625,000	2017	2019		
				3.1	6.0	14.9	2.34	1,510	$625,000	2016	2018	Under Design	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
E41	Micro-bioretention	Back River	Clifton Park	0.3	0.2	1.2	0.19	121	$35,000	2017	2019		
				0.3	0.2	1.2	0.19	121	$35,000	2016	2018	Under Design	
E42	Micro-bioretention	Back River	Clifton Park	2.9	2.3	13.7	2.15	1,389	$400,000	2017	2019		
				2.9	2.3	13.7	2.15	1,389	$400,000	2016	2018	Under Design	
			Subtotal ESD Practices (WIP):	**69**	**60**	**328**	**52**	**33,359**	**$10,391,400**				
			Subtotal ESD Practices (Current):	**69**	**60**	**328**	**52**	**33,359**	**$11,572,684**				
Alternative BMPs (Stream Restoration)-- Drainage Area = Stream Restoration Length (LF)													
A01	Stream Restoration	Gwynns Falls	Leakin Park Stream Restoration at Fairmount Storm Drain	2,080 LF	31	156	141	62,400	$700,000	2010	2014		
				2,080 LF	31	156	141	62,400	$700,000	2010	2014	Completed	
A02	Stream Restoration	Jones Falls	Lower Lower Stony Run	4,500 LF	68	338	306	135,000	$4,030,000	2015	2016		Cost includes S13 and A44. Advertised in August 2016.
				4,600 LF	69	345	313	138,000	$4,199,700	2015	2017	Under design	
A03	Stream Restoration	Gwynns Falls	Powder Mill Phase 1	3,900 LF	59	293	265	117,000	$3,420,000	2009	2017		Proposed to align with sanitary improvements.
				3,900 LF	59	293	265	117,000	$4,580,700	2009	2017	Under design	
A04	Stream Restoration	Jones Falls	East Stony Run Project 1	800 LF	12	60	54	24,000	$839,000	2014	2017		Advertisement scheduled for Dec. 2016.
				800 LF	12	60	54	24,000	$1,135,000	2014	2017	Under design	
A05	Stream Restoration	Back River	Chinquapin Run Project 1	2,200 LF	33	165	150	66,000	$3,670,000	2014	2017		Increased length to coincide with sanitary replacement project.
				10,100 LF	152	758	687	303,000	$8,103,000	2014	2017	Under design	
A06	Stream Restoration	Back River	Chinquapin Run Project 2	2,600 LF	39	195	177	78,000	$1,772,000	2015	2017		
				2,600 LF	39	195	177	78,000	$2,086,000			Under design	
A07	Stream Restoration	Gwynns Falls	Franklintown Culvert	2,400 LF	36	180	163	72,000	$1,700,000	2015	2018		
				2,500 LF	38	188	170	75,000	$3,410,300	2015	2018	Under Design	
A08	Stream Restoration	Back River	Lower Moore's Run Project 2	2,500 LF	38	188	170	75,000	$1,960,000	2015	2018		
				2,500 LF	38	188	170	75,000	$2,144,000	2015	2018	Under Design	
A09	Stream Restoration	Back River	Biddison Run Project 2	3,030 LF	45	227	206	90,900	$3,590,000	2014	2018		Priority slope stabilization shown as A43.
				3,060 LF	46	230	208	91,800	$4,488,000	2014	2018	Under design	
A10	Stream Restoration	Jones Falls	Western Run at Kelly Avenue	800 LF	12	60	54	24,000	$1,324,600	2015	2018		
				2,100 LF	32	158	143	63,000	$2,500,000	2016	2018	Under Design	
A11	Stream Restoration	Jones Falls	East Stony Run Project 2	1,340 LF	20	101	91	40,200	$2,040,000	2015	2018		Postponed due to increased scope of A10.
				0 LF	0	0	0	0	$0			Removed	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
A12	Stream Restoration	Back River	Biddison Run Projects 3	3,850 LF	58	289	262	115,500	$1,800,000	2014	2018		
				3,850 LF	58	289	262	115,500	$2,250,000	2014	2018	Under design	
A13	Stream Restoration	Back River	Moore's Run Restoration Project 1	2,500 LF	38	188	170	75,000	$1,822,000	2015	2018		
				3,700 LF	56	278	252	111,000	$3,174,000	2016	2018	Under Design	
A14	Stream Restoration	Back River	Moore's Run Restoration Project 2	2,800 LF	42	210	190	84,000	$1,822,000	2015	2018		Will be advertized with A13 - Moore's Run Stream Restoration
				2,800 LF	42	210	190	84,000	$2,402,000	2016	2018	Under Design	
A15	Stream Restoration	Back River	Herring Run stream	2,665 LF	40	200	181	79,950	$2,702,000	2015	2018		Postponed due to increase of A05 scope
				0 LF	0	0	0	0	$0			Removed	
A16	Stream Restoration	Jones Falls	Druid Hill Park Stream Project	1,875 LF	28	141	128	56,250	$2,702,000	2015	2018		Postponed due to increased scope of A10.
				0 LF	0	0	0	0	$0			Removed	
A17	Stream Restoration	Gwynns Falls	Dead Run (Huntington Ridge)	2,600 LF	39	195	177	78,000	$2,702,000	2015	2018		
				800 LF	12	60	54	24,000	$2,050,000	2017	2018	Pending	
A18	Stream Restoration	Gwynns Falls	Maiden's Choice	2,600 LF	39	195	177	78,000	$2,702,000	2015	2018		Access problems. Project deemed not practicable.
				0 LF	0	0	0	0				Removed	
A19	Stream Restoration	Gwynns Falls	Maiden's Choice Tributary (Upland)	2,300 LF	35	173	156	69,000	$2,702,000	2015	2018		
				3,100 LF	47	233	211	93,000	$3,535,000	2017	2019	Pending	
A20	Stream Restoration	Gwynns Falls	Dead Run	2,200 LF	33	165	150	66,000	$2,702,000	2016	2019		
				3,100 LF	47	233	211	93,000	$3,650,000	2017	2019	Pending	
A21	Stream Restoration	Back River	Herring Run Western Branch	2,675 LF	40	201	182	80,250	$2,702,000	2016	2019		
				6,500 LF	98	488	442	195,000	$6,552,000	2017	2019	Pending	
			Subtotal Alternative BMPs (Stream Restoration) (WIP):	**52,215 LF**	**783**	**3,916**	**3,551**	**1,566,450**	**$49,403,600**				
			Subtotal Alternative BMPs (Stream Restoration) (Current):	**58,090 LF**	**871**	**4,357**	**3,950**	**1,742,700**	**$56,959,700**				
Alternative BMPs (Other)													
A22	Regenerative Step Pool Storm Conveyance	Gwynns Falls	Seamon Avenue	20	9	146	13	6,622	$1,168,000	2015	2017		
				20	6	139	11	5,120	$1,416,000	2015	2017	Under design	
A23	IA Removal, afforestation, bioretention	Baltimore Harbor	CARE Communities / McElderry Park / Milton-Montford	3.1	3.75	19.2	4.34	2,852	$496,000	2016	2018		
				3.1	3.75	19.2	4.34	2,852	$527,000	2016	2018	Under Design	
A24	IA Removal, afforestation	Baltimore Harbor	Harford Hts ES (HA-R19)	0.9	0.60	3.3	0.92	523	$110,000	2016	2018		INSPIRE School
				0.0	0.00	0.0	0.00	0	$0	2016	2018	Removed	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
A25	IA Removal, afforestation, bioretention	Back River	Northwood ES and Rec Center (CH-R2A)	2.4	2.85	14.6	3.30	2,167	$565,000	2016	2018		INSPIRE School
				0.0	0.00	0.0	0.00	0	$0	2016	2018	Removed	
A26	IA Removal, afforestation	Back River	Sinclair Lane ES (HR-R18)	1.9	1.31	7.3	2.03	1,154	$260,400	2016	2018		
				1.9	1.31	7.3	2.03	1,154	$260,400	2016	2018	Under Design	
A27	IA Removal, afforestation	Back River	WEB DuBois (HR-R29A)	0.8	0.53	2.9	0.81	461	$104,200	2016	2018		
				0.8	0.53	2.9	0.81	461	$104,200	2016	2018	Under Design	
A28	IA Removal, afforestation, bioretention	Back River	Various Schools	0.5	0.6	3.1	0.70	456	$120,000	2016	2018		
				0.5	0.6	3.1	0.70	456	$120,000	2016	2018	Under Design	
A29	IA Removal, afforestation, bioretention	Gwynns Falls	Mt. Winans	3.1	3.75	19.2	4.34	2,852	$496,000	2016	2018		
				3.1	3.75	19.2	4.34	2,852	$496,000	2016	2018	Under Design	
A30	IA Removal, afforestation, bioretention	Back River	Montebello ES (HR-R41A)	0.9	1.05	5.4	1.22	799	$208,000	2016	2018		INSPIRE School
				0.0	0	0.0	0.00	0	$0	2016	2018	Removed	
A31	IA Removal, afforestation, bioretention	City-wide	Various Schools	1.5	1.76	9.0	2.03	1,335	$350,000	2016	2018		
				5.2	6.25	32.0	7.24	4,751	$350,000	2016	2018	Under Design	
A32	IA Removal, afforestation, bioretention	Jones Falls	Pimlico ES (LJ-R6)	1.1	1.35	6.9	1.56	1,027	$268,000	2016	2018		
				1.1	1.35	6.9	1.56	1,027	$268,000	2016	2018	Under Design	
A33	IA Removal, afforestation, bioretention	Jones Falls	Poly Western HS (LJ-R8C)	1.4	1.65	8.5	1.91	1,255	$328,000	2016	2018		
				1.4	1.65	8.5	1.91	1,255	$328,000	2016	2018	Under Design	
A34	IA Removal, afforestation, bioretention	Baltimore Harbor	Duane Avenue Park - parking lot (MC-21)	0.3	0.35	1.8	0.40	262	$42,000	2016	2018		
				0.3	0.35	1.8	0.40	262	$42,000	2016	2018	Under Design	
A35	IA Removal, afforestation	Baltimore Harbor	Oliver / Broadway East	4.0	2.8	15.6	4.32	2,461	$496,000	2017	2019		Locations were not practicable.
				0.0	0.0	0.0	0.00	0	$0			Removed	
A36	IA Removal, afforestation	Gwynns Falls	Carrollton Ridge / Shipley Hill / Mill Hill / Pigtown / New Southwest / Union	4.0	2.8	15.6	4.32	2,461	$496,000	2017	2019		
				2.9	2.0	11.1	3.08	1,756	$419,000	2016	2019	Under Design	
A37	IA Removal, afforestation	Baltimore Harbor	Harlem Park / Sandtown-Winchester / Uplands	2.0	1.40	7.8	2.16	1,230	$248,000	2017	2019		
				7.0	4.88	27.2	7.53	4,288	$190,000	2016	2019	Under Design	
A38	IA Removal, afforestation	Baltimore Harbor	Various Schools	2.0	1.40	7.8	2.16	1,230	$248,000	2017	2019		
				7.0	4.88	27.2	7.53	4,288	$190,000	2016	2019	Under Design	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
A39	Aforestation of IA	Gwynns Falls	TreeBaltimore Street Trees	2.0	1.40	19.3	2.29	1,121	$496,000	2017	2019		
				2.0	1.40	19.3	2.29	1,121	$496,000	2016	2019	Under Design	
A40	Aforestation of IA	Gwynns Falls	TreeBaltimore Street Trees	8.3	5.81	90.2	13.19	6,793	$496,000	NA	2017		
				8.3	5.81	90.2	13.19	6,793	$496,000	NA	2017	Under Design	
A41	Aforestation of IA	Jones Falls	TreeBaltimore Street Trees	8.3	5.81	90.2	13.19	6,793	$496,000	NA	2018		
				8.3	5.81	90.2	13.19	6,793	$496,000	NA	2018	Pending	
A42	Aforestation of IA	City-Wide	TreeBaltimore Street Trees	4.2	2.91	45.1	6.59	3,396	$248,000	NA	2019		
				4.2	2.91	45.1	6.59	3,396	$248,000	NA	2019	Pending	
A43	Regenerative Step Pool Storm Conveyance	Jones Falls	Lower Lower Stony Run	0	0	0	0	0	$0				Part of Project A02. Total costs shown in A02.
				5	5	44	6	3,080	$0	2015	2017	Under design	
			Subtotal Alternative BMPs (Other) (WIP):	**72**	**53**	**539**	**85**	**47,250**	**7,739,600**				
			Subtotal Alternative BMPs (Other) (Current):	**82**	**58**	**594**	**93**	**51,705**	**6,446,600**				
			Total Projects (WIP):		**1,205**	**6,238**	**3,930**	**1,829,045**	**$77,536,600**	**84**	**Projects**	**Proposed**	
			Total Projects (Current):		**1,144**	**6,038**	**4,215**	**1,917,298**	**$82,649,884**	**73**	**Projects**	**Proposed**	
					307	1,620	1,008	473,080	$20,518,000	9	Projects	Pending	
					806	4,262	3,066	1,381,818	$61,431,884	63	Projects	Under Design	
					0	0	0	0	$0	0	Projects	Under Construction	
					31	156	141	62,400	$700,000	1	Projects	Completed	
Summary Information: Current Projects Proposed for MS4 Permit listed by Watershed													
		Back River			597	2,962	2,451	1,094,601		21	Projects	Proposed	
		Baltimore Harbor			30	168	35	21,086		19	Projects	Proposed	
		City-Wide			9	77	14	8,148		2	Projects	Proposed	
		Gwynns Falls			332	1,856	1,142	529,910		17	Projects	Proposed	
		Jones Falls			173	960	572	262,043		13	Projects	Proposed	
		L. N. Branch Patapsco			3	15	2	1,510		1	Projects	Proposed	

Table M-1: Progress Status of WIP Projects

MS4 WIP Project ID	BMP Type	Watershed	Location	Drainage Area (ac)	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)			Estimated Capital Cost	Schedule to Start (FY)		Status as of 6/30/2016	NOTES
						TN	TP	TSS		Design	Construction		
Summary Information: Current Projects Proposed for MS4 Permit listed by BMP Type for Use in TMDL MAST													
	Bioretention Area				5	29	5	2,837					Listed as Bioretention, C/D soils underdrain in MAST.
	Micro-bioretention				60	328	52	33,359					
	Aforestation of IA				16	245	35	18,102					Listed as tree planting in MAST.
	IA Removal, afforestation				14	76	21	11,947					Listed as impervious area removal in MAST.
	IA Removal, afforestation, bioretention				18	91	20	13,455					
	Stream Restoration			58,090	871	4,357	3,950	1,742,700					Listed as stream restoration in MAST.
	Pond Retrofit and New Pond				0	0	0	0					Listed as wet ponds and wetlands in MAST.
	Regenerative Step Pool Storm Conveyance				11	182	16	8,200					
	SW Pond Retrofit				66	346	44	40,694					
	Shallow extended detention wetland				9	46	8	4,624					
	Shallow wetland				24	128	21	12,716					
	Slope Stabilization				0	0	0	0					
	Wetland				0	0	0	0					
	Wetland / Pond				50	211	43	28,662					
Summary Information: Completed Projects by Watershed													
		Back River			0	0	0	0	$0	0	Projects	Completed	
		Baltimore Harbor			0	0	0	0	$0	0	Projects	Completed	
		City-Wide			0	0	0	0	$0	0	Projects	Completed	
		Gwynns Falls			31	156	141	62,400	$700,000	1	Projects	Completed	
		Jones Falls			0	0	0	0	$0	0	Projects	Completed	
		L. N. Branch Patapsco			0	0	0	0	$0	0	Projects	Completed	

Table M-2: Progress Status of WIP Programs

Project No. / Type	Debris Collected	Equivalent Impervious Area Restoration (ac)	Reference Metric	Estimated Pollutant Removal (lbs / yr)			NOTES
				TN	TP	TSS	
Street Sweeping*							
Collection within CY 2012	9,988 tons	2,797	96,000 lane miles	24,471	9,788	2,936,472	Ref: Baltimore's New and Improved Mechanical Street Sweeping Program (October 2013)
Anticipated Increase after City-wide expansion (Peak):	9,109 tons	2,551		22,317	8,927	2,678,046	Ref :Baltimore's New and Improved Mechanical Street Sweeping Program (October 2013)
Sub-total Street Sweeping at full expansion (WIP):	**19,097 tons**	**5,347**	**96,000** lane miles	**46,788**	**18,715**	**5,614,518**	
Sub-total Street sweeping (Current Annual):	12,143 tons	3,400	111,435 lane miles	29,750	11,900	3,570,042	
Street Sweeping (Current increase since Dec. 2009)	*3,957 tons*	*1,108*	*41,292* lane miles	9,695	3,878	1,163,358	*Ref: MS4 Annual Report for CY 2009. Reported tonnage of 8,186 tons. Used for TMDL MAST.*
Street Sweeping (Planned increase since Dec. 2009)	*10,911 tons*	*3,055*	*41,292* lane miles	26,732	10,693	3,207,834	
Preventive Inlet Cleaning & Debris Collection							
Anticipated Increase after Asset Management (4% Inlets cleaned quarterly):	990 tons	215	1,075 inlets	2,425	970	291,052	Ref: Preliminary Asset Management Program and CIP Schedule for Inlet Screens.
Sub-total Preventive Inlet Cleaning (WIP):		**215**		**2,425**	**970**	**291,052**	
Sub-total Preventive Inlet Cleaning (Current Annual):	0 tons	0.0	0 inlets	0	0	0	Routine quarterly inlet cleaning initiated May 2016.
Illicit Discharge Detection and Elimination Program							
Sanitary Direct Connection**		**NA**	10 connections	100	18	**NA**	Pending asset management inventory for direct illicit connections.
Sub-total Sanitary Direct Connection***		**3.9**	10 connections	990	180	**NA**	Nutrient reductions per CBP protocol N-5, default values, see Appendix .
Sewage Exfiltration**		**NA**	300 miles lined	5,000	909	**NA**	Lining as part of DPW's capital program for sanitary sewers.
Drinking Water Transmission**		**NA**	60 miles lined / replaced	1,500	273	**NA**	Estimated water line lining / replacement by 2018.
Dry Weather SSO**		**NA**	30 SSOs / yr red	350	64	**NA**	Asset management / FOG program, education, enforcement, and enanced IDDE
Sub-total IDDE (WIP):				**6,950**	**1,264**	**0**	
Sub-total IDDE (Current up to FY 2015):		**3.9**		**990**	**180**	**0**	Calculations will be reported in Annual Report for FY 2016. Not includedd in CB TMDL MAST.
TOTAL Programs (WIP):		**5,562**		**56,163**	**20,949**	**5,905,570**	
TOTAL Programs (Current):		**3,404**		**30,740**	**12,080**	**3,570,042**	

19976000

* Assuming bi-weekly frequency.

** Equivalent impervious area restoration conversions and TSS reductions have not been designated at this time. Estimates of nutrient reduction are very conservative in estimates.

*** Equivalent impervious area restoration based on similar permanent credit given for septic system connected to a WWTP (Table 7, MS4 Accounting Guidance, MDE, 2014).

Table M-3: Progress Status of WIP Partnerships

Project No. / Type	Source ID	Watershed	Location	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)		
					TN	TP	TSS
Development							
Impervious area to pervious	DPW Plans Review	City-wide	City-wide	73.8	351	35	29,426
Treatment by ESD	DPW Plans Review	City-wide	City-wide	21.4	102	10	8,539
				40.5	109	6	3,686
Treatment by Traditional	DPW Plans Review	City-wide	City-wide	54.7	260	26	21,805
				173.3	468	26	15,771
			Sub-total Development (WIP):	**150**	**713**	**70**	**59,770**
Sub-total Development (Actual Completed in Jan. 2010 to June 2015):				**214**	**577**	**32**	**19,457**
Voluntary - included in the estimate for Development							
Impervious Removal	BWB	Jones Falls	Guilford ES/MS	0.28	0.4	0.1	33
Impervious Removal	BWB	Gwynns Falls	Calvin Rodwell ES	0.13	0.2	0.04	15
Micro-bioretention	BWB	Baltimore Harbor	Library Square	1.1	5.3	0.5	261
IA Removal, Rain Garden	DOT	Baltimore Harbor	200 N. Duncan Street	0.45	2.3	0.5	342

Table M-3: Progress Status of WIP Partnerships

Project No. / Type	Source ID	Watershed	Location	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)		
					TN	TP	TSS
IA Removal, afforestation	DOT	Baltimore Harbor	2300-2400 Eager St	1.5	7.7	1.7	1141
IA Removal, afforestation, bioretention	GGI Design Comp	Gwynns Falls	2306-8 Riggs Street	0.81	4.2	0.9	616
IA Removal, afforestation, bioretention	GGI Design Comp	Back River	CHM Gateway 32nd & Harford	0.18	0.9	0.2	137
IA Removal, afforestation, bioretention	GGI Design Comp	Baltimore Harbor	Day Spring Green Parking 1100 block N. Bradford	0.36	1.8	0.4	274
IA Removal, afforestation	GGI Design Comp	Baltimore Harbor	Druid Heights Peace Park Bloom & Druid Hill Ave	0.15	0.8	0.2	114
IA Removal, afforestation	GGI Design Comp	Baltimore Harbor	Hollins Roundhouse Lots of Art1218-20 W. Lombard	0.06	0.3	0.1	46
IA Removal, afforestation, and rainwater harvesting	GGI Design Comp	Baltimore Harbor	Janes House of Inspiration A-maze-N Lot728 North Avenue	0.20	1.0	0.2	148
IA Removal, afforestation	GGI Design Comp	Baltimore Harbor	Flower Farm1400 block Gay Street	0.75	3.8	0.9	570
Aforestation of IA	Tree Baltimore	Baltimore Harbor	TBD	25.2	10.9	1.6	818

Table M-3: Progress Status of WIP Partnerships

Project No. / Type	Source ID	Watershed	Location	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)		
					TN	TP	TSS
Aforestation of IA	Tree Baltimore	Gwynns Falls	TBD	23.1	10.9	1.6	818
Aforestation of IA	Tree Baltimore	Jones Falls	TBD	19.6	10.9	1.6	818
Aforestation of IA	Tree Baltimore	Back River	TBD	21.0	10.9	1.6	818
			Sub-total Volunteer (WIP):	**95**	**72**	**12**	**6,971**
			Sub-total Volunteer (Actual-Completed):	**0**	**0**	**0**	**0**
SW Fee Credit program							
Treatment BMPs	SAIS	City-wide	City-wide	24.0	206.7	26.5	16,157
Private tree planting (Reforestation on pervious)	SAIS	City-wide	City-wide	7.6	142.6	6.6	1596
				6.1	114.0	5.3	1277
Rain gardens	SAIS	City-wide	City-wide	2.0	17.2	2.2	1,346

Table M-3: Progress Status of WIP Partnerships

Project No. / Type	Source ID	Watershed	Location	Eq. Imp Area Restored (ac)	Estimated Pollutant Removal (lbs / yr)		
					TN	TP	TSS
Rainwater harvesting	SAIS	City-wide	City-wide	0.5	12.4	1.0	485
			Subtotal SW Fee Credit (WIP):	**34.1**	**378.9**	**36.3**	**19,584**
			Subtotal SW Fee Credit (Actual):	**6.1**	**114.0**	**5.3**	**1,277**
			Total for Partnerships (WIP):	**279**	**1,164**	**119**	**86,325**
			Total for Partnerships (Actual Completed 1/2010 -6/2015):	**220**	**691**	**37**	**20,734**

Appendix N: Progress of Chesapeake Bay TMDL

- Table N -1: Progress Status of Chesapeake Bay TMDL
- MAST Results for Baseline 2010
- MAST Results for 2015 Loadings
- MAST Results for 2018 Loadings

Table N-1: Progress Status of Chesapeake Bay TMDL

Location	Estimated Pollutant Removal (lbs / yr)			Reference
	TN	TP	TSS	
Chesapeake Bay Loading for Baltimore City	418,243	32,870	22,025,806	Bay TMDL MAST Scenario 2010 Loadings for Baltimore City MS4 Area
Reduction Goal for Urban Stormwater:	84,903	9,960	418,490	Maryland's Phase II WIP for the Chesapeake Bay, Oct. 2012, Executive Summary
	20.3%	*30.3%*	*1.9%*	
Progress based on MAST				
Total Reduction by end of MS4 permit:	67,229	15,479	15,044,692	Based on MAST Scenario file "2010 Baseload" compared to MAST Scenario file "2018 Loadings" using original WIP
% Reduction by end of MS4 Permit:	16.1%	47.1%	68.3%	
Total Reduction (Current):	2,152	15,479	4,421,095	MAST Scenario file "2010 Baseload", Compared to MAST Scenario file "2016 Current", using current progress.
% Reduction (Current):	*0.5%*	*47.1%*	*20.1%*	
Alternative Analysis based on MDE Accounting Guidelines				
Structural/ Traditional BMPs	1,455	243	181,986	Table M-1
ESD Practices	328	52	33,359	Table M-1
Alternative BMPs (Stream Restoration)	3,916	3,551	1,566,450	Table M-1
Alternative BMPs (Other)	539	85	47,250	Table M-1
Street Sweeping at full expansion	46,788	18,715	5,614,518	Table M-2
Inlet Cleaning	2,425	970	291,052	Table M-2
IDDE*	6,950	1,264	0	Table M-2
Partnerships	3,928	282	130,175	Table M-3
Total Reduction by end of MS4 permit:	**66,329**	**25,161**	**7,864,790**	
% Reduction by end of MS4 Permit:	*16%*	*77%*	*36%*	
Total Reduction by Projects (Completed):	156	141	62,400	Table M-1
Total Reduction by Programs (Current):	30,740	12,080	3,570,042	Table M-2
Total Reductions by Partnerships (Current):	691	37	20,734	Table M-3
Current Total Reduction Completed:	31,588	12,259	3,653,176	
% Reduction by end of MS4 Permit:	*8%*	*37%*	*17%*	

* Equivalent impervious area restoration conversions and TSS reductions have not been designated at this time. Estimates of nutrient reduction are very conservative in estimates.

2010 Base loadings Baltimore City Summary Results

Help

Description: Baltimore City, Urban Stormwater Sector, 2010 Baseline loadings
Initial Conditions: 2010, revised: 10/2014
Date Created: 12/23/2015 3:30:54 PM

Download Results | Compare Scenarios

Total Loads

Load Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Landuse	639,556.6	418,242.7	46,208.1	32,869.7	23,340,166.1	22,025,805.7
Septic	0.0	0.0	0.0	0.0	0.0	0.0
Waste Water and Combined Sewer Output	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4
Total:	4,130,045.2	3,907,169.6	141,886.7	126,486.9	24,668,174.0	23,349,944.1

Total Annualized Costs

Sector	Total Annualized Cost
Urban Land	$14,884,124
Septic	
Forest Land	$1,439
Agricultural Land	$0
Animal Manure	$0
Total:	$14,885,563

Land Use Loads

Info on agreement with the Chesapeake Bay Program's Watershed Model

Land Use	Pre-BMP Acres	Post-BMP Acres	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Sector: Agriculture								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sector: Forest								
	2,247.7	2,247.7	7,384.8	4,546.9	114.9	67.4	308,983.8	298,309.3
Sector: Urban								
	49,534.8	49,534.8	629,451.9	411,731.5	45,946.8	32,701.3	23,031,180.0	21,727,500.0
Sector: Water								
	251.5	251.5	2,719.9	1,964.3	146.4	101.0	0.0	0.0
Total:	52,034.0	52,034.0	639,556.6	418,242.7	46,208.1	32,869.7	23,340,170.0	22,025,810.0

Septic Loads

Septic Zone	Pre-BMP Systems	Post-BMP Systems	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered
Critical Area	0.0	0.0	0.0	0.0
Within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Outside of the Critical Area, not within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Total:	0.0	0.0	0.0	0.0

Wastewater Loads

Facility Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
CSO	0.0	0.0	0.0	0.0	0.0	0.0
Major Industrial	309,811.9	309,811.9	1,257.2	1,257.2	159,900.8	159,900.8
Major Municipal	3,126,590.5	3,126,590.5	89,728.6	89,728.6	1,054,676.1	1,054,676.1
Minor Industrial	54,086.2	52,524.5	4,692.8	2,631.4	113,431.0	109,561.5
Total:	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4

2016 Loadings Baltimore City
Summary Results

Help

Description: Model showing conditions as of end of FY 2016
Initial Conditions: 2010, revised: 10/2014
Date Created: 12/23/2015 3:00:29 PM

Download Results | Compare Scenarios

Total Loads

Load Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Landuse	636,220.8	416,090.9	45,706.0	32,520.6	18,617,716.1	17,604,711.0
Septic	0.0	0.0	0.0	0.0	0.0	0.0
Waste Water and Combined Sewer Output	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4
Total:	4,126,709.4	3,905,017.8	141,384.6	126,137.8	19,945,724.0	18,928,849.4

Total Annualized Costs

Sector	Total Annualized Cost
Urban Land	$18,426,812
Septic	
Forest Land	$1,439
Agricultural Land	$0
Animal Manure	$0
Total:	$18,428,251

Land Use Loads

Info on agreement with the Chesapeake Bay Program's Watershed Model

Land Use	Pre-BMP Acres	Post-BMP Acres	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Sector: Agriculture								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sector: Forest								
	2,247.7	2,247.7	7,384.8	4,546.9	114.9	67.4	308,983.8	298,309.3
Sector: Urban								
	49,534.8	49,534.8	626,116.1	409,579.7	45,444.7	32,352.2	18,308,730.0	17,306,400.0
Sector: Water								
	251.5	251.5	2,719.9	1,964.3	146.4	101.0	0.0	0.0
Total:	52,034.0	52,034.0	636,220.8	416,090.9	45,706.0	32,520.6	18,617,720.0	17,604,710.0

Septic Loads

Septic Zone	Pre-BMP Systems	Post-BMP Systems	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered
Critical Area	0.0	0.0	0.0	0.0
Within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Outside of the Critical Area, not within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Total:	0.0	0.0	0.0	0.0

Wastewater Loads

Facility Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
CSO	0.0	0.0	0.0	0.0	0.0	0.0
Major Industrial	309,811.9	309,811.9	1,257.2	1,257.2	159,900.8	159,900.8
Major Municipal	3,126,590.5	3,126,590.5	89,728.6	89,728.6	1,054,676.1	1,054,676.1
Minor Industrial	54,086.2	52,524.5	4,692.8	2,631.4	113,431.0	109,561.5
Total:	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4

2018 Loadings Baltimore City
Summary Results

Help

Description: Baltimore City, Urban Stormwater Sector, Anticipated loading by the end of MS4 permit period
Initial Conditions: 2010 original
Date Created: 11/17/2011 1:22:33 PM

Download Results | Compare Scenarios

Total Loads

Load Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Landuse	534,493.6	350,928.4	23,674.2	17,391.3	7,035,903.3	6,981,114.2
Septic	85.6	85.6	0.0	0.0	0.0	0.0
Waste Water and Combined Sewer Output	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4
Total:	4,025,067.8	3,839,940.9	119,352.8	111,008.5	8,363,911.2	8,305,252.6

Total Annualized Costs

Sector	Total Annualized Cost
Urban Land	$38,997,301
Septic	
Forest Land	$1,201
Agricultural Land	$0
Animal Manure	$0
Total:	$38,998,502

Land Use Loads

Info on agreement with the Chesapeake Bay Program's Watershed Model

Land Use	Pre-BMP Acres	Post-BMP Acres	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Sector: Agriculture								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sector: Forest								
	1,875.8	2,035.5	6,702.1	4,068.7	104.0	59.7	282,684.1	268,719.0
Sector: Urban								
	49,906.7	49,747.0	525,071.6	344,895.4	23,423.8	17,230.6	6,753,219.0	6,712,395.0
Sector: Water								
	251.5	251.5	2,719.9	1,964.3	146.4	101.0	0.0	0.0
Total:	52,034.0	52,034.0	534,493.6	350,928.4	23,674.2	17,391.3	7,035,904.0	6,981,114.0

Septic Loads

Septic Zone	Pre-BMP Systems	Post-BMP Systems	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered
Critical Area	5.0	5.0	85.6	85.6
Within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Outside of the Critical Area, not within 1000 ft of a perennial stream	0.0	0.0	0.0	0.0
Total:	5.0	5.0	85.6	85.6

Wastewater Loads

Facility Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
CSO	0.0	0.0	0.0	0.0	0.0	0.0
Major Industrial	309,811.9	309,811.9	1,257.2	1,257.2	159,900.8	159,900.8
Major Municipal	3,126,590.5	3,126,590.5	89,728.6	89,728.6	1,054,676.1	1,054,676.1
Minor Industrial	54,086.2	52,524.5	4,692.8	2,631.4	113,431.0	109,561.5
Total:	3,490,488.6	3,488,926.9	95,678.6	93,617.2	1,328,007.9	1,324,138.4

Table O-1: Progress Status for Nutrient TMDL for Back River

	BMP Type	Location	Estimated Pollutant Removal		NOTES
			TN	TP	
MS4 Baseline Load:			**73,429**	**8,315**	
Reduction Goal:			*15%*	*15%*	
BMPs installed between 2005 and 2010:					
	Stream Restoration	Biddison Run Phase I	113	102	Previous MS4 Annual Reports. 1,500 LF restored.
	Private / Other City BMPs	12 BMPs	24	3	Appendix B of WIP.
		Total removal between 2005 and 2010:	**136**	**105**	
Projects proposed within current MS4 permit:					
		Total Projects (WIP):	3,011	1,895	Table M-1.
		Total Projects (Current Planned):	2,962	2,451	
		Total Projects (Current Completed):	0	0	
Programs proposed within current MS4 permit:					
	Street Sweeping		10,761	4,304	Table M-2, estimated distribution based on Table 1 of WIP.
			6,843	2,737	
	Inlet Cleaning		558	223	
			0	0	
	IDDE		1,599	291	
			228	41	
		Total Programs (WIP):	**12,918**	**4,818**	
		Total Programs (Current):	**7,070**	**2,778**	
Partnerships proposed within current MS4 permit:					
	Development		164	16	Table M-3, and Appendix B data (Table B).
			3	0	
	Voluntary		12	2	Table M-3, estimated distribution based on Table 1 of WIP.
			0	0	
	Stormwater Fee Program		87	8	Table M-3, estimated distribution based on Table 1 of WIP.
			26	1	
		Total Partnerships (WIP):	**263**	**26**	
		Total Partnerships (Current):	**29**	**1**	
Total Reduction by end of MS4 Permit:			16,278	7,400	Based on current planned projects shown in Table M-1
% Reduction by end of MS4 Permit:			22%	89%	
Total Reduction Current Completed:			7,236	2,885	
% Reduction Current Completed:			10%	35%	

Appendix O: Progress of Regional TMDLs for Nutrients

- Table O-1: Progress Status of Back River Nutrient TMDL
- Table O-2: Progress Status of Baltimore Harbor Nutrient TMDL
- Table O-3: Progress Status of Gwynns Falls Sediment TMDL
- Table O-4: Progress Status of Jones Falls Sediment TMDL
- Table O-5: Progress Status of Lower N. Patapsco Sediment TMDL

Table O-2: Progress Status for Nutrient TMDL for Baltimore Harbor

	BMP Type	Watershed	Location	Estimated Pollutant Removal (lbs / yr) TN	TP	NOTES
MS4 Baseline Load				**260,323**	**28,177**	
Reduction Goal				*15%*	*15%*	
BMPs installed between 2007 and 2010:						
	ESD Practices	Gwynns Falls	Watershed 263 (5 locations)	20.4	3.26	Previous MS4 Annual Reports.
	Stream Restoration	Jones Falls	Lower Stony Run	139	126	Previous MS4 Annual Reports. 1,850 LF restored.
	Stream Restoration	Gwynns Falls	Maiden's Choice	203	184	Previous MS4 Annual Reports. 2,700 LF restored.
	Private / Other City BMPs	Gwynns Falls	4 BMPs	4	1	Appendix B of WIP.
	Private / Other City BMPs	Jones Falls	13 BMPs	84	10	Appendix B of WIP.
	Private / Other City BMPs	Baltimore Harbor	21 BMPs	34	5	Appendix B of WIP.
			Total removal between 2007 and 2010:	484	328	
Projects proposed within current MS4 permit:						
			Total Projects (WIP):	3,415	2,372	Table M-1
			Total Projects (Current Planned):	3,062	1,762	
			Total Projects (Current Completed):	156	141	
Programs proposed within current MS4 permit:						
	Street Sweeping			34,623	13,849	Table M-2, estimated distribution based on Table 1 of WIP.
				22,015	8,806	
	Inlet Cleaning			1,795	718	
				0	0	
	IDDE			5,143	935	
				733	133	
			Total Programs (WIP):	**41,561**	**15,502**	
			Total Programs (Current):	**22,748**	**8,939**	
Partnerships proposed within current MS4 permit:						
	Development			528	52	Table M-3, estimated distribution based on Table 1 of WIP.
				710	70	
	Voluntary			60	10	Table M-3, estimated distribution based on Table 1 of WIP.
				0	0	
	Stormwater Fee Program			280	27	Table M-3, estimated distribution based on Table 1 of WIP.
				84	4	
			Total Partnerships (WIP):	**868**	**89**	
			Total Partnerships (Current):	**794**	**74**	
Total Reduction by end of MS4 Permit:				**45,975**	**17,682**	
% Reduction by end of MS4 Permit:				18%	63%	
Total Reduction Current Completed:				**24,182**	**9,483**	
% Reduction Current Completed:				9%	34%	

Table O-3: Progress Status for Sediment TMDL for Gwynns Falls

	BMP Type	Watershed	Location	Estimated Pollutant TSS (lb)	NOTES
MS4 Baseline Load				**14,410,000**	Listed as 7,205 tons (Table 2 of WIP)
Reduction Goal				*49%*	
Projects proposed within current MS4 permit:					
			Total Projects (WIP):	905,197	Table M-1
			Total Projects (Current Planned):	529,910	
			Total Projects (Current Completed):	62,400	
Programs proposed within current MS4 permit:					
	Street Sweeping			1,403,630	Table M-2, estimated distribution based on Table 1 of WIP.
				892,511	
	Inlet Cleaning			72,763	
				0	
			Total Programs (WIP):	**1,476,392**	
			Total Programs (Current):	**892,511**	
Partnerships proposed within current MS4 permit:					
	Development			14,943	Table M-3, estimated distribution based on Table 1 of WIP.
				82	
	Voluntary			1,450	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
	Stormwater Fee Program			4,896	Table M-3, estimated distribution based on Table 1 of WIP.
				319	
			Total Partnerships (WIP):	21,288	
			Total Partnerships (Current):	401	
Total Reduction by end of MS4 Permit:				**2,402,878**	
% Reduction by end of MS4 Permit:				17%	
Total Reduction Current Completed:				**955,312**	
% Reduction Current Completed:				7%	

Table O-4: Progress Status for Sediment TMDL for Jones Falls

	BMP Type	Watershed	Location	Estimated Pollutant TSS (lb)	NOTES
MS4 Baseline Load				**9,466,000**	Listed as 4,733 tons (Table 2 of WIP)
Reduction Goal				*26.3%*	
Projects proposed within current MS4 permit:					
			Total Projects (WIP):	296,825	Table M-1
			Total Projects (Current Planned):	262,043	
			Total Projects (Current Completed):	0	
Programs proposed within current MS4 permit:					
	Street Sweeping			1,179,049	Table M-2, estimated distribution based on Table 1 of WIP.
				749,709	
	Inlet Cleaning			61,121	
				0	
			Total Programs (WIP):	**1,240,170**	
			Total Programs (Current):	**749,709**	
Partnerships proposed within current MS4 permit:					
	Development			12,552	Table M-3, estimated distribution based on Table 1 of WIP.
				69	
	Voluntary			1,464	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
	Stormwater Fee Program			4,113	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
			Total Partnerships (WIP):	**18,128**	
			Total Partnerships (Current):	**69**	
Total Reduction by end of MS4 Permit:				**1,555,123**	
% Reduction by end of MS4 Permit:				16%	
Total Reduction Current Completed:				**749,778**	
% Reduction Current Completed:				8%	

Table O-5: Progress Status for Sediment TMDL for Lower North Branch Patapsco

	BMP Type	Watershed	Location	Estimated Pollutant TSS (lb)	NOTES
MS4 Baseline Load				**1,220,000**	Listed as 610 tons (Table 2 of WIP)
Reduction Goal				*25.1%*	
Structural / Traditional BMPs					
			Total Projects (WIP):	3,663	Table M-1
			Total Projects (Current Planned):	1,510	
			Total Projects (Current Completed):	0	
Programs proposed within current MS4 permit:					
	Street Sweeping			112,290	Table M-2, estimated distribution based on Table 1 of WIP.
				71,401	
	Inlet Cleaning			5,821	
				0	
			Total Programs (WIP):	**118,111**	
			Total Programs (Current):	**71,401**	
Partnerships proposed within current MS4 permit:					
	Development			1,315	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
	Voluntary			0	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
	Stormwater Fee Program			431	Table M-3, estimated distribution based on Table 1 of WIP.
				0	
			Total Partnerships (WIP):	**1,746**	
			Total Partnerships (Current):	**0**	
Total Reduction by end of MS4 Permit:				**119,857**	
% Reduction by end of MS4 Permit:				10%	
Total Reduction by end of MS4 Permit:				**71,401**	
% Reduction by end of MS4 Permit:				6%	
Total Reduction Current Completed:				**71,401**	
% Reduction Current Completed:				6%	