GOVERMENT OF THE DISTRICT OF COLUMBIA
Vincent C. Gray, Mayor

Municipal Separate Storm Sewer System
NPDES Permit No. DC0000221

2013 Discharge Monitoring Report

2013 Annual Report Addendum

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DISTRICT DEPARTMENT OF THE ENVIRONMENT
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I. Introduction

The Government of the District of Columbia (the District) submits this Discharge Monitoring Report for the January 22, 2013 – January 22, 2014 monitoring period. This report documents interim monitoring activities required to fulfill the requirements of the District's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. DC0000221, reissued on October 7, 2011 and modified November 9, 2012.

II. Monitoring Stations

Water quality monitoring took place at six monitoring stations throughout the District during the 2013 sampling period (Table 1). Detailed maps of each of the monitoring stations, the associated drainage area and land use types are included in Appendix A.

Table 1 Monitoring Stations

Watershed	Site	Location	Drainage Area (Acres)	Dates of Wet Weather Sampling	Dates of Dry Weather Sampling
Anacostia River	A1	Anacostia High School (Corner of 17th Street and Minnesota Avenue, SE)	252	02/08/13 08/23/13 11/26/13	01/23/13 04/11/13
	A2	Gallatin & 14th Street NE (Across from the intersection of 14th Street and Gallatin Street, NE)	662	01/14/13 04/12/13 06/06/13	01/23/13 05/21/13
Potomac River	B1	Walter Reed (Fort Stevens Drive NW)	23	01/14/13 06/06/13 08/01/13	02/07/13 05/21/13
	B2	Soapstone Creek (Connecticut Avenue and Albemarle Street, NW)	320	02/08/13 04/12/13 08/01/13	02/07/13 04/11/13
Rock Creek	C1	Battery Kemble Creek (49th Street and Hawthorne Street, NW)	11	02/08/13 04/12/13 08/01/13	04/11/13 - NDF 05/21/13 - NDF
	C2	Oxon Run (Mississippi Avenue and 15th Street, SE)	43	02/08/13 06/06/13 08/01/13	01/23/13 04/11/13

NDF: No dry weather flow

III. Weather Information

The National Oceanic and Atmospheric Administration (NOAA) rain gauge located at Reagan National airport is used to track rain conditions for the District and surrounding areas (Table 2). The Annual precipitation for the District of Columbia and surrounding area for the 2013 monitoring period was 39.35 inches.

This monitoring period had few qualifying rainfall events (Table 3). A number of the rainfall events were in the form of short duration thunderstorms followed by a lengthy dry period which did not meet the sampling requirements in the MS4 Permit.

Table 2 Precipitation Record for the District of Columbia

Year	Month	Rainfall (inches)*	Number of Days in Month with Storms >0.10 inches	Monthly Average (inches)
2013	January	2.53	5	2.81
	February	1.67	5	2.62
	March	2.80	4	3.48
	April	2.76	5	3.06
	May	2.82	4	3.99
	June	9.97	10	3.78
	July	4.43	8	3.73
	August	1.34	3	2.93
	September	1.22	3	3.72
	October	6.25	5	3.40
	November	2.92	5	3.17
	December	5.53	9	3.05
Total		53.69	79	49.36

* Rain gauge reading at Ronald Reagan National Airport

Table 3 2013 Monitoring Period Qualifying Rainfall Events

Date	Precipitation (inches)	Storm Duration (hours)	Time to Previous Measurable Rainfall (approx. days)	Sites Sampled*
01/14/13	0.48	13	16	A2, B1
02/08/13	0.20	7	8	A1, B2, C1, C2
04/12/13	0.80	8	7	A2, B2, C1
06/06/13	0.85	7	3.5	A2, B1, C2
08/01/13	0.37	5	4	B1, B2, C1, C2
08/23/13	0.11	3	5	A1
11/26/13	1.46	8	7	A1

* See Table 1 for location of sampling sites

IV. Sample Collection and Analysis

Apex Companies, LLC conducted the water quality sampling and analysis in accordance with the requirements specified in the MS4 Permit and EPA regulations. Table 4 details the water quality sampling requirements.

Table 4 Sample Analysis Requirements

Bottle Type	Sample Type	Parameter	Method	Units	Monitoring Detection Limit
1000 mL Plastic, Sterile	Grab	E. coli	SM9221F	MPN/ 100 mL	200
500 mL Plastic H_2SO_4	Composite	Total Nitrogen	Calculation	mg/L	1.0
500 mL Plastic H_2SO_4	Composite	Phosphorus, Total	SM4500-P B, E	mg/L	0.010
1-L Plastic Unpreserved	Composite	Total Suspended Solids	SM2540D	mg/L	1.0
1000 mL Plastic HNO_3	Composite	Cadmium, Total	EPA 200.8	mg/L	0.00050
1000 mL Plastic HNO_3	Composite	Copper, Total	EPA 200.8	mg/L	0.0010
1000 mL Plastic HNO_3	Composite	Lead, Total	EPA 200.8	mg/L	0.0010
1000 mL Plastic HNO_3	Composite	Zinc, Total	EPA 200.8	mg/L	0.0050

V. Recordkeeping

DDOE Water Quality Division maintains rainfall event, sampling, and analysis data. This data includes;

- Description of Sampling
  - Sampling protocols
  - Location/Collection time
  - Sample collection procedures
  - Field notes
  - Sampling personnel
- Storm Event Data
  - Date and duration of storm events sampled
  - Rainfall measurements

- Duration between storm event sampled and the end of the previous measurable storm event
- Estimate of the total volume of the discharge sampled

- Storm Water Analysis Data
  - Field test results
  - Laboratory results

VI. Monitoring Results

Table 5 and Table 6 detail the ambient water quality results for the wet and dry weather sampling.

Table 5 Ambient Water Quality Data from Wet Weather Sampling

Site	Location	Date	Water Temp (°C)	pH	DO* (mg/L)	TRC (mg/L)
A1	Anacostia High School	02/08/13	10.3	7.09	10.0	0.00
		08/23/13	23.3	7.70	11.80	0.00
		11/26/13	08.0	6.79	11.02	0.00
A2	Gallatin and 14th St. NE	01/14/13	09.7	7.27	09.30	0.00
		04/12/13	11.4	7.61	11.00	0.00
		06/06/13	19.9	7.54	07.40	0.00
B1	Walter Reed	01/14/13	09.4	7.50	09.10	0.00
		06/06/13	20.0	7.34	06.90	0.00
		08/01/13	22.9	8.02	06.70	0.00
B2	Soapstone Creek	02/08/13	07.3	7.61	12.8	0.00
		04/12/13	15.9	7.63	06.40	0.00
		08/01/13	21.7	6.40	06.80	0.00
C1	Battery Kemble Creek	02/08/13	05.0	7.60	13.40	0.00
		04/12/13	14.9	7.78	07.30	0.00
		08/01/13	18.0	7.54	07.10	0.00
C2	Oxon Run	02/08/13	10.4	7.22	10.0	0.00
		06/06/13	18.0	7.84	09.70	0.00
		08/01/13	15.5	7.28	10.0	0.00

* Field measurements were taken as % saturation
DO: Dissolved Oxygen
TRC: Total Residual Chlorine

Table 6 Ambient Water Quality Data from Dry Weather Sampling

Site	Location	Date	Water Temp (°C)	pH	DO* (mg/L)	TRC (mg/L)
A1	Anacostia High School	01/23/13	3.72	7.61	13.65	0.01
		04/11/13	16.60	7.87	6.45	0.00
A2	Gallatin and 14th St. NE	01/23/13	6.60	7.54	12.27	0.04
		05/21/13	18.80	7.74	8.13	0.00
B1	Walter Reed	02/07/13	13.00	6.89	10.20	0.03
		05/21/13	17.22	7.33	11.67	0.00
B2	Soapstone Creek	02/07/13	13.10	6.6	9.26	0.03
		04/11/13	14.88	7.67	7.04	0.00
C1	Battery Kemble Creek	04/11/13	NDF	NDF	NDF	NDF
		05/21/13	NDF	NDF	NDF	NDF
C2	Oxon Run	01/23/13	9.33	7.30	13.65	0.00
		04/11/13	16.50	7.22	6.83	0.00

* Field measurements were taken as % saturation
DO: Dissolved Oxygen
TRC: total residual chlorine
NDF: No Dry Weather Flow

Table 7 and Table 8 detail the water quality monitoring data for both wet and dry weather sampling. The geometric mean for each parameter was calculated to represent the event mean concentration (EMC). The wet weather summary data has also been submitted electronically to EPA via NetDMR. The analysis for dry weather monitoring included additional parameters of concern. The full analysis for dry weather monitoring is included in Appendix B.

Table 7 Summary of Wet Weather Monitoring

Site	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS (mg/L)	E. Coli (MPN/100mls)	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
Anacostia High School	4.79 (n=3)	0.36 (n=3)	30.8 (n=3)	486 (n=3)	0.00064* (n=3)	0.0041 (n=3)	0.0019[b] (n=3)	0.049 (n=3)
Gallatin & 14th St. NE	3.67 (n=3)	0.30 (n=3)	25.5 (n=3)	1,446 (n=3)	ND (n=3)	0.021 (n=3)	0.0011 (n=3)	0.074 (n=3)
Water Reed	3.02 (n=3)	0.26 (n=3)	20.0 (n=3)	185.3 (n=3)	ND (n=3)	0.022 (n=3)	0.0061 (n=3)	0.073 (n=3)
Soapstone Creek	3.29 (n=3)	0.35 (n=3)	39.5 (n=3)	266.0 (n=3)	0.00021* (n=3)	0.043 (n=3)	0.0085 (n=3)	0.063 (n=3)
Battery Kemble Creek	2.99 (n=3)	0.30 (n=3)	22.3 (n=3)	389.0 (n=3)	ND (n=3)	0.11 (n=3)	0.0085 (n=3)	0.039 (n=3)
Oxon Run	3.29 (n=3)	0.18 (n=3)	24.4 (n=3)	452.1 (n=3)	0.00035* (n=3)	0.035 (n=3)	0.0068 (n=3)	0.13 (n=3)

* If a sample result is below the detection limit, one-half the detection limit is used in the calculation of the geometric mean
ND: Analyte not detected at or above the reporting limit
TSS: Total Suspended Solids

Table 8 Summary of Dry Weather Monitoring

Station	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	TSS (mg/L)	E. Coli (MPN/100mls)	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
Anacostia High School	1.94 (n=2)	0.13 (n=2)	17.6 (n=2)	47.5 (n=2)	ND (n=2)	0.0051 (n=2)	ND (n=2)	0.018 (n=2)
Gallatin & 14th St. NE	0.18* (n=2)	0.088 (n=2)	7.84 (n=2)	1,600 (n=2)	ND (n=2)	0.0059 (n=3)	0.0008* (n=2)	0.040 (n=2)
Water Reed/Fort Stevens	2.74 (n=2)	0.11 (n=2)	6.4 (n=2)	191.8 (n=2)	ND (n=2)	0.0034 (n=2)	ND (n=2)	0.016 (n=2)
Soapstone Creek	1.86 (n=2)	0.26 (n=2)	5.74 (n=2)	111.5 (n=2)	ND (n=2)	0.0066 (n=2)	0.0005 (n=2)	0.021 (n=2)
Battery Kemble Creek	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF
Oxon Run.	0.20* (n=2	0.10 (n=2)	6.63 (n=2)	47.5 (n=2)	ND (n=2)	0.0018 (n=2)	ND (n=2)	0.017 (n=2)

* If a sample result is below the detection limit, one-half the detection limit is used in the calculation of the geometric mean
ND: Analyte not detected at or above the reporting limit
NDF: No dry weather flow
TSS: Total Suspended Solids

VII. Estimates of Cumulative Pollutant Loading

The Simple Method is widely used to estimate stormwater runoff pollutant loads for urban areas. The Simple Method estimates pollutant loads for chemical constituents as a product of annual runoff volume and pollutant concentrations (Equation 1).

Equation 1 Simple Method

$$L = \sum_{i=1}^{\text{No. of landuse types}} \left(\frac{P}{12} \times CF \times Rv_i \times C_i \times A_i \times 2.72 \right)$$

Where:

L = Pollutant loading (lb/year for chemical constituents, MPN/yr for bacteria)
P = Average annual rainfall (inches)
CF = Correction factor (0.9) to adjust for storms where no runoff occurs (dimensionless) (EPA 1992)
Rv_i = Runoff coefficient for the land use type (dimensionless)
C_i = Average event mean concentration (EMC) (mg/L for chemical constituents)
A_i = Land use area (acres)
2.72 = Unit conversion factor for chemical constituents in concentration units of mg/L; 12,334,885 for bacteria in units of MPN/100 mL

The geometric mean of the measured event mean concentration (EMCs) were calculated for each monitoring station (Equation 2).

Equation 2 Event Mean Concentration

$$\text{Geomean of EMCs} = \left[\prod_{j=1}^{m} \text{EMC}_j\right]^{\frac{1}{m}}$$

Where:
EMCj = Event Mean Concentration of Storms
M = Number of storms at monitoring location

The total cumulative pollutant load for each of the three watersheds was calculated using the data from each monitoring site in a watershed. This calculation assumes that the two sampling stations are representative of the respective Potomac River, Anacostia River and Rock Creek watersheds. Given this assumption, a simple ratio is used to cover a cumulative load for each watershed (Equation 3). The annual pollutant loads for the selected pollutants is detailed in Table 9.

Equation 3 Cumulative Pollutant Load

$$L_A = \left(\frac{\sum L_i}{\sum A_i}\right) A_t$$

L_A = Estimated subwatershed cumulative pollutant load (lb/year)
A_t = Subwatershed total area (acres)
L_i = Pollutant loading for each monitoring site (lb/year)
A_i = Size of each monitoring site (acres)

Table 9 Annual Pollutant Loading

Station	Total Nitrogen (lb/yr)	Total Phosphorus (lb/yr)	TSS (lb/yr)	E. Coli (MPN/100ml)	Cadmium (lb/yr)	Copper (lb/yr)	Lead (lb/yr)	Zinc (lb/yr)
Anacostia High School	6,498.0	488.3	41,782.7	2.98E+12	0.00	5.50	2.6	66.5
Gallatin & 14th St. NE	14,309.4	1,169.7	99,425.2	2.55E+13	0.85	0.00	4.3	288.5
Water Reed	710.4	38.5	2,966.1	1.24E+11	0.00	3.30	0.9	10.8
Soapstone Creek	5,877.2	625.2	70.562.8	2.15E+12	0.50	76.8	15.1	112.5
Battery Kemble Creek	1,923.4	193.0	14,345.5	1.13E+12	0.00	70.7	5.5	2.18
Oxon Run	10,968.2	600.0	81,344.6	6.8E+12	1.2	116.7	22.7	433.4
Load Estimates Anacostia Watershed (lbs/yr)	418,020.67	33,309.22	2,836,866.71	5.72E+14	17.08	110.50	138.62	7,131.95
Load Estimates Potomac Watershed (lbs/yr)	61,791.69	6,225.51	689,701.08	2.13E+13	4.69	751.34	150.08	1,156.55
Load Estimates Rock Creek Watershed (lbs/yr)	610,932.92	37,580.27	4,534,753.84	3.76E+14	56.87	8,880.89	1,336.4	20,642.14
Total Load Estimates (lbs/yr)	**1,090,745.28**	**77,115.00**	**8,061,321.63**	**9.69E+14**	**78.63**	**9,742.72**	**1,625.1**	**28,930.64**

TSS: Total Suspended Solids

VIII. Water Quality Trend Analysis

An examination of water quality trends was limited due to the differences between the 2000-2012 monitoring regime and the current interim monitoring requirements. These variations include; analytical techniques, detection limits, sample size, size of the drainage area sampled, land use characteristics, number of samples, and rainfall characteristics.

During the 2000-2012 monitoring period, samples were collected annually from 22 sites rotating between the three (3) watersheds which resulted in 179 samples analyzed for over 140 parameters. Under the current interim monitoring plan only two (2) sites from each of the Anacostia River, Potomac River and Rock Creek watersheds are sampled during the 2013 monitoring year. Tables 10, 11, and 12 present the reference values for approximate water quality standards and the range in historic pollutant concentrations (minimum and maximum) for each watershed.

Concentrations found during the 2013 sampling period of cadmium, lead, zinc, nitrogen and phosphorous were found within historic ranges. TSS concentrations significantly decreased in the Anacostia River, Potomac River and Rock Creek watersheds. Copper was detected at a higher concentration, for the samples collected in the Anacostia watershed.

Table 10 Summary of Selected Parameters in the Potomac River Watershed

Parameters	Water Quality Standard Reference Value* (mg/L)	2005-2011** Concentration (mg/L)		2013*** Concentration (mg/L)	
		Low	High	Low	High
Cadmium, Total[1]	0.3	0.00022	0.016	ND	0.0036
Copper, Total[1]	10.1	0.0032	0.65	0.021	0.25
Lead, Total[1]	3.6	0.0036	0.38	0.0028	0.022
Zinc, Total[1]	129.9	0.0095	0.98	0.016	0.32
Total Suspended Solids[2]	20 NTU	5.2	558	9	120
Total Phosphorous[3]	NA	0.039	2.6	0.072	0.46
Total Nitrogen[4]	NA	1	9.2	1.9	5.7

* All values are approximate
*Samples were collected from seven (7) stations for a total of 33 sampling events from 2005 thru 2011
*** Samples were collected from two (2) stations for a total of six (6) sample events in 2013

[1] The value shown is the Criteria Continuous Concentration (CCC) standard, which is more stringent than the CMC (Criteria Maximum Concentration). The values were calculated using an assumed hardness value of 110 mg/L of $CaCO_3$.
[2] The District does not have a Water Quality Standard for Total Suspended Solids. The standard for turbidity (20 NTUs) was used to approximate a value for TSS.
[3] The District does not have a Water Quality Standard for Total Phosphorous.
[4] The District does not have a Water Quality Standard for Total Nitrogen.

Table 11 Summary of Selected Parameters in the Anacostia River Watershed

Parameters	Water Quality Standard Reference Value* (mg/L)	2001-2012** Concentration (mg/L)		2013*** Concentration (mg/L)	
		Low	High	Low	High
Cadmium, Total[5]	0.3	0.0003	0.012	ND	0.0037
Copper, Total[5]	10.1	0.006	0.45	0.016	0.917
Lead, Total[5]	3.6	0.0014	0.1	0.0033	0.014
Zinc, Total[5]	129.9	0.02	0.89	0.0055	0.27
Total Suspended Solid[6]	20 NTU	6	1400	10	75
Total Phosphorous[7]	NA	0.017	1.5	0.23	0.45
Total Nitrogen[8]	NA	0.9	13.0	2.7	5.6

* All values are approximate
** Samples were collected from nine (9) stations for a total of 99 sampling events from 2001 thru 2012
** *Samples were collected from two (2) stations for a total of six (6) sample events in 2013

Table 12 Summary of Selected Parameters in Rock Creek Watershed

Parameters	Water Quality Standard Reference Value* (mg/L)	2003-2011** Concentration (mg/L)		2013*** Concentration (mg/L)	
		Low	High	Low	High
Cadmium, Total[5]	0.3	0.0005	0.031	ND	0.00077
Copper, Total[5]	10.1	0.0028	0.36	0.012	0.12
Lead, Total[5]	3.6	0.003	0.28	0.0036	0.026
Zinc, Total[5]	129.9	0.017	0.344	0.036	0.094
Total Suspended Solids[6]	20 NTU	5.0	2,600	6.5	110
Total Phosphorous[7]	NA	0.076	13	0.17	0.63
Total Nitrogen[8]	NA	NA	NA	1.7	5.8

* All values are approximate
**Samples were collected from six (6) - 10 stations for a total of 47 sampling events from 2003 thru 2011
*** Samples were collected from two (2) stations for a total of six (6) sample events in 2013

[5] The value shown is the Criteria Continuous Concentration (CCC) standard, which is more stringent than the CMC (Criteria Maximum Concentration). The values were calculated using an assumed hardness value of 110 mg/L of $CaCO_3$.
[6] The District does not have a Water Quality Standard for Total Suspended Solids. The standard for turbidity (20 NTUs) was used to approximate a value for TSS.
[7] The District does not have a Water Quality Standard for Total Phosphorous.
[8] The District does not have a Water Quality Standard for Total Nitrogen.